TRANSPARENCY INTERNATIONAL KENYA

HOMA BAY COUNTY

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CLIMATE CHANGE RISK AND VULNERABILITY ASSESSMENT REPORT

HOMABAY COUNTY

Author: Transparency International Kenya (TI-Kenya)

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List of Abbreviations

ADP	Annual Development Plan
BMU	Beach Management Unit
CBO	Community Based Organization
CFG	Climate Finance Governance
CGHB	County Government of Homabay
CIDP	County Integrated Development Plan
CSO	Community Social Organization
DFID	Department for International Development of the United Kingdom Government
FGD	Focus Group Discussion
GIS	Geographic Information Systems
HBC	Homabay County
HH	Household
ICT	Information Communication Technology
IPCC	Inter-Governmental Panel on Climate Change
KFS	Kenya Forest Service
KII	Key Informant Interview
KWS	Kenya Wildlife Service
LBDA	Lake Basin Development Authority
LM	Lower Midlands
LREB	Lake Region Economic Block
LULC	Land Use and Land Cover
LVI	Livelihood Vulnerability Index
MSME	Micro Small and Medium Enterprises
NCCAP	National Climate Change Action Plan
NDC	Nationally Determined Contributions
NEMA	National Environment Management Authority
NGO	Non-Governmental Organization
ODK	Open Data Kit
PLWDS	People Living with Disabilities
SLA	Sustainable Livelihood Approach
SPSS	Statistical Package for Social Scientists
TI	Transparency International
TOR	Terms of Reference
UM	Upper Midlands
UNFCCC	United Nations Framework Convention on Climate Change
WMO	World Meteorological Organization

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Definition of Terms

Term	Definition
Adaptation	Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.
Adaptive capacity	The ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences.
Climate Change	Refers to a change in the climate system that is caused by significant changes in the concentration of greenhouse gases due to human activities, and which is in addition to the natural climate change that has been observed during a considerable period.
Climate Change Mainstreaming	The integration of priority climate change adaptation responses into development, so as to reduce potential development risks and take advantage of opportunities.
Climate Change Vulnerability	The degree to which geophysical, biological and socio-economic systems are susceptible to, and unable to cope with adverse impacts of climate change. Impact here refers to a specific change in a system caused by its exposure to climate change
Climate hazard	A physical process or event (hydro-meteorological or oceanographic variables or phenomena) that can harm human health, livelihoods, or natural resources
Exposure	Refers to whether the asset or system is located in an area experiencing direct effects of climate variables.
Mitigation	Refers to human interventions to prevent or slow down atmospheric GHG concentrations by limiting current or future emissions, and/or enhancing potential sinks for greenhouse gases.
Resilience	Refers to the capacity of social, economic and environmental systems to cope with a hazardous event, trend, or disturbance. It is manifested through responding or reorganizing in ways that assert the essential function, identity, and structure of the system, while also maintaining the capacity for adaptation, learning and transformation
Sensitivity	Refers to how the asset or system fares when exposed to a climate variable.

Executive Summary

The impacts of climate change have been and continue to be experienced in Kenya. The country has been ravaged by extreme climatic events such as droughts and floods that have damaged both property and livelihoods. Thus, climate change presents a threat to the achievement of Kenya's national goals, aspirations, and development priorities[1]. The assessment was conducted to: Identify the climate change risks, hazards and vulnerabilities in Homabay County; establish the probability and impact of climatic hazards currently and in the future in the County; identify the vulnerable sectors to climate change in the County and identify their respective adaptive capacities; develop a climate change vulnerability and risk map of the County and develop a list of indicators for the vulnerability to climate change in the County. This is in line with international and national policies on climate change action that recognise the role of climate change risk and vulnerability assessments in enhancing a targeted approach to tackling climate change. For instance, the Paris Agreement calls for the development of relevant plans and policies including the assessment of climate change impacts and vulnerability with a view to formulating nationally determined prioritised actions. The National Climate Change Framework Policy requires the Government to ensure integration of climate change risk and vulnerability assessment in environmental impact assessments and strategic environmental assessments to enhance climate resilience and adaptive capacity.

Results

The results of the assessment are based on the analysis of data obtained using the identified indicators and sub-indicators. The selection of the indicators was influenced by this assessment's need to determine how climate change is affecting the productive sectors in the County and the resultant impacts on people's livelihoods.

Contributing Factors to Climate Change Vulnerability and Risk in Homabay County

Homabay County is vulnerable to the impacts of climate change and faces the risk of the occurrence of climatic hazards such as droughts and floods. Several factors operating at the household and community level combine to contribute to the County's vulnerability to the impacts of climate change including: The Socio-demographic set-up; livelihood strategies used by communities; social networks in the communities; households' knowledge and skills; access to health services; food security; access to water; and exposure to climatic hazards. These factors also operate either negatively or positively, to contribute to the adaptive capacity, sensitivity and exposure of the County to impacts of climate change.

Climate Change Risks, Hazards and Vulnerabilities in Homabay County

Homabay County faces various climate change risks, hazards and vulnerabilities. This assessment identified occurrence of droughts, disease outbreaks, increased flooding and rise in lake water levels as some of the climate change risks in the County. These risks are occasioned by the occurrence of climatic hazards such as drought and floods as a result of either low or extreme precipitation, respectively. A combination of the climatic hazards and the risks eventually contribute to vulnerabilities to climate change such as: Decreased productivity; emergence of aggressive and invasive insects and pets; food scarcity; loss of income; loss of livelihoods; and loss of lives. These vulnerabilities basically affect people's livelihoods and the ability or inability to cope with impacts.

1 - The National Climate Change Action Plan, 2018-2022

Vulnerable Sectors in Homabay County and their Respective Adaptive Capacities

Up to 53.7 per cent of households in the County derive their livelihoods from agriculture (crop and livestock farming). Subsequently, the sectors that are most vulnerable to the impacts of climate change in the County are those that are closely related with agriculture such as: Fisheries; water; and health. Availability of and access to water in the County is critical for food production and good sanitation, hence the health of people. The health status of people in turn has an implication on their ability to undertake economic activities for their livelihoods. Despite the exposure of the sectors, they have adaptive capacities which have either been built from progressive efforts or are in various stages of planning and implementation. In the agricultural sector, farmers have been sensitised to adopt climate smart practices such cultivation of early maturing crops and keeping of improved livestock breeds. In the water sector, enhanced availability of and access to water is crucial. Despite some efforts towards this, the County still has a large part of its population accessing water from unsafe sources with parts of the County facing acute water shortages. In the health sector, efforts have been made to increase health facilities and reducing distances travelled to the facilities, but there is still need for enhanced health service provision in the new facilities.

Climate Change Governance in Homabay County

Climate change governance in the County was assessed using three parameters: climate change capacity building; climate change mainstreaming; and public participation and stakeholder engagement on climate change. There are steps that have been taken towards building the County's capacity in tackling climate change. Key amongst these is the designation of a County Executive Committee Member to be in charge of climate change in accordance with the provisions of the Climate Change Act, 2016[2]. There is a Homabay County Climate Change Policy in place. The incomplete status of the policy and legal framework presents a challenge to climate change governance in the County given that the County has not yet enacted a Climate Change Act. The County has not adequately taken measures to mainstream climate change action into its planning and decision-making process. The incoherence in County policy and planning on climate change is a challenge to climate change governance in the County. The County Government is yet to develop a climate change education curriculum, implying that the County has not yet rolled out a public education programme on climate change. However, the County Government has in the past mounted campaigns to encourage climate change relevant behavior change. This involved mass sensitisation of communities and households to shift to the use of clean cooking and household lighting technologies such as solar and improved cookstoves.

To enhance climate change governance, it is recommended that the Homabay County Climate Change Bill that is pending before the County Assembly be fast-tracked and passed. Further, the Homabay County Climate Change Policy that has already been formulated be activated and operationalised. Finally, the County Government should prioritise mainstreaming of climate change action into the County decision making processes, anchored in the County Integrated Development Plan (CIDP).

2 - Section 19 (3) of the Climate Change Act, 2016

1.0 Introduction & Background

Climate change has been a threat to the very existence of the Planet Earth for a long time. The conversation about climate change and its threats to world ecological order began in the late 1950s when scientists began to identify evidence of anthropogenic climate change drivers. Studies then showed that there was an increasing amount of Carbon Dioxide concentration in the atmosphere mainly as a result of increasing industrial activities and destruction of forested areas. This was then linked to the observed increases in global temperatures. In the 1970s the concern about the global environment became prominent, leading to the 1972 United Nations conference on the environment in Stockholm, Sweden. This led to the Stockholm Declaration and Action Plan for the Human Environment. A major outcome of the Stockholm Conference was the creation of the United Nations Environment Programme (UNEP). First forward to the 1980s, the climate change conversation continued to dominate the world agenda and in 1989 the Brundtland report also known as “Our Common Future” was released by the United Nations. The report contained several recommendations on addressing the threats and impacts of climate change and explained in great detail the increasing concentration of Green House Gases (GHG) in the atmosphere. This led to the formation of the Inter-Governmental Panel on Climate Change (IPCC) jointly by the UNEP and the World Meteorological Organization (WMO). The IPCC was formed to provide science backed information on climate change. In 1992, the United Nations Conference on Environment and Development (UNCED), also known as the Earth Summit, was convened in Rio de Janeiro, Brazil. The outcome of this conference was the United Nations Framework Convention on Climate Change (UNFCCC). The UNFCCC has since been ratified by over 192 countries and has been the main vehicle through which the world has been addressing issues around climate change. Article 2 of the UNFCCC calls on National Governments to works towards reducing and stabilising GHGs concentration in the atmosphere at levels that would avoid dangerous anthropogenic interference with the climate system. As a result of the UNFCCC ratification, there have been subsequent protocols and agreements on climate change including the Kyoto Protocol that committed 37 industrialised countries to reduce their GHG emissions by at least 5 per cent below the 1990 levels by the year 2012. This, however, failed due to the binding nature of the Protocol and the feeling amongst the targeted industrialised countries that the Protocol worked against their respective national development goals. Fast forward to 2015, the world gathered in Paris, France and produced the Paris Agreement. The Paris Agreement contains provisions to address climate change from all perspectives, including mitigation, adaptation, financing, technological transfer, transparency and accountability, minimisation and addressing of losses associated with climate change, capacity building to address climate change effectively, climate change education, training and public awareness and compliance[3].

From the foregoing, climate change is a global phenomenon with specific regional, national and local consequences. In Kenya, the impacts of climate change are already evident with increased occurrence of extreme climatic events such as flooding and droughts which have caused immeasurable damage to both

3 Paris Agreement

life and property in the country. Loss of livelihoods that has resulted in misery and desperation amongst the affected populations is of greater concern. Thus, climate change is a threat to the development of Kenya including the achievement of national goals and aspirations such as the Vision 2030 and the Big Four Agenda on food and nutrition security, affordable housing, increased manufacturing and universal healthcare[4]. To address the threat posed by climate change, Kenya has made progress in establishing the policy, legal and institutional framework to tackle it. On the policy front, the country has trailblazed with the formulation of several policies on climate change including: The Climate Change Response Strategy 2010; the National Climate Change Framework Policy of 2016; the National Adaptation Plan 2015-2030; the Updated Nationally Determined Contributions (NDCs); the National Climate Change Action Plans and the National Climate Finance Policy 2017. All these policies have since been enacted into law under the Climate Change Act of 2016.

The Climate Change Act, 2016 established an institutional framework on climate change including the National Climate Change Council chaired by the President of the Republic and the National Climate Change Directorate (CCD) charged with the technical and administrative issues on climate change. The Act requires the commitment of both the National and County Government to tackle climate change, effectively making climate change a responsibility of both levels of government.

To effectively address the threats posed by climate change and enhance resilience to its impacts, there needs to be a targeted approach with specific objectives and defined outcomes. Climate Change Risk and Vulnerabilities Assessments (CCRVA) provide the necessary information needed for the targeted approaches. The need for CCRVA is well documented at the global and national levels. The UNFCCC calls on the parties to the convention to take climate change considerations into account in their social, economic and environmental policies and actions. In doing this, the parties are expected to employ appropriate methods such as impact assessments with the aim of minimising adverse effects of policies and actions on the economy and the environment geared towards climate change mitigation and adaptation. The Paris Agreement requires parties to the Agreement to engage in adaptation planning processes and the implementation of actions including the development of relevant plans and policies; these may include the assessment of climate change impacts and vulnerability with a view to formulating nationally determined prioritised actions, taking into account vulnerable people, places and ecosystems. The National Climate Change Framework Policy requires the Government to ensure integration of climate change risk and vulnerability assessment in environmental impact assessments and strategic environmental assessments[5]. This is aimed at enhancing climate resilience and adaptive capacity.

1.1 Purpose and objectives of the Assessment

Transparency International Kenya (TI-Kenya) commissioned this assessment to enhance the planning process on climate change for Homabay County. This arose from the need for the effective adoption and implementation of national policies and legislations on climate change at the sub-national level. Of interest is the updated Nationally Determined Contributions (NDC) and the National Climate Change Action Plan (2018-2022). Besides, it is considered that a climate change risk and vulnerability assessment would promote the prudent use of resources and enhance transparency and accountability especially on the use of climate change finances in Homabay County.

4 NCCAP 2018-2022
5 Article 7 of the Paris Agreement

The assessment was conceived to establish the climate change risks, hazards and vulnerabilities in Homabay County; establish the probability and impact of climatic hazards currently and in the future in the County; identify the vulnerable sectors to climate change in the county and identify their respective adaptive capacities; develop a climate change vulnerability and risk map of the County and develop a list of indicators for the vulnerability to climate change in the County.

1.2 Description of the Assessment Area

The assessment was conducted within the geographical boundaries of Homabay County.

1.2.1 Location, Demographics and Administrative structures

Homabay County lies between latitudes $0^0$15 North and $0^0$52 South, and between longitudes 34^0 East and 35^0 West. The County covers an estimated area of 4,267.1 km^2 constituting 2,696 km^2 of land area and 1,227 Km^2 is covered by Lake Victoria. The County is located in Southwestern Kenya, and it borders Kisumu and Siaya counties to the North, Kisii and Nyamira counties to the East, Migori County to the South and the Republic of Uganda to the West. The County's population is 1, 131, 950 of which 52.3 per cent (592,367) are females and 47.7 per cent (539, 560) are males. The County has a population density of 359.1/km^2. Forty-four percent of the population falls in the age group of 0-14 years which translates to a high dependency ratio. Ninety percent of the population lives in the rural areas while only 10 per cent of the population is found in urban areas. Administratively, the County is divided into 8 Sub-Counties namely, Rachuonyo North, Rachuonyo East, Rachuonyo South, Rangwe, Ndhiwa, Homabay Town, Suba North and Suba South. The County is further divided into twenty-three divisions, fourty wards, 140 locations and 265 sub locations.

1.2.2 Agro-Ecological Zones

The County has seven distinct agro-ecological zones described as:

- The upper midlands (UM1) occupying the southern parts of Rachuonyo South and Rachuonyo East Sub-Counties where tea and coffee are grown.
- The upper midlands (UM3) cover the Gwasi hills of Suba South Sub-County. Maize, millet, pineapples, sorghum, sunflower and tomatoes grow well here.
- The upper midlands (UM4) cover areas surrounding Gwasi hills of Suba South Sub-County as well as Ndhiwa and Nyarongi areas of Ndhiwa Sub-County. It supports maize, soya beans and pineapples.
- The lower midlands (LM2) occupy parts of Ndhiwa, Homabay Town, Rangwe, Rachuonyo South and the north of Rachuonyo East Sub-Counties. This zone supports green grams, millet, sorghum, tobacco, sunflower, sugarcane, beans, pineapples, sisal and groundnuts.
- The lower midlands (LM3) occupy parts of Homabay Town and Rangwe Sub-Counties. It is suitable for growing maize, sorghum, cow peas, ground nuts, beans, soya, sweet potatoes, sunflower, simsim, green grams, rice and vegetables.
- The lower midlands (LM4) occupy a strip along east of Rachuonyo North, central Suba North and Gwasi areas of Suba South Sub-Counties. The area is suitable for growing cotton.
- The lower midlands (LM5) occupy south-west Suba South, Rusinga and Mfangano islands, Lambwe Valley and Gembe and Kasgunga areas of Suba North Sub-Counties. The area supports livestock rearing and millet growing.

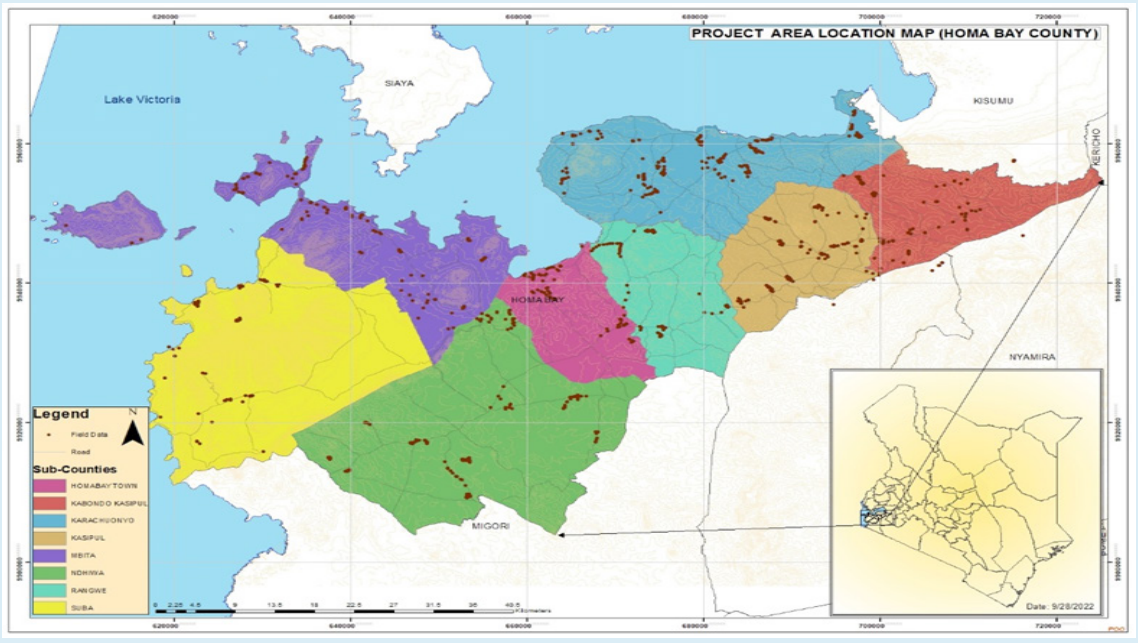
2.0 Methodology

This assessment was conducted following the Inter-Governmental Panel on Climate Change (IPCC) 2014 climate risk and vulnerability assessment framework and the Department for International Development's (DFID) sustainable livelihood approach (SLA). Following this approach, data was collected on pre-determined specific indicators that were designed to systematically analyse individual contributing factors of climate change vulnerability namely, adaptive capacity, sensitivity and exposure. To determine the extent of the vulnerability of the County to the impacts of climate change, the Livelihoods Vulnerability Index (LVI) approach was applied. Specifically, the LVI approach was applied in determining the influence of each indicator on the three contributing factors to vulnerability.

2.1 Assessment Area

The assessment was carried out within the geographical boundaries of Homabay County as shown in Figure 1 below.

Figure 1: The geographical boundaries of Homabay County



2.2 Sampling Methodology

A multi-stage sampling approach was adopted to determine the sample size for the household survey. The first stage involved selecting the number of Sub-Counties, wards and Sub-Locations to be included in the assessment. This resulted in the selection of the desired sample size as enumerated in Table 1 below.

Table 1: Sample size determination for sub-counties, wards and sub-locations

Step 1	Homabay County	
Step 2	8 Sub-Counties	
Step 3	**30 Wards** See Table 2 on the number of wards sampled per sub-county based on the formula: $w = \frac{n}{N} \times s$ ***Where:*** *W* - number of wards sampled per sub-county *n* - number of wards in a sub-county *N* - Total number of wards in Homabay County (40) *s* – desired number of wards (30)	The 30 wards are distributed to the eight sub-counties proportionally to the size of the sub-county. Wards randomly sampled within the sub-counties.
Step 4	3 Sub-Locations	Three sub-locations per ward randomly chosen within the sampled wards
Step 5	Households	The households proportionally distributed to the wards and the sub-locations based on the overall sample size.

The second stage involved determination of the sample size for the household survey. The sample size for the household survey was determined using the Nassiuma formula (Nassiuma, 2000). The coefficient of variation was assumed at 0.5 at the desired tolerance level of confidence, at 95% level (0.05).

$$n = \frac{NC^2}{C^2 + (N-1)e^2}$$

Where:

n – is the sample size

N – Total number of households in Homabay County

C – is the coefficient of variation (occurrence of the phenomenon under study in the population)

e – is the tolerance of desired level of confidence, at 95% level.

But,

$N = 262{,}036$

$C = 0.5$

$e = 0.05$

Thus:

$$n = \frac{NC^2}{C^2+(N-1)e^2} = \frac{262{,}036(0.5)^2}{0.5^2+(262{,}036-1)0.05^2} = \frac{65{,}509}{65.3375} = 1002.624 \sim 1000$$

$$n = \frac{NC^2}{C^2+(N-1)e^2} = \frac{262{,}036(0.5)^2}{0.5^2+(262{,}036-1)0.05^2} = \frac{65{,}509}{65.3375} = 1002.624 \sim 1000$$

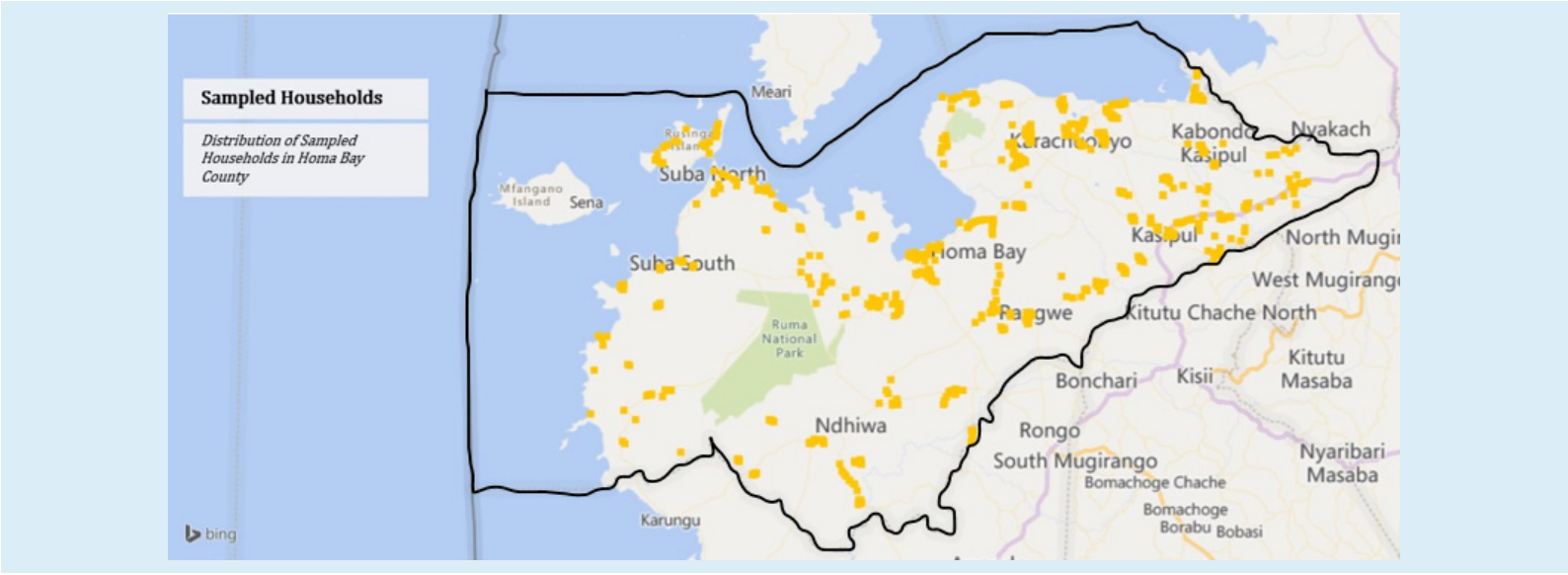
Thus, the desired sample for the household survey was one thousand households. However, 1,031 households were interviewed. The sampled households were distributed across the eight sub-counties and the 30 sampled wards based on the size of the sub-counties as shown in Table 2 below.

Table 2: Distribution of sample households in the eight sub-counties and thirty wards

Sub County W	Wards (n) (A)	Ratio (n/N) (B)	Desired No. of Wards $w = \frac{n}{N} \times s$ (C)	No. of HHs per sub-county (B*1000) (D)	No. of HHs per Ward (D/C)
Rachuonyo North	7	0.175	5	195	39
Rachuonyo South	5	0.125	4	139	34
Rachuonyo East	4	0.1	3	97	32
Ndhiwa	7	0.175	5	166	33
Homabay Town	4	0.1	3	92	31
Rangwe	4	0.1	3	101	33
Suba South	4	0.1	3	105	35
Suba North	5	0.125	4	136	34
Total	**40 (N)**		**30 (w)**	**1,031**	

The names of the wards locations and sub-locations sampled per sub-county are listed in Annex III Table 22. The actual distribution of the sa

Map 1: Sampled households



2.3 Data Collection

Data for this assessment was collected using structured household questionnaires, Key Informant Interviews (KIIs), Focus Group Discussion Guides (FGDs) and review of relevant literature that included reports, policies, legislations, articles and books. The questionnaires were administered in the sampled households by enumerators who were recruited for this assignment. The KIIs were administered to respondents from the agriculture, water, health and governance sectors while the FGDs were administered to ward climate change committee members in four wards namely: Wangchieng, Kochia, Homabay Central and Gwasi South.

2.4 Data Analysis

Data from the various sources was cross analysed to identify the climate change risks and vulnerabilities in Homabay County. Various data analysis tools and procedures were used and applied including Statistical Package for Social Scientists (SPSS), excel spreadsheets, NVivo and matrices.

3.0 The Climate Change Policy & Legal Framework

The climate change policy and legal framework in Kenya is based on the established international and national climate change agreements, treaties, policies and laws. This section presents an analysis of the climate change legal and policy framework in three categories namely:

a) International climate change policy and legal framework.

b) National climate change policy and legal framework; and,

c) Sub-national climate change policy and legal framework.

3.1 The International Climate Change Policy and Legal Framework.

The international climate change policy and legal regime is backed by a combination of treaties, agreements and conventions mainly negotiated within the United Nations (UN) system.

3.1.1 The United Nations Framework Convention on Climate Change (UNFCCC)

The main objective of the UNFCCC is to achieve stabilisation of greenhouse gas concentrations in the atmosphere, at a level that would prevent dangerous anthropogenic interference with the climate system. The convention aims to achieve this in time to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner. Article 4 of the convention outlines commitments expected from parties to the convention. About vulnerability assessments, the convention calls on parties to take climate change considerations into account in their social, economic and environmental policies and actions. In doing this, the parties are expected to employ appropriate methods such as impact assessments with the aim of minimising adverse effects of policies and actions on the economy and the environment geared towards climate change mitigation and adaptation.

3.1.2 The Paris Agreement

On 12th December 2015, the Paris Agreement was adopted in Paris, France at the 21st Conference of the Parties (COP 21) of the UNFCCC. The Agreement is meant to enhance the implementation of the UNFCCC including the achievement of its objective. The Agreement set out to strengthen global response to the threat of climate change by: Holding the increase in the global average temperature to below 2^0C above pre-industrial levels and pursuing efforts to limit temperature increase to 1.5^0C above pre-industrial levels in an effort to reduce the risks and impacts of climate change; increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production; and, making finance flow consistent with a pathway towards low greenhouse gas emission and climate resilient development[6].

6 Article 2 (1) of the Paris Agreement

The Agreement calls on the parties to engage in adaptation planning processes and the implementation of actions including the development of relevant plans and policies that may include, the assessment of climate change impacts and vulnerability with a view to formulating nationally determined prioritised actions, taking into account vulnerable people, places and ecosystems[7].

3.1.3 The Nationally Determined Contributions

The Nationally Determined Contributions (NDCs) are commitments made by countries who are parties to the Paris Agreement to reduce national emissions and adapt to the impacts of climate change. The Paris Agreement requires each party to prepare, communicate and maintain successive NDCs that it intends to achieve[8]. Kenya first submitted its NDC on 28th December 2016. In the first NDC, (Government of Kenya, 2020) Kenya committed to reduce its emissions by 30 per cent by the year 2030 given the Business as Usual (BAU) scenario of 143 MtCO2 eq. On 24th December 2020, Kenya submitted its updated NDC with a commitment to reduce its national emissions by 32 per cent by the year 2030 relative to the BAU scenario of 143 MtCO2 eq. In the updated NDCs Kenya committed to meet 13 per cent (USD 8.06 Billion) of the total required costs (USD 62 Billion) of implementing the mitigation and adaptation actions. The updated NDCs contains Kenya's mitigation and adaptation goals.

Mitigation Goal: *Kenya seeks to undertake an ambitious mitigation contribution towards the Paris Agreement. Kenya therefore seeks to abate her GHG emissions by 32 per cent by 2030 relative to the BAU scenario of 143 MtCO2eq: and in line with her sustainable development agenda. Subject to national circumstances, Kenya intends to bear 21 per cent of the mitigation cost from domestic sources while 79 per cent of this is subject to international support in the form of finance, technology development and transfer, and capacity building[9].*

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

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

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

3.1.4 The National Climate Change Response Strategy (NCCRS), 2010

The NCCRS was the first national document on climate change formulated in 2010. The strategy focuses on ensuring that adaptation and mitigation measures are integrated in all government planning and development objectives. The objective of the strategy is to respond to climate change by: Enhancing the understanding of the global climate change negotiations process, international agreements, policies and processes and most importantly, the positions Kenya needs to take in order to maximise beneficial effects; assessing the evidence and impacts of climate change in Kenya; recommending robust adaptation and mitigation measures needed to minimise risks associated with climate change while maximising opportunities; enhancing understanding

7 Article 7 (9) of the Paris Agreement.
8 Article 4 (2) of the Paris Agreement
9 Kenya's Updated Nationally Determined Contribution
10 Article (4) of the Paris Agreement

of climate change and its impacts nationally and in local regions; recommending vulnerability assessment, impacts monitoring and capacity building framework needs; recommending research and technological needs and avenues for transferring existing technologies; providing a conducive and enabling policy, legal and institutional framework to combat climate change; and, providing concerted action plan, resource mobilisation plan and robust monitoring and evaluation plan[11].

The NCCRS laid the foundation for the establishment of the current climate change response policy and legislative framework in Kenya[12]. The policies, plans and legislations emanating from the implementation of the strategy include: The National Climate Change Action Plans; the National Adaptation Plan; the National Climate Change Framework Policy of 2016; and the National Climate Change Act.

3.2.2 The National Climate Change Framework Policy-2016

The National Climate Change Framework Policy was ratified by the National Assembly in 2016. The main objective of the policy is to enable a coordinated, coherent and effective response to the local, national and global challenges and opportunities presented by climate change. The policy aims to enhance adaptive capacity and build resilience to climate variability and change, while promoting a low carbon development pathway. The policy identifies the adaptive capacity of individuals and communities as being key to improving their socio-economic situations. Thus, to effectively establish the adaptive capacities of individuals and communities, the policy recognises the need for vulnerability assessment. As a policy statement on enhancing climate resilience and adaptive capacity, the Government commits to ensure integration of climate change risk and vulnerability assessment in environmental impact assessments and strategic environmental assessments. The policy further compels the Government to promote public and stakeholder consultation and participation, including with vulnerable groups, to enhance adaptive capacity and climate resilience.

3.2.3. The National Climate Change Action Plan (NCCAP)

The first NCCAP in Kenya was developed in 2012 to cover the five-year period between 2013-2017. The NCCAP 2013-2017 aimed to enhance the implementation of the NCCRS and to contribute to the achievement of t Vision 2030. The NCCAP 2013-2017 had eight indicators namely: long term national low carbon climate resilient development pathway; enabling policy and regulatory framework; adaptation analysis and prioritisation; mitigation actions; technology; national performance and benefit measurement; knowledge management and capacity development; and finance. The plan specified priority actions for the realisation of each of the eight indicators. The NCCAP 2013-2017 contributed to the improvement in Kenya's climate change policy and legal framework and to the establishment of climate change funds in five counties[13]. It also informed the development of the National Adaptation Plan (NAP).

The National Climate Change Action Plan (NCCAP) 2018-2022 was developed pursuant to the provisions of the Climate Change Act, 2016[14]. The NCCAP 2018-2022 builds on the NCCAP 2013-2017. It contains detailed actions that the country intended to take to tackle climate change from 2018 to 2023. The plan set out to support Kenya's development goals by providing mechanisms and measures to achieve low carbon climate resilient development in a manner that prioritises adaptation and recognises the essence of enhancing the climate resilience of vulnerable groups including children, women, youth, persons with disabilities, the elderly and marginalised and minority communities. The plan specifically seeks to: Align climate change actions in the country with the Government's development agenda, including the Big Four Agenda; encourage participation

11 The NCCRS, 2010.

12 The NCCRS recommended the establishment of policy and legislative framework to enhance climate change governance in Kenya.

13 National Climate Change Action Plan 2018-2022.

14 Section 13 of the Climate Change Act, 2016 mandates the cabinet secretary to coordinate the preparation of the climate change action plans.

of the private sector, civil society and vulnerable groups within society, including children, women, older members of society, persons with disabilities, youth and members of minority or marginalised communities; provide the framework to deliver Kenya's NDC for the 2018-2022 period; and, provide a framework for mainstreaming climate change into sector functions at the National and County levels.

3.2.4 The National Adaptation Plan (NAP)

The National Adaptation Plan was developed following recommendations and activities resulting from the implementation of the NCCRS and NCCAP 2013-2017. The NAP forms the basis for the adaptation component of Kenya's Nationally Determined Contributions (updated in 2020). The objectives of the NAP are to: 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; and, enhance resilience of vulnerable populations to climate shocks through adaptation and disaster risk reduction strategies[15].

1.1.5 The Climate Change Act No. 11 of 2016

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

3.3 The Sub-National Climate Change Policy and Legal Framework

The sub-national framework here refers to the climate change policy and legal framework in Homabay County. This framework included the Homabay County Integrated Development Plan (CIDP) 2018-2022 and the Homabay County Climate Change Policy, 2021.

3.3.1 The Homabay County Integrated Development Plan 2018-2022

The CIDP identifies population dynamics, environmental degradation and climate change as challenges to development in Homabay County. The plan further categorises the county as a low climate change resilient County that requires urgent interventions to build resilience. Thus, to achieve sustainable development the plan prioritises climate change action. The CIDP specifically prioritises the reduction of climate change risks and impacts and identifies education, training and awareness creation as one of the strategies for combatting the negative impacts of climate change. Thus, carrying out this climate change risk and vulnerability assessment will contribute to the realisation of the CIDP's objectives of tackling climate change and will inform the mainstreaming of climate actions into the next CIDP (2022-2027).

15 National Adaptation Plan

3.3.2 The Homabay County Climate Change Policy, 2021

The Homabay County Climate Change Policy was ratified by the County Assembly of Homabay in December 2021. The policy's main objective is to achieve an industrialised, healthy and wealthy County with adaptive and resilient communities, through sustainable development based on low carbon, blue and green economy. One of the objectives of the policy is to establish mechanisms for assessing, monitoring and reporting the impacts of climate change actions. To this end, the policy requires the County government to among other measures promote the development of specific sectoral climate change indicators. This risk and vulnerability assessment will be instrumental in achieving this policy objective.

3.3.3 The Homabay County Climate Change Act, 2022

The County Government of Homabay has developed the Homa Bay County Climate Change Act, 2022. The Act provides a climate change governance and response framework in the County. It provides for: The climate change coordination and oversight framework; planning and implementation framework; measures and actions for responding to climate change; and the duties relating to climate change in the County.

4.0 Results and Discussions

In this section, the results of this assessment are presented and discussed. The results are presented and analysed based on the objectives of the assessment: Identification of vulnerability and risk factors to climate change; identification of climate change risks, hazards and vulnerabilities in Homabay County; determination of the probability of impacts currently and in the future; identification of vulnerable sectors and their respective adaptive capacities; identification of indicators for the vulnerability and adaptive capacity used in the assessment; and, presentation of vulnerability and risk maps.

4.1 Climate Change Vulnerability and Risk Factors in Homabay County

Climate change vulnerability is the degree to which geophysical, biological and socio-economic systems are susceptible to, and unable to cope with adverse impacts of climate change (IPCC, 2010). On the other hand, climate change risk in the context of climate change impacts, result from dynamic interactions between climate-related hazards with the exposure and vulnerability of the affected human or ecological system to the hazards (Reisinger et al., 2020). Thus, vulnerability to climate change increases the risk of adverse impacts because of the occurrence of climatic hazards.

The climate change vulnerability and risk factors are classified into three broad categories namely: Contributing factors to the adaptive capacity of Homabay County to climate change; contributing factors to the sensitivity of Homabay County to climate change impacts; and, contributing factors to the exposure of Homabay County to climate change impacts. This classification is informed by the knowledge that vulnerability to climate change is a function of exposure, sensitivity and adaptive capacity (Field et al., n.d. 2014). Where, sensitivity refers to how a system fares when exposed to a climate variable (temperature, precipitation). Adaptive capacity refers to the ability of a system to adjust to potential damage by taking advantage of opportunities or responding to consequences; and exposure referring to the question as to whether the system is in an area experiencing direct effects of climate variables (IPCC, 2014). The discussions here are based on the data as collected from households, community groups and key informants in the assessment area.

4.1.1 Contributing Factors to the Adaptive Capacity of Homabay County to Climate Change

Adaptive capacity is one of the contributing factors to climate change vulnerability that in turn contributes to climate change risks. Some of the factors that influence the adaptive capacity of Homabay County to climate change are as discussed below.

4.1.1.1 Socio-Demographic Factors

The indicators used in this assessment for collecting data on the socio-demographic factors included: Gender; level of education (household heads); age; and size of households.

Gender of Household Heads: The households in the assessment area are mostly female headed at 56.2 per cent with 43.7 per cent of the households being male headed. There was a recorded case of a transgender person -headed household as shown in Table 3 below.

Table 3 : Household heads gender & level of education

		Frequency	Percentage
Gender of Household Head	Male	451	43.7
	Female	579	56.2
	Transgender	1	0.1
	N	1031	100.0
Level of Education	Did not attend school	111	10.8
	Primary	550	53.3
	Secondary	247	24.0
	Post-Secondary	81	7.9
	Graduate	39	3.8
	Post-Graduate	3	0.3
	N	1031	100.0

Studies have shown that household power structure regarding use of resources and labour is influenced by the gender of the household head. In male headed households, it is often the case that it is the male head that determines the household expenditures regardless of whether the income is earned by the collective labour of the whole household. When the head of the household influences expenditure to an extent that little or no investment is made towards diversifying income sources, then the household's vulnerability to climate change impacts increases given that it will continue depending on a source of livelihood that is itself exposed to the impacts of climate change. The power imbalance in households brought about by gender only increases the vulnerability of sections of the population who are already marginalised such as women to the impacts of climate change. Further it has been established that women and girls are disproportionately affected by the impacts of climate change. This is brought about by the multiple roles women play including childbearing and care, caring for the sick in the household, fetching and cooking food and providing water. Women are also negatively impacted by the humanitarian crises occasioned by disasters such as flooding and droughts. In such situations women and girls suffer most from sexual and gender-based violence, disruptions to health care, water and sanitation which affect their sexual and reproductive health[16].

Level of Education of Household Heads: Most household heads in the assessment area attained some level of education with most of them having primary school level of education at 53 per cent as shown in Table 3 above. However, 11 per cent of the household heads did not attend school. The indicator used to determine vulnerability here is the percentage of household heads with average level of education. For this assessment, the average level of education was derived from the Kenya national mean years of schooling which stands at 6.6 years (UNDP, 2020). In this assessment, the household heads with 6.6 mean years of schooling were 53 per cent (households heads with primary level of education). Household head's level of education has been found to influence the use of climate change information that is available to them. Household heads with an education are more likely to positively use climate change information available to them to adequately adopt to the impacts of climate change (UNFCCC, 2017).

16 United Nations Economic and Social Council report on population dynamics, vulnerable groups and resilience to climate change and disasters

Age of Household Heads: The mean age of the household heads in the assessment area is 47.2 years. Most of the household heads were 40 years old. The households are headed by people of ages ranging from a minimum of 20 years to a maximum of 94 years as shown in Table 4 below. The average (mean) age of household heads is the specific indicator for adaptive capacity used in this assessment.

Table 4: Households heads age & households' size

	Age	Size of Household
N	1031	1031
Mean	47.2	5.6
Mode	40.0	5.0
Minimum	20.0	1.0
Maximum	94.0	15.0

Age of household head is crucial in determining the access to information on climate change as established by research. For instance, young farmers are more likely to be early adopters of new technology as compared to older age groups (Chandni et al, 2018). Similarly, younger farmers tend to have a diversified pool of information sources that increases their likelihood of getting climate change information faster than their older counterparts (Sanga & Elia, 2020). Access to climate change information empowers households to adequately adapt to the impacts of climate change. On the other hand, studies have shown that older farmers are more adaptive to the impacts of climate change because of their high farming experience. This makes them good observers of climatic changes, thus are more likely to know which actions to take as a result of the changes (Mwadzingeni, et al, 2022).

Household Size: The average size of households in the assessment area is 5.6 people which is above the national mean household size of 3.9 people (KNBS, 2019). The lowest number of people in a household was one and the highest number of people in a household in the assessment area was 15. Most households had an average of five people as shown in Table 4 above.

4.1.1.2 Livelihood Strategies

These are the ways and means by which households provide for their daily needs in terms of food and other basic needs. As an indicator for adaptive capacity, the livelihood strategies of the households in the assessment were queried by collecting data on the indicators as analysed in Table 5 below.

Main Source of Income: Most households in the assessment area derive their income from agriculture (53.7 per cent). Thus, it is inferred that 53.4 per cent of households in the assessment area derive their livelihoods from agriculture (crop and livestock farming). After agriculture, households derive their income from trading activities at 16.5 per cent followed by casual labour and other sources of income at 9.3 percent and 8.1 percent respectively. 7.4 per cent of the household derive their income from formal employment and 4.5 percent of the households have fisheries as their main source of income. 0.6 % of the households depend on transfers from relatives and other benefactors. As shown in part A of Table 5 below.

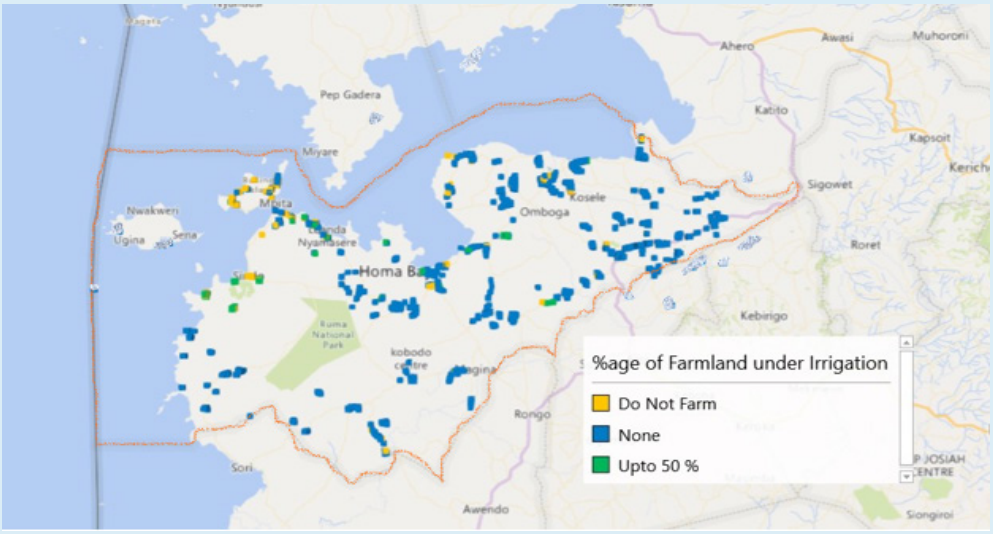
Table 5: Households livelihood strategies sub-indicators

		Frequency	Percent
A. Main Source of Income (Main Source of livelihood)	Farming (Livestock/crop)	554	53.7
	Fisheries	46	4.5
	Formal Employment	76	7.4
	Trading	170	16.5
	Casual Labour	96	9.3
	Transfers	6	0.6
	Other	83	8.1
	N	1031	100.0
B. Percentage of Farmland under Irrigation	None	868	84.2
	Up to 50 %	77	7.5
	Not Farming	86	8.3
	N	1031	100.00
C. Households have access to credit	Yes	399	38.7
	No	632	61.3
	N	1031	100.0
D. Source of credit	Commercial bank	27	2.6
	SACCO	74	7.2
	Input supplier	6	0.6
	Micro-Finance Institution	35	3.4
	Local Savings & Loans Group	243	23.6
	Others (specify)	14	1.4
	Total	399	38.7
	Do not access credit	632	61.3
	Commercial bank	27	2.6
	SACCO	74	7.2
	Input supplier	6	0.6
	N	1,031	100.00

According to the 2009 population and housing census, 74 percent of the labour force in Homabay County is employed in the agricultural sector. This is closely related to the findings in this assessment where up to 54 percent of households derive their income from agriculture and related activities. Given the exposure of the agricultural sector to the impacts of climate change, the large percentage of the population depending on the sector for their income and livelihoods increases their vulnerability.

Dependence on rain-fed agriculture: Percentage of farmland under irrigation was used as a substitution to determine the dependence on rain-fed agriculture in the County. As observed, most households in the assessment area engage in agricultural activities especially crop farming. Only 7.5 percent of the households engaging in crop farming had up to 50 percent of their farmlands under some form of irrigation. A larger percentage of those households engaged in crop farming had none of their farmlands under irrigation at 84.2 per cent as shown in part B of Table 5 above. The dependence on rain-fed agriculture is spread throughout the County as show in Map 2 below. Irrigation farming is almost nonexistent in the County despite the County being home to the Oluch-Kimira irrigation scheme in Rachuonyo North and Rangwe sub-counties.

Map 2: Dependence on rainfed agriculture in Homabay County



Number of people Working and Earning an Income in a Household: This indicator revealed the extend of dependency on a single income earner in a household. Up to 97.1 per cent of households in the assessment area had a person (s) working and earning an income. However, 65 per cent of the households had only one person (the household head) working and earning an income. 32.1 per cent of the households had more than one person earning an income while only 2.9 per cent of the household did not have an income earner. This finding infers a high rate of dependency in the assessment area.

Households' Access to Credit: Less than half the respondents indicated that they have access to credit at 38.7 per cent. Most of the households in the assessment area do not have access to credit at 61.3 per cent as shown in part C of Table 5 above

4.1.1.3 Social Networks

Social networks refer to the household's connection to people, groups or organisations within their locality. These networks are crucial in enhancing the adaptive capacity of a household to climate change impacts since they also act as "safety nets" in times of need.

Households' Membership to Groups: The household heads interviewed were asked if they belong to any kind of group to which 52.3 per cent responded as not belonging to any group while the remaining 47.7 per cent indicated that they belong to a group. The groups in which the household heads are members include Savings and Cooperative Companies (SACCOs); marketing societies; Community Forest Associations (CFAs); saving and loans; and others such as family groupings and religious formations as shown in parts A and B of Table 6 below. The relationships households build with each other and through social groupings for a support mechanism around them in term help the households in addressing the challenges resulting from climate change impacts.

Table 6: Social networks indicators

		Frequency	Percent
A. Membership to a Group	Yes	492	47.7
	No	539	52.3
	N	**1031**	**100.0**
B. Type of Group	SACCO	88	17.9
	Marketing Society	5	1.0
	Community Forest Association	8	1.6
	Saving & Loans	343	69.7
	Others (Specify)	48	9.8
	N of those who belong to a group	**492**	**100.0**
C. Support from the Group (s)	Yes	468	95.1
	No	24	4.9
	N of those who belong to a group	**492**	**100.0**
D. Access to Agricultural Extension Services	Yes	66	6.9
	No	893	93.1
	N of those who farm	**959**	**100.0**

Support from Groups: Households heads were asked if the groups in which they were members could offer them support in times of need like occurrence of disasters and personal need. An overwhelming majority of households that had membership in a group indicated that they could get support from their respective groups in times of need. Only 4.5 per cent of households who belonged to a group indicated that their respective groups do not offer them support in times of need as shown in part C of Table 6 above. The support households get from these groups goes beyond help in emergency situations but also contribute to the building of their adaptive capacity and resilience to climate change over time.

Households' Access to Agricultural Extension Services: Less than 10 per cent of the households have access to agricultural extension services in the assessment area. A vast majority of the households do not have access to agricultural extension services at 86.6 per cent. The remaining 7 per cent of the households are not engaged in farming, thus do not need agricultural extension services as shown in part C of Table 6 above. Agricultural extension officers are a major source of knowledge and information on climate change especially to farmers whose trade is highly exposed to the impacts of climate change. Access to extension services is one way of exposing farmers to the current activities that the government at both levels could be implementing on climate change response.

4.1.1.4 Knowledge and Skills

Availability of Vocational Skills in Households: Vocational skills are an integral part of livelihood strategies and contributes to households' adaptive capacity to climate change (IPCC, 2014). In the assessment area, the household heads interviewed tended not to have any kind of vocational skill with only 22.7 per cent indicating that they have a skill that they could use for their livelihood support. Some of the skills included: Crop and animal husbandry; water related skills (plumbing and hydrology); boat making; fishing net weaving; and vocational skills like hair plaiting; motor vehicle repair; tailoring and pottery. Most of the household heads at 77.3 per cent had no vocational skills as shown part A of Table 7 below.

Table 7: Households knowledge and skills sub-indicators

		Frequency	Percent
A. Vocational Skills in Households	Crop Husbandry	61	5.6%
	Animal Husbandry	34	3.1%
	Water related skills (Plumbing, hydrology)	16	1.5%
	Boat making	16	1.5%
	Fishing net weaving	42	3.9%
	Others (specify)	78	7.2%
	None	843	77.3%
N		1090	100.0%
B. Awareness of Climate Change	Yes	674	65.4
	No	357	34.6
	N	1031	100.0
C. Awareness of Impacts of Climate Change	Yes	584	86.6
	No	90	13.4
	N	674	100.00

Vocational skills are important in encouraging self-employment, thus diversifies income sources from agriculture and related activities. When households have varying sources of income, their dependency especially on rain-fed agriculture reduces and with it, their adaptive capacity increases, hence a reduction in their vulnerability to the impacts of climate change. As it is the seemingly low levels of vocational skills amongst the population, further exposes them to the impacts of climate change given their continued dependence on the vulnerable sectors.

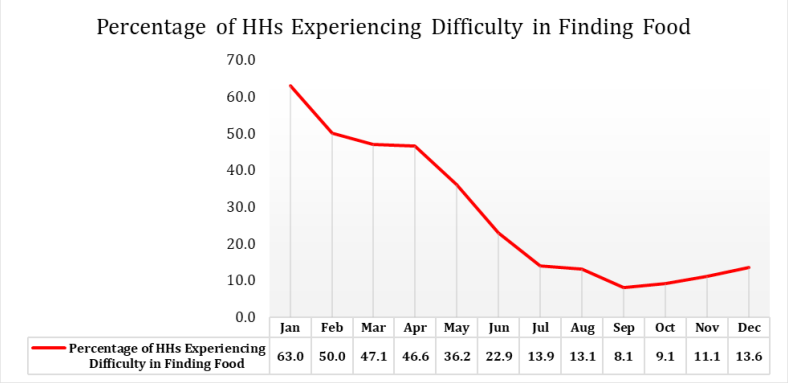
Households' Awareness of Climate Change and its impacts: On the awareness of climate change, 34.6 per cent of the respondents were not aware and 65.4 per cent had some information or knowledge about the phenomenon known as climate change. 86.6 per cent of those aware of climate change are also aware of its impacts while 13.4 per cent are not aware of its impacts as shown in part C of Table 7 above. Awareness of climate change and its impacts contributes to the preparedness of communities to take measures to adapt and build resilience to the impacts of climate change (IPCC, 2010).

4.1.2 Contributing Factors to the Sensitivity of Homabay County to Climate Change Impacts

4.1.2.1 Food Security

Access to food is one of the indicators of food security and ease or difficulty in obtaining food is a proxy indicator of access to food. The households tend to have the most struggle in obtaining food in the first four months of the year, between January and April. The level of difficulty in obtaining food begins to drop significantly from May and begins to rise again in October peaking in January as shown in Figure 2 below.

Figure 2: Months in which households have difficulty in obtaining food



The households gave distinct reasons for the difficulty in obtaining food, which included land preparation and planting time at 33.7 per cent; crops in the field at 23.5 per cent; rainy season at 9.1 per cent; drought at 48.2 per cent, and lack of money to buy food at 65.5 per cent as shown in part A of Table 8 below. That 48.2 per cent of households cited drought as a reason for difficulty in obtaining food points to the extent to which climatic hazards contribute to food insecurity in the area of assessment.

Table 8: Food security indicators

			Frequency	Percent
A. Reasons for Difficulty in obtaining food.	Land preparation and planting time	No	684	66.3
		Yes	347	33.7
		N	1031	100.0
	Crops in the field	No	789	76.5
		Yes	242	23.5
		N	1031	100.0
	Rainy Season	No	937	90.9
		Yes	94	9.1
		N	1031	100.0
	Drought	No	534	51.8
		Yes	497	48.2
		N	1031	100.0
	Lack of money to buy food	No	356	34.5
		Yes	675	65.5
		N	1031	100.0
	Others	No	972	94.3
		Yes	59	5.7
		N	1031	100.0
B. Number of meals taken by households in a day		None	2	0.2
		One	67	6.5
		Two	413	40.1
		Three	531	51.5
		More than three	18	1.7
		N	1031	100.0
C. Contribution of own production to households' grain needs in a year		Less than half of your grain needs	425	41.2
		Half your grain needs	366	35.5
		More than half your grain needs	115	11.2
		All your grain needs	6	0.6
		Total	912	88.5
		Do not farm	119	11.5
		N	1031	100.00

Up to 50 per cent of the population in Homabay County is food insecure with up to 84 per cent of households not having enough food to meet their needs[17]. The Food and Agriculture Organization (FAO), defines food security as "all people, at all times, having physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life"[18]. The prevailing food insufficiency in the County increases vulnerability to climate change. A situation made worse by secondary effects of food insecurity such as malnutrition in children in the County which stands at 32.1 per cent [19].

17 - Kenya County Climate Risk Profiles- Climate Risk Profile for Homabay County.
18 - Food and Agriculture Organization (FAO), 1996.
19 - 2015/16 Kenya Integrated Household Budget Survey, 2018.

Number of meals taken by households in a day: The number of meals taken in a day is a proxy indicator for access to food. In the assessment area, 51.5 per cent of households have three meals in a day while 40.1 per cent and 6.5 per cent have two and one meal(s) respectively as shown in part B of Table 8 above.

Contribution of own production to households' grain needs in a year: Grains, especially maize and millet, form a major part of meals taken by households in the assessment area. Availability of grains contribute a significant percentage to the household's food security. The assessment inferred that 0.6 per cent of the households satisfy all their grain needs from their own production as shown in part C of Table 8 above. This can be explained in part by a finding of this assessment that the scale of farming practiced in this assessment is relatively small with most farms being below five acres. Drought also plays a significant role in the insufficient nature of grain production given that 48 per cent of households also cited drought as a major reason they have difficulty in obtaining food.

4.1.2.2 Access to Water

Households' main sources of drinking water: Boreholes are a main source of water for 25.3 per cent of the respondents and 17.5 per cent of the households access their drinking water from Lake Victoria. Rivers and shallow wells are the main source of water for 15 per cent and 7.7 per cent of the households, respectively. Very few households have piped water in their dwellings at 4.1 per cent with 9.3 per cent of the households accessing their drinking water from water kiosks. Up to 21 per cent of the households' access drinking water from other sources which include water pans, rainwater and protected springs as shown in part A of Table 9 below.

Table 9: Access to water indicators

		Frequency	Percent
A. Main source of drinking water	Shallow well	79	7.7
	Borehole	261	25.3
	River	155	15.0
	Lake Victoria	180	17.5
	Piped into dwelling	42	4.1
	Water Kiosk	96	9.3
	Others	218	21.1
	N	1031	100.0
B. Access to a functional water treatment and distribution system	Yes	200	19.4
	No	831	80.6
	N	1031	100.0
C. Disruption to main source of water in the last five years	Yes	656	63.6
	No	375	36.4
	N	1031	100.0
D. Cause of disruption to main source of water	Natural Disaster	205	19.9
	Damage on road	21	2.0
	Damaged water supply system	175	17.0
	The water dried up	165	16.0
	The water was not fit for human consumption.	52	5.0
	Others (specify)	38	3.7
	Total	656	63.6
	No disruption	375	36.4
	N	1031	100.00

Households' Access to a Functional Water Treatment and Distribution System: This assessment inferred that access to functional water treatment and distribution systems in the assessment area is low given that only 19.4 per cent of the respondents indicated having access to the same as shown in part B of Table 9 above. A functional water treatment and distribution system weans communities and households off the direct dependence on natural water sources for their water needs which also significantly reduces their vulnerability to the impacts of climate change.

Disruptions to Main Source of Water and Causes: A substantial number of households reported disruptions to their main source of water in the last five years at 63.6 per cent as shown in part C of Table 9 above. 19.9 per cent of the households reported disruptions to their water source, citing natural disaster as the cause. Other causes included: Damage on the road/path leading to water source; damage on water pipes; drying up/ depletion of water source; and, declaration of the water from the source to be unfit for human consumption as shown in part D of Table 9 above.

Time Taken by Households to Reach Drinking Water Source: The households must spend some time to access drinking water from the various sources. Most of the households spend 30 minutes to access their main source of drinking water. However, the average time taken to access main source of drinking water is 23 minutes. Households spend a minimum of zero minutes and a maximum of 202 minutes to access their main sources of water.

4.1.2.3 Health

Missed workdays in households due to ill health in the past one year: Households reported missing an average of eight workdays due to ill health in the past one year. The maximum number of missed workdays was 120 days in the assessment area. It is important to note that missed worked days contribute to a household's vulnerability to food insecurity given that these workdays directly affect the household's ability to attend to their livelihood chores. Time taken to reach a health facility is a representation of determining access to basic health care and further measures the spatial distribution of physical healthcare facility in each area.

Time Taken to Reach a Health Facility: It takes households a minimum of 35 minutes and a maximum of 180 minutes to reach a health facility using the quickest means of transportation available to them as shown in Table 10 below.

Table 10: Health sub-indicators

	N	Mean	Minimum	Maximum
Workdays missed due to ill health	1031	7.6324	0.00	120.00
Time taken to nearest health facility	1031	35.9418	0.00	180.00

In this assessment, the time taken to a health facility infer to the ability of households to access medical services considering climatic risks they face. This finding, when compared against the officials records on the distribution of health facilities in the County reveals an almost similar pattern given that there are 262 health facilities (public and private) in the County, out of which 186 are public facilities and 76 are private owned. These facilities are evenly distributed within the Sub-Counties and across the County as shown in Figure 3 below.

Figure 3: Distribution of health facilities in Homabay County

Source: USAID Homabay County Health Fact Sheets

4.1.2 Contributing Factors to the Exposure of Homabay County to Climate Change Impacts

The main indicator used to determine the exposure of the assessment area to the impacts of climate change is natural vulnerability. The sub-indicator used to determine natural vulnerability is the occurrence of climatic hazards which have been identified by the households and communities. Other sub-indicators used include the impacts of the identified hazards on the households' ability to earn income, effects of the hazards on property and their impacts on human health.

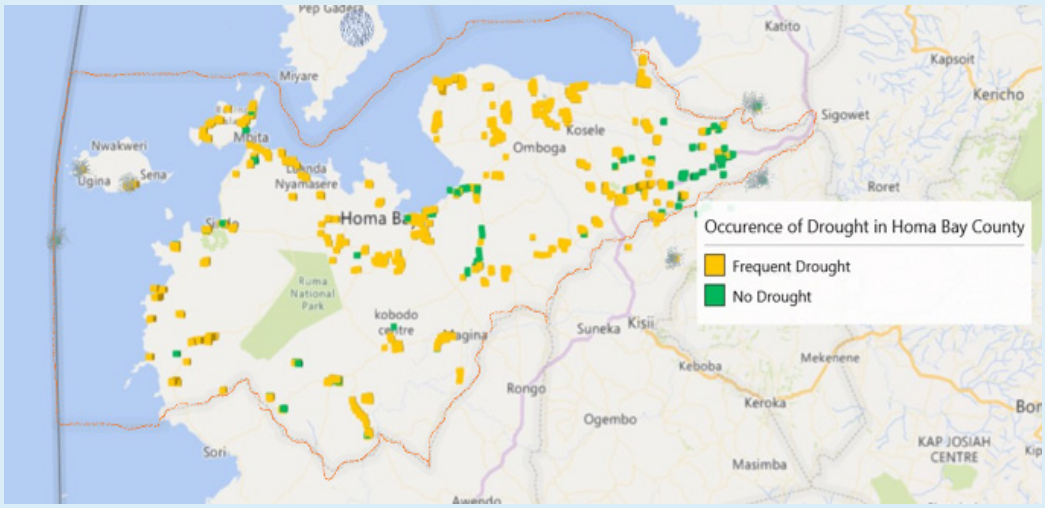
4.1.3.1 Natural Vulnerability

Table 11: Common climatic hazards in Homabay County

		Frequency	Percent
The Most Common Climatic Hazards in Homabay County	Drought	819	79.4
	Flooding	106	10.3
	Rainstorm	17	1.6
	Extreme heat	84	8.1
	Others (specify)	5	0.5
	Total	1031	100.0

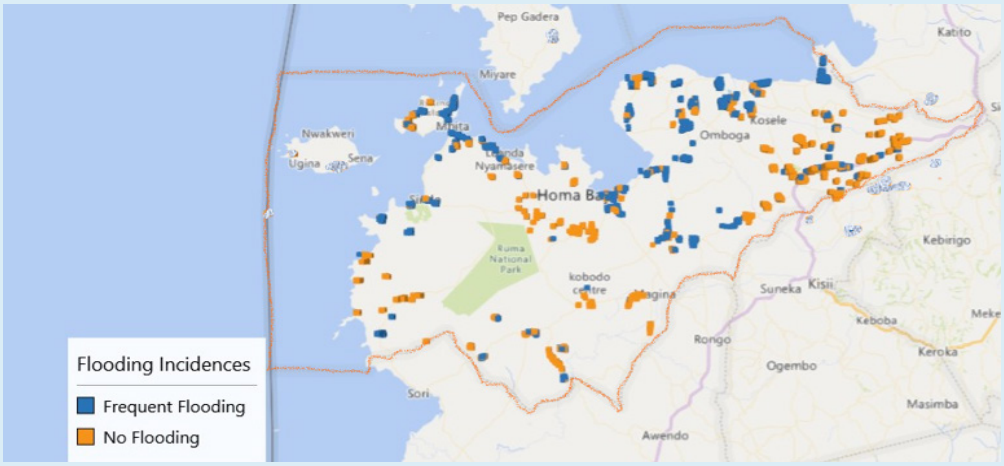
The households and communities identified drought as the most common climatic hazard in the County as shown in Table 11 above.

Map 3: Occurrence of drought in Homabay County



The occurrence of drought is widespread throughout the County, affecting all the eight sub-counties as indicated in Map 3 above. The distribution of the reported drought incidences affirms that drought is the major climatic hazard in the County. Flooding was identified as the second most significant climatic hazard occurring in Homabay County.

Map 4: occurrence of floods in Homabay County



The flooding incidences are mainly concentrated in the low-lying areas of the County but are more frequent in Rachuonyo North and Suba North sub-counties as indicated in Map 4 above.

According to the 2015/16 Kenya National Integrated Budget Survey (KNIBS), 88 per cent of households in Homabay County reported experiencing shocks that impacted their socio-economic status. The most reported shocks for the County in the 2015/16 KNIBS were floods and droughts.

Impacts of the Identified Climatic Hazards: The households and communities identified various impacts resulting from the occurrence of the identified climatic hazards as shown in Table 12 below.

Table 12: Impacts of Climatic Hazards

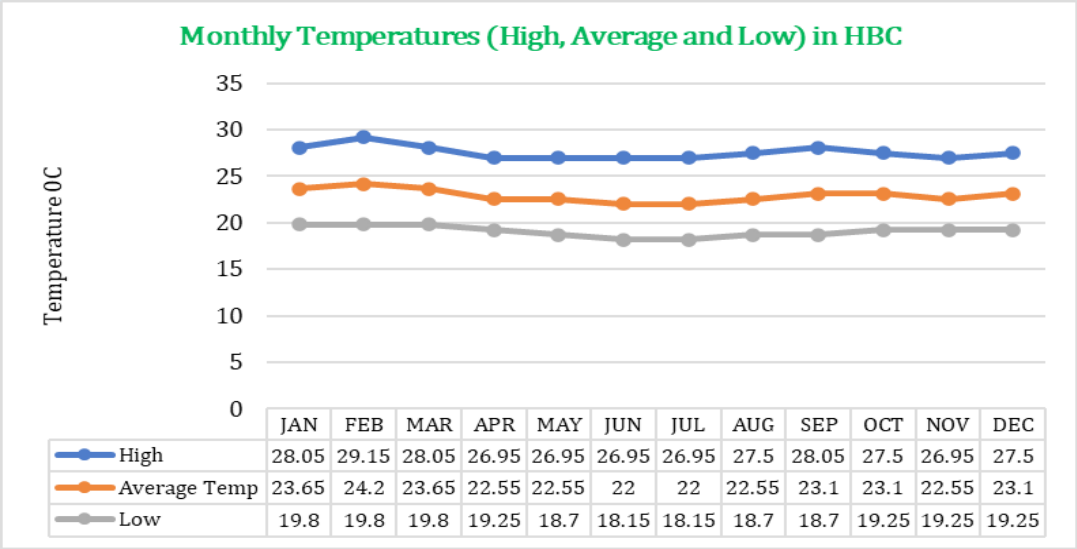
		Frequency	Percent
Impact on ability to earn income	No	520	50.4
	Yes	511	49.6
	N	1031	100.0
Damage to property	No	798	77.4
	Yes	233	22.6
	N	1031	100.0
Displacement of households	No	967	93.8
	Yes	64	6.2
	N	1031	100.0
Damage to crops and livestock	No	232	22.5
	Yes	799	77.5
	N	1031	100.0
Impact on human health	No	610	59.2
	Yes	421	40.8
	N	1031	100.0

The households and communities indicated that the occurrence of these climatic hazards directly affect their ability to earn an income; results in damage to their properties; leads to displacement of people from their dwelling areas; damages crops and livestock; and results in outbreak of diseases which affect their health and general well-being.

4.1.4 Current and Future Trends of Climatic Variables in HBC

4.1.4.1 Current and Future Trends of Temperature

Time series analysis of temperature data for Homabay County show little variations between the maximum and minimum temperatures and between average monthly temperatures as shown in Figure 4 below.



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
High	28.05	29.15	28.05	26.95	26.95	26.95	26.95	27.5	28.05	27.5	26.95	27.5
Average Temp	23.65	24.2	23.65	22.55	22.55	22	22	22.55	23.1	23.1	22.55	23.1
Low	19.8	19.8	19.8	19.25	18.7	18.15	18.15	18.7	18.7	19.25	19.25	19.25

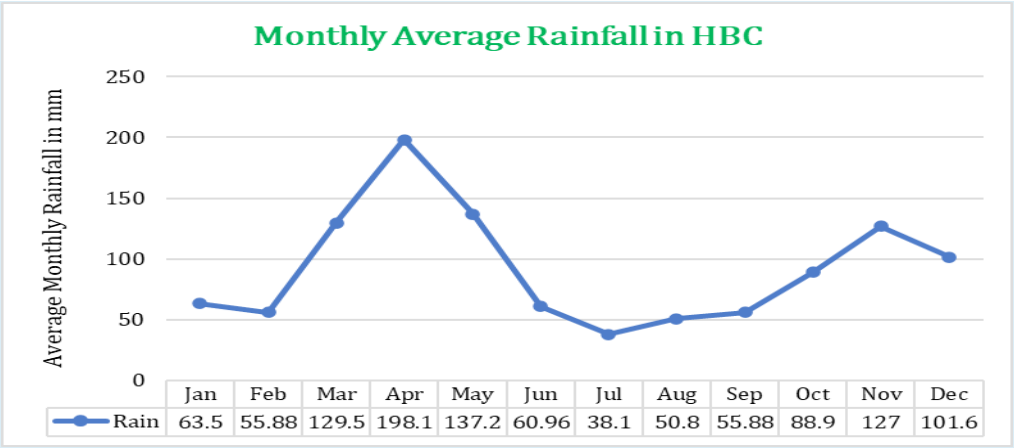
Source: Kenya Meteorological Department

The hottest months in the County are January and March when average temperatures peak at 23.65^0 C and the elevated temperatures for these months peak at 28.05^0 C. The coolest months are June and July when the average temperatures are 22^0 C and the low temperatures for these months drop to 18.15^0 C. Since 1981, the average temperatures in the County have been observed to have increased by 1^{0}C[20]. Forward into the future (2021-2065), temperature is the County is projected to increase by 0.4^{0}C. The projected increase in temperature increases future drought risk in the County.

4.1.4.2 Current and Future Trends of Precipitation (rainfall)

Precipitation in Homabay County peaks in the month of April (198.1 mm) and drops to its lowest in July (38.1 mm) as indicated in Figure 5 below.

Figure 5 Monthly Rainfall in HBC



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rain	63.5	55.88	129.5	198.1	137.2	60.96	38.1	50.8	55.88	88.9	127	101.6

Source: Kenya Meteorological Department

20 Kenya County Climate Risk Profile Series-Homabay County Climate Risk Profile.

Precipitation rates determine the occurrence of both drought and flood hazards. There have been observed increases and decreases in precipitation in the County since 1981[21]. The observed decreases in precipitation have contributed to the occurrence of drought hazard in the County while the observed periodic increases in precipitation have contributed to the occurrence of flood hazard in the County. Future projections show a 0.7 per cent increase in precipitation for the period 2021-2065. This projected increase in precipitation, increases future flood risk in the County.

4.2 Climate Change Risks, Hazards and Vulnerabilities in Homabay County

4.2.1 Climate Change Risks and Hazards in Homabay County

Hazard refers to the potential occurrence of climate-related physical events or trends that may cause damage and loss. The most common climatic hazards in Homabay County were identified by the communities and community groups. The potential risks from these hazards were also identified. As previously stated in this report, floods and droughts are the most common climate related hazards that occur in the County. In Table 13 below, precipitation and temperature are the climate variables whose impacts results in the identified hazards that have negative impacts on the human and ecological systems in the County. The interaction of the climatic hazards with the exposed human and ecological systems in the County results into climate change risks identified in column C of Table 13 below. It is observed that precipitation can lead to either of the two identified climatic hazards depending on the magnitude and intensity. For instance, low precipitation leads to drought hazard while high precipitation leads to flood hazard. The risks associated with either occurrence of the precipitation variable is the occurrence of floods and droughts and rise in the lake water levels in the case of high (extreme) precipitation. The temperature variable is mostly associated with drought hazard in the County which exposes the County to the risk of frequent drought incidences.

Table 13: Identification of Climate Change Hazards and Risks in Homabay County

A		B	C
CLIMATIC VARIABLE		**CLIMATIC HAZARD**	**CLIMATE CHANGE RISK**
Variable	Magnitude		
Precipitation	Low	Drought	▪ Occurrence of droughts ▪ Disease Outbreaks ▪ Irregular fish breeding patterns
	High	Floods	▪ Increased Flooding Incidences ▪ Rise in lake water levels ▪ Disease outbreaks
Temperature		Drought	▪ Increased Drought incidence ▪ Disruption of fish breeding patterns

4.2.2 Climate Change Vulnerabilities in Homabay County

Climate change vulnerabilities contribute to the risk of the occurrence of climate change impacts. Homabay County's climate change vulnerabilities manifest in various forms including Decreased crop production, loss of income, emergence of new and aggressive insects, pests and diseases, loss of livelihoods and loss of life among others as enumerated in Table 14 column B below.

21 - Kenya County Climate Risk Profiles-Homabay County Climate Risk Profile

Table 14: Climate Change Vulnerabilities in Homabay County

A	B
CLIMATE CHANGE Risks	**VULNERABILITIES**
(Precipitation) **Flooding** **Rise in lake water levels**	▪ Decreased crop production ▪ Food scarcity ▪ Emergence of new and aggressive insects and pests ▪ Loss of income ▪ Low milk productivity ▪ Livestock diseases ▪ Loss of income ▪ Loss of livelihoods ▪ Inadequate water supply ▪ Spread of infectious and contagious infections ▪ Loss of life
(Temperature) **Droughts** **Airborne diseases**	▪ Decreased productivity ▪ Emergence of aggressive and invasive insects and pests ▪ Loss of productive agricultural land ▪ Loss of income ▪ Declining livestock productivity ▪ Loss of livelihoods ▪ Inadequate water for human and livestock use ▪ Loss of life ▪ Spread of contagious and infectious diseases

4.2.2.1 Measuring the Vulnerability of Homabay County to Climate Change.

The composite measure of vulnerability of the County to the impacts of climate change has been determined using the Livelihoods Vulnerability Index (LVI). The LVI is measured on scale of 0 to 0.5 and is interpreted as follows: 0 – 0.2 = Not vulnerable; 0.21 – 0.4 = Vulnerable/Moderate; 0.41 – 0.5 = Very vulnerable. Each of the contributing factors to vulnerability (Adaptive capacity, Sensitivity and Exposure) were factored in the calculations to determine the County's vulnerability. The major indicators for each of the contributing factors to vulnerability are as defined in Table 15 below. Each of the contributing factors were allocated indicators as defined in Table 18 of Annex I. The results of the LVI calculations to determine vulnerability are as presented in Table 15 below.

Table 15: Summary results of LVI Calculations

Contributing Factors (CF)	Major Indicators	LVI Value	CF LVI Value
Adaptive Capacity	Socio-Demographic	0.3	0.5
	Livelihood Strategies	0.5	
	Social Networks	0.6	
	Knowledge & Skills	0.5	
Sensitivity	Health	0.3	0.4
	Food	0.5	
	Water	0.5	
Exposure	Natural Vulnerability	0.5	0.6
LVI-HBC		**0.5**	

4.2.2.2 Interpretation of the Livelihood Vulnerability Index Scores

The LVI scores are based on the contributing factors of climate change vulnerabilities and risks in Homabay County as identified in this assessment.

The LVI Scores for the Contributing Factors to Adaptive Capacity of Homabay County to the Impacts of Climate Change

The LVI score for the socio-demographic profile is 0.3, implying moderate vulnerability. The LVI score for livelihood strategies is 0.,7 implying extreme vulnerability. This finding indicates that the population in Homabay County depends on sources of livelihood that are extremely exposed to the impacts of climate change. For instance, up to 58 per cent of households in the County depend on agriculture for their income and hence livelihood. Further there is a high dependency rate where up to 68 per cent of households have none or just one income earner.

The LVI score for social networks of 0.6 indicates weak linkages amongst the people of Homabay County in terms of groupings, source of help in case of emergencies and connection to early warning systems. This in turn lowers their adaptive capacity to the impacts of climate change. Knowledge and skills have been shown to improve the adaptive capacities of populations to the impacts of climate change. However, in Homabay County, there is observed low levels of knowledge and skill relevant to absorbing the shocks arising from climatic hazards. This manifests itself in form of the availability of skills in households, awareness on the causes and impacts of climate change and the level of education of household heads. To this end, the high number of households that do not have an individual with skills (vocational/ technical) at 81 per cent contributes to the low adaptive capacity and is confirmed by the LVI score of 0.6 which is above the outer limit of the LVI range. The LVI score for the finance indicator is 0.4 which indicates a high vulnerability in this respect and further exacerbates the low adaptive capacity prevalent in the County. Lack of access to credit and low levels of income diversification combine to further erode the adaptive capacity of the county to the impacts of climate change.

Contributing Factor to the Sensitivity of Homabay County to the Impacts of Climate Change

The LVI score for the health indicator is 0.3, implying that the health indicators in Homabay County are generally poor. Specifically, the indicators measured in this assessment such as the percentage of households reporting ill health in the preceding one year (63 per cent) and the average number of workdays lost due to ill health (8 days) increases the sensitivity of the County to the impacts of climate change. The food indicator returned a LVI score of 0.5, pointing to its significant contribution to the sensitivity of the County to climate change. A major factor to this was found to be that a high percentage of the County's population do not produce enough food in their farms to sustain them in between harvests. Subsequently, they find it difficult to obtain food for an average of four months in a year. Water is a key component of sensitivity in Homabay County. The LVI score for water is 0.5, indicating high vulnerability of the water sector. Factors such as the percentage of households accessing drinking water directly from natural sources (87 per cent) makes the water sector highly vulnerable to the impacts of climate change. This in turn increases the sensitivity of the County to climate change impacts.

Contributing Factors to the Exposure of Homabay County to the Impacts of Climate Change

The LVI score for natural vulnerability is 0.5. This score is an indication of the significant level of exposure of Homabay County to the impacts of climate change hence the high overall vulnerability score. The major contributing factors to this scenario are the erratic rainfall patterns, the incessant droughts and the perennial flooding menace in some parts of the County.

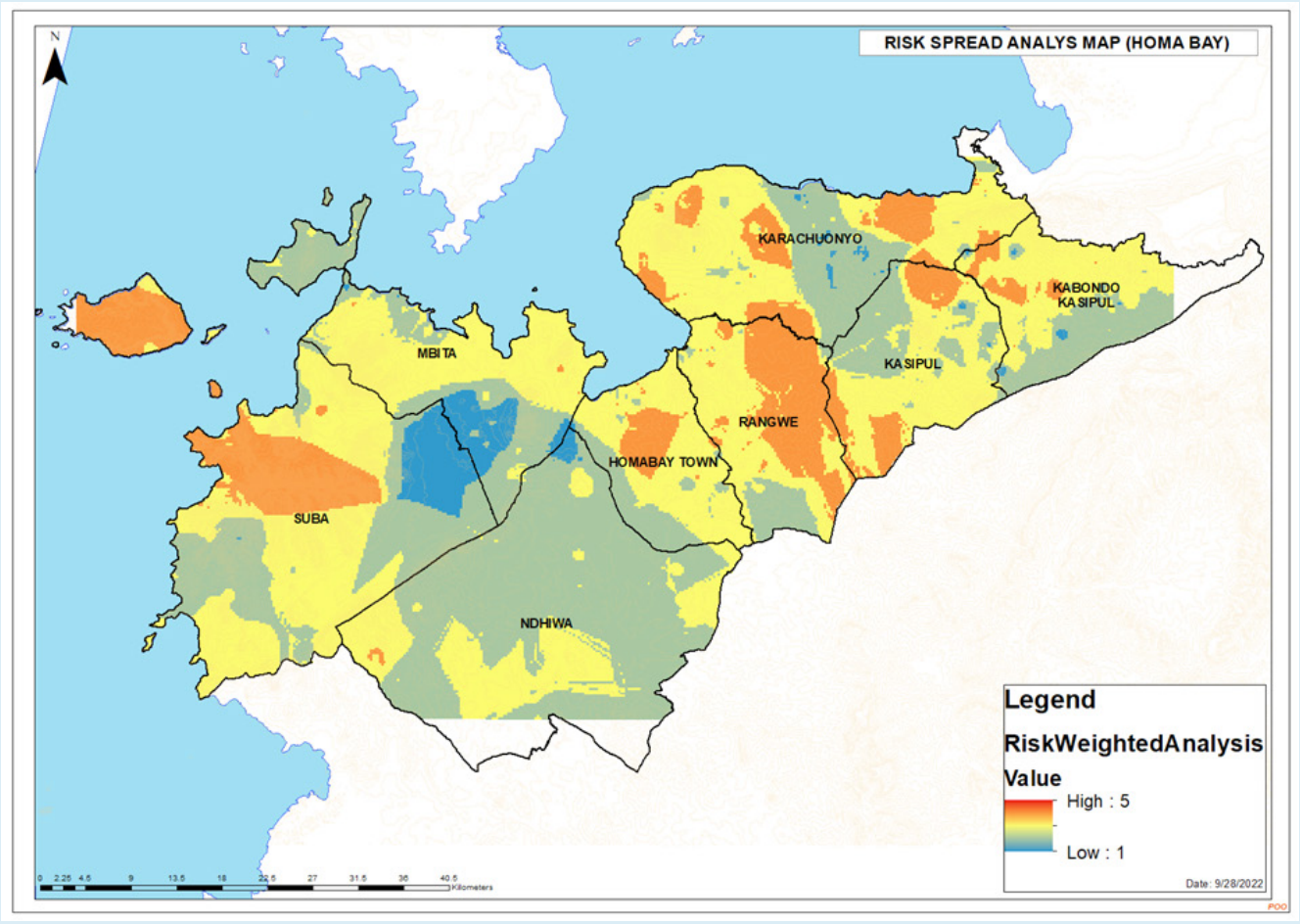
Overall, Homabay County is 'very vulnerable' to the impacts of climate change given the LVI score of 0.5 from Table 15 above. A detailed step by step calculation of the LVI scores is presented in Annex II of this report.

4.3 The Climate Change Risk and Vulnerability Map (s) for Homabay County

The ranking method was used to classify the mapped indicators considering their impacts resulting to risks and vulnerabilities. The Hierarchical Decision Making (HDM) method was deployed with highest value adopted at 5 and lowest being 1 where 5 represented worst scenario while 1 represented moderate/acceptable scenario. For data interpolation, Inverse Distance Weighting (IDW) method was used for values proration and classification purpose.

4.3.1 The Climate Change Risk Map for Homabay County

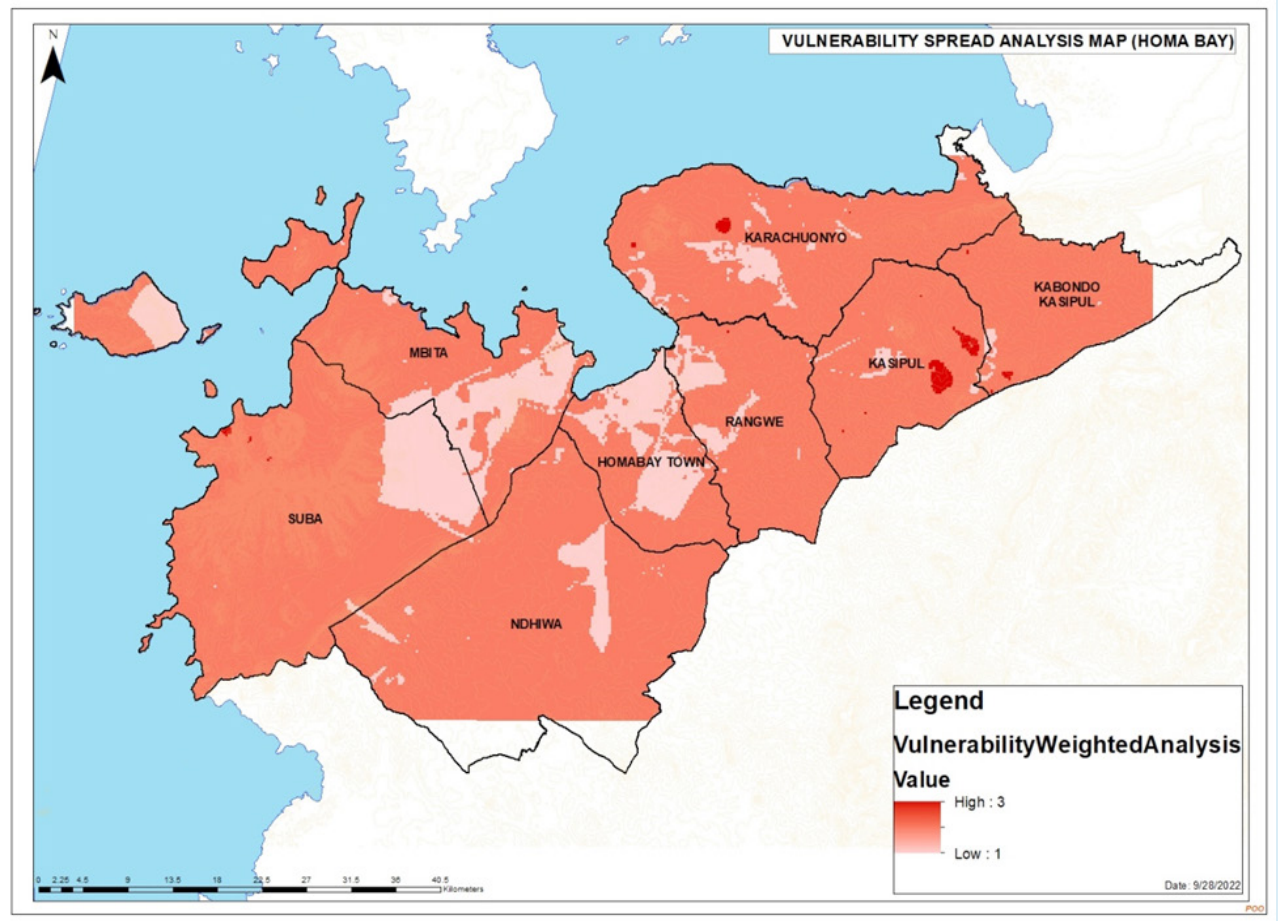
Figure 6: Climate Change Risk Map for Homabay County



The two main climate change risks in Homabay County are the occurrence of floods and droughts. The map shows that most parts of the county is faced with the occurrence of either risk hazards.

4.3.2 The Climate Change Vulnerability Map for Homabay County

Figure 7: Homabay County vulnerability to climate change impacts map



The vulnerability map confirms that the County is highly vulnerable to the impacts of climate change given that this assessment determined a vulnerability index of 5 for the County. The contributing factors to climate change vulnerability occur almost evenly across the County in all the Sub-Counties.

4.4 Sectoral Climate Change Analysis in Homabay County

This section contains a discussion on the vulnerable sectors to climate change, the impacts and the respective adaptive capacities.

4.4.1 The Vulnerable Sectors to Climate Change in Homabay County

Agriculture (crop, livestock and fisheries), Water and Health are identified as vulnerable sectors to the impacts of climate change as shown in column B of Table 16 below. The assets impacted by climate change in the sectors are categorised into natural, physical, human, social and financial assets as indicated in column C of Table 16 below. Column D gives a description of the various assets in each sector.

Table 16: Identification of the vulnerable sectors to climate change in Homabay County

A	B	C	D	E	F
CLIMATE CHANGE Risks (From Error! Reference source not found. **Column A & D)**	**EXPOSED SECTOR**	**ASSETS**	**ASSET DESCRIPTION**	**IMPACTED?**	**DESCRIPTION OF IMPACTS ON SECTORAL ASSETS**
Precipitation ▪ **Flooding** ▪ **Rise in lake water levels** ▪ **Drought**	Agriculture (Crops)	Natural	Land tenure, crops and seed varieties, sources of water for crop farming	Yes	▪ Damage to crops in the fields during flooding ▪ Outbreak of crop diseases and pests ▪ Loss of productive agricultural land due to rise in lake water levels
		Physical	Access to markets (roads), means of transportation, supporting infrastructure (availability of processing facilities)	Yes	
		Human	Level of crop farming knowledge, availability of information on crop farming	No	
		Social	Membership to farmer groups, access to extension services	No	
		Financial	Income from crop farming, access to credit	Yes	
	Livestock	Natural	Livestock varieties and breeds, livestock feeds, availability of livestock feeds and grazing fields.	Yes	▪ Loss of livestock grazing fields due to flooding ▪ Outbreak of fungal diseases due to prolonged wet periods ▪ Unhygienic conditions in livestock holding spaces/ shades/pens due to prolonged wet periods
		Physical	Access to markets	Yes	
		Human	Knowledge and skills in livestock farming	No	
		Social	Membership to groups	No	
		Financial	Income from livestock keeping, access to credit	Yes	
	Fisheries	Natural	Sources of fish and fish varieties	Yes	▪ Destruction of fish breeding grounds due to flooding in the river deltas and estuaries. ▪ Increased difficulty in getting fish to market due to destruction of roads caused by flooding ▪ Rise in the lake water levels ▪ Destruction of fish landing grounds due to rise in lake water levels
		Physical	Fish landing grounds	Yes	
		Human	Gender in fisheries and sources of labour	No	
		Social	Membership to groups, social relationships and administration of fish landing grounds	No	
		Financial	Access to credit, income from fisheries and investments in fisheries	Yes	
	Water	Natural	Sources of water	Yes	▪ Destruction of water and sanitation infrastructure due to flooding ▪ Increased difficulty in accessing water sources due to destruction of roads by floods
		Physical	Access to water	Yes	
		Human	Skill and knowledge in water sector services	No	
		Social	Membership to groups	No	
		Financial	Income from water and investments in the water sector	Yes	
	Health	Natural	Occurrence of diseases and types of diseases	Yes	▪ Increased incidences of waterborne diseases due to prolonged wet periods and floods ▪ Destruction of health facilities in flood prone areas ▪ Increased incidences of infectious diseases in dry periods ▪ Increased incidences of injuries and deaths due to flooding ▪ Increased vulnerability of those living with diseases such as HIV and AIDS
		Physical	Access to health facilities and availability of health facilities	Yes	
		Human	Knowledge and skills in health	No	
		Social	Membership to groups (Community health worker networks)	No	
		Financial	Investments in the health sector.	Yes	

(Temperature) **Droughts** **Airborne diseases**	Agriculture (Crops)	Natural	Land tenure, crops and seed varieties, sources of water for crop farming	Yes	▪ Extreme loss of soil moisture due to elevated temperatures ▪ Crop failures due to drought and extreme heat ▪ Outbreak of crop pests and diseases. ▪ Loss of crop productivity due to long dry spells and droughts
		Physical	Access to markets (roads), means of transportation, supporting infrastructure (availability of processing facilities)	No	
		Human	Level of crop farming knowledge, availability of information on crop farming	No	
		Social	Membership to farmer groups, access to extension services	No	
		Financial	Income from crop farming, access to credit	Yes	
	Livestock	Natural	Livestock varieties and breeds, livestock feeds, availability of livestock feeds and grazing fields.	Yes	▪ Depletion of livestock water sources due to prolonged droughts and dry spells ▪ Loss of income to livestock farmers ▪ Loss of pasture and grazing fields
		Physical	Access to markets	No	
		Human	Knowledge and skills in livestock farming	No	
		Social	Membership to groups	No	
		Financial	Income from livestock keeping, access to credit	Yes	
	Fisheries	Natural	Sources of fish and fish varieties.	Yes	▪ Reduced water levels in rivers affects fish breeding upstream from river deltas ▪ Prolonged droughts negatively affect survival of fish species such as catfish and mad fish ▪ Loss of income by fisherfolk
		Physical	Fish landing grounds	No	
		Human	Gender in fisheries and sources of labour	No	
		Social	Membership to groups, social relationships and administration of fish landing grounds	No	
		Financial	Access to credit, income from fisheries and investments in fisheries	Yes	
	Water	Natural	Sources of water	Yes	▪ Depletion of underground water sources due to prolonged droughts and dry spells ▪ Drying up of rivers and ponds due to prolonged dry spells and droughts
		Physical	Access to water	Yes	
		Human	Skill and knowledge in water sector services	No	
		Social	Membership to groups	No	
		Financial	Income from water and investments in the water sector	Yes	
	Health	Natural	Occurrence of diseases and types of diseases	Yes	▪ Increased pressure on the health system due to increased incidences of communicable diseases mainly caused by general water scarcity ▪ Reduced productivity of the population due to heat stress
		Physical	Access to health facilities and availability of health facilities	No	
		Human	Knowledge and skills in health	No	
		Social	Membership to groups (Community Health Worker networks)	No	
		Financial	Investments in the health sector	Yes	

4.4.2 Climate Change Impact on the Sectors and their Respective Adaptive Capacities

4.4.2.1 Agriculture & Fisheries Sector

Agriculture is widely practiced in Homabay County with 88.5 per cent of households growing crops and 75.6 per cent keeping livestock. Up to 53.7 per cent of households in Homabay County depend on agriculture (crop and livestock farming) for their livelihoods. The crops grown are mainly cereals (maize, millet, sorghum) and tubers (cassava and sweet potatoes). There are pockets of fruit farming for instance in Kochia Ward in Rangwe Sub-County where pineapple farming is dominant. There is an emerging horticultural and fresh vegetable farming sector in the Oluch-Kimira irrigation scheme in Rachuonyo North and Rangwe Sub-Counties. Households predominantly keep the local breeds of cattle, goats, sheep and poultry. Small scale dairy farming takes place in the County's high-altitude areas predominantly in Rachuonyo South and Rachuonyo East Sub-Counties and in the cooler parts of Rangwe and Ndhiwa Sub-Counties. Households engage in crop and livestock farming mainly for subsistence. However, households also engage in farming activities for commercial purposes especially for crops such as maize, sorghum and sweet potatoes. Those who engage in dairy farming also do so for both subsistence and commercial purposes.

This assessment found that fisheries related activities provide an income to 4.5 per cent of households in the assessment area. The Homabay County Climate Risk Profile report estimated that 17,000 households in the County derive their income from fishing and related activities. The most predominant form of fishing is capture fisheries although aquaculture, including cage fishing, is fast picking pace in the County.

Climate Change Impacts on the Agriculture and Fisheries Sector

Agriculture remains to be the most exposed sector to the impacts of climate change in Homabay County. Climatic hazards such as floods and droughts directly impact the sector especially on farming activities hence on the livelihoods of people in the County. Floods predominantly affect the low-lying areas to the North of the County along the shores of Lake Victoria. The greatest impact has been on the Sondu-Miriu river delta in Rachuonyo North Sub-County, the River Awach delta in Rachuonyo North and Rangwe Sub-Counties and parts of the Lambwe Valley in Suba North Sub-County. Droughts have affected most parts of the County due to the intermittent rainfall patterns occasioned by long dry spells. Flooding has led to the loss of productive agricultural land and loss of crop productivity. Flooding has been observed to encourage the outbreak of fungal diseases in livestock, destruction of livestock grazing fields and pasture and inundates livestock holding areas and shelters, leading to unhygienic conditions in those spaces. Loss of soil moisture and soil fertility have been connected to incessant droughts in the county. The fisheries sector faces various challenges including invasive species that deplete the fish stock. Invasive species such as the water hyacinth that hinder access to the fishing grounds also affect fishing activities. Over-fishing has been identified as a major threat to the survival of the fishing industry in the County.

Adaptive Capacities in the Agricultural and Fisheries Sector in Homabay County

In response to the impacts of climate change in the County there are existing adaptation options that have been adopted either by design or default. Those adopted by design include the World Bank - funded National Agricultural and Rural Inclusive Growth Project (NARIG-P) that is focused on increasing agricultural productivity and profitability of rural communities. The project as implemented in Homabay County focuses on priority value chains that includes poultry and dairy and works to empower farmer organisations around those value chains and finances farmer groups to engage in better agricultural practices that increase their productivity and profitability. Communities have been sensitised to shift to early maturing and drought resistant crop varieties to cope with the effects of shortened rainy seasons and prolonged dry spells. Livestock farmers have been sensitised on optimal stocking strategies for livestock to counter the impacts of drought on livestock.

To control floods and mitigate its effects, riverbank embankments have been done on rivers prone to flooding such the Sondu-Miriu river in Rachuonyo North Sub-County and the river Awach in Rachuonyo North and Rangwe Sub-Counties. In the fisheries sector, aquaculture is providing an alternative to capture fisheries. If developed further, this will greatly improve the adaptive capacity of the fishermen to the impacts of climate change on the sector.

4.4.2.2 The Water Sector

Homabay County is endowed with an abundance of natural water sources in the form of Lake Victoria and a number of seasonal and permanent rivers running through it from the highlands and draining into Lake Victoria. There is also a significant amount of underground water reserves that have been exploited to produce shallow wells boreholes with some manifesting themselves as natural springs. There is however significant disparity within the County in access to these water sources, resulting in some areas of the County experiencing perennial and chronic water scarcity while other regions enjoy fairly stable access to water. In Homabay County, 87 per cent of the population get their drinking water directly from natural sources (underground water, rivers and the lake and rainfall). Only 13 per cent of the population access piped water in the County. The piped water is in two categories, either piped into dwelling or in a water kiosk. Further, there are huge disparities in terms of access to piped water within the County with some of the Sub-Counties like Rachuonyo South and Suba South having no connection of households to a piped water system. Other Sub-Counties are heavily reliant on a sole source of water. For instance, up to 66 per cent of households in Ndhiwa Sub-County rely on boreholes for their drinking water, an almost similar scenario playing out in Rachuonyo East Sub-County where up to 57 per cent of the population relies on rivers for their drinking water. In Suba North Sub-County, up to 61 per cent of the population directly depends on the waters from Lake Victoria for their drinking needs.

Impacts of Climate Change on the Water Sector in Homabay County

With the direct heavy dependence of the population on natural water sources in Homabay County, the water sector remains highly exposed to the impacts of climate change. This situation is aggravated by the heavy degradation of the environment happening in the high-altitude areas around the Lake Victoria basin that supplies water into Homabay County. Thus, the water sectors remain exposed to the impacts of changed rainfall patterns, incessant droughts and the intermittent flooding that take place almost on an annual basis. With a growing population, there is increased pressure on the available water sources and resources which also continue to be adversely affected by climatic variations.

Adaptive Capacities to Climate Change in the Water Sector in Homabay County

With low investment in piped water system and subsequent low penetration of treated water, the population in Homabay County have devised means and ways to offset the difficulties in accessing clean and safe water for both domestic and farm use. As confirmed by statistics, an impressive number of boreholes and shallow wells have been built across the County to provide alternative sources of water. There are ongoing efforts towards rainwater harvesting initiatives especially for domestic use that have yielded results given the rapid penetration of high-capacity water storage tanks in households. On the investment in water infrastructure front, the National and County Government of Homabay, have attracted funding for the re-development and expansion of water treatment plants in various clusters within the County. Of significance is the Rachuonyo and Homabay Town water clusters that will significantly increase the County's clean water production capacity.

4.4.2.3 The Health Sector

The health sector in Homabay County is characterised by heavy reliance on the public sector for the provision of health services. There is high HIV/AIDS prevalence in the County currently standing at 20.7 per cent against a national average of about 4.8 per cent[22]. The health sector is also burdened with high incidences of communicable and waterborne diseases such as dysentery, typhoid and respiratory illnesses. There is a high correlation between the occurrence of respiratory illnesses in the population and the type of energy used for cooking and lighting which is predominantly firewood and kerosene, respectively. Thus, indoor air pollution in the County is a major concern. For instance, the households survey revealed that up to 14.5 per cent of the households had cases of respiratory illnesses in the last one year. Access to healthcare facilities in the County is fairly easy with the average time taken to reach a health facility being 36 minutes. Ill health is a common occurrence in the County with up to 63 per cent of respondents to the household survey indicating that a member of their household suffered ill health in the preceding one year.

Impacts of Climate Change on the Health Sector in Homabay County

Climatic hazards expose the health sector in Homabay County to the impacts of climate change. Respiratory illnesses and waterborne diseases caused by climatic hazards such as droughts and floods have an implication on the health service provision in the County

particularly on the human resources and financial outlay needed to adequately contain the spread of such diseases if and when they break out. A common illness in the County that can be directly attributed to climatic hazards is cholera which thrives in both dry and wet conditions resulting from the compromised hygiene situations that prevail whenever there is a large-scale occurrence of droughts and flooding.

Climatic hazards affect the physical health infrastructure in County. This is mainly due to the incidences of extreme precipitation that results in floods that destroy the existing health facilities in the flood prone areas. There have been incidences of intense winds that damage health facilities by blowing off roofs and causing injuries to health workers and patients in those facilities.

Reduced rainfall and inadequate food availability increase malnutrition risks. Pregnant and lactating women, young children and the elderly are particularly vulnerable to malnutrition, which can have long-term developmental consequences for children, resulting in stunted growth and development. Stress caused during disasters can also affect mothers' breast milk production and breast-milk substitutes pose serious health risks where clean water is not available. Uneven accessibility, affordability and quality of health services across the county exacerbates climate-related health risks. Older people, especially older women and people with a disability, face additional challenges accessing health services.

Adaptive Capacities to Climate Change in the Health Sector in Homabay County

The annual budgeting cycle presents an opportunity for the increase in the adaptive capacity of the health sector to the impacts of climate change. Increasing allocation of County Government resources for the building of more climate resilient health facilities is one such steps. With increased adherence to physical planning protocols, health facilities have been located in areas that are safe from the effects of flooding but accessible to the populations living in the flood-prone areas. In terms of health services provision during emergency/disaster periods, there have been investments in emergency and rescue centers such as the designation of certain areas as rescue centers in case of flooding and investment in emergency response such as availability of ambulances and firefighting equipment in the County.

22 Kenya HIV Estimates Report, 2018

4.5 Climate Change Governance in Homabay County

The Inter-Governmental Panel on Climate Change (IPCC) defines governance as the structures, processes and actions through which private and public actors interact to address societal goals. The need to address the impacts of climate change is now a prioritised societal goal which is being dealt with by Governments and institutions at the international, national and sub-national levels. Climate change governance is geared towards achieving results on climate change mitigation and climate change adaptation (Meadowcroft, 2010). For societies to achieve the ultimate goals of climate change mitigation, there is need to change embrace behaviour change and stopping activities or practices that further climate change. Besides, for the adaptation goals to be achieved, society needs to adjust to a changing climate. Thus, effective climate change governance requires the understanding of the principles of both mitigation and adaptation governance. This is necessary because the governance of mitigation is best achieved with the comprehension of sources of emissions of GHGs which are the major drivers of global warming, and ultimately climate change. On the other hand, the governance of adaptation needs the in-depth understanding of the prevailing and predicted impacts of climate change and further requires planning to deal with these predicted impacts. To achieve the twin goals of climate change governance it is necessary to have in place a comprehensive governance framework that covers: Climate change capacity building; climate change mainstreaming into the decision-making processes; and public participation and stakeholder engagement on climate change.

This assessment set out to establish the current status of climate change governance in Homabay County and its effectiveness in addressing the climate change mitigation and adaptation needs. To establish the County's climate change governance framework and its effectiveness, a checklist of indicators of comprehensive climate change governance based on the three parameters (climate change capacity building, climate change mainstreaming and public participation and stakeholder engagement on climate change) was developed and used to prepare Key Informant Interview questions to obtain data on the status of climate change governance in the County. An analysis based on the three parameters identified above is presented in the following section.

4.5.1 Status of Climate Change Capacity Building in Homabay County

To establish the status of initiatives to build a strategic capacity to climate change governance in the County, two key indicators for this were examined and included: Climate change leadership and the establishment of a policy and legal framework for climate change governance.

Climate Change Leadership in Homabay County: The respondent to the KII on climate change governance indicated that the Governor had designated a County Executive Committee Member to be in charge of climate change matters in the County in accordance with the provisions of the Climate Change Act, 2016[23]. The County Government has also established a Climate Change Unit domiciled in the County Department of Water, Sanitation, Environment, Forestry & Climate Change. The unit was established to manage climate change matters in the County. A Climate Change director has been appointed to head the unit with four other officers designated as Climate Change Officers. In terms of overall climate change coordination, oversight, implementation and planning, the County Government is yet to form put in place a County Executive Committee Level Committee mandated to coordinate and oversight climate change matters in the County. On the same note the County Government is yet to form a multi-sectoral committee/working group tasked exclusively with planning and implementing climate change activities and projects. The respondent attributed the absence of a coordination, oversight planning and implementation leadership structure to the lack of a Climate Change legal framework in the County.

23 Section 19 (3) of the Climate Change Act, 2016

Climate Change Policy and Legal Framework in Homabay County: The County Government of Homabay has formulated a policy on climate change now known as the Homabay County Climate Change Policy.

The Homabay County Climate Change Policy has the following objectives:

- To mainstream climate change adaptation and mitigation in all county government policies, plans and programmes for sustainable development.
- To enhance community and stakeholder capacity to implement climate change adaptation and mitigation measures.
- To provide a regulatory framework and governance structures for effective implementation of adaptation and mitigation measures.
- To facilitate research and technology transfer for sustainable use and management of County resources.
- To establish mechanisms for assessing, monitoring and reporting the impacts of climate change programmes.
- To maintain and restore critical ecosystems for environmental stability; and
- To facilitate effective mobilisation and utilisation of financial resources for implementing climate change actions[24].

The policy documents enumerate the measures the County Government will take in realising each of the policy objectives. It further contains measures on monitoring evaluation, verification, reporting, and review.

On the legal front, the County Government is yet to enact a Climate Change Act. However, the process is ongoing and there is already in place a Homabay County Climate Change Bill that is awaiting approval at the Homabay County Assembly. The Bill makes provisions for: The establishment of a coordination and oversight mechanism for climate change in the County; a planning and implementation mechanism for climate change; a public participation and stakeholder engagement framework; and a climate change duties and obligations framework that will require the involvement of both the public and private sectors players in responding to climate change.

Overall, the status of climate change capacity building in the County in terms of leadership and the establishment of a policy and legal framework is not yet complete and is a work in progress.

4.5.2 Status of Climate Change Mainstreaming in Homabay County

Climate change mainstreaming in planning and decision-making processes is crucial in achieving mitigation and adaptation goals (UNDP, 2010). Our assessment of the County's progress in mainstreaming climate change into its planning and decision-making processes considered four key indicators namely:

- Appointment of climate change focal persons in each department.
- Establishment of a County climate change stakeholder forum.
- Laying down of procedures for climate change impact assessment; and
- Evidence of climate change mainstreaming efforts in its planning documents.

24 Homabay County Climate Change Policy, 2021.

In this regard, the County Government is yet to appoint climate change focal person in its entire department to handle climate change matters relevant to the respective departments. Secondly, the County Government has not established a countywide stakeholder forum to bring together all the relevant parties in discussing climate change matters. Third, the County Government is yet to formulate guidelines and procedures to guide the conduct of climate change impact assessments for projects proposed for implementation in the County.

However, the respondents noted that the County relies on the provisions of the Environmental Management and Coordination Act, 1999 and its regulations on Environmental Impact Assessment. Fourth, the County has not adequately taken measures to mainstream climate change action into its planning and decision-making process. For instance, though the Homabay County Integrated Development Plan (CIDP), 2018-2022, recognises climate change as a threat to the achievement of the County's development goals, it does not make proposals for the implementation of climate change response activities in the County, and does not allocate adequate financial resources for climate change response.

An analysis of the CIDP reveals that as part of tackling climate change, the County is focused on adaptation planning to reduce vulnerabilities to risk and impacts of climate change through.

- Promoting the use of raw materials from sustainable sources.
- Encouraging transition to organic/conservation agriculture.
- Encouraging the use of recycled and biodegradable materials.
- A focus on achieving domestic energy use efficiency through education, training and awareness creation.
- Promotion of non-motorised transportation; and
- Development of green building guides and investment in land restoration activities such as tree planting[25].

These were pragmatic ambitions to encourage climate change adaptation. However, at the tail end of the CIDP implementation period, none of these pronouncements has been achieved.

In conclusion, the County Government has not effectively mainstreamed climate change action into its planning and decision-making processes as required by the Climate Change Act, 2016. To this end, the governance of climate change in the County faces bottlenecks because of incoherence in County policy and planning on climate change.

4.5.3 Status of Public Participation and Stakeholder Engagement

Public participation and stakeholder engagement are key in developing effective response to climate change. This is informed by the reality that climate change impacts are most felt at the community and household level and thus, any plans or projects toward climate change mitigation and adaptation will have to be implemented at these levels (Meadowcroft, 2010). To establish the County Government's position on public participation and stakeholder engagement on climate change, several indicators were used namely: The County's approach towards public participation and stakeholder engagement; availability of a developed curriculum on climate change education in the County; and the County's efforts in communicating climate change-oriented behavior changes.

25 Homabay CIDP, 2018-2022

The respondents indicated that the County Government does not have a dedicated climate change public participation and stakeholder engagement strategy. The County Government is yet to develop a climate change education curriculum, implying that the County has not yet rolled out a public education programme on climate change. lastly, the respondents explained that the County Government has in the past mounted campaigns to encourage climate change relevant behavior change. The behavior change campaign involved mass sensitisation of communities and households to shift to the use of clean cooking and household lighting technologies to reduce using paraffin for cooking and lighting in the County. This was mainly done to address the root-causes of respiratory infections in the County which had the co-benefit of also addressing the causes of GHG emissions in the County. A triangulation of responses from FGDs reveals that the County Government has not adequately engaged the public and other stakeholders on climate change matters. This is evidenced by gaps in the public's knowledge of climate change related issues and their common sources of climate change information. This assessment finds that NGOs and CBOs, rather than the County Government are responsible for much of the climate change information available to the public in the County. The awareness levels on climate issues amongst citizens in the County is impressive given that up to 65.4 per cent of households interviewed indicated that they have some information on climate change. However, to effectively sensitise the public, the government (National and County) needs to roll out a comprehensive public/stakeholder engagement strategy.

4.5.4 Implications of Climate Change on Security and Use of Public Resources

Climate change contributes to the breakdown of government functions and delivery of services. In Homabay County, climate related hazards have on several occasions, resulted in the reallocation of resources from budgeted functions to respond to climatic emergencies like floods and droughts/famines. The impacts are also felt in the provision of security services in instances where populations move from one area into another, putting immense pressure on the capacity of security agencies in the affected areas. There are issues arising around the use of public resources, particularly those allocated to respond to climatic hazards. Thus, climate change impacts on the transparency and accountability of the use of public resources. Accountability concerns have been raised by the Office of the Auditor General regarding use of finances allocated for emergency responses.

4.5.5 Recommendations on Climate Change Governance

This assessment finds that lack of a comprehensive sub-national policy and legal framework on climate change presents the greatest challenge for proper planning and implementation of climate change mitigation and adaptation activities in the County. It is thus, recommended that the Homabay County Climate Change Bill that is still pending before the County Assembly be fast-tracked and passed. Further, the Homabay County Climate Change Policy that has already been formulated should be activated and operationalised. Finally, the County Government should prioritise mainstreaming of climate change action into the County decision making processes. The mainstreaming should be anchored in the County Integrated Development Plan.

4.6 Adaptation Options to Climate Change in Homabay County

Table 17: Adaptation options to climate change in Homabay County

A	B	C	D	E	F
CLIMATE CHANGE THREATS (From Column D)	**FREQUENCY OF THREATS**	**VULNERABILITIES (Synthesized from Table 16 Column B)**	**SERIOUSNESS OF IMPACTS (Evidence according to indicators)**	**VULNER-ABILITY RATING (By the Community)**	**ADAPTATION OPTIONS**
Floods	Seasonal - Occurs at least once a year in the last ten years	▪ Decreased crop productivity ▪ Food scarcity ▪ Emergence of new and aggressive insects and pests ▪ Inadequate supply of clean water ▪ Loss of life ▪ Spread of infectious and contagious infections ▪ Loss of productive agricultural land	▪ Only 0.6 per cent of households engaged in farming met their food (grains) needs from their farms. ▪ 98 per cent of households reported having difficulties in getting food in a year. ▪ 48 per cent of households have observed occurrence of floods over the last ten years. ▪ 20 per cent of households reported disruptions to their water sources due to floods	High	▪ Adoption of integrated pest management practices ▪ Adoption of climate smart agricultural practices ▪ Construction of dikes on flood -prone riverbanks ▪ Development of flood early warning systems ▪ Investment in climate proofing of water and sanitation infrastructure ▪ Income diversification ▪ Development of bulk grain storage facilities ▪ Value addition for agricultural produce
Rise in lake water levels	Occurred in 1963 and again in 2019/2020.	▪ Loss of productive agricultural land ▪ Human wildlife conflict ▪ Displacement of populations ▪ Loss of property, investments and infrastructure	▪ FGD responses confirmed loss of productive agricultural land, investments and property due to rise in lake water levels	Moderate	▪ Protection of riparian land from encroachment
Droughts		▪ Decreased agricultural productivity ▪ Loss of income ▪ Loss of soil productivity ▪ Loss of livestock ▪ Cross border resource conflicts ▪ Inadequate water supply ▪ Loss of life ▪ Spread of contagious and infectious diseases	▪ 85.7 per cent of households reported to have observed frequent droughts over the last ten years ▪ FGD responses indicated frequent occurrence of cross border conflicts especially between Kenyan fishers and Ugandan security officers ▪ Over 35 per cent of households rely on water from boreholes and shallow wells	High	▪ Introduction of drought resistant crops ▪ Introduction of climate smart agricultural practices such as minimum tillage ▪ Building of livestock auction centers ▪ Introduction of stock level control measures for livestock ▪ Development of irrigation infrastructure ▪ Sensitisation of livestock farmers on alternative livestock feeds. ▪ Agroforestry

Homabay County is vulnerable to the impacts of climate change in all sectors including those that have not been tackled in this assessment such as infrastructure. This assessment has identified vulnerabilities in the considered sectors of agriculture, water and health. This assessment identified adaptation options that should be considered as a response to the identified vulnerabilities as listed in column C of Table 17 above. In response to the vulnerabilities mentioned above, this assessment identified the following as adaptation options in broad categories (summary of column F) as enumerated below:

Improved Agricultural Practices.

Agriculture as currently practiced in Homabay County is basic and highly dependent on the climatic conditions. Consequently, the sector is highly exposed to climatic hazards and is a major driver of vulnerability to climate change in the County. In this respect, it is prudent to emphasise on smart agricultural practices that include adoption of the use of improved seed varieties and livestock breeds to enhance resilience. Adoption of climate smart agricultural practices such as minimum tillage and integrated pest management practices using technologies that minimise the use of inorganic fertilizers and pesticides. Other practices that should be adopted are optimal stocking levels for livestock farmers and the establishment of livestock auction centers to give increased returns to farmers.

Response to Climatic Hazards

Flooding and droughts have been identified as the main climatic hazards prevalent in Homabay County. As a response to the perennial flooding menace there should be investment in the embarkment of riverbanks to direct excess water away from human settlements and farmlands. On the same breadth investments should be made in the building of dikes to offer a permanent solution to flooding in the river plains.

In response to droughts, efforts must be put in expanding the capacity for food storage that will also help minimise post-harvest losses occasioned by lack of storage facilities. Since droughts affect agricultural productivity, emphasis should be put in the adoption of drought resistant seed varieties that are fast maturing and require minimum water. This would also call for investments in underground water infrastructure and rainwater harvesting and storage facilities especially at the household level. This will have the effect of addressing water shortages.

Environmental Protection

Environmental degradation is a driver to the exposure of Homabay County to the impacts of climate change. This manifest in itself in the degradation happening on hilltops, riverbanks and the lake riparian areas which weakens the adaptive capacity of the natural environment. Thus, action must be taken to protect hilltops and in cases where there has already been degradation, then landscape restoration activities should be undertaken, including afforestation and reforestation of the degraded areas. The riverbanks too must be conserved and preserved through tree planting along the rivers and protection against excessive abstraction of river waters. The rise in the levels of Lake Victoria waters witnessed from 2019 has led to massive loss of properties and productive agricultural land along the lake shores. Such losses would have been prevented if the encroachment into the riparian land was checked. This has highlighted the urgent need to stop encroachment into the riparian areas of the lake through enforcement of the existing laws and public education to avoid both the exposure and vulnerability of the lake shore to the impacts of climate change.

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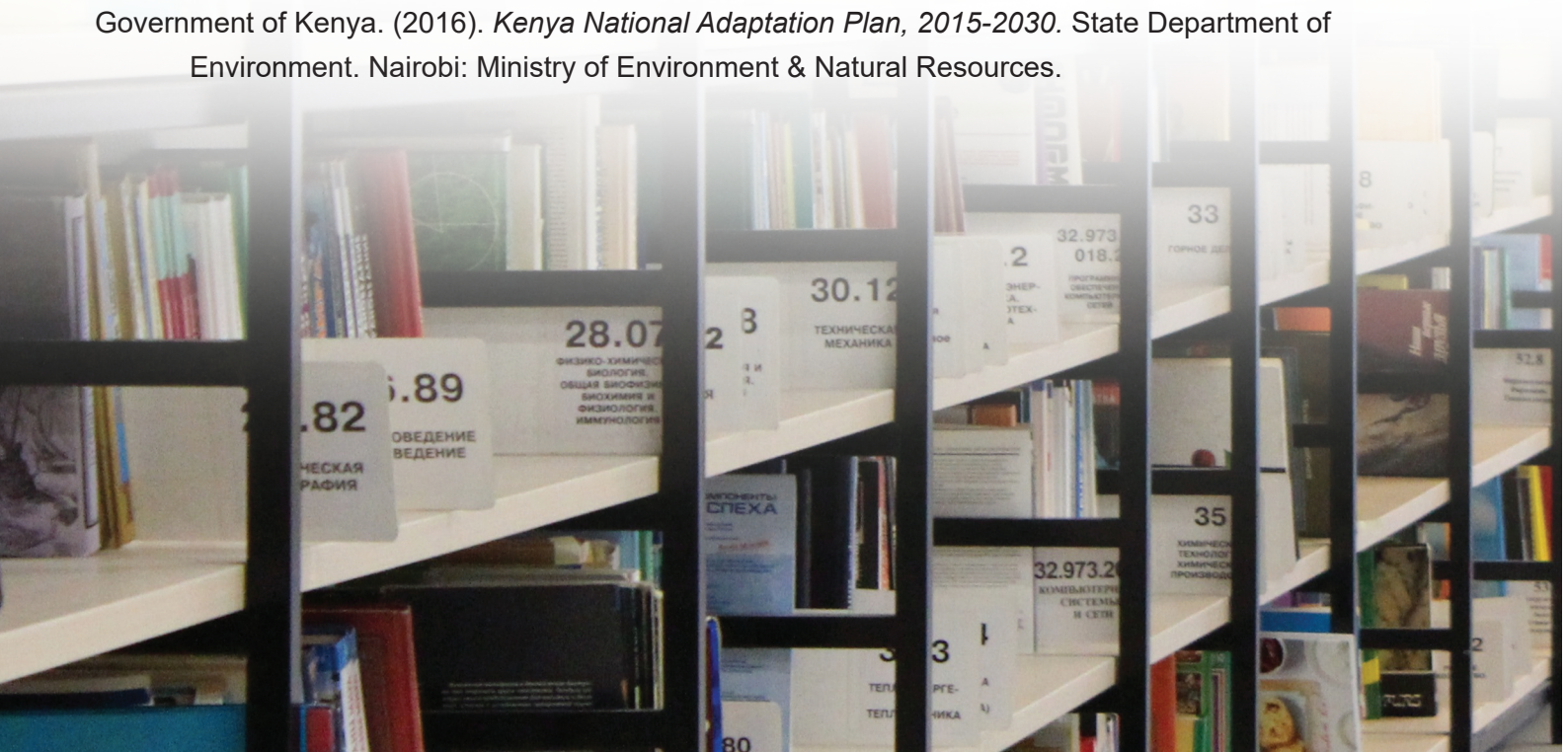

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Annex I: Risk and Vulnerability Indicators

Table 18: Indicators used to assess climate change risks and vulnerabilities in Homabay County

Indicator	Sub-Indicator	Measurement
Socio-Demographic	Female-headed households	Percentage
	Age of household heads	Average Age
	Households where head has not attended school	Percentage
	Household size	Average household size
Livelihood Strategies	Households with more than one income earner	Percentage
	Households dependent on agriculture as a source of income	Percentage
	Households without irrigated farms	Percentage
	Households with no access to credit	Percentage
Social Networks	Households that do not belong to any group	Percentage
	Households that have nowhere to seek help in case of emergencies	Percentage
	Households that do not receive support from groups they belong to	Percentage
	Households that do not have access to agricultural extension service	Percentage
Knowledge & Skills	Households with no vocational skills	Percentage
	Households not conversant with the phenomenon known as climate change	Percentage
	Households that are not aware of the causes and impacts of climate change	Percentage
Health	Workdays missed due to ill health in households	Average days
	Time taken to reach health facility	Average time (minutes)
	Households that have had members suffer ill health in the past year	Percentage
Food	Households that do not meet more than Half of their grain (main staple) needs from their farms	percentage
	Number of months households find it difficult to obtain food	Average months
	Households that do not have three or more meals in a day	Percentage
Water	Households accessing drinking water from natural sources	Percentage
	Time taken to source of drinking water	Average time (minutes)
	Households without access to a water treatment and distribution system	Percentage
	Households reporting disruptions to their sources of water due to climatic hazards	Percentage
Natural Vulnerability	Households identifying flooding as the most problematic climatic hazard	Percentage
	Households identifying drought as the most problematic climatic hazard	Percentage
	Households identifying rainstorms as the most problematic climatic hazard	Percentage
	Households identifying extreme heat as the most problematic climatic hazard	Percentage

$index_{s_c}$ $index_{s_c}$ is the original indicator (s) for county *c* and $s_{min}s_{min}$ and s_{max} s_{max} are the minimum and maximum values, respectively, for each of indicator (s) determined by data collected in the assessment area.

Table 19: Standardization of Indicators

Indicators	Sub-Indicators	Indicator Value (SCV)	Max SCV (s_{max})	Min SCV (s_{min})	$index_{s_c}$
Socio-Demographic	Percentage of female-headed households	56.00	100.00	0.00	0.560
	Average age of household head	47.20	94.00	20.00	0.289
	Percentage of household where HH head has not attended school	11.00	100.00	0.00	0.110
	Average household size	5.60	15.00	1.00	0.307
Livelihood Strategies	Percentage of HHs with more than one income earner	32.00	100.00	0.00	0.320
	Percentage of household dependent on agriculture as a source of income	54.00	100.00	0.00	0.540
	Percentage of HHs without irrigated farms	84.00	100.00	0.00	0.840
	Percentage of HHs with no access to credit	61.00	100.00	0.00	0.610
Social Networks	Percentage of HHs that do not belong to any group	52.00	100.00	0.00	0.520
	Percentage of HHs that do not receive support from groups they belong to	45.00	100.00	0.00	0.450
	Percentage of HHs that do not have access to agricultural extension service	93.00	100.00	0.00	0.930
Knowledge & Skills	Percentage of HHs with no vocational skills	81.00	100.00	0.00	0.810
	Percentage of HHs who are not conversant with the phenomenon known as climate change	35.00	100.00	0.00	0.350
	Percentage of HHs who are not aware of the causes and impacts of climate change	9.00	75.00	0.00	0.120
Health	Average number of workdays missed due to ill health in households	7.60	120.00	0.00	0.063
	Average time to health facility (Minutes)	35.90	180	0	0.199
	Percentage of HHs who have had members suffer ill health in the past year	63.00	100	0	0.630
Food	Percentage of HHs that do not meet more than Half of their grain (main staple) needs from their farms	76.70	100.00	0.00	0.767
	Average number of months households find it difficult to obtain food	4.00	12.00	0.00	0.333
	Percentage of HHs who do not have three or more meals in a day	46.80	100.00	0.00	0.468
Water	Percentage of households accessing drinking water from natural sources	39.00	100.00	0.00	0.390
	Average time to source of drinking water (Minutes)	22.67	202.00	0.00	0.112
	Percentage of HHs without access to a water treatment and distribution system	80.60	100.00	0.00	0.806
	Percentage of HHs reporting disruptions to their sources of water due to climatic hazards	19.90	100.00	0.00	0.199
Natural Vulnerability	Percentage of households identifying flooding as the most problematic climatic hazard	10.00	100.00	0.00	0.100
	Percentage of households identifying drought as the most problematic climatic hazard	79.40	100.00	0.00	0.794
	Percentage of households identifying rainstorms as the most problematic climatic hazard	1.60	100.00	0.00	0.016
	Percentage of households identifying extreme heat as the most problematic climatic hazard	8.10	100.00	0.00	0.081

In the second step, the index value of each major component is calculated by aggregating all the index values for all the indicators therein and then dividing by the total number of the indicators in the major component

$$M_d = \frac{\sum_{i=1}^{n} index_{s_{d^i}}}{n} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

W h e r e :

$M_d M_d$ is one of the eight major components for county *c* (Socio-Demographic Profile (SDP), Livelihood Strategies (LS), Knowledge & Skills (N&S) Social Networks (SN), Health (H), Food (F), Water (W), or Natural hazards and Climate Variability (NHCV). $index_{s_{d^i}} index_{s_{d^i}}$ represents the indicators, indexed by *i*, that make up each major component, and *n* is the number of indicators in each major component.

Table 20: Indicators Index Values

Indicators	Indicator Indicators	$index_{s_i}$	Number of Indicators (n)	$M_d = \frac{\sum_{i=1}^{n} index_{s_i}}{n}$
Socio-Demographic	Percentage of female-headed households	0.56	**4**	$M_d = \frac{1.27}{4}$=**0.318**
	Average age of household head	0.29		
	Percentage of household where HH head has not attended school	0.11		
	Average household size	0.31		
	$\sum_{i=1}^{n} index_{s_i}$	**1.27**		
Livelihood Strategies	Percentage of HHs with more than one income earner	0.32	**4**	$M_d = \frac{2.31}{4} M_d = \frac{2.31}{4}$=**0.578**
	Percentage of household dependent on agriculture as a source of income	0.54		
	Percentage of HHs without irrigated farms	0.84		
	Percentage of HHs with no access to credit	0.61		
	$\sum_{i=1}^{n} index_{s_i}$	**2.31**		
Social Networks	Percentage of HHs that do not belong to any group	0.52	**3**	$M_d = \frac{1.90}{3} M_d = \frac{1.90}{3}$=**0.501**
	Percentage of HHs that do not receive support from groups they belong to	0.45		
	Percentage of HHs that do not have access to agricultural extension service	0.93		
	$\sum_{i=1}^{n} index_{s_i}$	**1.90**		
Knowledge & Skills	Percentage of HHs with no vocational skills	0.81	**3**	$M_d = \frac{1.28}{3} M_d = \frac{1.28}{3}$=**0.426**
	Percentage of HHs who are not conversant with the phenomenon known as climate change	0.35		
	Percentage of HHs who are not aware of the causes and impacts of climate change	0.12		
	$\sum_{i=1}^{n} index_{s_i}$	**1.28**		

Health	Average number of workdays missed due to ill health in households	0.06	**3**	$M_d = \frac{0.89}{3} M_d = \frac{0.89}{3}$ **=0.297**
	Average time to health facility (Minutes)	0.20		
	Percentage of HHs who have had members suffer ill health in the past year	0.63		
	$\sum_{i=1}^{n} index_{i,d}$	**0.89**		
Food	Percentage of HHs that do not meet more than Half of their grain (main staple) needs from their farms	0.77	**3**	$M_d = \frac{1.57}{3} M_d = \frac{1.57}{3}$ **=0.523**
	Average number of months households find it difficult to obtain food	0.33		
	Percentage of HHs who do not have three or more meals in a day	0.47		
	$\sum_{i=1}^{n} index_{i,d}$	**1.57**		
Water	Percentage of households accessing drinking water from natural sources	0.39	**4**	$M_d = \frac{1.51}{4} M_d = \frac{1.51}{4}$ **=0.378**
	Average time to source of drinking water (Minutes)	0.11		
	Percentage of HHs without access to a water treatment and distribution system	0.81		
	Percentage of HHs reporting disruptions to their sources of water due to climatic hazards	0.20		
	$\sum_{i=1}^{n} index_{i,d}$	**1.51**		
Natural Vulnerability	Percentage of households identifying flooding as the most problematic climatic hazard	0.10	**4**	$M_d = \frac{0.99}{4} M_d = \frac{0.99}{4}$ **=0.248**
	Percentage of households identifying drought as the most problematic climatic hazard	0.79		
	Percentage of households identifying rainstorms as the most problematic climatic hazard	0.02		
	Percentage of households identifying extreme heat as the most problematic climatic hazard	0.08		
	$\sum_{i=1}^{n} index_{i,d}$	**0.99**		

$$LVI_c = \frac{\sum_{i=1}^{7} w_{m_i} M_{di}}{\sum_{i=1}^{7} w_{m_i}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

$$LVI_c = \frac{w_{SDP} SDP_c + w_{LS} LS_c + w_{SN} SN_c + w_H H_c + w_F F_c + w_W W_c + w_{NDC} NDCV_c}{w_{SDP} + w_{LS} + w_H + w_{SN} + w_F + w_W + w_{NDC}} \ldots\ldots\ldots (4)$$

Where:

$LVI_c LVI_c$, the Livelihood Vulnerability Index for county/sub-county/ward/village ***c***, equals the weighted average of the seven major components. The weights of each major component, $\mathbf{w_{m_i}} \mathbf{w_{m_i}}$, are determined by the number of indicators that make up each major component and are included to ensure that all indicators contribute equally to the overall LVI.

$$LVI_c = \frac{(4)(0.317) + (3)(0.677) + (3)(0.577) + (4)(0.513) + (2)(0.525) + (3)(0.298) + (3)(0.568) + (4)(0.336) + (4)(0.745) + (3)(0.467)}{4 + 4 + 3 + 4 + 2 + 3 + 3 + 4 + 4 + 3}$$

$$LVI_c = \frac{16.47}{33} = \mathbf{0.49}$$

The LVI can be scaled from 0 (least vulnerable) to 0.5 (most vulnerable).

Calculating the Livelihood Vulnerability Index for the Contributing Factors to Vulnerability.

The IPCC defined contributing factors to vulnerability to climate change are exposure, sensitivity and adaptive capacity. The LVI for these contributing factors is calculated using the LVI-IPCC framework approach as outlined below.

The same indicators outlined in Table 19 and Table 20 above and the equations 1-3 used in the LVI calculations are used to calculate the LVI – IPCC. The LVI – IPCC diverges from the LVI when the major components are combined. Rather than merge the major components into the LVI in one step, they are first combined

$$CF_c = \frac{\sum_{i=1}^{n} w_{M_i} M_{ci}}{\sum_{i=1}^{n} w_{M_i}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Where:

$CF_c CF_c$ is an IPCC-defined contributing factor (exposure, sensitivity or adaptive capacity) for county/sub-county/ward *c*.

$w_{M_i} w_{M_i}$ is the weight of each major component, and *n* is the number of major components in each contributing factor. Once the exposure, sensitivity, and adaptive capacity are calculated, the three contributing factors are combined using the equation below:

$$LVI - IPCC_c = (e_c - a_c) * s_c$$

Where:

$LVI - IPCC_c$ $LVI - IPCC_c$ is the LVI for county/sub-county/ward ***c*** expressed using the IPCC vulnerability framework.

e is the calculated exposure score for county/sub-county/ward c (equivalent to the Natural Disaster and Climate Variability major component).

a, is the calculated adaptive capacity score for county/sub-county/ward *c* (weighted average of the Socio-Demographic, Livelihood Strategies, and Social Networks major components) and

s is the calculated sensitivity score for county/sub-county/ward c (weighted average of the Health, Food, and Water major components).

Table 21: LVI-IPCC summary results

Contributing Factors	Major Components	Major Component Values	Number of Indicators (n)	Contributing Factor Values	LVI-IPCC Value for Homabay County $LVI - IPCC_c = (e_c - a_c) * s_c$
Adaptive Capacity	Socio-Demographic	0.317	4	0.48	$LVI - IPCC_c = (0.25_c - 0.483_c) * 0.40_c$ $LVI - IPCC_c = (0.25_c - 0.483_c) * 0.40_c$ =-0.1 **LVI-IPCC = - 0.1**
	Livelihood Strategies	0.578	4		
	Social Networks	0.501	3		
	Knowledge & Skills	0.427	3		
Sensitivity	Health	0.298	3	0.40	
	Food	0.523	3		
	Water	0.377	3		
Exposure	Natural Vulnerability	0.248	4	0.25	

Annex III: Geographical Boundaries and Names of Sampled Areas

Table 22: Wards, locations and sub-locations sampled

Sub-County	Ward	Locations	Sub-Locations
Rachuonyo South	West Kasipul	Kodera North	Kadel Kamidigo
		Konuong'a	Kotieno Konuong'a
		Konuong'a	Kotieno Kochich
	Central Kasipul	Kachien North	North Kachien
		Kachien South	South Kachien
		North Kamagak	Kawere East
	West Kamagak	West Kamagak	Obisa
		West Kamagak	Kamuma
	East Kamagak	East Kamagak	Kachieng
		East Kamagak	Sino Kagola
Rachuonyo North	West Karachuonyo	Kanam A	Kowuor
		Kanam B	Rabuor
		Kakdhimu East	Kamuga
	Kibiri	Kawadhgone Nyongo	Kawadhgone
		Koyugi	Kamuga
		Kanyipir	Kodero
	Central Karachuonyo	Nyakongo	Kodondi
		Kogweno Oriang	Kogweno Oriang East
		Nyakongo	Kamser A
	Kendu Bay Town	Karachuonyo North East	Kotieno Gumba
		North Karachuonyo	Upper Kakwajuok
		North Karachuonyo	Kanyadhiang
	Wangchieng'	Wangchieng'	Kobala
		Kobuya	Kobuya West
		Rambira	Kagwa
Rachuonyo East	Kokwanyo Kakelo	Kokwanyo	Kokwanyo West
		Kakelo	Kakelo Kamroth
		Kokwanyo	Kokwanyo East
	Kabondo West	Kasewe	Kasewe A
		Ramba	Kodumo
		Ramula	Kakumu
	Kojwach	Kojwach	Kojwach Kamuga
		Kojwach East	Kojwach East
		Kojwach	Kojwach Kawere
Homabay Town	Homabay Central	Homabay Town	Simenya
		Kalanya Kanyango	Kalanya Kanyango
		Kanyango	Kanyango South
	Homabay West	Kanyabala	South Kanyabala
		Kanyabala	Central Kanyabala
		Kanyabala	North Kanyabala
	Homabay East	East Kanyada	South Kogwang Kobuola
		Kothidha	North Kothidha
		Kanyach Kachar	North Kanyach Kachar

Rangwe	Kochia	West Kochia	Kanam
		Central Kochia	Upper Kowili
		Korayo	Lower Korayo
	West Gem	Genga	Genga
		West Gem	Kamagawi
		Komolo	Komolo
	Kagan	West Kagan	Kanyiriema
		Central Kagan	Kokoko
		Gongo	Nyawita
Ndhiwa	Kwabwai	Rachar	Rachar
		West Kwabwai	Kasirime Kawanga
		East Kwabwai	Kachuth
	Kanyadoto	Central Kanyadoto	Kaganda North
		West Kanyadoto	Kabura North
		West Kanyadoto	Odhiambo Rambo
	Kabuoch North	West Kabuoch	East Kachieng
		East Kabuoch	Kawuor
		Central Kabuoch	Karading
	Kanyikela	South Kanyikela	South Kanyikela
		North Kanyikela	Ongaro
	Kanyamwa Kologi	South East Kanyamwa	Kadwet
		North East Kanyamwa	East Kochieng
		North Kanyamwa	Kakaeta
Suba North	Rusinga Island	Kamasengre East	Waware North
		Kaswanga	Kaswanga
		Waware North	Kamasengre East
	Kasgunga	Kasgunga Central	Kasgunga East
		Kasgunga East	Kasgunga West
		Kasgunga West	Kasgunga Central
	Lambwe	God Jope	God Jope
		Nyamaji East	Ogongo
		Ogongo	Nyamaji East
	Gembe	Kamreri West	Waondo
		Usao	Usao
		Waondo	Kamreri West
Suba South	Gwassi South	Gwassi South	Lwala
		Gwassi Central	Samba
		Gwassi East	Seka
	Gwassi North	Gwassi North	Kisaku
		Gwassi North	Uterere
		Gwassi North	Malongo
	Kaksingri west	Kaksingri Central	Sindo
		Kaksingri West	Nyamrira
		Kaksingri West	Rangwa East

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