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2023

COMPENDIUM OF ENVIRONMENT STATISTICS, 2023

PARTNER AGENCIES

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Preface



The Compendium of Environment Statistics 2023 (CES 2023) is an outcome of a participatory process by Ministries, Departments and Agencies (MDAs) in the field of environment. This was made possible by the active participation of various experts from the member institutions who constitute the Environment Statistics Technical Committee (ESTeC).

The following are the institutions that participated in the production of the report: Kenya National Bureau of Statistics (KNBS); Ministry of Environment, Climate Change and Forestry (MECCF), Ministry of Water, Sanitation and Irrigation (MoWSI); Ministry of Tourism and Wildlife (MoTW); Ministry of Mining, Blue Economy and Maritime Affairs; Climate Change Secretariat (CCS); Kenya Wildlife Service (KWS);Kenya Forestry Service (KFS); Kenya Meteorological Department (KMD); Nairobi City County Government; National Museums of Kenya (NMK); National Environmental Management Authority (NEMA); Directorate of Resource Surveys and Remote Sensing (DRSRS); Water Resources Authority (WRA); Kenya Fisheries Service (KeFS); National Disaster Operation Centre (NDOC), and the Council of Governors.

This publication has been prepared as per the guidelines of the United Nation Framework for the Development of Environment Statistics (UNFDES) on useful data sets and analysis. The report covers a wide range of environment topics to facilitate one stop access and use of environment statistics for evidence-based decision making. The report provides statistics for monitoring of national, regional, and global development frameworks such as Kenya Vision, 2030; the Medium-Term Plans; the Africa Development Agenda, 2063; the Sendai Framework for Disaster Risk Reduction, 2015–2030; the Paris Climate Agreement 2015 and the Sustainable Development Goals, 2030 (SDGs, 2030). This report provides a comprehensive scenario of the environmental situation of the country and provides an important instrument for policy integration and informed decision making.

Most statistics in this report have been gathered from surveys, censuses, and administrative sources from various institutions that are charged with responsibilities of collecting, analysing and archiving such data. There is thus great possibility that some of the data presented here are available in other publications already. Notwithstanding the foregoing, there are still data gaps that would need to be addressed to comprehensively meet the high and growing demand for environment data and statistics. The Kenya National Bureau of Statistics in collaboration with other stakeholders will put more efforts to fill the identified data gaps and update this publication biannually.

Production of this report would not have been successful without the collaboration of various participants who contributed valuable inputs throughout the process. In this regard, I wish to extend special thanks to the heads of Ministries, Departments, Counties and Agencies (MDCAs) from which members of the Environment Statistics Technical Committee (ESTeC) on environment statistics were appointed. I equally extend special thanks to the dedicated technical officers from KNBS that worked

tirelessly to develop this report under the leadership of Mr.Paul Nderitu, Senior Manager with his team including Mr. James Munguti, Mr. Abdi Mohamud, Mrs. Lillian Onono and Mr. Simon Maundu.

I also wish to extend my sincere gratitude to the United Nations Statistics Division (UNSD), the East African Community (EAC) Secretariat and Statistics Sweden (SCB) under the KNBS SCB statistical cooperation project for their technical support.

My heartfelt appreciation go to The Common Market for Eastern and Southern Africa (COMESA) for the financial support provided from the European Union, through the European Development Fund (EDF) COMESA Institutional Capacity Building Programme (ICBP), that faciltiated the national workshops and data validation for the finalisaiton of this compedium on environment statistics.

In addition, this work received the much needed technical expertise from COMESA's Statitical Capacity Building Programme phase 5 (SCB-V) consultants on Environmental and Climate Change Statistics Anand Sookun, (PhD) and Mr Gerard Barutwanayo. Special thanks to Ms. Ngawo Banda – COMESA Agricultural Statistician for her valuable technical support, without this collaboration, this work wouldn't have been possible.

I also appreciate the substantial technical contribution made by Jonas Bergström and Julia Hytteborn, environment experts from Statistics Sweden led by Peter Nilsson, KNBS/Statistics Sweden Project Senior Advisor. KNBS welcomes comments and suggestions regarding this report and for improving quality of future reports. All comments and suggestions should be addressed to the Director General, Kenya National Bureau of Statistics, P.O. Box 30266 00100, Nairobi, e-mail dg@knbs.or.ke.



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List of Acronyms and Abbreviations

ACZ	Areas Covering Zones
ASAL	Arid and Semi Arid Land
BOD	Biochemical Oxygen Demand
CITES	Convention on International Trade in Endangered Species
CLRTAP	Convention on Long-range Transboundary Air Pollution
COD	Chemical Oxygen Demand
COMESA	Common Market for Eastern and Southern Africa
CR	Critically Endangered
DD	Data Deficient
DHIS-MOH	District Health Information System - Ministry of Health
DWFN	Distant Water Fishing Nations
EDF	European Development Fund
EEZ	Economic Exclusive Zone
EN	Endangered
ESTeC	Environment Statistics Technical Committee
EU	European Union
EW	Extinct in the Wild
EX	Extinct
FAO	Food and Agriculture Organization
FDES	Framework for Development of Environment Statistics
FTWG-KEN	Fertilizer technical Working Group - Kenya
g/km	Gram Per Kilometre
GEF	Global Environment Facility
GHG	Greenhouse Gases
GoK	Government of Kenya
Ha	Hectare
ITCZ	Inter Tropical Convergence Zone
IUCN	International Union for Conservation of Nature
IWRM	Integrated Water Resources Management
JMP	Joint Monitoring Programme
KFS	Kenya Forestry Service
KFS	Kenya Forest Service

KIHBS	Kenya Integrated Household Budget Survey
km3	Cubic Kilometre
KMD	Kenya Meteorological Department
KNBS	Kenya National Bureau of Statistics
KWS	Kenya Wildlife Service
LC	Least Concern
LR/cd	Lower Risk/Conservation Dependent
LR/lc	Lower Risk, Least Concern
LR/nt	Lower Risk/Near Threatened
LULUCF	Land Use, Land Use Change and Forestry
M.A.S.L	Metres Above Sea Level
MCM	Million Cubic Meters
MEA	Multilateral Environmental Agreement
mm	Milimetre
MECCF	Ministry of Environment, Climate Change and Forestry
MoWSI	Ministry of Water, Sanitation and Irrigation
NEMA	National Environment Management Authority
NMK	National Museum of Kenya
NT	Near Threatened
ºC	Degree Centigrade
SHER	Similar Hydrologic Element Response
Sq. km.	Square Kilometre
UN	United Nations
UNCBD	United Nations Convention on Bio-diversity
UNCCD	United Nations Convention on Combating Desertification
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
VU	Vulnerable
WASH	Water Sanitation and Health
WPDA	World Database Protected Area
WRA	Water Resources Authority

FDES STRUCTURE





BACKGROUND, METHODOLOGY, CONCEPTS AND DEFINITIONS

1. Background

The demand for environmental statistics is increasing in tandem with the ongoing environmental challenges faced by societies. These challenges emanate from use of technology, population pressure, energy issues, sustainable development and climate change. The realization that human wellbeing and development depend on the environment has led to an increasing emphasis on the environment and sustainability concerns on which decisions and actions need to be taken. For instance, environment is among the three pillars of sustainable development to ensure environment sustainability is achieved in parallel with social and economic development of the society. Of paramount importance to these actions is the regular production of environment statistics of the highest quality to monitor the performance of national, regional and international development plans, policies and programmes for sustainable development.

Compilation of environmental statistics has been a challenge in the past for Kenya. This is mainly due to the fact that these types of statistics cover a wide range of information and are interdisciplinary in nature. They can be collected from a diverse range of sectors meaning numerous methods require to be applied in their compilation. To effectively produce environment statistics, a number of things must be in place. There must be specific statistical and environmental expertise, scientific knowledge, institutional development capacities and adequate resources.

In strengthening the production and dissemination of environment statistics in the country, an assessment was carried out in 2015 by KNBS in collaboration with the East African Community (EAC) Secretariat on the status of Environment Statistics in the country. The assessment revealed the following challenges: inadequate financial and human resources, inadequate technical capacities and tools/instruments for data collection and lack of institutional coordination.

Following the assessment, a roadmap for implementation of the FDES 2013 was developed by stakeholders in the Environment and Natural Resource sector. EAC Secretariat, as an initial step towards the support to its member countries, undertook to collaborate with the United Nations Statistics Division (UNSD) on the implementation of the FDES 2013. UNSD continued to support EAC in the implementation of FDES 2013 in its member countries through: review of data from national institutions, review of processes related to data collection. In addition, several capacity building workshops were held with support from UNSD to disseminate FDES 2013 among institutions producing environment statistics in Kenya. Likewise, assessments of environment data availability in the country were conducted using data assessment tools. This synergy was realized through the UNSD Development Account Project named, “Supporting Member States in developing and strengthening environment statistics and integrated environmental-economic accounting for improved monitoring of sustainable development” of which Module A focuses on strengthening environment statistics.

Environment statistics therefore, require a proper framework to guide their development, coordination and organization at all levels. It is against the aforesaid background that the Framework for Development of Environment Statistics (FDES) was established.

2. Methodology

Data for the Compendium of Environment Statistics were obtained from results of the surveys or censuses conducted by the KNBS, and the annual reports or publications from institutions that related to environment at the National and County/subnational levels.

As a first step in data collection, the Environment Statistics Technical Committee (ESTeC) was established comprising of key environment data producers and users. Thereafter, quarterly meetings were held with a view to laying plans for data collection. During the meetings, dummy tables were designed based on the FDES 2013 and shared with key institutions for data collection. Data collection was followed by the compilation of the draft compendium which was thereafter validated by the ESTeC. To identify relevant variables, FDES 2013 was used and several indicators were derived for inclusion in the publication.

3. Key Concepts and Definitions

The concepts and definitions used in this compendium are taken from several sources. However, the definitions presented here are the Legal definitions given mainly by either the FDES 2013 or official gazettes and laws establishing relevant institutions.



1. Weather: Weather is the state of the atmosphere of a given place at a given time. The elements of weather include, but are not limited to, rainfall, temperature, pressure, wind, cloud cover and humidity.



2. Climate: Climate is the average weather pattern in a place over a period of at least thirty years as defined by the World Meteorological Organization



3. Climate change: Climate change is a permanent shift in the state of climate that persists for an extended period (decades or longer). It is attributed directly or indirectly to human (anthropogenic) activity that alters the composition of the global atmosphere



4. Climate variability: Climate variability refers to fluctuations or deviations in the mean state of climate over a given period ranging from months, season or years and space when compared to long-term statistics for the same calendar period



5. Environment: The totality of all the external conditions (physical, biological, and socio-economic) affecting the life, development, and survival of an organism.



6. Environmental Impact Assessment (EIA): A systematic examination conducted to determine whether a project, policy, program, etc, will have any adverse impacts on the environment. The EIA also provides plans for mitigation of the adverse effects.



7. Sustainable Use: A use of resources which does not compromise the right to use the same resource (e.g., land, forest, water etc) by future generations.



8. Conservation: Management of human use of organisms or eco-systems so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations.



9. Environmental Protection: Any activity to maintain or restore the quality of the environment, through preventing the degradation of air, land, and water resources.



10. Air Pollution: The presence of contaminants or pollutant substances in the air at levels that interfere with the health or welfare of human and other organisms or can produce other harmful environmental effects.



11. Land Degradation: The physical, chemical, or biological impairment of the attributes of land.

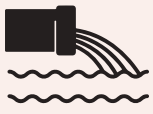


12. Eco-system: The complex of plant and animal communities and their inter-relations with each other and with non-living environment.



13. Biodiversity: The total variety of life on earth in all its forms, levels, and combinations. It includes diversity within genetic differences, species differences and eco-system differences in each area.





14. Biological Sludge: The by-product of a biological treatment of effluents (waste products from industries). The biological sludge can then be used for soil improvement. The amount of waste that can be treated with biological means for other useful purposes



15. Biomass: Total living weight (generally dry weight) of all organisms in a particular area or habitat. It is sometimes expressed as weight per unit area of land or per unit volume of water.



16. Wetland: An area which is permanently or seasonally flooded by water, where characteristic plants and animals have become adapted.



17. Water Catchment Area: An area from which rainwater drains into river systems, lakes and seas.

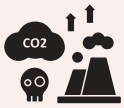
18. Watershed: An area separating one or more water catchments.



19. Greenhouse Gases: These are Gases that trap the infra-red (heat) radiation in the Earth's atmosphere, producing the greenhouse effect. The two major greenhouse gases are water vapor and carbon dioxide.



20. Greenhouse Effect: The trapping of infra-red (heat) radiation from the Earth's surface in the atmosphere by the greenhouse gases.



21. Greenhouse Gas Emission: It is Emission of those gases that, by affecting the radiation transfer through the atmosphere, contribute to the greenhouse effect.



22. Global Warming: The increase in the average temperature of the earth's atmosphere and oceans that has been observed in the recent decades. Carbon dioxide is responsible for most of global warming, although methane and other greenhouse gases also warm the climate.



23. Emission: Discharge of substances, heat, and sound into the atmosphere,water and soil from sources such as smokestacks, vents, surface areas of commercial or industrial facilities etc.



24. Afforestation: An artificial establishment of a forest by planting or seeding in an area of non-forest land.

25. Reforestation: An artificial establishment of a forest by planting or seeding in an area which was originally a forest.



26. Deforestation: The process of replacement of forests by other land use or vegetation types.



27. Fauna : All animal life.

28. Flora: All plant life.



29. Environmental Sanitation: Improvement of conditions in households that affect human health by means of drainage and disposal of sewage, human excreta, and refuse.



30. Waste: Any material (solid, liquid, or gaseous) discharged into the environment without immediate use.



31. Solid Waste: Any useless and sometimes hazardous material with low liquid content. Solid wastes include municipal garbage, industrial and commercial waste, sewage sludge, wastes resulting from agricultural and animal husbandry operations and other connected activities, demolition wastes and mining residues.



32. Biological Waste: Waste containing natural organic materials (remains of plants, animal excreta, biological sludge from waste-water treatment, plants, etc) and capable of undergoing biological degradation.



33. Agricultural Waste: Any waste produced as a result of various agricultural operations. It includes manure and other wastes from farms, poultry houses and slaughterhouse, harvest waste, fertilizer run-offs from fields, pesticides that enter into water, air or soils, etc.



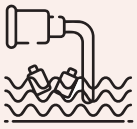
34. Industrial Waste: Liquid, solid and gaseous wastes originating from the manufacture of specific products.



35. Species: All the individuals and populations of a particular kind of organism maintained by biological mechanisms that result in their breeding only with their own kind.



36. Water Conservation: The control and development of water resources, both surface and underground water, in a manner that promotes sustainable use.



37. Water Pollution: The presence in water of harmful and objectionable materials (obtained mainly from sewers, industrial wastes, and rainwater run-offs) and in sufficient concentrations to make the water unfit for use.



38. Safe Drinking Water: Clean water supplied from an improved water source, such as a borehole/shallow well fitted with a hand pump, or a protected spring or gravity flow scheme, or treated piped water, subject to maintenance of a safe drinking-water chain. Bottled water packed by approved companies is also considered safe water.



39. Sanitation: Encompasses the isolation/management of excreta from the environment, maintenance of personal, domestic and food hygiene, safe disposal of solid and liquid wastes, maintaining a safe drinking-water chain and vector control.

40. Population using basic drinking water service: population using an improved drinking water source/facility with a total collection time of 30 minutes or less for a round-trip, including queuing

41. Population using safely managed drinking water services: population using an improved source of drinking water (improved source of drinking water include: Piped water into dwelling yard or plot, borehole or tube wells, protected dug wells, protected spring, rainwater and packaged or delivered water) which is located on premises, available when needed and free of (faecal and priority chemical) contamination.



42. Population using basic sanitation services: population using an improved sanitation facility (improved Sanitation facilities include: flush/pour flush to piped sewer system, septic tank or latrine; ventilated improved pit latrine, composting toilet or pit latrine with slab) which is not shared with households

43. Population using safely managed sanitation services: population using an improved sanitation facilities (improved sanitation facilities include: flush or pour flush to piped sewer systems; septic tanks or pit latrine; ventilated improved pit latrine; composting toilet or pit latrine with slab) which is not shared with other household and where excreta are treated and disposed in situ or transported and treated offsite



44. Meteorological: Related to the weather or changes in the Earth's atmosphere.



45. Hydrographical: is the branch of applied sciences which deals with the measurement and description of the physical features of oceans, seas, coastal areas, lakes and rivers, as well as with the prediction of their change over time, for the primary purpose of safety of navigation and in support of all other marine activities.



46. Geological: relating to the study of the earth's physical structure and substance



47. Geographical: based on or derived from the physical features of an area

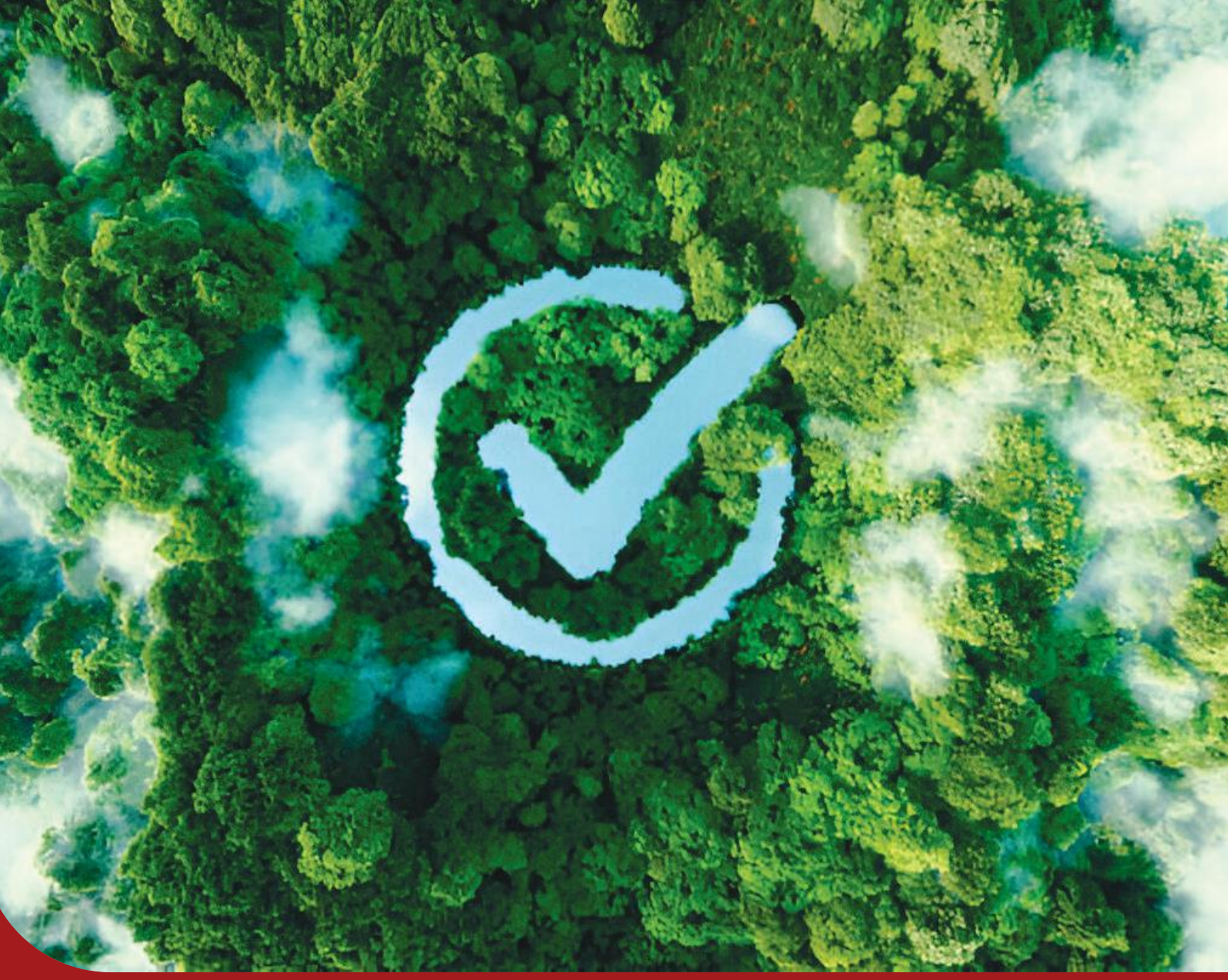
48. Biological: relating to biology or living organisms



49. Inter Tropical Convergence Zone (ITCZ): is a belt of low pressure which circles the Earth generally near the equator where the trade winds of the Northern and Southern Hemispheres come together. It is characterised by convective activity which generates often vigorous thunderstorms over large areas



50. Synoptic Weather Stations: are instruments which collect meteorological information at synoptic time 00h00, 06h00, 12h00, 18h00 (UTC) and at intermediate synoptic hours 03h00, 09h00, 15h00, 21h00 (UTC)



01

ENVIRONMENTAL CONDITIONS AND QUALITY

1.0 Introduction

This chapter covers statistics on the physical, biological and chemical characteristics of the environment and their changes over time. Environmental condition refers to the state of the environment at a given time point. Environmental quality on the other hand refers to a measure of the condition of the environment relative to a requirement or threshold of one or more species or to any human need or purpose.

1.1 Physical Conditions

This sub component aims to capture the physical aspects of the environment and focuses on statistics on the meteorological,hydrograpghical,geological and geograhical conditions and soil characterustics.

1.1.1 Atmosphere, Climate and Weather

This topic covers data on atmospheric, climatic and weather conditions across territories and over time. Weather describes the atmosphere's behavior over a short period of time while climate is determined by long term weather conditions, both of which are recorded through monitoring stations. Information about the atmosphere, climate, and weather is important to understand the conditions and trends to explain other phenomena such as ecosystem change, biodiversity and living conditions, among others.

The climatic regions and their corresponding synomtic weather stations are presented in Table 1.1 namely, North Western, North Eastern, Western, Central Rift Valley, Central, Nairobi, South Eastern and the Coastal strip.

Table 1.1: Climatic Regions and Meteorological Stations Under Each Region

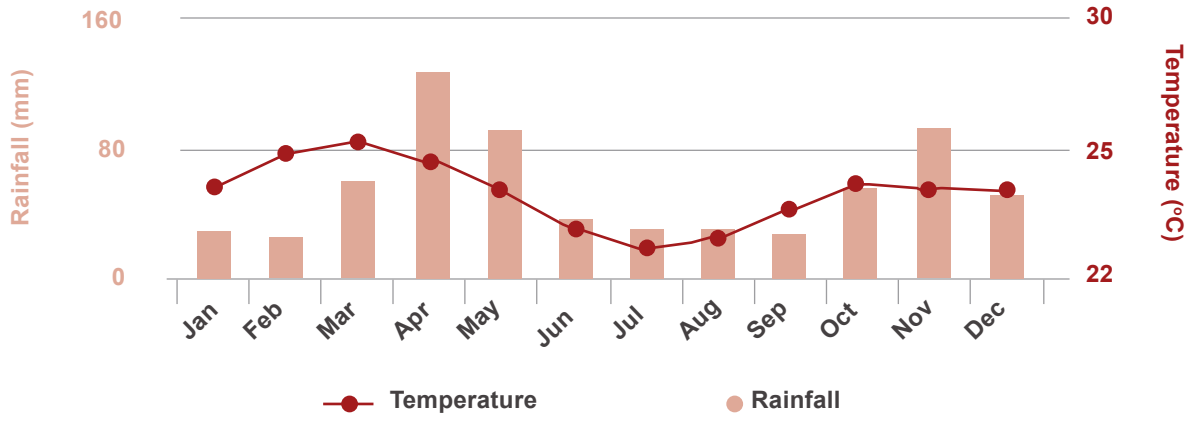
Meteorological Region	North Western	North Eastern	Western	Central Rift Valley	Central	Nairobi	South Eastern	Coastal
Synoptic Stations	Lodwar	Marsabit	Kitale	Nyahururu	Nyeri	Moi Airbase (Eastleigh)	Machakos	Lamu
		Moyale	Kakamega	Nakuru	Kangema	Dagoretti Corner	Kitui	Malindi
		Garissa	Eldoret	Kabarak	Embu	Wilson Airport	Makindu	Msabaha
		Wajir	Kericho	Narok	Meru	JKIA	Voi	Mtwapa
		Mandera	Kisii		Laikipia	Thika		Mombasa
			Matungu					
			Eldoret-Airport					
			Suba					
			Kisumu					

Source: *Kenya Meteorological Department*

Climate

Kenya has a moderate tropical climate which is tempered by topographic relief, especially mountains such as Mt. Kenya, Aberdare Ranges, Mau Forest Complex, and Mt. Elgon, as well as the movements in the Inter Tropical Convergence Zone (ITCZ).The climate is also affected by large water bodies and the relatively wet and narrow tropical belt along the Indian Ocean as well as the large areas of the Arid and Semi-Arid lands (ASALs). The average monthly temperature and rainfall for Kenya is presented in Figure 1.1. Kenya has two main seasons namely March April May(MAM) and October November December (OND)

Figure 1.1: Average Monthly Temperature and Average Rainfall for Kenya from 1991-2020



Source: *Kenya Meteorological Department*

Rainfall Distribution

As seen in Table 1.2, regions which receive high annual rainfall are Western, Central, Coastal Strip and Central Rift Valley. North Western and North Eastern parts of the country receive the lowest amount of rainfall.

Table 1.2: Annual Rainfall, by Regions, 2012-2023 (mm)

Region	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	LTM (2012-2023)
North Western	399.0	296.0	139.3	170.0	219.3	226.2	282.7	309.5	380.8	176.5	103.6	248.7	245.9
North Eastern	367.5	529.0	396.6	394.2	367.0	367.7	971.3	555.3	427.0	247.7	246.1	883.8	479.4
Western	1,880.0	1,793.6	1,508.4	1,690.8	1,407.2	1,715.1	1,830.5	1,855.1	1,971.7	1,534.5	1,369.6	1,635.7	1682.7
Central Rift Valley	1,024.8	1,173.5	744.0	901.8	888.7	786.3	1,169.9	1,062.6	1,212.5	784.1	846.4	907.5	958.5
Central	1,305.2	1,000.5	1,032.9	1,224.3	908.4	1,033.4	1,540.2	1,582.8	1,334.2	987.9	770.6	1,373.7	1174.5
Nairobi	1,154.5	902.0	686.8	1,110.0	877.2	618.1	1,195.5	1,006.3	1,061.0	846.4	697.2	966.7	926.8
South Eastern	608.2	621.0	491.5	573.4	392.7	601.6	1,004.2	807.9	843.1	388.4	291.8	824.3	620.7
Coastal Strip	829.6	1,020.8	997.5	947.3	571.1	1,061.2	1,314.2	1,482.0	938.5	495.2	716.0	1,555.9	994.1

Source: *Kenya Meteorological Department*

Table 1.3 presents average monthly rainfall in each of the regions. Most areas had April as the month with the highest rainfall. However, while May was the highest rainfall month in the coastal region, November emerged as the highest rainfall month in the case of the South Eastern region. Similarly, whereas January/February were the lowest rainfall months for most regions, July was the lowest rainfall month in the case of Central, Nairobi and the South Eastern regions.

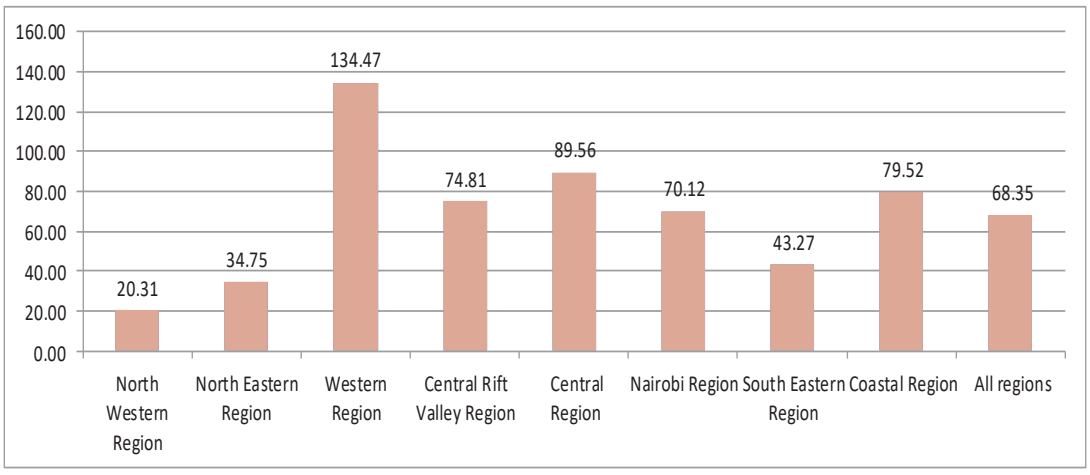
Table 1.3: Average Monthly Rainfall in (mm) for All Regions, 2010-2023

Meteorological Regions	North Western	North Eastern	Western	Central Rift Valley	Central	Nairobi	South Eastern	Coastal	All Regions
	Lodwar	Marsabit, Moyale, Garissa, Wajir and Mandera	Kitale, Kakamega, Eldoret, Kericho, Kisii and Kisumu	Nyahururu, Nakuru, Kabarak and Narok	Nyeri, Kangema, Embu and Meru	Moi Airbase (Eastleigh), Dagoretti Corner, Wilson Airport, JKIA and Thika	Machakos, Kitui, Makindu and Voi	Lamu, Malindi, Msabaha, Mtwapa and Mombasa	All stations
January	6.2	8.4	51.9	35.1	44.3	36.7	28.6	4.1	26.9
February	3.3	8.0	53.5	46.7	31.6	43.1	25.2	3.9	26.9
March	31.5	36.3	134.0	70.9	77.1	88.9	76.2	37.4	69.0
April	52.2	107.8	214.9	121.2	225.6	180.4	83.4	121.1	138.3
May	23.1	31.1	199.0	95.9	117.8	102.0	31.0	291.0	111.4
June	7.2	3.7	130.4	64.3	22.6	36.8	5.1	107.1	47.2
July	11.6	3.3	122.6	77.7	20.1	10.7	2.2	53.9	37.8
August	22.3	4.7	159.6	87.8	28.9	21.3	4.1	55.8	48.1
September	15.7	4.6	157.4	68.7	17.7	21.5	3.2	37.0	40.7
October	19.2	86.6	142.8	72.0	168.0	62.8	21.5	115.0	86.0
November	31.7	95.7	140.9	86.3	224.2	146.4	130.8	91.1	118.4
December	19.8	26.8	106.4	71.3	96.9	90.8	107.9	36.7	69.6
Average	**20.3**	**34.8**	**134.5**	**74.8**	**89.6**	**70.1**	**43.3**	**79.5**	**68.4**

Source: *Kenya Meteorological Department*

A comparison of the regions in terms of average rainfall is presented in Figure 1.2. Overall, the western Kenya region emerged as the most endowed region in terms of having received the highest rainfall while the north western region received the lowest.

Figure 1.2: Long Term Overall Average Monthly Rainfall (mm)



Source: *Kenya Meteorological Department*

Temperatures

Temperatures in Kenya's tropical climate vary considerably according to topography; the central highlands are substantially cooler than the coast regions. The surface temperature varies from one area to another and from season to season as illustrated in Table 1.4. The year 2015 and 2017 were the hottest years in Kenya while years 2013 and 2019, were the coolest years with a minimum temperature of 17.0°C over the years.

Table 1.4: Monthly Mean Maximum and Minimum Temperatures (°C), 2013-2023

Year	Jan	Feb	Marc	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Min	15.1	16	16.8	18.4	17.6	16.8	16.3	15.9	16.4	17.6	17.3	17.1	16.8
2013 Max	29.4	30.6	30.4	28	27.4	26	26.1	26	28.3	29.1	28.3	28.2	28.2
Min	16.7	16.6	18.2	18.3	17.2	16.5	15.8	15.9	16.6	17.3	17.7	17.3	17
2014 Max	30	30.2	30.1	29.2	28.3	27.2	26.7	27.2	27.8	28.9	28.1	28.9	28.6
Min	16.6	17.4	17.8	18.1	18.3	17.5	16.8	16.7	16.5	17.7	17.7	16.9	17.3
2015 Max	30.5	31.5	31.3	28.8	28.1	27.6	27	27.5	29.2	29.3	28.1	28.8	29
Min	15.9	16.9	17.2	18	18.4	17.4	16.3	16.3	16.6	18.5	18.3	17.6	17.3
2016 Max	29.7	30.8	32.3	29.6	27.5	26.8	26.3	26.7	27.9	29.7	28.5	29.2	28.8
Min	18.3	17.5	18	19.4	18	16.7	16.2	16	16.1	17	17.8	16.8	17.3
2017 Max	30.4	30.5	32.1	30.4	28.3	28.1	27	27.2	27.9	29.2	27.7	29	29
Min	15.8	17.6	18.2	18.8	18.3	16.4	16.8	17	17.3	17.8	17.6	16.3	17.3
2018 Max	29.7	31	28.2	27.2	27	26.2	25.5	26.6	28.1	28.5	28.6	28.2	27.9
Min	16.6	17.2	18.1	18.2	17.7	16.9	16.1	16.1	16.7	17.5	17.4	17.5	17.2
2019 Max	30.1	31	31	29.1	27.8	27.3	26.5	27.1	28.3	29.2	28.4	28.9	28.7
Min	16.7	16.7	17.1	18.4	17.7	16.7	16.3	15.9	16.4	17.3	17.5	17.5	17
2020 Max	29.8	31.2	23.9	31.5	24.5	27	27.1	27.4	28.5	27.4	27.6	27.6	28.8
Min	18.3	18.2	19	18.7	18.2	17.3	16.8	16.7	17.1	18.3	18.1	17.2	17.8
2021 Max	27.6	28.3	29.3	28	26.3	25.5	24.4	25.9	26.6	27.9	28.3	26.9	27.1
Min	16.5	16	16.4	16.8	17.6	17.1	15.7	16.8	15.4	16.3	16.8	17.1	16.8
2022 Max	28.1	28.9	30.1	28.5	27.1	25.7	25.2	25.1	26.7	28.4	27.1	27.4	27.7
Min	17.6	17.5	18.4	18.1	17.6	16.6	16.1	15.6	16.3	17.2	17.5	16.5	17.1
2023 Max	27.3	28.3	28.5	27.3	26.9	26	25	25.8	26.5	27.6	26.7	27.6	27

Source: *Kenya Meteorological Department*

In general, high maximum temperatures of above 30 degrees Celsius (°C) are recorded over the North Western parts of the country (Lodwar), parts of North Eastern region (Moyale, Marsabit, Garrissa, Wajir and Mandera) and the Coastal strip (Lamu, Malindi, Msabaha, Mtwapa and Mombasa) during the December, January, February season as presented in Table 1.5. The northen and coastal parts of the country have less cloud cover during this season, hence receive maximum insolation which leads to high day time temperatures. The lowest maximum temperatures are recorded over the June, July, August season over the central highlands depicting the influence of high altitudes and low insolation on temperatures.

Table 1.5: Annual Mean Maximum and Minimum Temperature (°C), for Regions

Regions		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	LTM(2012-2023)
Nairobi	Max	25.7	25.5	25.7	26.3	25.8	26	24.4	25.3	24.7	24.1	24.9	25.6	25.3
	Min	14.0	14.1	14.4	14.4	14.3	14.6	14.3	14.8	14.9	14.4	15.4	14.9	14.5
North Western	Max	35.4	35.5	35.9	36.2	36.0	35.9	35.0	36.0	35.4	36.1	35.8	35.9	35.8
	Min	23.6	24.3	24.2	24.7	24.9	23.8	24.7	24.3	24.7	24.1	24.8	24.8	24.4
North Eastern	Max	31.4	31.0	33.0	33.0	33.0	33.5	31.4	32.5	31.3	31.0	31.1	30.4	31.9
	Min	21	21.1	21.1	20.9	21.4	22.5	20.6	21.6	21.7	21.2	21.8	21.8	21.4
Western	Max	26.3	26.2	26.2	26.9	26.6	26.2	25.3	26.6	25.8	26.3	26.4	27.3	26.3
	Min	13.8	13.8	13.8	14.2	14.2	13.1	13.3	14.6	14.6	14.3	14.9	15.5	14.2
Central Rift Valley	Max	24.1	24	24.4	25.0	25.0	25.3	24.0	25.2	24.1	24.6	24.9	25.3	24.7
	Min	10.2	10.3	10.4	10.7	10.5	10.2	10.7	11.2	11.7	10.9	11.9	11.3	10.8
South Eastern	Max	29.3	28.6	28.5	29.2	28.9	29	28.2	28.9	28.3	30.6	29.8	29.4	29.1
	Min	17.1	17.1	17.2	17.5	17.4	17.5	17.2	17.7	17.3	18.9	18.1	17.5	17.5
Coastal Strip	Max	30.6	30.5	30.7	30.9	31.0	31.0	30.7	31.0	30.8	31.0	30.4	30.7	30.8
	Min	23.7	23.5	23.7	23.9	24.0	24.0	23.5	24.3	24.2	24.1	24.5	24.0	24.0
Central	Max	24.4	23.9	24.0	24.6	24.1	25.0	24.1	25.2	24.4	24.9	25.0	25.2	24.6
	Min	13.1	13.4	13.6	13.4	13.6	12.8	13.0	13.4	13.5	12.5	13.1	13.8	13.3
Country	**Max**	28.4	28.1	28.5	29.0	28.7	29.0	27.9	28.8	28.1	28.6	28.6	28.7	28.5
	Min	17.1	17.2	17.3	17.5	17.5	17.3	17.2	17.7	17.8	17.5	18.1	18.0	17.5

Source: *Kenya Meteorological Department*

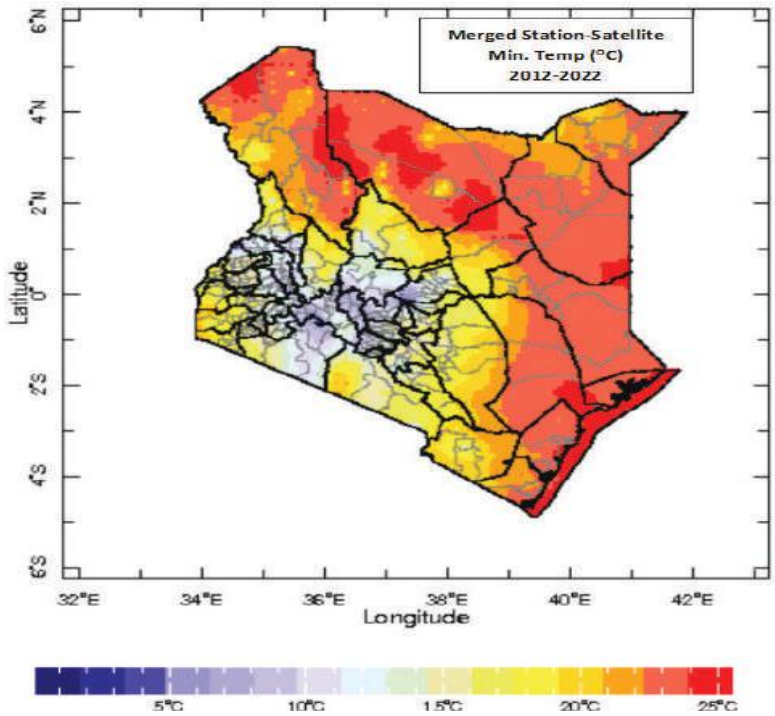
The maximum temperatures data in Table 1.6 shows a decreasing trend. The increase in the minimum temperature is weak in the country as shown in Table 1.6 and Figure 1.6 and Figure 1.7.

Table 1.6: Annual Trend in Average Maximum and Minimum Temperature (°C)

Indicator	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	LTM (2012-2023)
Maximum	28.4	28.1	28.5	29.0	28.7	29.0	27.9	28.8	28.1	28.6	28.6	28.7	28.5
Minimum	17.1	17.2	17.3	17.5	17.5	17.3	17.2	17.7	17.8	17.5	18.1	18.0	17.5

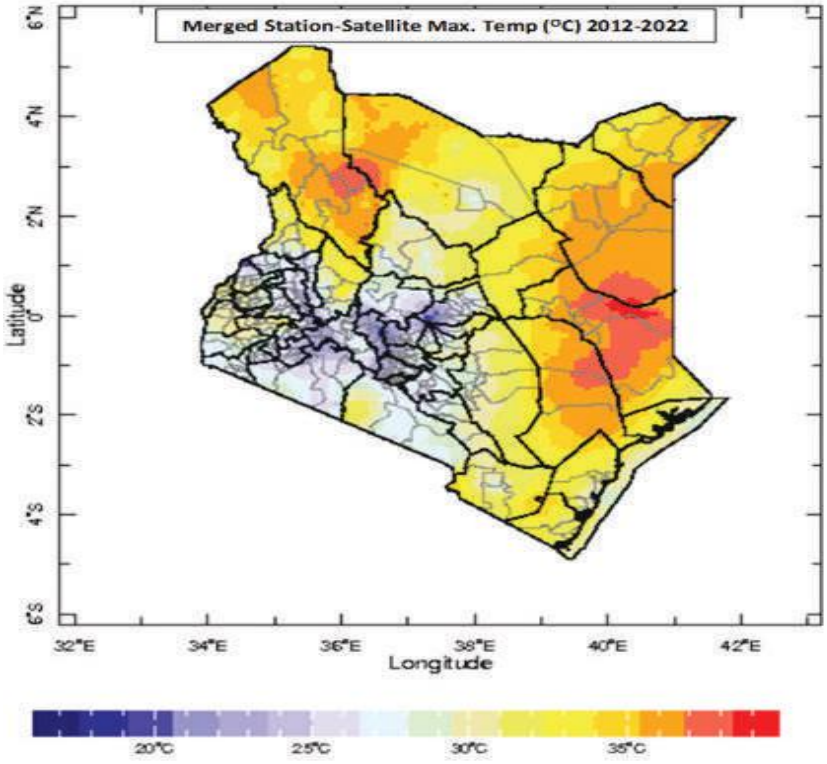
Source: *Kenya Meteorological Department*

Figure 1.3: Merged Stations -Minimum Temperature



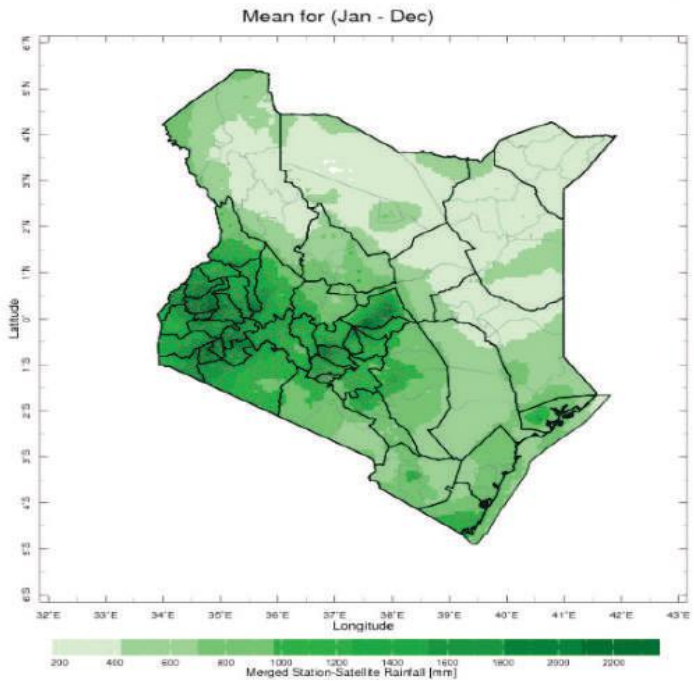
Source: *Kenya Meteorological Department*

Figure 1.4: Merged Stations -Maximum Temperature



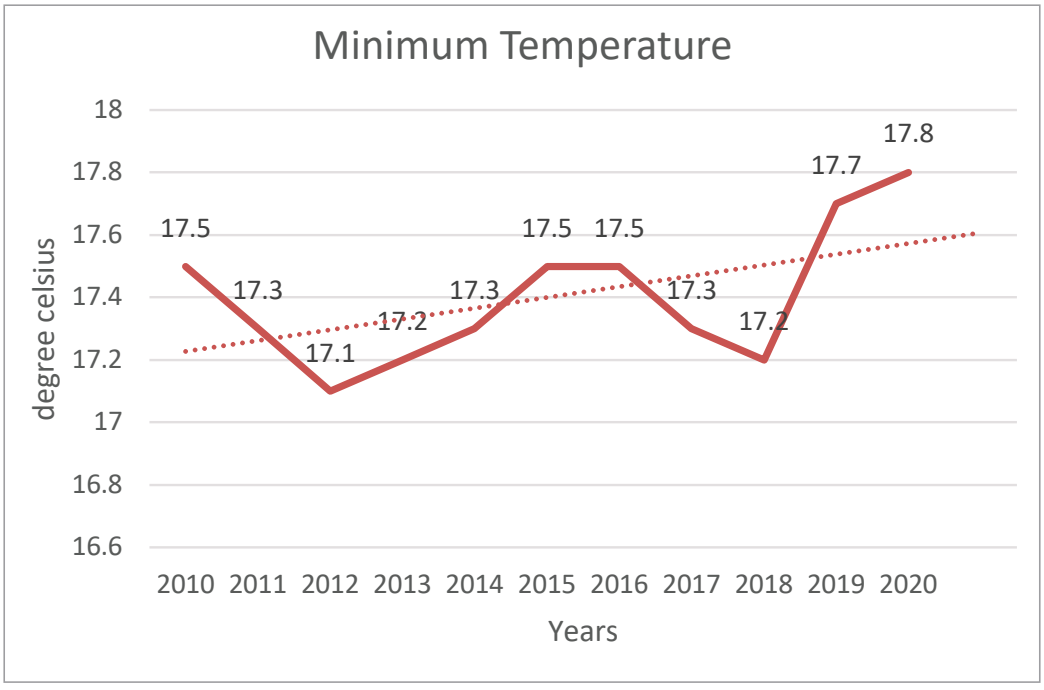
Source: *Kenya Meteorological Department*

Figure 1.5: Rainfall (Mean January to December)



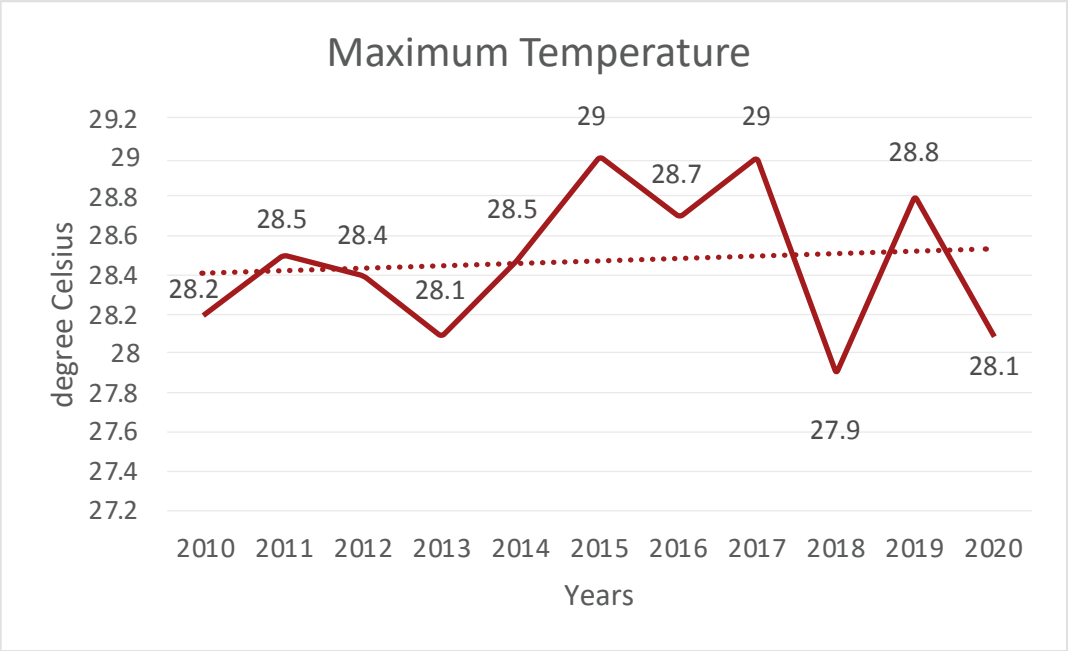
Source: *Kenya Meteorological Department*

Figure 1.6: Trend in Minimum Temperature



Source: *Kenya Meteorological Department*

Figure 1.7: Trend in Maximum Temperature



Source: *Kenya Meteorological Department*

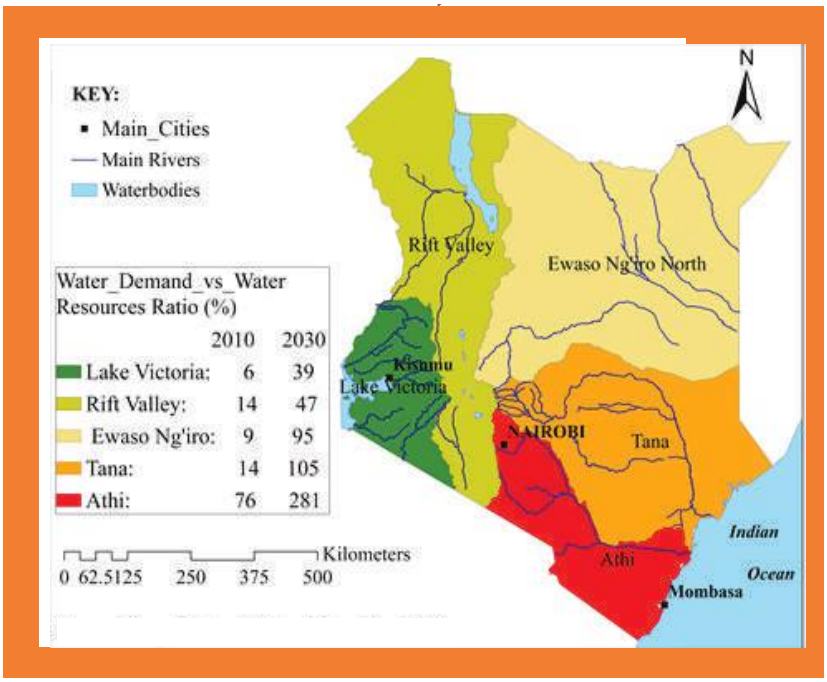
1.1.2. Hydrographical Characteristics

Hydrographical characteristics include information on the location, extent and characteristics of lakes, rivers, and streams, artificial reservoirs, watersheds, seas and aquifers. This information is compiled to serve as basis for understanding water and flows of water.

Water Basins

Kenya has five major water basins: namely; Lake Victoria, Rift Valley, Athi River, Tana River and Ewaso Ngiro basins. However, only two of these basins can be rated to have surplus water resources: Lake Victoria and Tana River as illustrated in Figure 1.8.

Figure 1.8: Water Basins and Water Balance in Kenya



Source: *Kenya National Water Master Plan 2030*

Watersheds

The main five watershed in the country are the: Aberdare mountain, the Mau forest complex, the Mount Kenya, the Mount Elgon and the Cherengani hills.

Aberdare Mountain Watershed. The Aberdare mountains are an isolated volcanic range that forms the easternmost wall of the Great Rift Valley, to the east of the high Kinangop/Laikipia plateau. They are around 100 km long from north to south (the northern end almost reaching the equator). Mist and rain occur throughout much of the year, with precipitation varying from around 1,000 mm on the drier north-western slopes to as much as 3,000 mm in the south-east. The major rivers from Aberdare Forest are Athi and Tana, which flow into the India Ocean, Ewaso Nyiro that drains into the Lorian Swamp and River Malewa that drains into Lake Naivasha. The ranges also have several tributaries, and higher up are bog markings that are the source of the rivers on the moorlands and afro-alpine. The Athi, Lake Naivasha, Tana and Ewaso Nyiro river basins have their source in Aberdare Forest Reserve.

Mau Forest Watershed. Mau Forest is a forest complex in the Rift Valley of Kenya. It is the largest indigenous montane forest in East Africa. The Mau Forest complex has an area of 273,300 hectares (675,000 acres). The forest area has some of the highest rainfall rates in Kenya. Mau Forest is the largest drainage basin in Kenya. Numerous rivers originate from the forest, including Southern Ewaso Ng'iro, Sondu River, Mara River and Njoro River. These rivers feed Lake Victoria, Lake Nakuru and Lake Natron. Western slopes of the Mau Escarpment are covered by Mau Forest.

Mount Kenya Watershed. Mount Kenya is the highest mountain in Kenya and the second-highest in Africa, after Kilimanjaro. The highest peaks of the mountain are Batian (5,199 metres (17,057 ft)), Nelion (5,188 metres (17,021 ft)) and Point Lenana (4,985 metres (16,355 ft)). Mount Kenya is located in the former Eastern and central provinces of Kenya, , about 16.5 kilometres (10.3 mi) south of the equator, around 150 kilometres (93 mi) north-northeast of the capital Nairobi. The forested slopes are an important source of water for much of Kenya.

Mount Elgon Watershed. Mount Elgon National Park is a national park 140 kilometres (87 mi) northeast of **Lake Victoria.** The park covers an area of 1,279 sq km (494 sq mi) and is bisected by the border of Kenya and Uganda. The Ugandan part of the park covers 1,110 sq km (430 sq mi) while the Kenyan part covers 169 sq km (65 sq mi). Mount Elgon is an important water catchment for the Nzoia River, which flows to Lake Victoria, and for the Turkwel River which flows into Lake Turkana.The climate is moist to moderate dry. Annual rainfall is over 1,270 millimetres.

Cherangani Hills Forest Watershed. Cherangani Hills Forest is a collection of thirteen forest reserve blocks in western Kenya, located in the Cherangani Hills on the western ridge of the East African Rift. The forested area is about 1,200 sq km (463 sq mi), 956 sq km (369 sq mi) of which has been gazetted into forest reserves. These forest reserves form the upper catchments of the Kerio and Nzoia and Turkwel rivers.

Status of Lakes Victoria and Turkana Water Levels

Following the heavy rainfall experienced in Kenya and the region over the last two seasons (October to December and March to May), Lake Victoria as well as Rift valley Lakes (i.e Turkana, Nakuru, Naivasha, Baringo among others) recorded very high levels and have remained high for several months. The lakes have thus continued to inundate the shoreline areas and displacing many people.

1. Lake Victoria

Lake Victoria is the world's second largest lake and the largest in the developing world. It covers an area of 68,800 sq km, spanning 400 km north-south and 240 km east-west. The lake is shared by Kenya, Tanzania and Uganda with only 6% of the surface area of the lake within the Kenyan territory, while Tanzania and Uganda have 51% and 43% respectively. The depths range from an average of only 40m, and a maximum depth of 79m in the open lake. The main rivers which originate from Kenya and feed the lake include Nzoia, Yala, Nyando, Sondu, Mara and Gucha Migori plus the shoreline streams. These contribute 42% of the total river discharge entering Lake Victoria from land catchment. Consequently activities in Kenya catchments potentially affect a substantial portion of the river discharge to the lake and especially in Winam Gulf.

The Kenyan side of the lake encompasses the Rusinga channel and Winam gulf which is relatively shallow (0-5m). The lake's aquatic environment represents a considerable part of the economic potential of the lake region with regard to fisheries and navigation and a source of livelihood to riparian communities.

Analysis of Rise in Lake Victoria Levels

Data from the monitoring station at Kisumu port indicate that Lake Victoria level has been steadily rising from October 2019. The lake level has risen by more than 1.4m (vertical height) in the last 7 months. As a result, the Lake has reclaimed the riparian land submerging settlement and farms within the contour buffer. This has also caused an increased back water flow causing floods at the river mouths of Nzoia, Yala, Nyando, Sondu and Gucha Migori displacing communities and inundating homes and farms. Because of the shallow depths of Winam gulf, a small vertical gain translates to a larger horizontal inundation, hence communities around the lake have been advised to move to higher grounds away from the lake shores as rains continue at the catchments and over the lake. The most affected areas include shorelines around Kisumu and Homabay Counties, Islands such as Remba, Takawiri and Ringiti among others.

The lake level data from monitoring station is corroborated by the analysis of relative lake height variations computed from satellite altimetry data sets based on satellite data series showing that lake Victoria levels have risen beyond the highest recorded values in recent years.

2. Lake Turkana

Lake Turkana is located within Kenya's northern arid and semi-arid lands. The area is prone to frequent droughts during which livestock perish in large numbers. The Lake Turkana catchment area is 130,860 sq km both in Kenya and Ethiopia. The lake is Africa's fourth largest lake, and the world's largest desert lake. The lake is located in Kenya within an area inhabited by predominantly pastoralist community.

The lake is sustained by the inflows of Ethiopia's Omo River, which alone provides 90% of the lake inflow. Lake Turkana is a closed basin, hence the inflows are totally evaporated over time, and hence the lake waters are almost saline, unfit for consumption, and unsuitable for agriculture. However the lake has a thriving and diverse fish population. Other rivers draining the lake from Kenya include Kerio and Turkwel.

The Omo River which discharges into the northern end of Lake Turkana river has formed a delta, which has expanded and encroached further south into the lake in recent years. The delta expansion is perhaps partly a consequence of increased sediment runoff and higher floods arising from escalation of human activities in the Omo Basin, plus lake recession exposing formerly inundated areas.

Analysis of Lake Turkana Levels

The lake levels have been monitored at Fergusons Gulf on the Kenyan side. There are no monitoring stations on the Ethiopian side of the delta. Analysis show that the levels have been fluctuating over the years. The Ferguson's Gulf dried out completely in 1986. However, the annual flood in River Omo resulted in a rise in lake level of approximately 0.5m during the same year but this was not sufficient to compensate for the loss by evaporation of 2.3m on an annual basis. The lake level has been falling steadily since the beginning of 2015, this recession period being coincident with the filling of Gibe III dam's reservoir on the Omo River. However, there has been a steady rise since the end of 2017 in response to localised storm-water runoff from catchments near the lake.

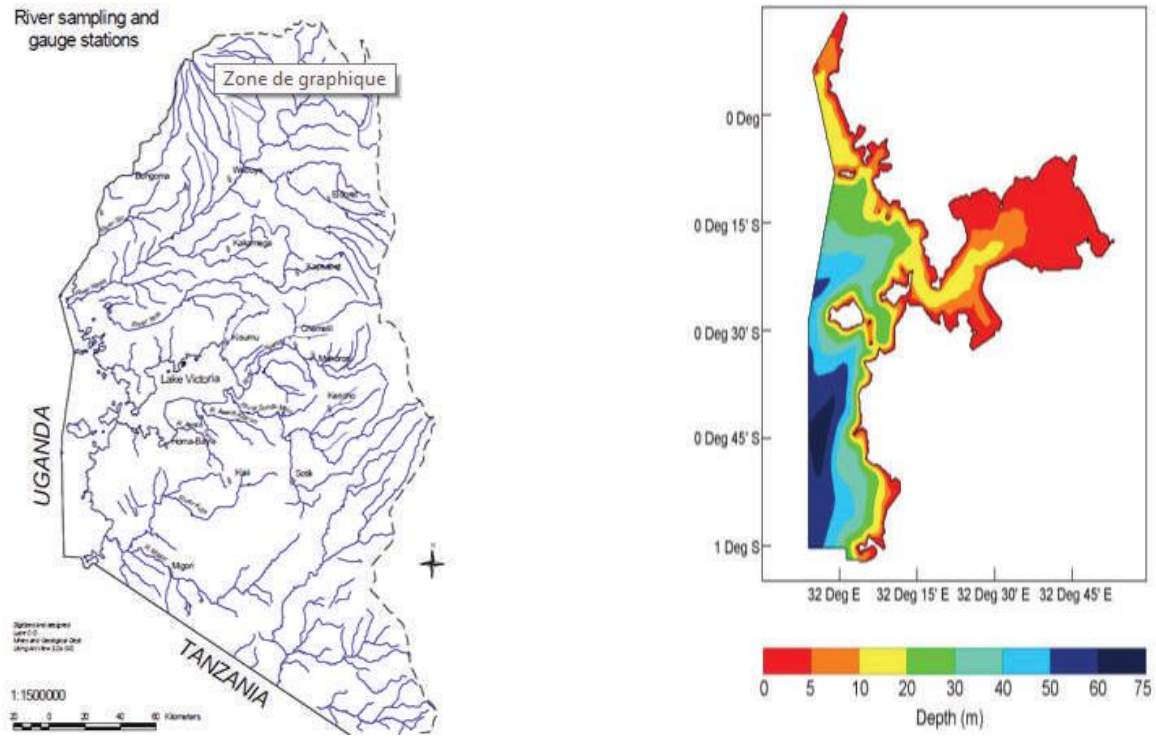
Following the heavy rainfall experienced in Lake Turkana catchment both in Kenya and Ethiopia over the last few months , the lake has recorded very high levels and have remained high for several months, inundating the shoreline areas on Kenyan side and displacing the fisher folk.



Data from the monitoring station at Kisumu port indicate that Lake Victoria level has been steadily rising from October 2019. The lake level has risen by more than 1.4m (vertical height) in the last 7 months.

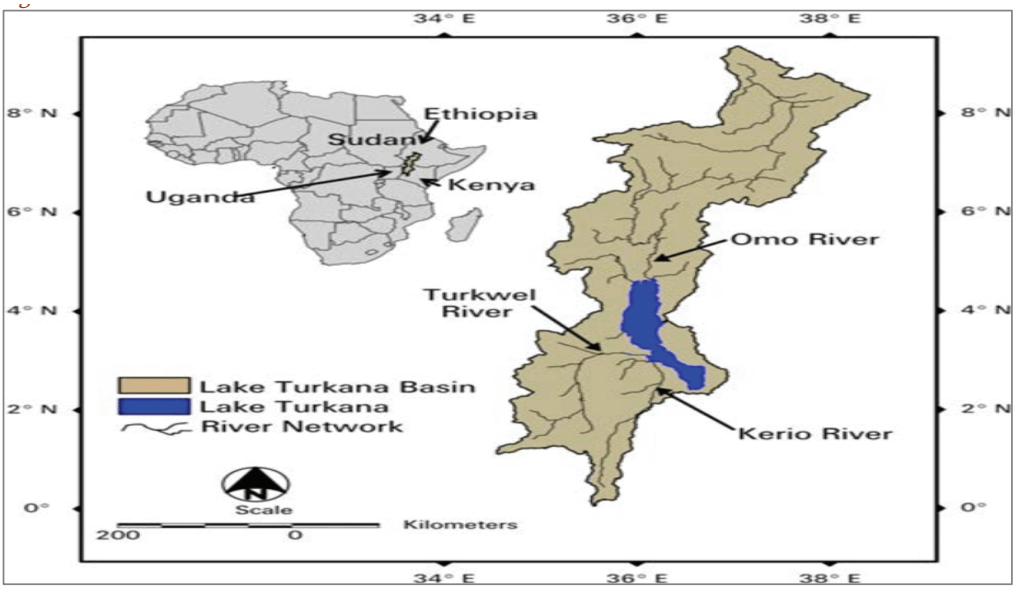
1.0 Rivers feeding Lake Victoria from the Kenyan Side

Figure 1.9: Rivers feeding Lake Victoria from the Kenyan Side and Depths of the Kenyan portion of Lake Victoria



Source: *Water Resources Authrity*

Figure 1.10: Lake Turkana Watershed

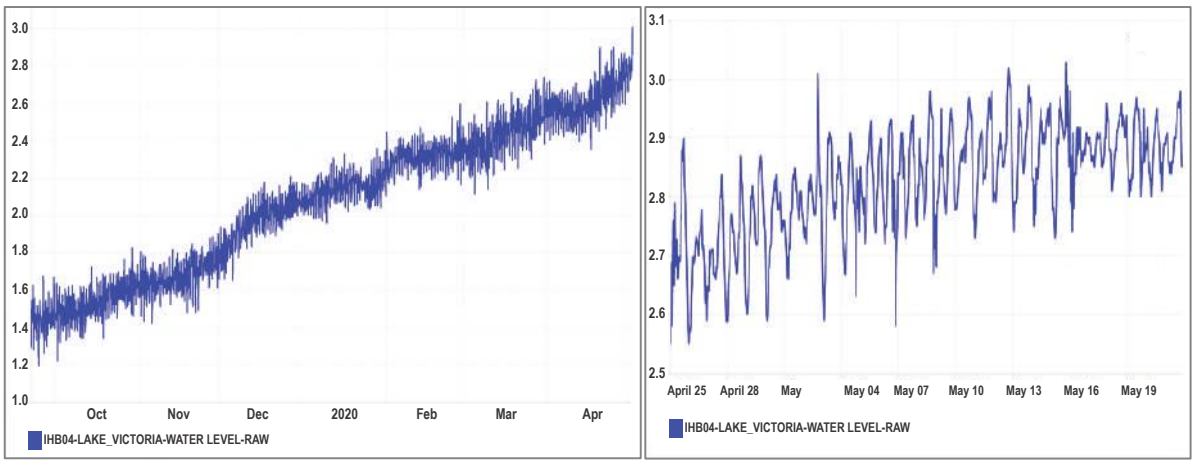


Source: *Water Resources Authority*

2.0. Analysis of Lake Victoria level Fluctuation

Lake Victoria levels at Kisumu Port RGS 1HB04. The data is recorded on hourly basis and transmitted to Water Resources Authority server every three hours. A rise of about 1.4m has been observed between October 2019 and May 2020.

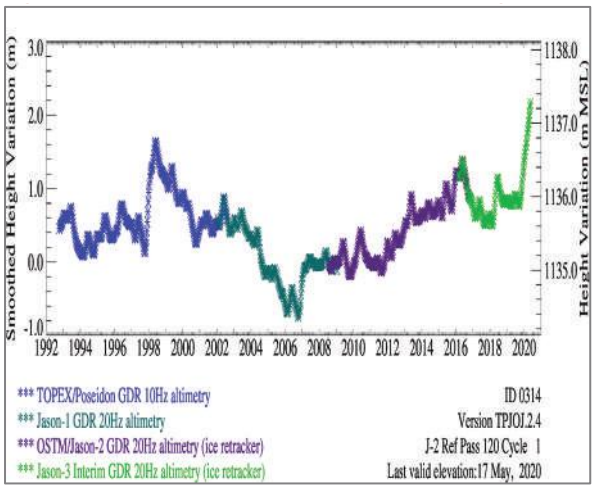
Figure 1.11: Lake Victoria Water Levels



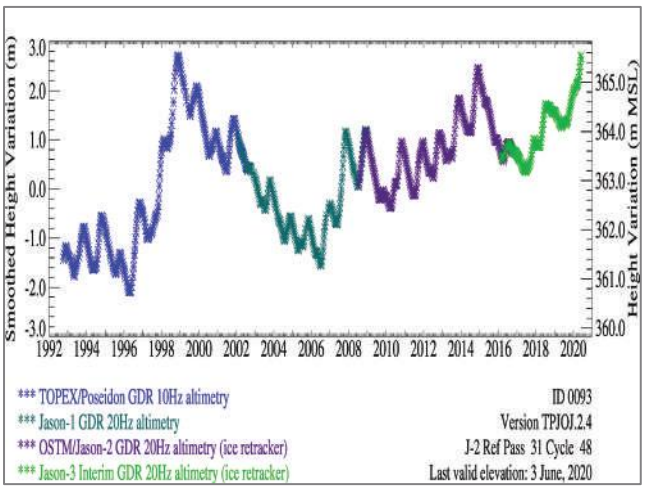
Source: *Water Resources Authority*

Relative lake height variations computed from satellite altimetry data sets show that both lake Victoria and Turkana levels have risen tremendously in the last few months.The data is based on the TOPEX/Poseidon/Jason satellite series, the ERS/ENVISAT/SARAL satellite series and the Sentinel-3 satellite series. The graphs are results from a smoothing/filtering function that aims to reduce outliers and reduce high frequency noise.

Figure 1.12: Lake Victoria and Turkana Height Variations



Lake Victoria



Lake Turkana

Source: *Water Resources Authority*

Lakes, Mountains; and National Parks

Kenya has a large number of freshwater and saltwater lakes with a total area of about 10,839 sq km as shown in Table 1.7. Lake Turkana is the largest lake in the country with a surface area of 6,405 sq km followed by lake Victoria. Lake Nakuru, Bogoria and Elementaita are the most important salt water lakes in the country for their environmental and historic richness. The lakes are not only salty, but are also home to about 75 per cent of the world's population of flamingos. The area surrounding these lakes is home to hundreds of bird species and have all been declared Ramsar sites. Major mountains include; Aberdare Ranges, Mount Kenya, Mau Escarpment, Mount Elgon and Cherangani Hills. Mount Kenya is the tallest mountain followed by Mount Elgon.

Table 1.7: Area of Lakes, Mountains and National Parks

Lakes	Area (Sq. Km)	Mountains	Height (Metres)	National Parks	Area (Sq. Km)	National Parks cont'd	Area (Sq. Km)
Victoria	3,855	Mount Kenya	5,199	Tsavo	20,430	Marsabit	360
Turkana	6,405	Mount Elgon	4,310	Aberdares	766	Ruma	120
Naivasha	149	Aberdare Ranges	3,999	Mount Kenya	715	Saiwa Swamp	2
Baringo	155	Cheranganyi Hills.	3,370	Mount Elgon	169	Chyulu	734
Bogoria	40	Mau Escarpment..	3,098	Nairobi	117	Mombasa	10
Nakuru	32			Lake Nakuru.	188	Malindi Marine	6
Elementaita	21			Oldonyo Sabuk	18	Ndere Island	4
Jipe	25			Watamu Marine	10	Arabuko Sokoke.	6
Magadi	110			Meru	870	Malika Mari	876
Bolossat	3			Amboseli	392	Kora	1,787
Chala	5			Sibiloi	1,570	Fourteen Falls	2
Kabongo	3			Hells Gate	68	Mau	304
Kanyaboli	9			Longonot	52	**Total**	**29,648**
Logipi	24			Kisita Marina	28		
Loongojit	3			South Island	39		
Total	**10,839**			Central Island	5		

Source: *Ministry of Lands, Housing and Urban Development.*

[1] All lakes except Lake Victoria have no outlet, and therefore level and area fluctuate.

1.1.3. Geological and Geographical Features

Geological and geographical information involves general geological and topographic information along with the characteristics of the country's territory and relief. This information is normally static, that is, it changes very slowly through time. It is helpful to present these statistics in a form of a map. Data for geological and geographical information are helpful to know the agreement on boundaries and understand geological events.

The geography of Kenya is diverse, with relief, climatic and ecological extremes affected by altitudes, which vary from sea level to over 5,199 M.A.S.L. on Mt. Kenya, the highest mountain in the country. The terrain ranges from coastal reefs to inland plains, plateaus, with dominant features being major highlands which constitute the "Water Towers" of the country.

Kenya lies in Eastern Africa, straddling the equator, between latitudes 4o N and 4o S, and longitudes 34o E and 41o E; .Kenya shares borders with Uganda to the west, Tanzania to the south, Ethiopia in the north, South Sudan in the north-west, Somalia in the east and the Indian Ocean to the southeast. This strategic position accords Kenya an important influence as a regional and economic hub for East Africa.

The country has land boundaries totaling 3,457 km and has the following border length: Ethiopia (867 km), Somalia (684 km), South Sudan(317 km), Tanzania (775 km) and Uganda (814 km).

The Kenyan coastline is about 600 km in length with an estimated continental shelf area of about 19,210 Sq. km. The Coastline runs from the Tanzania boarder in the south to the Somalia boarder in the north between latitudes 1°40'S and 4°25'S and longitudes 41°34'E and 39°17'E. Kenya's territorial sea and Exclusive Economic Zone (EEZ) extend 12 nautical miles (nm) and 200 nm respectively. The coastal region stretches roughly 150 km from the seafront, covering an area of 67,500 Sq. km.

Table 1.8 shows the total area of the country and by counties. The surface area is about 610,000 Sq. km comprising of land area (580,609 Sq. km.), water area (11,362 Sq. km.) and terrestrial water area (18,029 Sq. km.). The largest counties in size are Marsabit, Turkana, Wajir, Garrissa, Tana River, Isiolo and Kitui while the smallest ones are Mombasa, Vihiga, Nairobi, Nyamira, Kirinyaga, Kisii, and Busia.



3,457 km

The country has land boundaries totaling 3,457 km and has the following border length: Ethiopia (867 km), Somalia (684 km), South Sudan(317 km), Tanzania (775 km) and Uganda (814 km).

600 km

The Kenyan coastline is about 600 km in length with an estimated continental shelf area of about 19,210 Sq. km.

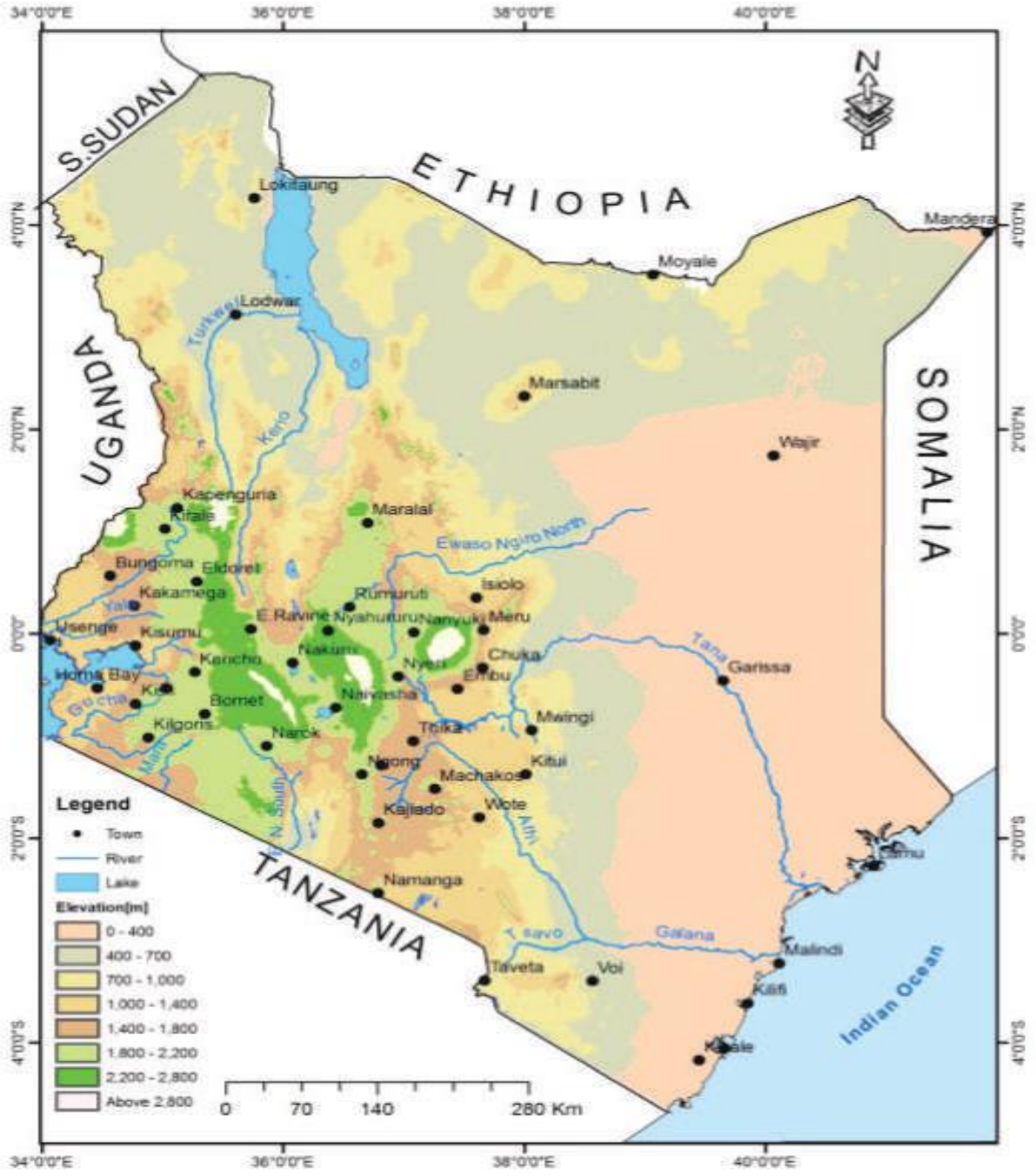
12 nm

Kenya's territorial sea and Exclusive Economic Zone (EEZ) extend 12 nautical miles (nm) and 200 nm respectively.

610,000 sq.km

Kenya's surface area comprising of land area **(580,609 Sq. km.),** water area **(11,362 Sq. km.)** and terrestrial water area **(18,029 Sq. km.).**

Figure 1.13: Map of Kenya Showing Extent, Location



Source: *Kenya Meteorological Department*

Table 1.8: Total Area of Country and by Counties, 2023

County	Land Area	Water Area	Total Area	County	Land Area	Water Area	Total Area
Kilifi	12,396	109	12,505	Nakuru	7,287	202	7,489
Kwale	8,165	65	8,230	Nandi	2,847	-	2,847
Lamu	5,832	308	6,140	Kericho	2,617	-	2,617
Mombasa	151	65	216	Elgeyo/Marakwet.	3,018	-	3,018
Taita/Taveta	17,090	30	17,120	Bomet	2,355	-	2,355
Tana River	39,153	-	39,153	Baringo	10,717	195	10,912
Garissa	43,591	-	43,591	Turkana	68,307	2,279	70,586
Wajir.	56,649	-	56,649	Samburu	21,024	-	21,024
Mandera	25,986	-	25,986	Trans-Nzoia	2,496	-	2,496
Machakos	6,016	-	6,016	Uasin Gishu	3,407	-	3,407
Kitui	30,437	-	30,437	West Pokot	9,108	-	9,108
Embu	2,828	-	2,828	Laikipia	9,544	-	9,544
Isiolo	25,382	-	25,382	Kisii.	1,321	-	1,321
Marsabit	71,905	4,126	76,031	Kisumu	2,110	567	2,677
Makueni	8,172	-	8,172	Siaya	2,453	1,089	3,542
Meru	7,057	-	7,057	Homa Bay	2,696	2,064	4,760
Tharaka Nithi	2,514	-	2,514	Migori	3,165	-	3,165
Nyeri.	3,336	-	3,336	Nyamira	901	-	901
Murang'a	2,527	-	2,527	Kakamega	3,023	-	3,023
Kirinyaga	1,475	-	1,475	Bungoma	3,033	-	3,033
Kiambu.	2,569	-	2,569	Vihiga	563	-	563
Nyandarua	3,267	3	3,270	Busia	1,686	144	1,830
Nairobi	707	-	707	**Total Area**	**580,609**	**11,362**	**591,971**
Narok	17,943	-	17,943	**Terrestrial Waters**	**-**	**18,029**	**18,029**
Kajiado	21,783	116	21,899	**Total Area Kenya**	**580,609**	**29,391**	**610,000**

Source: *Independent Electoral and Boundaries Commision*

1.2. Land Cover, Ecosystems and Biodiversity

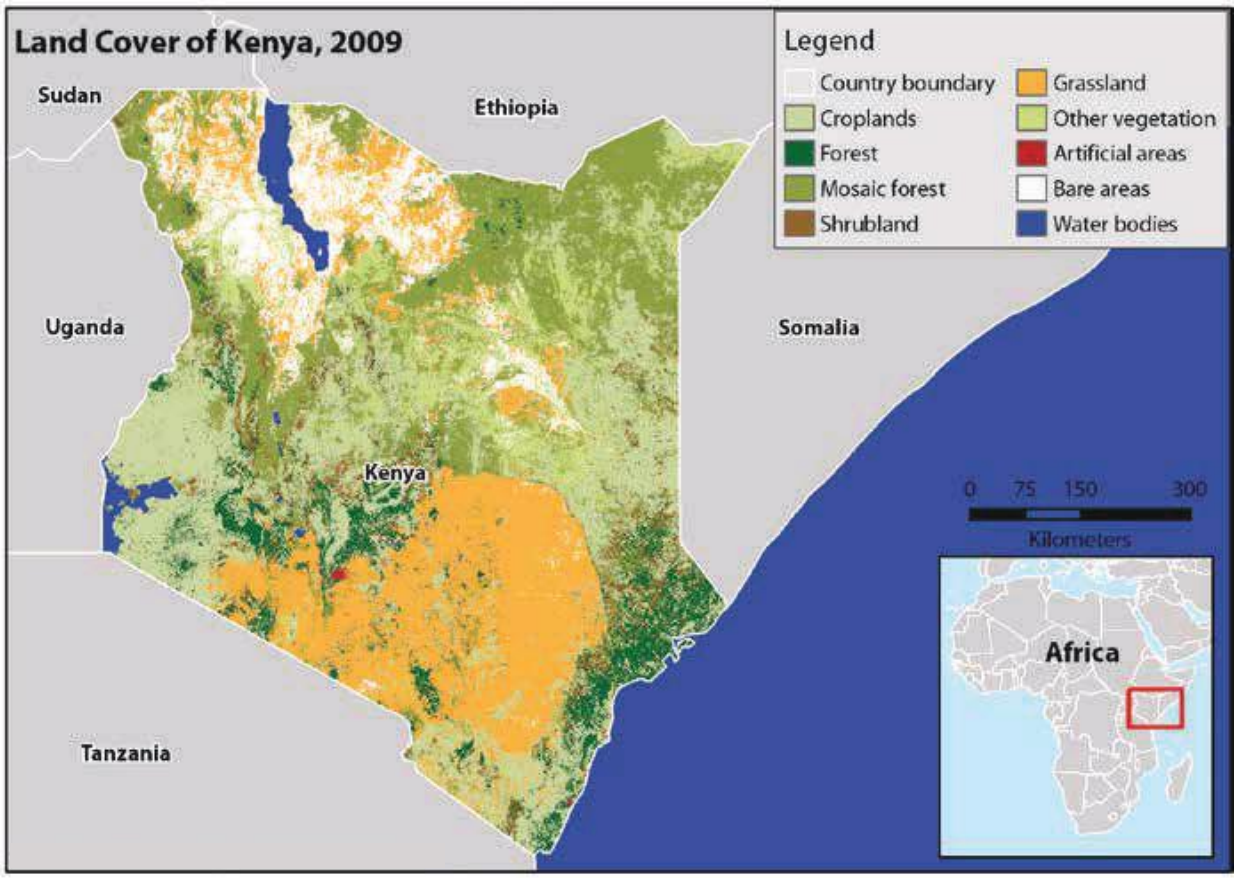
This subcomponent organizes the interrelated environment statistics on land cover, ecosystems and biodiversity, as well as their recordable changes over time and across locations. Land cover, as defined by the Food and Agriculture Organization (FAO), is the observed (bio)physical cover of the earth's surface. It is one of the indicators of ecosystem type. Biodiversity, a measure of ecosystem health, is the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes.

1.2.1. Land Cover

Statistics on land cover include the land area and the area under inland water, coastal water bodies and inter-tidal areas, excluding marine water. It is important to compile

data on land cover because human activities are the main drivers in the change of land cover. Information on land cover is generated by interpreting satellite images in a given period of time. For the 2015 Land Cover Statistics, the Kenya Forest Service (KFS) used the FAO 2009 International Standard as basis in land cover classification, which is aggregated into 9 categories– Cropland, Forest, Mosaic forest, Shrubslands, Grassland, Sother vegetation, Artificial areas,Bare areas and water bodies as shown in Figure 1.14.

Figure 1.14 :Land Cover of Kenya



Source: *FAO/ ESA GlobCover 2009, ESA 2010 and UCLouvain*

In Kenya, land cover is classified into six broad classifications namely; forestlands, croplands, grassland, settlements, wetlands and other lands as shown in Table 1.9. As of 2020, Kenya had 40.0 million hectares of grassland (68.9 percent), which is the largest share in the country's total land cover area. Cropland has about 11.1 million hectares of land which is 19.1 per cent of the total land area.

40.0 million

As of 2020, Kenya had 40.0 million hectares of grassland (68.9 percent), which is the largest share in the country's total land cover area.

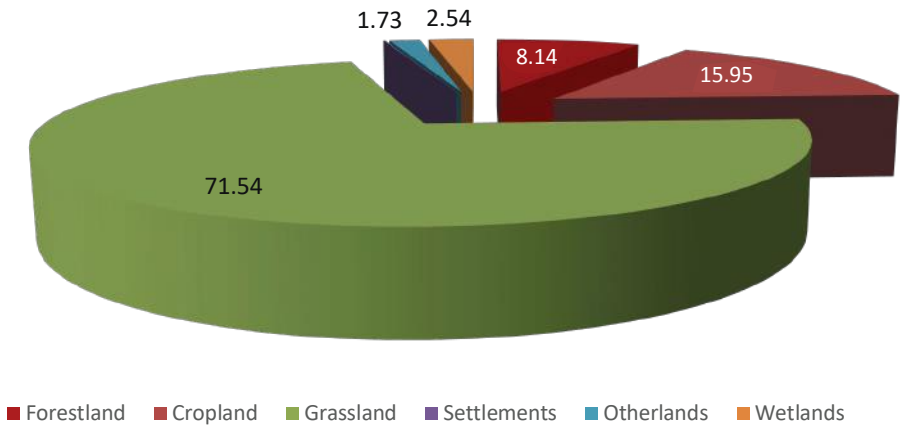


Table 1.9: Trend in Land -Cover / Use Changes in Kenya, 1990-2018

	1990		2000		2005		2010		2015		2018	
Category	('000ha)	%	('000ha)	%	('000ha)	%	('000ha)	%	('000ha)	%	('000ha)	%
Forestland	4724	8.14	3557	6.13	4047	6.97	4230	7.28	4158	7.6	4225	7.13
Cropland	9258	15.95	9661	16.65	9868	17	10072	18.05	10476	17.71	11,086	19.1
Grassland	41522	71.54	41654	71.77	41496	71.5	41080	70.79	40665	70.07	40000	68.93
Settlements	57	0.1	87	0.15	109	0.19	126	0.22	165	0.25	165	0.28
Other lands	1004	1.73	1574	2.71	1035	1.78	1044	1.8	1085	1.81	1080	1.86
Wetlands	1472	2.54	1504	2.59	1482	2.55	1485	2.56	1485	2.56	1482	2.55

Source: *Kenya Forest Service*

Figure1.15:Trend in Land Cover, 2018

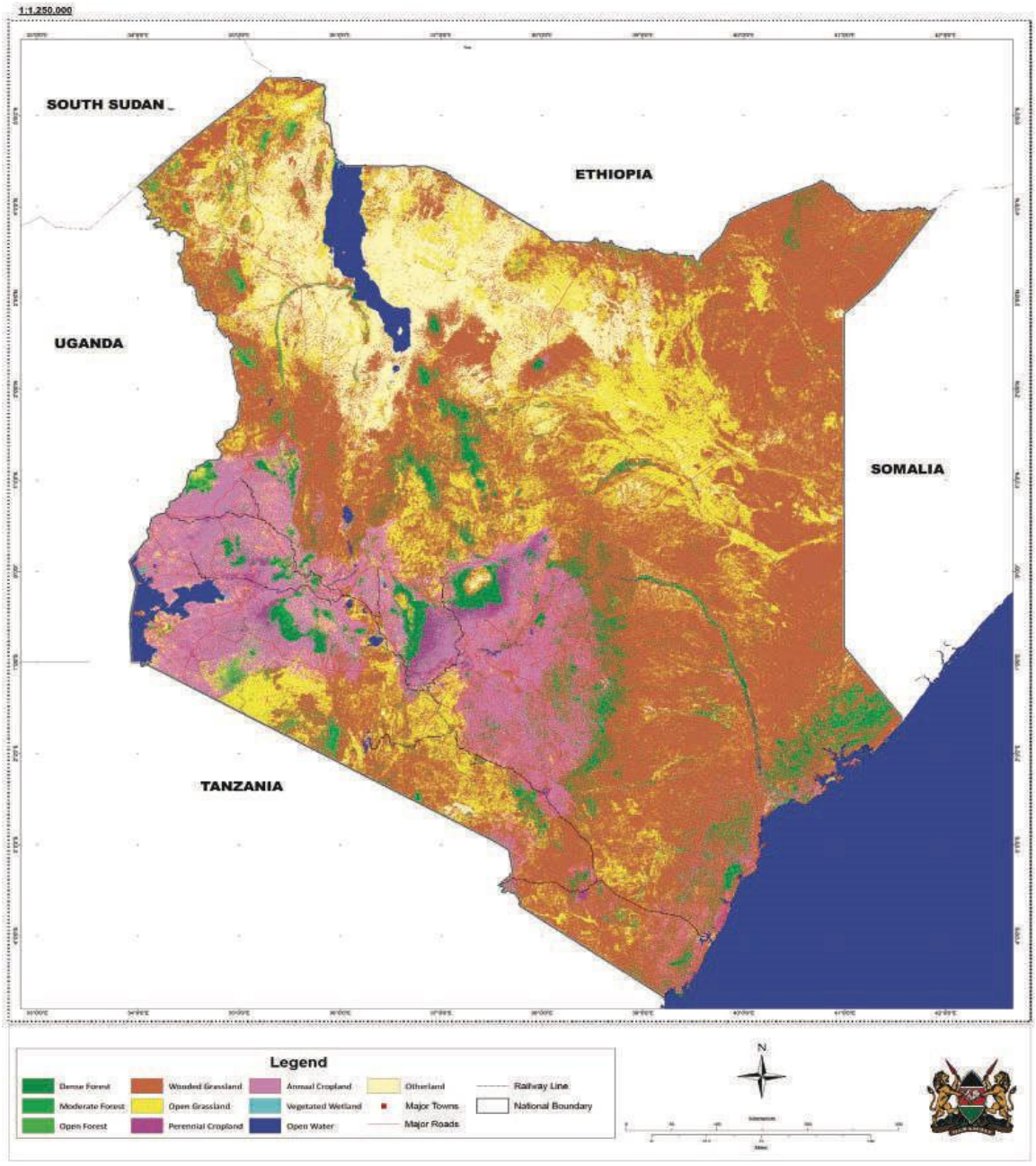


Source: *Kenya Forest Service*

Land Cover as Habitat for Biological Diversity

The land cover as habitat for biological diversity was categorized into 10 classes by the Directorate of Resource surveys and Remote Sensing (DRSRS). These were primarily from remote sensing perspective and the classes include: Dense Forest (above 65 per cent canopy cover), Moderate Forest (40 per cent to 65 per cent canopy cover), Open Forest (15 per cent to 40 per cent canopy cover), Annual Crops, Perennial Crops, Open Grasses, Wooded grass, Water body, Vegetated Wetland and Otherland. Landsat Satellite Imageries (spatial resolution 30m) were used by DRSRS to generate the land cover data. For the purpose of this work, data at 4 year interval covering 2002, 2006,2010,2014, and 2018 was used to generate land cover maps to

Figure 1.16: Spatial Distribution of Land Cover in Kenya



Source: *DRSRS/ ESA GlobCover 2009*

1.2.1. Biodiversity and Ecosystem

Statistics related to ecosystems and biodiversity are critical given the increasing understanding of the role ecosystems play in human well-being and the evidence of biodiversity loss across the planet. Maintaining biodiversity and ecosystem health is necessary to preserve the genetic and ecosystem inheritance of a country, as well as its ecological productivity.

Threatened Species

Table 1.10: Number of Threatened Species in Each Major Group of Organisms, 2023

Indicator	Mammals	Birds	Reptiles	Amphibians	Fishes	Molluscs	Other Inverterbrates	Plants	Fungi & protists	Total
Number of Threatened Species	27	42	11	11	72	19	67	230	0	479

Source: *KWS, IUCN and BirdLife International*

Note

** Reptiles, fishes, molluscs, other invertebrates, plants, fungi & protists: please note that for these groups, there are still many species that have not yet been assessed for the IUCN Red List and therefore their status is not known (i.e., these groups have not yet been completely assessed). Therefore, the figures presented below for these groups should be interpreted as the number of species known to be threatened within those species that have been assessed to date, and not as the overall total number of threatened species for each group.*

Table 1.11: Number of Animals in Each Red List Category, 2023

Indicator	EX	EW	Subtotal	CR	EN	VU	sub total	NT	LR/cd	DD	LC	TOTAL
Number of animals in each Red list	2	0	2	43	54	152	249	188	2	235	2925	3597

Source: *KWS, IUCN and BirdLife International*

Notes

IUCN Red List Categories: EX - Extinct, EW - Extinct in the Wild, CR - Critically Endangered, EN - Endangered, VU - Vulnerable, LR/cd - Lower Risk/conservation dependent, NT - Near Threatened (includes LR/nt - Lower Risk/near threatened), DD - Data Deficient, LC - Least Concern (includes LR/lc - Lower Risk, least concern).

Table. 1.12: Number of Plants in Each Red List Category, 2023

Indicator	EX	EW	Subtotal	CR	EN	VU	sub total	NT	LR/cd	DD	LC	TOTAL
Number of Plants in each Red list	0	0	0	18	72	140	230	51	1	15	457	754

Source: *KWS, IUCN and BirdLife International*

Note

IUCN Red List Categories: EX - Extinct, EW - Extinct in the Wild, CR - Critically Endangered, EN - Endangered, VU - Vulnerable, LR/cd - Lower Risk/conservation dependent, NT - Near Threatened (includes LR/nt - Lower Risk/near threatened), DD - Data Deficient, LC - Least Concern (includes LR/lc - Lower Risk, least concern).

In Kenya, the flora and fauna are diverse, due to the variation in altitude, rainfall and temperature. The country has one of the highest gene pools with some species being either endemic,rare,, threatened or vulnerable. It is estimated that there are over 35,000 species of known flora and fauna species as illustrated in Table 1.13. The number of known flora (plants) species stood at 7004 while those of fauna(animal) species were 28,334. However, many species still remain unknown and possibly not even discovered.

Table 1.13: Known Flora and Fauna Species

	1990	1995	2000	2005	2010	2015
Flora	**-**	**6,302**	**6,506**	**-**	**6,846**	**7,004**
Fauna	**27,462**	**26,795**	**27,452**	**26,484**	**26,551**	**28,334**
Birds	1,065	1,080	1,089	1,089	1,100	1,100
Reptiles	222	230	237	250	261	262
Amphibians	100	100	101	105	110	114
Invertebrates	25,000	25,010	25,025	25,040	25,080	25,150
Mammals	375	375	-	-	-	378
Fish	700	-	1,000	-	-	1,330

Source: *National Museum of Kenya (NMK)*

Threat Categorization and Listing of Species

The number of threatened species in each major group of is depicted in Table 1.14. Of the 245 species listed in Schedule 6 of Wildlife Conservation and Management Act, 2013, 19 are critically endangered, 45 endangered, 73 vulnerable, 30 near threatened, 3 threatened and 75 are protected.

Of these groups, seven mammals, two birds, seven fish, one insect, one frog and one turtle are critically endangered.



Mammals: Out of the seven mammals that are critically endangered, the black rhino with year 2017 population of **746** has shown increasing population trends. The black rhino is distributed in **10** National Parks, **1** National Reserve, and **7** Community Conservancies.



Birds: The two critically endangered bird species- the Taita Apalis **(200-400 individuals)** and Taita Thrush are facing severe decline in numbers due to the destruction of their habitats and land use change especially in Taita Hills.



Fish: The six fish species are listed as critically endangered four of which are tilapia **(2 in Lake Jipe, 1 in Lake Challa and 1 in Lake Victoria)**. The decline in Victoria Tilapia is attributed to the invasive Nile Perch which was introduced in the lake for commercial purposes in 1957. The other two critically endangered fish species are Rainbow Sheller and deep water Cat fish whose decline is attributed to the invasive Nile Perch predation in Lake Victoria.



Insects: Only one insect, the Montane Dancing Jewel, is listed as critically endangered. This species is found in the riverine forest around the Aberdares and is declining due to loss of its area of occupation.



Frog: The Du Toit's Torrent Frog which is endemic to Mt. Elgon is one of the amphibian listed as critically endangered. The species was last sighted in 1962 and is suspected to have been affected by infectious fungal disease chytridiomycosis.



Turtle: The Hawksbill turtle is the only marine species listed as critically endangered. Its survival is threatened by a host of factors ranging from climate change (affecting sex ratio) to habitat intrusion and over exploitation for both meat and eggs.



Table 1.14: List of Endangered Species in Kenya, 2023

Taxonomic group		CR	EN	VN	NT	T	Protected
Mammals		7	19	36	-	-	-
Birds		2	12	13	30	-	37
Fish		7	4	15	-	-	-
Trees		-	2	6	-	-	-
Insect		1	-	-	-	-	-
Reptiles & Amphipians	Snakes	-	1	1	-	-	10
	Frogs	1	5	1	-	-	7
	Toads	-	-	-	-	1	3
	Tortoise	-	-	-	-	1	-
	Terrapin	-	-	-	-	-	1
	Gecko	-	-	-	-	-	2
	Skinks	-	-	-	-	-	2
	Lizard	-	-	-	-	-	3
	Chameleon	-	-	-	-	-	6
	Turtles	1	2	-	-	1	4
Total		**19**	**45**	**72**	**30**	**3**	**75**

Source: *Kenya wildlife Service*

- CE-critically endangered, EN-endangered, VN-vulnerable-NT-near threatened, T-threatened, Protected

- According to the 7th Schedule of Wildlife Act 2013, the Invasive species are; 1 mammal- coypu found in Lake Naivasha,7 reptiles,17 Birds,10 plants,1 Invertebrates (crown of Thorn). The Nile Perch and Parthenium hysterophorus are not listed.

- Species protection involves conserving the variety of animal and plant species and stopping the loss of biological diversity.

Notes

- Critically endangered (CR) - Extremely high risk of extinction in the wild

- Endangered (EN)---------- High Risk of extinction in the wild

- Not Evaluated (NE)---------Has not yet been evaluated against the criteria

- Extinct (EX)----------No Known individuals remaining

- Extinct in the wil (EW)-----Known only to survive in captivity, or as a naturalized

Population outside its historic range

- Vulnerable (VU)----------High risk of endangerment in the wild

- Near Threatened (NT)-----Likely to become endangered in the near future

- Least concern (LC)--------Lowest risk. Does not qualify for a higher risk category.

- Widespread and abundant taxa are included in this category

- Data Deficient (DD)--Not enough data to make an assessment of its risk of extinction

Protected Areas

A protected area is any portion of land or water that has been outlined as officially controlled privately or by the state with a view to preserve the natural environment and its services such as biodiversity conservation. Land designated as protected areas, include; forests, national parks, national reserves, conservancies, ramsar sites, biosphere reserves and world heritage sites. The number of protected areas in 2022 were 411 covering 13.16 per cent of the total land area. As illustrated in Table 1.15, terrestrial and marine protected areas cover 12.4 per cent and 0.8 per cent of the total area in Kenya, respectively.

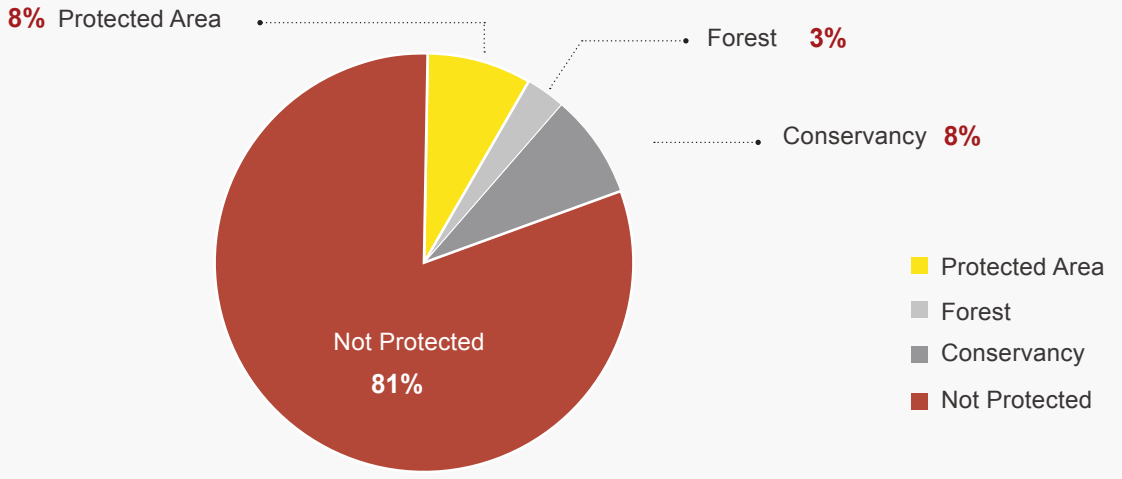
Table 1.15: Protected Terrestrial and Marine Areas as of 2023

Category of area	Unit	Total area
Number of protected areas in Kenya	No.	411
Total terrestrial area	Km^2	586,770
Land Area protected	Km^2	72,544
Percentage area protected	%	12
Total marine area	Km^2	112,400
Marine area protected	Km^2	904
Percentage area protected	%	1

Source: *National Museums of Kenya 2022*

The protected area in Kenya is 8.0 per cent of the total land area. The forest protected area is about 3 per cent whereas area under conservancies is 8 per cent. The total area of land under no protection is 81 per cent.

Figure 1.17: Protected Area as a Percent of Total Land Area



Source: *National Museums of Kenya*

Terrestrial Parks- 24 (distributed in 17 counties) covering 29,504 sq km (5.08% of Kenya). Marine Parks: Malindi (6 sq km), Watamu (10 sq km), Mombasa 26.093 sq km), Kisite (28 sq km).

Terrestrials Reserves- 31 (distributed in 21 counties) covering 17.358 sq km (3% 0f Kenya). Are managed by counties except 4 which are managed by KWS.

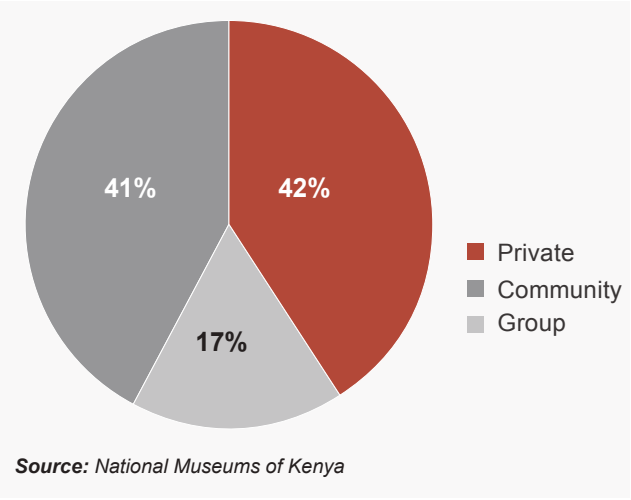
Marine Reserves. Malindi (213 sq km), Watamu (32 sq km), Mombasa (200 sq km), Mpunguti (11 sq km), Kiunga (250 sq km), Diani Chale (165 sq km).

Forest Reserves- 257 sites registered as natural forests:52 as community forests (180245 ha), 201 as Forest reserves (2,045,406ha),3 as national monuments (401ha),1 trustland (188,207ha).

Conservancies. There are 164 conservancies in the country covering an area of 63,600 sq km. 4 are marine,76 are community,58 are private, and 26 are group.

Of the 164 conservancies in the country 60 are listed under the world Database protected Area (WPDA). The largest conservancy in the country is Melako (5467 sq km)in Marsabit County , followed by Malkahalaku (4800 sq km) in Tana River County and then lokichar (4540 sq km) in Turkana County.

Figure 1.18: Conservancy Types



Source: *National Museums of Kenya*

Terrestrial and marine protected areas as a share of total territorial area. The number of protected areas in Kenya is 411. Protected areas embrace various types of ecosystems namely: forests, wetlands, savannah, marine, arid and semi-arid and comprise of 23 terrestrial National Parks, 28 terrestrial National Reserves, 4 marine National Parks, 6 marine National Reserves and 4 national sanctuaries. Kenya terrestrial and marine protected areas as a share of total territorial area was 13.16 per cent in 2017.

Marine protected areas as a share of territorial waters. Marine protected areas are areas of intertidal or subtidal terrain--and overlying water and associated flora and fauna and historical and cultural features--that have been reserved by law or other effective means to protect part or all of the enclosed environment. Kenya marine protected areas as a share of territorial waters 0.8 per cent in 2017.

Ramsar sites. A Ramsar site is a wetland site designated to be of international importance under the Ramsar Convention. The Convention on Wetlands, known as the Ramsar Convention, is an intergovernmental environmental treaty established in 1971 by UNESCO, which came into force in 1975. The convention entered into force in Kenya on 5 October 1990. Kenya currently has 6 sites designated as Wetlands of International Importance (Ramsar Sites), with a surface area of 265,449 hectares.

Table 1.16: Ramsar Sites

Ramsar site	Year established	Area (ha)	Importance
Lake Nakuru	1990	18,880	lesser flamingo
Lake Naivasha	1995	30,000	Red Knobbed Coot
Lake Bogoria	2001	10,700	lesser flamingoes (over 1 million)
Lake Baringo	2002	31,469	oreochromis niloticus baringoensis is endemic
Lake Elementaita	2005	10,880	has 28.5% of the worlds lesser flamingoes
Tana River Delta	2012	163,600	second important estualine & deltaic ecosytems

Source: *NEMA*

Important Bird Areas. In addition to the ramsar there are 63 Importance Birds Areas in Kenya.

Biodiversity Hotspots in Kenya. There are 25 global hotspots in the world 5 of which are found in Kenya. Shimba Hills- Holds more than half of Kenya's rare trees. Three Sisters Cave Complex (15 Km north of Shimoni)- Pangani, Kisimani and Midenyenye- sacred site of the Kaya. It is a non gazetted forest with about 121 species of threatened species (1.9 per cent of Kenya's 6500 flora) and 46 fauna (8.1 per cent of the 1500 species)

Arabuko Sokoke/ Boni- Dodori- last stronghold globally for the critically endangered Aders Duiker. Mt. Kenya- Afro-alpine species that are endemic to Kenya (area covered is about 715 sq km). Mt. Elgon- the forest ecosystem (107821ha)- 22 mammals, 2 insects and 13 bird species of which 9 are endemic

The Nagoya Protocol. It was signed on October 29th of 2010 and entered into force on 12th October 2014. It has been ratified by 112 parties including 111 UN members states and the European Union. Kenya ratified it on 1st of May, 2014.



Table 1.17: National Parks and Reserves

Name	Category	Management	Area (Sq.Km)
Kisite Marine NP	Marine National Park	KWS	28
Mombasa Marine NP	Marine National Park	KWS	26
Watamu Marine NR	Marine National Park	Malindi County	10
Malindi Marine NP	Marine National Park	Malindi County	6
Diani Chale Marine NR	Marine National Reserve	Kwale County	75
Mpunguti Marine NR	Marine National Reserve	Kwale County	11
Kiunga Marine NR	Marine National Reserve	Lamu County	250
Mombasa Marine NR	Marine National Reserve	Mombasa County	200
Watamu Marine NP	Marine National Reserve	KWS	10
Malindi Marine NR	Marine National Reserve	Malindi County	213
Aberdare NP	National Park	KWS	765.7
Amboseli NP	National Park	KWS	392
Arabuko Sokoke NP	National Park	KWS	6
Central Island NP	National Park	KWS	5
Chyulu Hills NP	National Park	KWS	471
Hell's Gate NP	National Park	KWS	68.26
Kora NP	National Park	KWS	1787
Lake Nakuru NP	National Park	KWS	188
Malka Mari NP	National Park	KWS	876
Meru NP	National Park	KWS	870
Mt. Elgon NP	National Park	KWS	169
Mt. Kenya NP	National Park	KWS	715
Mt. Longonot NP	National Park	KWS	52
Ndere Island NP	National Park	KWS	4.2
Nairobi NP	National Park	KWS	117
Oldonyo Sabuk NP	National Park	KWS	18
Ruma NP	National Park	KWS	120
Saiwa Swamp NP	National Park	KWS	2
Sibiloi NP	National Park	KWS	1570
South Island NP	National Park	KWS	150.5
Tsavo West NP	National Park	KWS	9065
Tsavo East NP	National Park	KWS	11747
Proposed Marsabit NP	National Park	KWS	347

Table 1.17: National Parks and Reserves *(continued)*

Name	Category	Management	Area (Sq.Km)
Arawale NR	National Reserve	Garissa County	533
Bisandi NR	National Reserve	Isiolo County	606
Buffalo Springs NR	National Reserve	Isiolo County	131
Chepkitale NR	National Reserve	Bungoma County	178.2
Dodori NR	National Reserve	Lamu County	877
Kisite Marine NP	Marine National Park	KWS	2159.3236
Mombasa Marine NP	Marine National Park	KWS	2224.2317
Watamu Marine NR	Marine National Park	Malindi County	2289.1398
Malindi Marine NP	Marine National Park	Malindi County	2354.0479
Diani Chale Marine NR	Marine National Reserve	Kwale County	2418.956
Mpunguti Marine NR	Marine National Reserve	Kwale County	2483.8642
Kiunga Marine NR	Marine National Reserve	Lamu County	2548.7723
Mt. Kenya NR	National Reserve	Nyeri County	2124
Mwea NR	National Reserve	Embu County	68
Nasolot NR	National Reserve	West Pokot County	92
Mwingi NR	National Reserve	Kitui County	745
Nyambene NR	National Reserve	Isiolo_Meru Couties	640.6
Rahole NR	National Reserve	Garissa County	1270
Samburu NR	National Reserve	Samburu County	165
Shaba NR	National Reserve	Isiolo County	239
Shimba Hills NR	National Reserve	Kwale County	192.51
South Kitui NR	National Reserve	Kitui County	1833
South Turkana NR	National Reserve	Turkana County	1091
Tana River Primate NR	National Reserve	Tana River County	169
Ngai Ndethia NR	National Reserve	Kitui	212
Tsavo Road & Railways NR	National Reserve	KWS	5.27
Marsabit NR	National Reserve	Marsabit	1122
Boni National Reserve	National Reserve	Garissa/Lamu	1339
Kisumu Impala Sanctuary	National Sanctuary	KWS	0.34
Lake Elementaita Wildlife Sanctuary	National Sanctuary	KWS	25.34
L. Simbi Sanctuary	National Sanctuary	Homa Bay	0.42
Maralal Sanctuary	National Sanctuary	Samburu County	5

Table 1.17: National Parks and Reserves *(continued)*

NAME	Category	Management	AREA (Sq.KM)
Mt. Kenya NR	National Reserve	Nyeri County	2124
Mwea NR	National Reserve	Embu County	68
Nasolot NR	National Reserve	West Pokot County	92
Mwingi NR	National Reserve	Kitui County	745
Nyambene NR	National Reserve	Isiolo_Meru Couties	640.6
Rahole NR	National Reserve	Garissa County	1270
Samburu NR	National Reserve	Samburu County	165
Shaba NR	National Reserve	Isiolo County	239
Shimba Hills NR	National Reserve	Kwale County	192.51
South Kitui NR	National Reserve	Kitui County	1833
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Tana River Primate NR	National Reserve	Tana River County	169
Ngai Ndethia NR	National Reserve	Kitui	212
Tsavo Road & Railways NR	National Reserve	KWS	5.27
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Kisumu Impala Sanctuary	National Sanctuary	KWS	0.34
Lake Elementaita Wildlife Sanctuary	National Sanctuary	KWS	25.34
L. Simbi Sanctuary	National Sanctuary	Homa Bay	0.42
Maralal Sanctuary	National Sanctuary	Samburu County	5

Source: *Kenya Wildlife Service*

Elephant Ivory and Rhinoceros Horns.

The total weight of the ivory stockpile held in the country as of 27th August 2017 was 55,883.30 Kg and 419.29 kg for the Rhino horns as shown in Table 1.18. As a symbol of the country's fight against poaching and rendering the stock piles beyond economic use the country destroys elephant ivory and rhino horns through burning.

Table 1.18: Elephant Ivory and Rhinoceros' Horns in KWS Custody

Stock in stores	Elephant ivory (Kg)	Rhino horn (kg)
2015	135,784.00	1,515.90
2016	40,176.15	364.9
2017	55,883.30	419.29

Source: *Kenya Wildlife Service*

Wildlife Population Estimates in the Rangelands

The rangelands of Kenya are critically important for wildlife conservation. Aerial surveys of wildlife in the rangelands have been conducted and these data analysed to determine population trends for the period 2010 to 2023 as shown in Table 1.19 . All wildlife species except Buffalo. Burchels Zebra and elephant showed a decline during the 2010-2019 period. H. Hartbeest and Topi declined by more than half during the same period.



Table 1.19a: Wildlife Population Estimates in the Rangelands '000 Number

SPECIES	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Buffalo	17.5	16.2	15.2	13.0	15.6	15.0	18.7	17.8	19.6	19.1	25.7	35.5	41.7	40.3
Burchell's Zebra	102.0	101.7	100.0	100.3	110.2	100.0	110.0	104.5	108.8	107.5	105.0	119.8	122.4	122.0
Eland	7.9	7.4	6.8	5.8	5.0	4.3	5.6	5.3	5.4	5.6	7.5	11.6	13.5	13.7
Elephant	22.0	20.5	18.5	16.0	15.9	15.8	22.0	20.0	22.0	22.1				
Genenuk	20.2	19.8	18.5	16.0	15.9	15.5	12.0	11.4	10.8	10.7	11.7	13.0	13.4	13.9
Giraffe	24.0	23.0	23.1	19.0	18.9	18.5	18.6	17.0	19.9	18.0	22.3	30.5	34.2	33.6
Grant's Gazzele	112.5	112.7	112.0	111.7	111.9	111.9	112.1	106.5	105.3	103.9	101.0	68.7	66.5	66.8
Grevy's Zebra	3.6	3.4	3.1	3.0	3.0	3.0	2.9	2.6	2.8	2.7	2.6	2.7	3.0	2.7
H. Hartebeest	0.9	0.8	0.8	0.7	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.3	0.1	0.5
Impala	62.6	61.0	60.5	61.8	59.9	59.0	58.0	55.1	48.9	47.5	36.2	26.5	22.2	26.6
Kongoni	8.4	7.8	6.9	5.0	4.9	4.9	5.5	5.2	6.3	6.2	6.5	7.3	6.6	7.3
Kudu	10.5	11.2	11.1	11.0	11.0	11.0	9.9	9.4	8.7	8.6	7.2	4.6	2.5	2.3
Oryx	17.8	16.4	15.2	14.5	14.0	13.9	10.0	9.5	12.3	12.2	12.2	12.0	11.1	11.7
Ostrich	8.0	8.0	8.2	8.5	7.8	7.7	8.4	6.9	7.2	7.1	6.8	6.3	6.0	6.4
Thomsons's Gazzele	47.0	46.0	43.5	42.0	43.4	43.0	42.6	40.5	38.2	38.1	35.0	28.3	18.1	18.2
Topi	23.3	21.0	20.0	20.5	15.3	15.3	14.9	12.0	12.7	11.4	10.8	10.1	9.4	8.6
Warthog	18.6	17.0	18.0	18.4	17.0	16.9	15.2	14.4	13.5	14.0	13.5	12.7	7.7	8.1
Waterbuck	4.0	3.0	2.9	3.5	2.9	2.8	2.7	2.6	2.5	2.4	2.5	1.2	1.2	1.0
Wildebeest	294.6	295.0	288.0	276.0	279.4	265.0	240.0	228.0	289.0	285.0	225.0	148.0	139.8	58.0

Source: *Directorate of Resource Surveys and Remote Sensing*

Table 1.19b: Endangered Wildlife Population Estimates in Kenya, 2016 – 2023

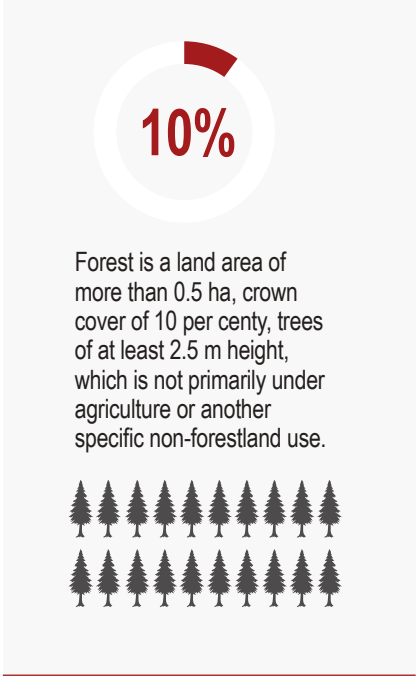
Species	2016	2017	2018	2019	2020	2021	2022	2023
Elephant	35,364	34,214	33,519	34,487	34,125	36,280	36,280	36,280
Black Rhino	678	696	766	794	853	897	963	1,004
White Rhino	441	450	622	645	750	842	922	971
Hirola Antelope	0	0	430	-	475	497	497	497
Mountain Bongo	125	125	125	100	96	150	150	150
Lions	2000	2,000	2,000	2,000	2,489	2,589	2,587	2,587
Roan Antelope	23	16	19	11	15	15	25	18
Sable Antelope	60	60	60	60	51	51	32	36
Spotted hyena	2000-4000	2000-4000	2,000-4,000	2000 - 4000	5,147	5,147	5,147	5,147
Cheetah	1,160	1,160	1,160	1,160	1,160	1,160	1,160	1,160
African wild dog	865	865	865	865	865	865	865	865
Leopard	6000	600	33,519	600	600	600	600	600

Source: *Wildlife Research and Training Institute*



Forests

Forest is a land area of more than 0.5 ha, crown cover of 10 per centy, trees of at least 2.5 m height, which is not primarily under agriculture or another specific non-forestland use. Increased forest cover is one of the Kenya vision 2030. The goal is to increase area under forest to 10 % and sustainably manage natural forest resources for environmental protection and enhanced economic growth.



Distribution and Trends of Forests in Kenya

Deforestation and forest degradation continue to pose significant challenges driven by among others pressure for conversion to agriculture, urbanization and other developments, unsustainable utilization of forest resources, inadequate forest governance and forest fires. The country has been experiencing sharp decline in forest cover and canopy distribution between 2002 -2006 and 2010-2014 as indicated in Table 1.20. With accelerated corrective efforts however, the trend has been changing between 2018- 2023. Worth mentioning also is the fact that the technology deployed for 2021 National forest resource assessment involved high resolution imagery. This is unlike the previous assessments where the assessments were based on low to medium resolution imagery.

Table 1.20: Distribution and Trends of Forests in Kenya

	2002		2006		2010		2014		2018		2023	
land use Strata	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)
Dense Forest	2,057,649	4	2,139,703	4	2,463,674	4	2,558,363	4	2,205,189	4	1,756,715	3
Moderate Forest	1,021,083	2	657,767	1	889,327	2	609,436	1	816,174	1	1,648,860	3
Open Forest	591,035	1	522,508	1	525,469	1	415,061	1	441,173	1	1,820,617	3
Total Forest	**3,669,768**	**6**	**3,319,978**	**6**	**3,878,470**	**7**	**3,582,861**	**6**	**3,462,536**	**6**	**5,226,192**	**9**

Source *:Kenya Forest Service*

Stratification of Forests

The forests are further stratified into four strata as shown on the Table 1.21 which have been adopted for assigning emission factors to different forest types. These are, (Dryland forest areas, Montane & Western Rain forest areas and Coastal & Mangrove forest areas) defined by altitude and climate.

A second level stratification on the three strata based on ecozones (Dryland forest areas, Montane & Western Rain forest areas and Coastal & Mangrove forest areas) was done on the basis of canopy closure. The resultant canopy classes are: 15-40 % (Open), 40-65 % (Moderate), and above 65 % (Dense).

Table 1.21: The Resultant Canopy Classes

Land Category	First level stratification	Second level stratification
Forest	Montane/western rainforest/bamboo	Dense (canopy cover ≥65%) Moderate (Canopy cover 40-65%) Open (Canopy cover 15-40%)
	Coastal and Mangrove forests	Dense (canopy cover ≥65%) Moderate (Canopy cover 40-65%) Open (Canopy cover 15-40%)
	Dryland forest	Dense (canopy cover ≥65%) Moderate (Canopy cover 40-65%) Open (Canopy cover 15-40%)
	Plantation forest	Plantation forest
Non forest	Cropland Grassland Wetland Settlement and Other lands	

Source: *Kenya Forest Service*

Sale of forest products is as shown in the Table 1.22.

Table 1.22: Recorded Sale of Government Forest Products , 2015-2023 ('000 Ha)

Forest Stocking	2015	2016	2017	2018	2019	2020	2021	2022	2023
Timber - '000 true cu. Meters									
Soft Wood	621.1	966.4	798.4	30.9	1.5	44.1	7.9	4.2	148.5
Hard Wood	12.4	70.9	83.4	113.3	9.2	35.9	26.3	33.6	10.9
Total	**633.5**	**1037.3**	**881.8**	**144.2**	**10.7**	**80**	**34.2**	**37.8**	**159.4**
Fuelwood/Charcoal ('000 stacked cu.metres)	43.7	147.2	53.7	9.6	2.1	4.1	10.5	15.5	35.9
Power Poles ('000s)…	34.5	23	34.2	29.2	13.2	18.1	0	0	0

Source: *Kenya Forest Service*

National Forest Resource Assessment 2023

Details of government forest plantation stocking from 2017 to 2023 are presented in the Table 1.23.

Table 1.23: Government Forest Plantation Stocking, 2017 – 2023 ('000 Ha)

Forest Stocking	2017	2018	2019	2020	2021	2022	2023
Previous Year Stcoked Plantation Area1	131.4	135.1	137.0	141.1	142.9	143.9	144.0
New Area planted (Ha)	11.0	4.6	5.3	4.1	1.1	1.2	2.4
Gross Stcoked Plantation Area (Ha)	142.4	139.7	142.3	145.2	144.0	145.1	146.4
Area clear felled (Ha)	5.2	0.9	0	0	0	0	1.5
Planting failures /fire damages (Ha)	2.1	1.8	1.2	2.3	0.2	1.1	0.1
Total Reduction (Ha)	-	2.7	1.2	2.3	0.1	1.1	1.6
Total Area	**135.1**	**137.0**	**141.1**	**142.9**	**143.9**	**144.0**	**144.8**

Source: *Kenya Forest Service*

Forest Cover

Mapping was done using satellite images that had the following properties; spatial resolution of 0.5m, Ortho-rectified, WGS 84 datum (EPSG 4326) and RMSE accuracy 3.914m. The satellite images were captured between 2019 to 2021. Forest land was derived from the tree cover by subjecting the classification to the area parameter of forest definition. This was achieved by computing the area of the tree cover blocks (groupings) and later eliminating those with an area of less than 0.5ha. This grouping was irrespective of the tenure system in Kenya.

In line with the current forest resource assessment methodology, there was a departure from the normal segregation of statistics under indigenous mixed trees, Bamboo and Mangrove. An adoption of new grouping based on forest density was been done namely Dense, Moderate and Open Forest & this covers plantations.

Forest resources cover 4.23 million hectares (ha) of the total land area as presented in Table 1.24. Natural forests comprising of indigeneous mixed trees, bambo and mangoves cover 4.03 million ha (95.5 per cent) of the forestland, while plantations forests cover 196.6 thousand hectares comprising of 149.6 thousand hectares of public plantation forests and 47.0 thousand hectares of private plantation forests, respectively.



144.80
Thousand hectares
Total area under state forest plantation increased from 144.0 thousand hectares in 2022 to 144.80 thousand hectares in 2023.



2.4
Thousand hectares
Area planted during period under review was 2.4 thousand hectares, an increase from the 1.2 thousand hectares realized in 2022.

4.23
Million hectares
Forest resources cover 4.23 million hectares (ha) of the total land area

Table 1.24: Forest Cover by Type of Forest ('000 ha)

Category of Forest Type	2017	2018	2019	2020	Forest Canopy Density(2021)	2021	2022	2023
Natural Forests								
Indigenous mixed trees	3,925.0	3,925.0	3,925.0	3,925.0	Of which Dense Forest	1756.70	1756.70	1756.70
Bamboo	59.0	59.0	59.0	59.0	Of which Moderate Forest	1,648.90	1,648.90	1,648.90
Mangroves	49.0	49.0	49.0	49.0	Of which Open Forest	1,820.60	1,820.60	1,820.60
Sub Total (Natural Forest)	**4,033.0**	**4,033.0**	**4,033.0**	**4,033.0**	**Sub Total Forest Area**	**5,226.20**	**5,226.20**	**5,226.20**
Public Plantations	135.1	141.6	147.6	149.6				
Private Plantation	47.0	47.0	47.0	47.0				
Total Forest Area	**4,215.1**	**4,221.6**	**4,227.6**	**4,229.6**	**Total Forest Area**	**5,226.20**	**5,226.20**	**5,226.20**
Grassland & Bush land	41,100.0	41,100.0	41,100.0	41,100.0	Grassland & Bush land	41,647.60	41,647.60	41,647.60
Total Area for Country	59,196.9	59,196.9	59,196.9	59,196.9	Total Area for country	59,196.90	59,196.90	59,196.90
Forest %	**7.12**	**7.13**	**7.14**	**7.14**		**8.83**	**8.83**	**8.83**

Source: *Kenya Forest Service*



Table 1.25: National Tree Cover, 2023

National Tree Cover (Ha.)	Total Area of Country (Ha.)	% Cover
7,180,000.66	59,196,877.24	12.13%

Source: *Kenya Forest Service*

Table 1.26: Forest Cover by Counties

County	Forest Area(ha)	Total area (ha)	% of Forest cover	County	Forest Area(ha)	Total area (ha)	% of Forest cover
Baringo	274,157	1,091,197	25.1	Mandera	78,914	2,598,251	3.0
Bomet	33,927	267,196	12.7	Marsabit	129,396	7,602,995	1.7
Bungoma	45,049	303,123	14.9	Meru	128,028	699,038	18.3
Busia	1,848	182,336	1.0	Migori	2,029	316,458	0.6
Elgeyo Marakwet	113,145	301,805	37.5	Mombasa	1,462	28,566	5.1
Embu	26,242	282,315	9.3	Murangá	36,729	252,651	14.5
Garissa	309,264	4,359,107	7.1	Nairobi	5,506	70,806	7.8
Homa Bay	12,334	475,925	2.6	Nakuru	69,563	748,920	9.3
Isiolo	135,626	2,538,173	5.3	Nandi	47,810	284,655	16.8
Kajiado	156,260	2,189,803	7.1	Narok	298,828	1,794,207	16.7
Kakamega	29,656	302,246	9.8	Nyamira	6,568	90,905	7.2
Kericho	54,150	229,962	23.5	Nyandarua	60,310	327,034	18.4
Kiambu	42,118	254,473	16.6	Nyeri	126,883	333,623	38.0
Kilifi	96,115	1,252,382	7.7	Samburu	269,325	2,102,371	12.8
Kirinyaga	30,515	147,530	20.7	Siaya	1,480	354,212	0.4
Kisii	3,456	132,112	2.6	Taita Taveta	62,113	1,711,824	3.6
Kisumu	1,184	2,677,694	0.4	Tharaka Nithi	50,066	258,007	19.4
Kitui	215,340	3,043,650	7.1	Transzoia	40,241	249,526	16.1
Kwale	44,984	826,391	5.4	Turkana	285,962	7,035,330	4.1
Laikipia	64,794	954,386	6.8	Uasin Gishu	25,714	340,711	7.5
Lamu	209,674	618,507	33.9	Vihiga	5,501	56,300	9.8
Machakos	20,218	604,411	3.4	Wajir	110,144	5,664,861	1.9
Makueni	106,746	817,225	13.1	West Pokot	78,357	933,689	8.4

Source: *Kenya Forest Service*

Table 1.27 presents the progress made towards achievements of sustainable forest management in Kenya. Forest area (% of land area) in Kenya was 7.28 per cent in 2018 from 6.96 per cent in 2000 due to good forest management. Annual change rate of total forest cover refers to the average variation in hectares per year calculated over 5, 10 and 15 years of the total forest area. Between 2000 and 2010, Kenya lost an average of 0.91 per cent per year of forest land. This loss declined to a loss of 0.52 per cent between 2010 and 2015. However, between 2015 and 2017 the country gained an average of 0.83 per cent of forest land. Likewise, the proportion of forest area within legally established protected area has also remained at 33.46 per cent while the proportion of forest area under Long Term Forest Management Plan has remained at 4.34 per cent since year 2000

Table 1.27: Indicators of Sustainable Forest Management

	2000	2010	2015	2016	2017	2018
Forest area as proportion of total land area	6.96	6.99	7.16	7.21	7.28	7.28
Proportion of forest area located within legally established protected areas (2015 forest area baseline)	32.72	32.51	33.32	33.36	33.41	33.46
Proportion of forest area under long term forest management plan (2015 forest area baseline)	4.34	4.34	4.34	4.34	4.34	4.34
	2000-2010	**2010-2015**	**2015-2016**	**2016-2017**	**2017-2018**	**2018-2019**
Forest area annual net change rate	-0.91	-0.52	0.83	0.83	0.82	0

Source: *Kenya Forest Service*

1.3. Environmental Quality

Environment quality refers to the varied characteristics such as air and water purity or pollution, noise, access to open space and the visual effects of buildings and the potential effects. Environmental quality deals with the concentration of pollutants in the environment which results from combined and cumulative impacts of human and natural processes. Statistics on environmental quality are important in monitoring pollution impacts to human sub-system and ecosystems.

1.3.1. Air Quality

Concentration of air pollutants, suspended solid particles, and other gases are the statistics compiled for this subcomponent. Air quality is measured by monitoring stations which are located mostly near the major sources of pollution. Compilation of these statistics is important to assess the effects of air quality to human and ecosystem health. Kenya like most developing countries, is experiencing high rate of motorization. Currently, transport emissions account for approximately 13 per cent of total national emissions.

Vehicular average carbon dioxide emissions data for selected car models are shown in Table 1.28. High emissions vehicles are the Landrover, lexus and Jaguar at 262.69, 244.72 and 220.29 g/km.



Table 1.28: Average Carbon Dioxide Emissions by Vehicle Fuel Consumption

Vehicle	Average fuel consumption (L/100KM)	Average CO2 emission (g/km)
Lexus	10.36	244.72
Land Rover	10.32	262.69
Jaguar	9.18	220.29
BMW	8.8	215.89
Audi	8.17	205.56
Suzuki	8.15	199.07
Volkswagen	8.14	200.85
Mitsubishi	7.95	191.26
Nissan	7.63	186.99
Mazda	7.59	182.11
Subaru	7.59	180.07
Honda	7.51	176.21
Mercedes Benz	7.46	180.93
GM Chevrolet	7.41	178.42
Toyota	7.32	174.71
Peugeot	6.79	161.59
GM Opel Astra	5.57	137.72
Grand Average	**7.5**	**181.7**

Source: *NEMA/ ERC*

1.3.2. Water Quality

Table 1.29 depicts the Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) of raw effluent by sectors. The higher the BOD value, the greater the amount of organic matter or food available for oxygen consuming bacterias. The COD test is used as an alternative to BOD due to the shorter length of testing time. Sectors with high pollutant discharge load includes the poultry manure, pig sty slurry, industry, cofee pulping, and paper and pulp.

Table 1.29: Pollutant Discharge Load by Sector

Pollution Source	Typical BOD Level of Raw Effluent, mg/l	Typical COD Level of Raw Effluent, mg/l
Industry	1 500 – 22,000	2 000 – 35 000
Coffee Pulping	3 000 – 9 000	3 000 – 28 000
Textile	1 500	3 300
Leather Tanning	1 500	5 000
Paper and Pulp	1 500 -7 000	2 000 – 10 000
Slaughter House	1 400	2 100
Fruit Canning	2 000	3 500 – 6 500
Milk Processing	1 000	1 900
Domestic Waste	500	2 200
Agriculture	8 00 – 1 200	1 000 – 2 000
Cattle Pen washings	1 500	2 000
Pig Sty Slurry	15 000	2 500
Poultry Manure	30 000	2 800

Source: *Water Resources Authority (2022)*



Major Rivers Water Quality Status

Major rivers include Tana (800 km), Athi/Galana/Sabaki (530 km), Ewaso-Ngiro-North (520 km), Kerio (350 km), Suam-Turkwel (350 km), Mara (280 km), Nzoia (240 km), Voi (200 km), Yala (170 km), Ewaso-Ngiro-South (140 km), Sondu (105 km), Malewa (105 km) and Kuja (80 km).

The maximum,minimum and average (mean) values of different water quality river parameters are indicated in the Table 1.30. Values above average (mean) shows a higher pollution level. The mean, maximum and minimum values have been indicated to show the analysis for the years of data collection he average. Since the ambient water standards have not been developed, no values can be used to conclude if the water quality parameters are below or above permissible levels.

Table 1.30: The Maximum and Minimum Values of Different Water Quality Parameters

Rivers	Range	Temp (°C)	pH (scale 0-14)	DO (mg/l)	Turbid-ity	Iron (mg/l)	Mn	Cond	T. Hard	PO4	Ca	F	Ni-trate	Nitrite
Malewa	Average	19.4	7.06	6.142	37.6	0.7	8.8	107.2	58.3	0.78	13.8		19.5	-
	Minimum	12.3	5.9	5.35	3.3	0	0.06	21	6	0	0.6	0.01	0	-
	Maximum	24.5	8.8	6.92	365	2.83	35	407	1211	2.2	44.8	2.8	412	-
Chania	Average	18.1	8.2	4.4	32.8	-	-	88.5	-	-	-	-	3.32	-
	Minimum	10	6.3	1.56	1.4	-	-	17.3	-	-	-	-	0.8	-
	Maximum	22.8	10.08	9.06	156	-	-	194	-	-	-	-	8	-
Sagana	Average	19.6	8.5	5.3	34.8	-	-	264.4	-	-	-	-	2.01	-
	Minimum	15.6	6.3	1.63	3.4	-	-	67.8	-	-	-	-	0.8	-
	Maximum	26.4	12.4	11.32	187	-	-	989	-	-	-	-	5.5	-
Athi River at Munyu	Average	7.9	76.4	-	-	-	-	486.7	-	-	-	-	1.1	-
	Minimum	7.3	5	-	-	-	-	166	-	-	-	-	0.02	-
	Maximum	8.3	327	-	-	-	-	935	-	-	-	-	5	-
Athi River at Baricho	Average	8.3	596.2	-	-	-	-	0.09	-	-	-	-	2.55	-
	Minimum	6.2	101.5	-	-	-	-	0.01	-	-	-	-	0.28	-
	Maximum	9.3	2033	-	-	-	-	0.16	-	-	-	-	5	-
Nyando River	Average	7.4	556.8	-	-	-	-	170.9	-	-	-	-	0.46	-
	Minimum	5.4	8.21	-	-	-	-	130	-	-	-	-	0.01	-
	Maximum	8.5	2708	-	-	-	-	340	-	-	-	-	1	-
Nzoia River	Average	7.8	-	-	4.44	-	-	258.8	-	-	-	-	0.35	-
	Minimum	7.2	-	-	4	-	-	126.8	-	-	-	-	0	-
	Maximum	8.5	-	-	5.2	-	-	575	-	-	-	-	1.4	-
Ewason-giro River	Average	0.35	7.8	-	4.44	-	-	258.9	-	-	-	-	2.7	0.006
	Minimum	0	7.2	-	4	-	-	126.8	-	-	-	-	0	0
	Maximum	1.4	8.5	-	5.2	-	-	575	-	-	-	-	13.5	0.012
Nyando River	Average	-	7.4	-	556.8	-	-	170.98	-	-	-	-	0.45	-
	Minimum	-	5.4	-	8.2	-	-	130	-	-	-	-	0.01	-
	Maximum	-	8.5	-	2708	-	-	340	-	-	-	-	1	-

Source: *Water Resource Authority*

Malewa River.The range value for Dissolves oxygen which a pollution indicator parameter was 5.35 – 6.92 and and a PH of 5.9 – 8.8 for Malewa river.

The Baricho monitoring point is at the delta zone of Athi river as it enters the Indian ocean. The PH recorded is really high at 9.3 with a conductivity of 2033µS this an indicator of high dissolved solid which are making the water more alkaline, which are contributed by sea water flow backs to the river. The nitrates and the conductivity recorded very high with the three years of analysis, though the PH was within the expected range of 7.2-8.5. The high nutrients maybe associated with runoff from agricultural farms. Generally, the water quality for Ewasogiro is not poor in reference to these parameters.

Table 1.31: The Maximum and Minimum Values of Different Water Quality Parameters for Tana River

Station_ID	Station Name	Date & Time Sampled	Temp	pH	DO	Turbidity	Cond	Nitrate (NO_3)
4F13	Tana Grand Falls	3/23/2012 12:55	-	7.38	-	60.1	121.8	-
4F13	Tana Grand Falls	5/18/2012 9:32	26.6	7.31	7.98	-	105.8	-
4F13	Tana Grand Falls	4/10/2012 09:30:00Hrs	24.3	7.35	3.55	-	118	-
4F13	Tana Grand Falls	17/04/2013 15:15:00Hrs	27.7	6.11	0	-	95.7	-
4BE10	Tana Rukanga	4/16/2013 0:00	17.9	6.8	6.1	342	55.2	-
4F13	Tana Grand Falls	10/05/2013 09:30:00Hrs	26.6	7.35	3.55	-	108	-
4F13	Tana Grand Falls	19/03/2014 14:40:00AM	28.3	6.25	3.27	-	125.4	-
4G01	Tana river at Garissa Bridge	26-11-015 11:20:00	32.3±0.9 (n=3)	7.1±0.01 (n=3)	0.085±0.1 (n=3)	885.7±3.79 (n=3)	157.1±3.6 (n=3)	-
	Tana river at Korakora Water Treatment Plant	12/8/2015 0:00	35.5	7.14	0.69	596±1.0 (n=3)	178.2	-
4G01	Tana river at Garissa	18-03-016 09:20:00	34.6±0.3 (n=3)	7.7±0.01 (n=3)	0.085±0.1 (n=3)	230.7±1.4 (n=3)	138.7±1.2 (n=3)	-
4G01	Tana River at Garissa		28.7	7.62	-	258	164	-
4G01	Tana River 4G01	6/4/2020 0:00	25.3	8.2	-	-	396	-
Misc	Tana River 8.5km U/S of 4G01	6/5/2020 0:00	24	7.4	-	-	196.2	-
Misc	Tana River 10km D/S of 4G01	6/6/2020 0:00	25	7.4	-	-	-	-

Source: *Water Resource Authority*

1.3.3.Conclusion

This first chapter dealt with information on the physical, biological, and chemical characteristics of the environment and their changes over time. Many of these natural conditions change very slowly as a result of natural processes or human influence. Others may show immediate and dramatic effects. The source of the data is usually remote sensing and monitoring by environmental, meteorological, hydrological, geological, and geographical authorities or institutions for example the Water Resources Authority, the National Environment Management Authority,Kenya forest service, Directorate of Resource Surveys and Remote Sensing, Kenya Wildlife Service and the Kenya Meteorological Department. The second chapter will gather statiitsics on environmental resources and their use.



02

ENVIRONMENTAL RESOURCES AND USE

2.0. Introduction

Environmental resources and their use, groups statistics related to the availability and use of environmental resources. Environmental resources and their use focus on measuring stocks and changes in stocks of these resources and their use for production and consumption. They include natural resources, such as subsoil resources (mineral and energy), biological resources and water resources, and land.

2.1. Mineral Resources

Mineral resources represent a unique type of environmental asset which can be extracted and used in economic activity but cannot be renewed on any human time scale. There is therefore particular interest in understanding the rate at which these assets are extracted and depleted, the overall availability of these assets, and the sustainability of the industries that exploit them.

Kenya has various mineral resources on the surface and in the subsoil. These include metallic minerals such as gold, titanium and iron ore.; gemstones such as ruby, garnet and sapphire; industrial minerals such as kaolin, soda ash, phosphate, lime, gypsum, diatomite, bentonite, vermiculite, salt and beach sand; building materials such as stone aggregates and sand; and energy minerals such as coal.

2.1.1. Mineral Occurrences

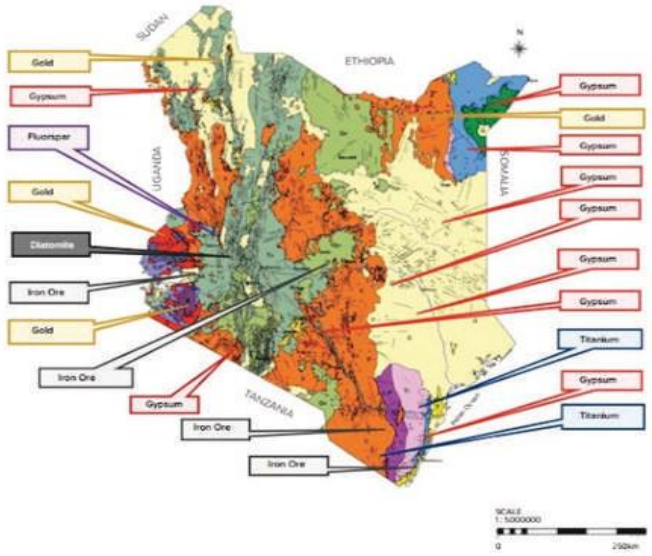
Kenya remains a green field with much of its mineral stock potential unquantified; however, registered mineral occurrences are in the following locations as illustrated in Table 2.1 and Figure 2.1. Table 2.2 further depicts the occurence, stocks and value of key minerals in the country.

Table 2.1: Occurrences of Minerals

County	Minerals
Kajiado	Soda Ash, Feldspar, Limestone Gypsum, Gemstones, Marble & Granite(dimension stone)
Uasin Gishu	Carbon Dioxide Gas
Elgeyo Marakwet	Fluorspar
Baringo	Gemstones (Baringo Ruby), Diatomite
Nakuru	Diatomite
Turkana	Gold, Gemstones, Gypsum
West Pokot	Gold, Gemstones, Chromite
Samburu	Gold, Gemstones, Manganese, Chromite, Vermiculite
Narok (Transmara)	Gold
Nandi (Kibigori)	Gold
Kakamega	Gold, Dimension stone
Siaya	Gold, Iron Ore
Migori	Gold, Copper
Homa Bay	Iron Ore, Gold
Kiambu	Carbon Dioxide, Diatomite
Machakos	Gypsum, Pozzolana
Kitui	Coal, Iron Ore, Copper, Gemstones, Limestone, Magnetite
Makueni	Vermiculite, Gemstones
Tharaka Nithi	Iron Ore, Gemstones
Isiolo	Gemstones
Marsabit	Gold, Gemstones, Manganese, Chromite
Taita Taveta	Iron Ore, Gemstones, Manganese, Graphite
Kwale	Gemstones, Heavy Mineral sands (titanium minerals), Silica Sand, Rare Earth Elements, Niobium
Kilifi	Titanium Minerals, Manganese, Barytes, Gypsum, Gemstones
Tana River	Gypsum
Garissa	Gypsum
Mandera	Gypsum

Source: *State Department for Mining*

Figure 2.1: Mineral Occurence



Source: *State Department for Mining*

Table 2.2: Key Mineral Stocks

Mineral Name	Occurrence (Where Found)	Estimated Quantity and or Grade	Estimated Value (Ksh)
Precious and Base Metals (Gold, Copper, Zinc)	Migori, Homa-bay, Kisumu, Siaya, Vihiga, Kitui, Kakamega, Busia, Nandi, Narok, Turkana, West Pokot, and Kwale	10 Metric Tonnes	40 Billion/ Year
Niobium and Rare Earth Elements	Mrima Hills in Kwale County	100 Million Metric Tonnes of Niobium Oxide (Grade 0.7% - 0.8%) 110 Million Tonnes of Rare Earth Oxide Grade 3.1%	Over 1 Trillion
Industrial Minerals (Gypsum, Limestone, Silica sand and Clay)	Homa Bay, Kisumu, Kericho, Kitui, Machakos, West Pokot, Mandera, Marsabit, Isiolo, Wajir, Taita Taveta, Kilifi, Kwale and Elgeyo Marakwet, Garissa, Tana River, Kajiado		50 Billion/ Year
Coal	Kitui, Kilifi and Kwale Counties	1.5 Billion Tonnes MT Mui Basin alone: a) The calorific value of 18 MJ/Kg	50 Billion/ Year
Dimension stones (Granite and Marble)	Meru, Isiolo, Muranga, Nyeri, Kiambu, Nairobi, Homabay, Kericho, Mandera, Vihiga, Kajiado, Kisumu counties	Good quality	10 Billion/ Yea
Agro- Minerals (Apatite, Guano, Limestone, Magnetite, zeolites, Rock phosphate and Vermiculite)	Kwale, Mombasa, Kilifi, Tana River, Kitui, Nakuru, Narok, Nyandarua, Kisumu, Homabay, Bungoma counties	Good quality	10 Billion/ Year
Titanium Minerals (Rutile, Zircon and Ilmenite)	Kwale, Kilifi and Tana River Counties	Total Heavy Mineral content: Kwale ~2.1-5.7% Vipingo ~2% Mambrui ~3.7% Kilifi ~3%	400 Billion Overall
Radio-active Minerals (Uranium and Thorium)	Homabay, Kisumu and Kwale counties	Mineral grades: Uranium ~ 463-507 ppm Thorium ~ 23-26 ppm	50 Billion/ Year

Source: *State Department for Mining*

2.1.2. Extraction of Minerals

Mineral resources are not renewable so their depletion reduces their availability in the environment over time. The scale of their extraction can determine the amount of stress placed on the environment. The quantities and corresponding values of various minerals are shown in Table 2.3. Table 2.4 shows the quantity of mineral exports for the period 2020 to 2023.

Table 2.3: Quantity of Main Mineral Production, 2011 – 2023

								Gemstones		Titanium Ore Minerals		
Mineral	Soda Ash (tons)	Fluor-spar (tons)	Salt (Crude) (tons)	Crushed Refined Soda. (tons)	Carbon Dioxide (tons)	Diatomite (tons)	Gold (in Kgs)	cut in '000 carrats	rough (tons)	Illmenite (tons)	Rutile (tons)	Zircon (tons)
2011	499,052	95,051	24,639	1,054,236	15,197	2,039	1,600	-	310	-	-	-
2012	449,269	91,000	9,980	882,801	19,919	1,746	3,600	-	121	-	-	-
2013	468,215	71,987	8,895	947,074	18,436	1,054	2,100	-	563	-	-	-
2014	409,845	97,156	18,936	851,906	19,450	1,195	240	-	247	281,543	52,465	40,123
2015	319,761	70,096	21,201	614,055	19,750	1,090	337	471	442	444,999	78,947	25,951
2016	301,719	42,656	23,425	741,000	15,493	1,238	197	5,466	518	359,885	69,975	27,671
2017	311,000	6,945	43,245	538,952	11,855	1,406	503	22,955	1,248	491,003	87,167	65,324
2018	339,025	-	28,841	511,977	11,000	1,548	472	14,500	509	463,000	98,132	36,604
2019	230,355	-	13,728	388,460	11,111	921	395	19,796	404	352,000	85,796	48,356
2020	254,579	-	4,703	159,554	16,257	928	150	5,187	56	334,900	72,836	32,224
2021	283,620.6		7,098.9	418,657.0	21,127.4	763.4	291.5	7,398.7	441.9	345,000.0	69,844.0	25,928.0
2022	321,779.0		23,214.5	586,755.2	18,156.7	1,400.8	563.6	12,844.5	1,523.1	188,000.0	163,242.0	90,698.0
2023	240,784.0		55,090.6	483,981.0	15,319.4	770.4	410.0	6,944.2	428.7	192,000.0	67,604.0	21,094.0

Source: *State Department for Mining*



Table 2.4: Quantity and Value of Mineral Exports, 2020-2023

Mineral Export Sales Summary 2022	2020		2021		2022		2023	
	2020		2021		2022		2023	
Mineral	Quantity (Tonnes)	Value in USD	Quantity (Tonnes)	Quantity (Tonnes)	Quantity (Tonnes)	Value in USD	Quantity (Tonnes)	Value in USD
Mineral Sands								
Ilmenite	334,900.00	66,234,180.00	345,000.00	92,596,471.00	188,000.00	62,526,000.00		7,813.3
Rutile	72,836.00	88,044,487.08	69,884.00	102,710,607.56	163,242.00	159,407,250.94	67,604.00	11,341.7
Zircon	32,224.00	40,600,964.59	25,928.00	38,448,133.58	90,698.00	75,291,568.74	21,094.00	5,063.9
Soda Ash & Crushed Refined Soda	242,055.75	3,095,493.99	283,620.63	66,944,517.40	271,494.00	91,519,648.09		
Gold (Kgs)	149.9	6,851,049.95	291.5	13,138,586.49	563.6	28,769,917.60	410.0	3,179.9
Gemstones								
Cut (Carats)	5,186.72	917,020.32	7,398.68	1,590,028.87	12,844.19	1,821,998.42	6,944.2	1,810,200.63
Rough	55.6	1,657,358.88	441.85	4,344,715.25	1,523.06	3,377,807.21	428.7	516.3
Copper	342	101,207.23	1,366.90	398,700.00	5,042.74	1,452,014.20		
Manganese	27,461.00	1,350,870.00	69,237.00	3,315,754.31	33,270.50	1,530,473.08		
Iron Ore	54,000.02	3,154,240.00	106,000.00	8,096,760.00				
Lead					54,000.00	10,800.00		
Salt	4,702.7	5.9	178,924.98	23,271,399.26	385,737.49	45,952,026.20	55,090.6	17.0
Limestone	16,000.00	96,000.00	12,854.70	1,742,614.47	111,436.87	4,568,773.64		
Gravel					383.5	4,166.47		
Gypsum	1,500.00	16,933.21	41,256.00	1,280,853.26	62,486.00	1,248,998.84		
Quartz					157	14,540.00		
Ramming Mass			107	16,040.00	357	51,090.00		
Sodium Silicate			924	294,420.00	2,400.12	987,290.00		
Vermiculite			400.01	34,965.00	446.6	66,572.00		
Alumina Clays	22,000.00	330,000.00						
Kaolin			364	48,613.56	1,026.00	147,345.00		
Mica	25	1,980.00						
Diatomite	928.1	(55.0) 17,300.00	763.4	45.2	1,400.8	(105.0) 25,224.00	770.4	51.8
Soapstone	238.05	593,185.74	343.07	414,442.67	433.12	550,719.29	948.9	72.8
Carbon dioxide	16,256.5	455.2	21,127.4	(225.4) 1,042,082.00	18,156.66	(193.7) 5,832,684.45	15,319.4	715.7
Total		**253,062,271.00**		**359,589,704.67**		**484,922,908.17**		

Source: *State Department for Mining*

2.2. Energy Resources

Energy resources are all forms of fuels used in the modern world, either for heating, generation of electrical energy, or for other forms of energy conversion processes. Energy can be produced from non-renewable (including fossil fuels, peat, uranium, and thorium ones) or renewable sources (including solar, hydroelectric, geothermal, marine and wind energy). Statistics on the production and consumption of energy are required to assist in sustainable energy management. Kenya is endowed with significant amount of renewable and non renewable energy resources. Renewable energy resources include: hydropower, geothermal, biomass, solar and wind while non renewable resources as shown in Table 2.5.

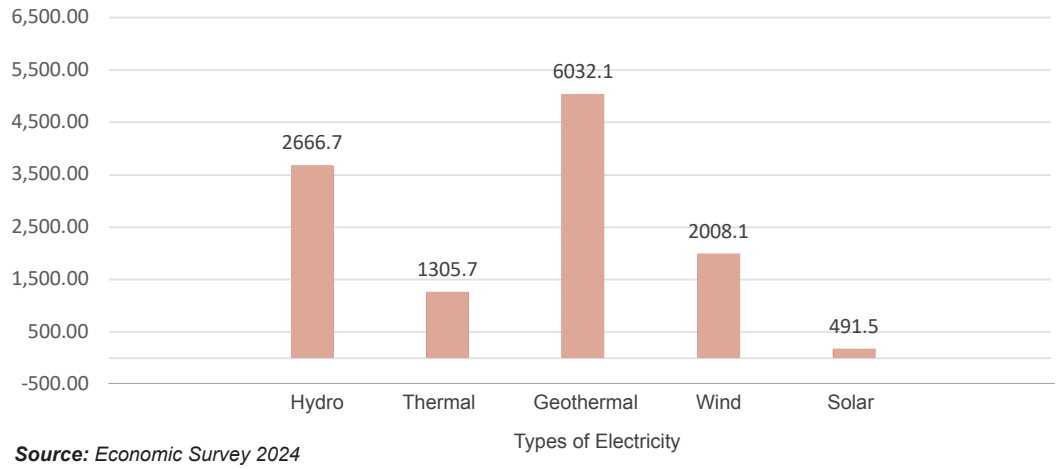
Table 2.5: Electricity Generation by Fuel Type, 2011-2023 in GWh

Type	Hydro	Thermal	Geothermal	Wind	Solar	Total
2011	3,217.20	2,800.50	1,443.70	-	-	7,461.40
2012	3,976.80	2,200.40	1,515.90	-	-	7,693.10
2013	4,386.00	2,161.70	1,780.90	-	-	8,328.60
2014	3,410.60	2,585.20	2,917.40	17	-	8,930.20
2015	3,463.30	1,412.10	4,520.70	59.7	-	9,455.80
2016	3,959.90	1,470.90	4,484.20	56.4	-	9,971.40
2017	2,776.80	2,534.10	4,756.30	61.30	-	10,128.50
2018	3,986.40	1,545.80	5,127.80	375.60	13.68	110,349.28
2019	3,205.30	1,313.30	5,234.70	1,562.70	92.30	11,408.30
2020	4,233.00	754.50	5,059.80	1,331.40	88.40	11,467.10
2021	3,675.00	1,262.00	5,037.00	1,984.80	167.40	12,126.20
2022	3,039.90	1,584.90	5,517.50	2,143.00	383.70	12669.00
2023	2,666.70	1,305.70	6,032.10	2,008.10	491.50	12504.10

Source: *State Department for Energy*

Electricity supply is predominantly sourced from geothermal, hydro and solar/wind and fossil fuel (thermal) sources. This generation energy mix comprises 48.2 per cent geothermal, 21.3 per cent from hydro, 14.5 per cent from solar 3.9 per cent ,wind from 16.1 per cent and 10.4 per cent from fossil fuel (thermal) sources, respectively, as illustrated in Figure 2.1.

Figure 2.2: Electricity Generation by Source, 2023



Source: *Economic Survey 2024*

2.3. Biological Resources

These are genetic resources, organisms or parts thereof, populations, or any other biotic component of ecosystems that have actual or potential value or use to humanity.

2.3.1. Aquatic Resources

Kenya is endowed with both marine and inland water resources.Table 2.6(a) and (b) shows the quantity and value of fish resources in the country.The inland water sources include lakes, dams and rivers of varying sizes while Indian Ocean is the source for marine fish resources.



Table 2.6(a): Quantity of Fish Landed, 2015 – 2023

	Quantity (Tonne)							
	2015	2016	2018	2019	2020	2021	2022	2023*
Fresh Water Fish								
Lake Victoria	109,902.0	98,666.0	98,150.0	90,743.0	88,223.0	94,349.0	86,394.0	70,313.0
Lake Turkana	10,605.0	7,926.0	7,587.0	7,031.0	13,190.0	15,644.0	17,251.0	15,899.0
Lake Naivasha - Commercial	1,072.0	1,064.0	2,287.0	3,087.0	2,216.0	1,804.0	2,190.0	1,140.0
Lake Baringo	176.0	141.0	145.0	203.0	162.0	406.0	442.0	420.0
Lake Jipe	23.0	106.0	131.0	157.0	197.0	227.0	280.0	282.0
Lake Kanyaboli	132.0	110.0	203.0	300.0	264.0	286	387	84.3
Lake Kenyatta	53.0	30.0	14.0	140.0	167.0	68.0	150.0	192.4
Tana River Dams	852.0	444.0	297.0	394.0	283.0	197.0	210.0	226.0
Tana River Delta	56.0	30.0	46.0	94.0	63.0	135.0	129.0	132.0
Aquaculture/fish farming	18,656.0	14,952.0	15,120.0	18,542.0	19,945.0	20,973.0	27,833.0	31,655.0
Turkwel Dam	60.0	39.0	34.0	50.0	107.0	98.0	100.0	93.4
Riverline	11.0	5.0	320.0	380.0	411.0	393	401	486
Small Dams			339.0	459.0	358.0	380.0	374.0	434.0
Total	**141,698.0**	**123,513.0**	**124,673.0**	**121,580.0**	**125,586.0**	**134,960.0**	**136,141.0**	**121,357.1**
Marine Fish by County:								
Lamu	6,035.0	6,139.0	6,985.0	6,917.0	6,512.8	5,213	5,891.0	7,754.4
Tana River	1,350.0	1,282.0	1,253.0	462.0	521.2	1,452	1,679.0	1,329.6
Kilifi	5,862.0	6,245.0	4,997.0	3,609.0	4,968.7	4,652	8,519.0	8,819.2
Mombasa	1,570.0	1,615.0	2,216.0	1,394.0	1,338.7	2,627	2,556.0	3,552.8
Kwale	4,925.0	5,909.0	4,863.0	9,367.0	6,910.1	8,036	11,404.0	9,586.0
Total	**19,742.0**	**21,190.0**	**20,314.0**	**21,749.0**	**20,251.4**	**21,980.0**	**30,049**	**31,042**
Crustaceans by County:								
Lamu	222.0	342.0	370.0	639.0	393	333	464	480.9
Tana River	119.0	177.0	63.0	41.0	41	148	33	145.8
Kilifi	77.0	96.0	238.0	161.0	125	317	296	220.0
Mombasa	33.0	27.0	492.0	507.0	311	348	390	933.6
Kwale	170.0	130.0	537.0	585.0	722	664	1,010	1,464.8
Total	**621.0**	**772.0**	**1,700.0**	**1,933.0**	**1,592.0**	**1,810.0**	**2,193.0**	**3,244.9**
Molluscs by County:								
Lamu	237.0	302.0	270.0	254.0	185	114	182	251
Tana River	139.0	176.0	109.0	50.0	47	79	97	78
Kilifi	475.0	675.0	675.0	380.0	1,136	322	492	667
Mombasa	165.0	234.0	244.0	147.0	279	313	203	235
Kwale	747.0	816.0	973.0	1,233.0	278	865	2,380	1,567
Total	**1,763.0**	**2,203.0**	**2,271.0**	**2,064.0**	**1,925.0**	**1,693.0**	**3,354.0**	**2,797.9**
Marine Industrial			**1,170.0**	**1,994.0**	**1,972.0**	**1,796.0**	**2,025.0**	**2,855.0**
Grand Total	**163,824.0**	**147,678.0**	**150,128.0**	**149,320.0**	**151,326.4**	**162,239.0**	**173,762.0**	**161,297.0**

Source: *State Department for Fisheries, Aquaculture, and the Blue Economy*

Table 2.6(b): Value of Fish Landed, 2015 – 2023

	Value (KSh '000)								
	2015	2016	2017	2018	2019	2020	2021	2022	2023*
Fresh Water Fish									
Lake Victoria	14,653,588.0	14,602,568.0	13,976,586.0	14,487,650.0	11,640,537.0	12,403,564.8	14,082,375.0	14,344,784.0	12,065,790.0
Lake Turkana	735,717.0	576,493.0	486,540.0	564,739.0	645,107.0	1,177,193.0	1,479,953.0	3,350,628.0	3,132,103.0
Lake Naivasha - Commercial	132,617.0	141,006.0	222,579.0	287,194.0	391,719.0	238,638.2	217,974.0	263,715.0	147,429.0
Lake Baringo	51,094.0	41,595.0	46,606.0	43,442.0	49,499.0	39,502.0	118,590.0	129,328.0	124,998.0
Lake Jipe	15,469.0	18,719.0	21,756.0	38,260.0	45,957.0	57,549.4	67,851.0	89,124.0	89,231.0
Lake Kanyaboli	9874	9870	26346	29656	43826	60,201.0	73,873.0	63,438.0	74,777.0
Lake Kenyatta	4,920.0	4,560.0	3,473.0	1,330.0	5,844.0	16,671.3	8,016.0	14,205.0	19,242.0
Tana River Dams	115,020.0	72,229.0	84,500.0	37,373.0	60,571.0	50,959.5	28,563.0	30,348.0	33,900.0
Tana River Delta	2,419.0	1,970.0	9,296.0	5,069.0	14,476.0	10,984.0	14,048	11,634.0	12,545.0
Aquaculture/fish farming	5,014,149.0	4,253,844.0	3,691,046.0	4,480,875.0	5,581,142.0	6,303,617.0	6,711,360.0	8,735,512.0	9,971,325.0
Turkwel Dam	10,880.0	9,030.0	9,905.0	9,822.0	12,850.0	16,112.3	15,750.0	20,257.0	28,117.0
Riverline	4212	3500	2368	86400	106371.2642	115048.92	109,454.0	111,643.0	160,380.0
Small Dams			75,120.0	42,015.0	126,455.0	95,022.1	84,565.0	82,381.0	120,451.0
Total	**20,749,959.0**	**19,735,384.0**	**18,656,121.0**	**20,113,825.0**	**18,724,354.3**	**20,585,063**	**22,998,324.0**	**27,246,997.0**	**25,980,288.0**
Marine Fish by County:									
Lamu	320,195.0	441,177.0	623,904.0	644,191.0	644,954.0	754,599.0	900,780.7	714,219.0	892,901.9
Tana River	41,971.0	35,098.0	131,672.0	125,554.0	60,993.0	103,074.0	330,467.0	344,830.0	134,247.8
Kilifi	1,727,750.0	1,921,407.0	1,237,927.0	881,438.0	780,534.0	1,081,926.0	964,210.0	1,892,949.0	2,072,190.9
Mombasa	315,638.0	402,873.0	408,593.0	603,562.0	456,296.7	484,345.0	670,792.0	716,772.0	784,069.6
Kwale	612,579.0	623,804.0	574,096.0	805,502.0	962,990.0	818,458.5	1,087,106.0	2,174,012.0	1,507,874.7
Total	**3,018,133.0**	**3,424,359.0**	**2,976,192.0**	**3,060,247.0**	**2,905,767.7**	**3,242,402.5**	**3,953,355.7**	**5,842,782.0**	**5,391,284.9**
Crustaceans by County:									
Lamu	288,528.0	576,226.0	480,123.0	446,968.0	501,625.0	371,004	314,455	848,607	647,881
Tana River	54,991.0	117,304.0	27,298.0	29,821.0	27,719.0	15,516	112,815	17,341	110,980
Kilifi	69,743.0	77,870.0	169,357.0	148,276.0	108,799.0	106,365	150,111	328,826	150,792
Mombasa	14,565.0	10,813.0	176,665.0	176,313.0	218,129.0	130,645	188,220	208,500	395,462
Kwale	46,685.0	105,450.0	63,500.0	197,784.0	270,462.0	295,236	315,198	524,481	684,390
Total	**474,512.0**	**887,663.0**	**916,943.0**	**999,162.0**	**1,126,734.0**	**918,766.0**	**1,080,799.3**	**1,927,755.0**	**1,989,505.9**
Molluscs by County:									
Lamu	4,910.0	6,108.0	66,119.0	58,478.0	67,952.0	81,373	79,751	82,676	117,472
Tana River	1,993.0	408.0	25,814.0	4,372.0	12,757.0	11,365	8,769	18,744	8,627
Kilifi	171,864.0	205,240.0	149,110.0	160,678.0	111,762.0	226,946	85,037	160,188	225,948
Mombasa	26,260.0	21,702.0	41,212.0	59,793.0	39,882.0	302,718	200,101	65,488	65,377
Kwale	97,905.0	145,061.0	115,636.0	159,386.0	253,171.0	84,985	125,754	611,948	511,539
Total	**302,932.0**	**378,519.0**	**397,891.0**	**442,707.0**	**485,524.0**	**707,387.0**	**499,412.0**	**939,044.0**	**928,962.2**
Marine Industrial			**126,376.0**	**252,559.0**	**405,820.0**	**793,981.0**	**756,809**	**1,042,142**	**1,611,550**
Grand Total	**24,545,536.0**	**24,425,925.0**	**23,073,523.0**	**24,868,500.0**	**23,648,200.0**	**26,247,600.0**	**29,288,700.0**	**36,998,720.0**	**35,901,591.0**

Source: *State Department for Fisheries, Aquaculture, and the Blue Economy*



Table 2.7 shows selected attributes of lake Victoria fishery based on frame surveys from 2000 to 2020.Frame surveys were carried out to determine certain characteristic of the fishery to guide developments and managwement of the fishery.

Table 2.7: Selected Attributes of Lake Victoria Fishery

	2000	2002	2004	2006	2008	2010	2012	2014	2016	2020
No Landing sites	297	306	304	316	307	331	324	321	338	329
No. of Fishers	38,431	54,163	37,348	44,263	42,307	41,912	40,078	40,113	43,799	47,976
Fisher density No. Km^2	9	13	9	11	10	10	10	10	11	11
No. of Fishing crafts	11,515	12,209	12,284	15,280	14,257	14,251	13,717	13,402	14,365	15,463
No. of gillnets <5	33,544	28,527	28,996	30,876	43,467	47,629	54,085	75,205	76,731	49,522
No. of gillnets >5	99,820	101,981	161,760	185,807	170,312	165,246	153,865	113,779	116,256	131,599
No. of Gillnets	1,039,893	130,708	190,756	217,358	213,779	212,875	207,950	188,984	192,987	181,121
No. LL hooks	133,364	2,562,066	2,045,605	2,623,553	2,501,944	2,710,395	2,478,976	2,573,736	2,507,893	2,959,726
Beach seines	5,803	1,157	869	553	762	991	1,063	856	906	1,347
Cast net	4,548	102	78	114	131	143	85	128	75	50
Monofilament nets			58	469	4,190	1,468	12	1,432	20,842	13,770
Total Small seines	**12,387**	**2,097**	**3,048**	**3,181**	**2,700**	**3,029**	**3,859**	**4,137**	**13,156**	**3,173**

Source: *Frame surveys*

Lake Victoria's contribution to total annual fish production is enormous even in the face of rapidly declining fish stocks in the lake. The lake is a multi-species fishery with hundreds of known species, but only Rastrien argentea (Omena), Lates niloticus (Nile perch), and Oreochromis niloticus (Nile tilapia) are of economic significance as shown in Table 2.8.

Table 2.8: Fish Species Production, 2021-2023

YEAR	2021			2022			2023		
FRESH WATER FISHES	**Tonnes**	**000KSh**	**Price per KG**	**Tonnes**	**000KSh**	**Price per KG**	**Tonnes**	**000KSh**	**Price per KG**
Alestes	929	81,839	88	1,535	135,159	88	3,905	706,284	181
Bagrus	16	925	58	12	696	58	195	64,888	333
Barbus	52	29,459	569	16	9,111	569	31	6,179	199
Black bass	4,426	533,081	120	2	241	120	0.3	67	223
Clarias	1,631	324,753	199	3,859	768,390	199	3,436	475,301	138
Omena	51,305	5,233,150	102	46,342	4,726,884	102	35,910	5,324,598	148
Labeo	638	80,451	126	769	97,043	126	534	110,158	206
Haplochromis	434	55,402	128	1,472	188,114	128	9,279	1,024,466	110
Nile Perch	16,260	3,507,278	279	21,845	6,099,881	279	19,907	3,278,923	165
Mormyrus	5	1,650	330	6	1,980	330	17	3,002	177
Lungfish	1,179	231,703	197	1,823	358,359	197	758	228,689	302
Synodontis	1,559	182,714	117	1,131	132,522	117	1,044	130,991	125
Tilapia niloticus	28,666	6,593,180	230	25,693	5,909,390	230	20,677	3,162,679	153
Tilapia others	16,857	3,647,126	216	14,774	3,196,455	216	12,500	3,750,000	300
Trout	3	1,668	552	2	1,104	552	10	5,572	557
Carps	973	90,309	93	1,135	105,346	93	416	52,221	126
Eels	-	-		-	-	-	110	44,000	400
Citharinus	19	1,925	103	-	-	-	22	4,998	227
Hydrocinus	12	1,191	103	-	-	-	40	4,500	113
Distichodus	241	24,807	103	-	-	-	153	30,182	197
Unspecified	9,755	2,375,712	114	15,725	1,793,792	114	4,090	535,134	131
TOTAL	**134,960**	**22,998,324**	**166**	**136,141**	**27,246,997**	**200**	**121,357**	**25,980,288**	**214**
MARINE FISH									
Demersals	12,264	1,671,186	177	15,329	3,059,347	190	15,351	3,016,989	197
Pelagics	6,086	2,005,068	357	12,241	2,518,014	202	12,250	1,994,332	162
Shark/Rays	1,342	153,694	156	380	18,530	202	702	90,282	128
Sardines	1,895	74,528	48	1,449	200,000	135	2,117	201,448	95
Unspecified	393	48,880	175	650	46,891	134	622	88,234	142
TOTAL	**21,980**	**3,953,356**	**`180**	**30,049**	**5,842,782**	**194**	**31,042**	**5,391,285**	**173**
CRUSTACEA									
Lobster	482	423,843	846	567	1,120,284	1,976	443	675,709	1525
Prawns	696	328,877	535	1,012	438,383	433	2,174	897,012	413
crabs	632	328,079	576	614	369,088	601	627	416,785	665
others	-	-		-	-	-	-	-	
TOTAL	**1,810**	**1,080,799**	**632**	**2,193**	**1,927,755**	**879**	**3,244**	**1,989,506**	**613**
MOLLUSCS									
OYSTERS	48	25,906	539.7083333	78	27,177	348	109	29,123	267
Squids & Cuttlefish	327	130,758	399.8715596	921	230,340	250	617	238,482	387
Octopus	889	163,551	183.9718785	2,220	591,477	266	1,404	542,019	386
Sea cucumber	262	129,196	493.1145038	135	90,050	667	566	119,339	211
others	167	50,001	299.4071856	-	-	-	-	-	-
TOTAL	**1,693**	**499,412**	**295**	**3,354**	**939,044**	**280**	**2,696**	**928,963**	**345**
TOTAL MARINE	**25,483**	**5,491,800**	**245**	**35,596**	**8,709,581**	**245**	**36,982**	**8,309,754**	**225**
GRAND TOTAL	**158,293**	**29,288,700**	**185.0283967**	**173,741**	**36,998,720**	**213**	**161,307**	**35,901,591**	**223**

Source: *State Department for Fisheries, Aquaculture, and the Blue Economy*

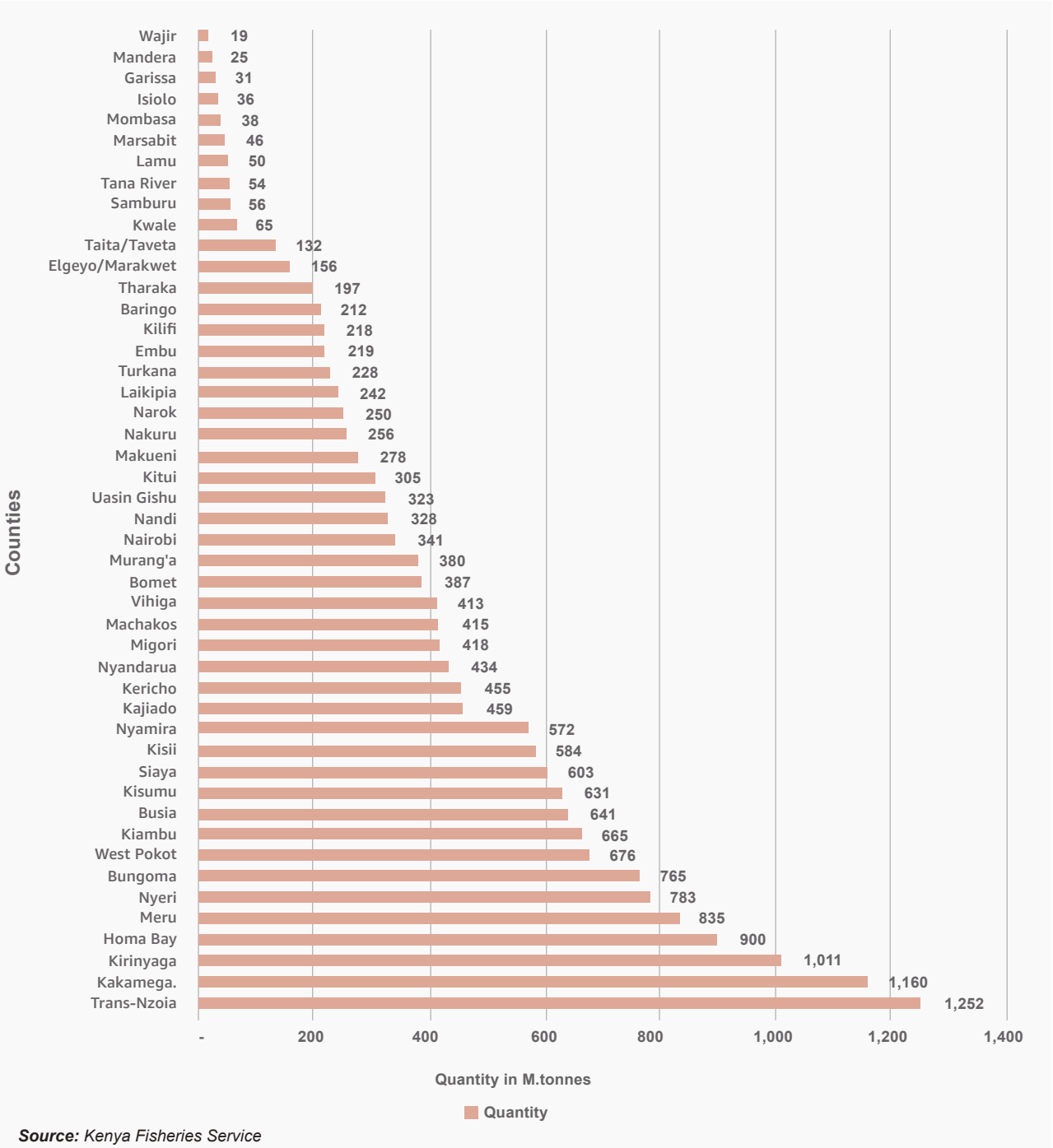
Table 2 9: Fresh Water and Marine Fish Catches by Species, Weight, 2012-2023, Tonnes

Type of Fish	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Fresh Water												
Alestes	276	329	318	283	246	223	244			929	1,535	3,905
Bagrus	49	105	101	90	78	71	78			16	12	195
Barbus	10	94	101	90	78	71	78			52	16	31
Black bass	2	1	3	3	2	2	2			4,426	2	0.3
Clarias	6,596	6918	7,174	6380	5,561	5034	5,514			1,631	3,859	3,436
Rastreonobola (Omena)	52,948	66,717	69,561	61859	53,920	48,813	53,463			51,305	46,342	35,910
Labeo	480	659	622	553	482	436	478			638	769	534
Haplochromis	723	1126	929	826	720	652	714			434	1,472	9,279
Lates niloticus (Nile Perch)	53,023	44,319	43,399	38594	33,641	30,454	33,356			12,560	21,845	19,907
Protopterus (Lungfish)	1,196	1318	1,339	1191	1,038	940	1,029			1,179	1,823	758
Synodontis	15	141	136	121	105	95	105			1,559	1,131	1,044
Tilapia niloticus	22,196	25,071	26,278	23368	20,369	18,440	20,197			28,666	25,693	20,677
Tilapia others	1,935	2,395	2,612	2323	2,025	1,833	2,008			16,857	14,774	12,500
Trout	215	235	241	214	187	169	185			3	2	10
Carps	1,727	1,920	2,083	1852	1,615	1,462	1,601			973	1,135	416
Eels	1	-	-							-	-	110
Citharinus	14	120	116	103	90	81	89			19	-	22
Hydrocynus	60	109	106	94	82	74	81			12	-	40
Distichodu niloticus	298	330	319	284	247	224	245			241	-	153
Unspecified	3,386	2,251	3,903	3471	3,025	2,739	3,000			9,343	15,725	4,090
Marine Fish												
Demersal	4,300	2147	4,519	11335	12,166	11828	12,241			12,264	16,129	16,851
Pelagic	2,297	698	2,506	6286	6,747	6559	6,788			6,830	12,489	12,250
Sharks/Rays	373	2136	293	735	789	767	794			1,342	1,080	1,652
Sardines	194	855	239	599	643	626	647			1,895	2,049	3,286
Unspecified	313	1867	314	788	845	822	851			393	350	922
Crustacea												
Spiny Lobster	96	123	107	120	149	135	145			582	567	443
Prawns	408	365	269	301	374	340	364			896	1,012	2,174
Crabs	235	274	180	201	250	228	243			658	614	627
Molluscs												
Oysters	74	32	35	96	119	107	116			138	78	109
Beche-de-mers (Sea cucumber)	36	48	24	65	82	74	80			347	135	566
Octopus	394	446	437	1193	1,490	1341	1,454			1,358	2,220	1,404
Squids and cattlefish	144	143	151	412	515	464	503			577	921	617

source: *Kenya Fisheries Service*

Aquaculture. Aquaculture entails growing (farming) of fish and other aquatic organisms in controlled environment. It is dominated by four commonly cultured fish species namely Nile Tilapia, African Catfish, Rainbow Trout, Common Carp and ornamentals. The aquaculture production by counties for 2020 is presented in Figure 12. Transzoia followed by Kakamega and Kirinyaga were the best performing counties in the country.The ASAL counties of Wajir, Mandera and Garrissa hardly practices aquaculture production.

Figure 2.3: Aquaculture Production by Counties, 2020



Source: *Kenya Fisheries Service*

2.3.2 Crops

Agriculture remains the backbone of the Kenyan economy. Kenya's agriculture is determined by factors such as climate, hydrology, and terrain as well as agro-ecological factors which determine the suitability of an area for land use. Agricultural potential can be classified into high, medium and low. Intensive cultivation is prevalent in the high-potential highlands where rainfall is high as illustrated in Table 2.10.



Table 2.10: Categories of Agricultural Land (As of 2013)

'000 Ha

County	High Potential	Medium Potential	Low Potential	Total Land	All Other	Total Land Area
Murang'a } Kiambu	386	5	24	415	78	493
Kirinyaga	98	10	-	108	35	143
Nyandarua	265	-	5	270	83	353
Nyeri	160	-	12	172	157	329
Kilifi	104	247	851	1,202	39	1,241
Kwale	126	162	508	796	30	826
Lamu	7	319	321	647	4	651
Mombasa	21	-	-	21	-	21
Taita Taveta	42	10	590	642	1,054	1,696
Tana River	73	58	3,393	3,524	345	3,869
Embu	66	186	-	252	19	271
Isiolo	-	-	2,561	2,561	-	2,561
Kitui	67	1,137	1,078	2,282	657	2,939
Makueni } Machakos	125	771	454	1,350	68	1,418
Marsabit	4	-	7,045	7,049	346	7,395
Tharaka Nithi } Meru	241	95	315	651	341	992
Nairobi	16	-	38	54	14	68
Garissa	-	-	4,393	4,393	-	4,393
Mandera	-	-	2,647	2,647	-	2,647
Wajir	-	-	5,650	5,650	-	5,650
Kisumu } Siaya	432	29	-	461	-	461
Kisii } Nyamira	220	-	-	220	-	220
Migori } Homa Bay	566	5	-	571	-	571
Baringo	166	84	751	1,001	62	1,063
Elgeyo-Marakwet	104	-	92	196	77	273
Kajiado	22	-	1,760	1,782	314	2,096
Bomet } Kericho	380	-	-	380	109	489
Laikipia	130	-	768	898	74	972
Nakuru	291	39	231	561	141	702
Nandi	234	-	-	234	40	274
Narok	908	-	704	1,612	240	1,852
Samburu	140	-	1,612	1,752	329	2,081
Trans Nzoia	208	-	-	208	39	247
Turkana	12	-	5,937	5,949	-	5,949
Uasin Gishu	327	-	-	327	51	378
West Pokot	103	-	365	468	39	507
Bungoma	253	-	-	253	55	308
Busia	163	-	-	163	-	163
Vihiga } Kakamega	325	-	-	325	27	352
TOTAL	**6,785**	**3,157**	**42,105**	**52,047**	**4,867**	**56,914**

Source: *Ministry of Agriculture, Livestock & Fisheries / Kenya Meteorological Service*

[1]The three categories are defined as follows:

High potential:annual rainfall of 857.5mm or more (over 980mm in Coast region).

Medium potential: annual rainfall of 735mm-857.5mm.(735mm-980mm in Coast region and 612.5mm-857.5mm in Eastern region).

Low potental:Annual rainfall of 612.5mm or less.

In Kenya, crops are produced under rain-fed and irrigated systems, with the rain-fed system accounting for over 90 percent of all production. Trends in production of selected agriculture commodities is shown in Table 2.11 and Table 2.12.

Table 2.11: Trends in Crop Production

Crop	1990 - 2001			2001 - 2011			2011 - 2021			2021 - 2023		
	Area (Ha)	Prod. (Tons)	Yield (Hg/ ha)	Area (Ha)	Prod. (Tons)	Yield (Hg/ ha)	Area (Ha)	Prod. (Tons)	Yield (Hg/ ha)	Area (Ha)	Prod. (Tons)	Yield (Hg/ ha)
Wheat	(1.2)	(1.3)	(0.0)	(0.9)	(0.9)	(0.1)	(0.6)	0.2	0.8	(0.3)	0.43	0.7
Maize	1.6	0.2	(0.3)	0.4	0.0	(0.4)	2.7	1.8	(1.0)	1.9	1.74	(0.1)
Beans	**4.1**	**(2.9)**	**(6.8)**	**1.2**	**2.2**	**1.1**	**(0.7)**	**2.0**	**2.7**	**2.4**	**3.2**	**0.8**
Irish potatoes	4.5	1.4	(3.0)	5.7	(2.4)	(7.6)	0.2	11.6	11.4	2.9	4.2	1.3
Paddy rice	**(0.1)**	**0.6**	**0.7**	**(1.3)**	**3.7**	**5.1**	**7.7**	**5.0**	**(2.5)**	**3.9**	**4.55**	**0.6**
Cassava	3.2	0.4	(2.7)	(0.6)	0.0	0.6	(1.3)	0.5	1.7	0.5	1.75	1.3
Sorghum	1.3	(0.8)	(2.1)	(0.8)	2.9	3.7	4.9	1.6	(3.2)	2.5	2.66	0.2
Millet	**(0.2)**	**(3.1)**	**(2.9)**	**0.1**	**(2.0)**	**(2.1)**	**(1.5)**	**1.0**	**2.6**	**1.1**	**2.67**	**1.6**
Tea	2.2	9.4	7.1	3.8	3.7	(0.1)	3.7	2.8	(0.9)	3.4	4.18	0.8
Coffee	1.3	(3.4)	(4.7)	0.4	(1.4)	(1.7)	(2.3)	(2.5)	(0.2)	(1.5)	-3.02	(1.5)
Sugar-cane	**1.3**	**(1.2)**	**(2.5)**	**0.2**	**0.6**	**0.3**	**4.0**	**3.8**	**(0.2)**	**2.0**	**1.52**	**(0.5)**
Barley	0.03	3.2	3.17	-1.88	-3.89	-2.05	-1.21	-2.24	-1.04	-0.86	1.39	2.28

Source: *Ministry of Agriculture and Livestock Development*

Table 2.12: Summary Food Crops Production, 2019-2023

year	2019		2020		2021		2022		2023	
Area / Production	Area(Ha)	Pro-duction (Tonnes)	Area(Ha)	Pro-duction (Tonnes)	Area(Ha)	Pro-duction (Tonnes)	Area(Ha)	Pro-duction (Tonnes)	Area(Ha)	Pro-duction (Tonnes)
Maize	2,207,325	3,960,385	2,171,697	3,795,175	2,168,603	3,304,430	2,113,520	3,087,220	2,430,013	4,285,206
Wheat	136,525	366,191	125,737	404,696	124,880	349,102	119,554	368,697	104,440	309,492
Rice (Irrigated)	32,324	160,585	31,591	180,890	32,028	194,908	44,255	206,527	38,939	229,064
Sorghum	238,814	290,206	219,945	310,628	207,811	138,893	206,884	120,422	207,740	198,923
Finger Millet	55,062	46,729	46,573	42,533	47,534	37,538	42,651	29,969	48,182	39,405
Pearl Millet	68,538	91,872	70,285	109,430	82,634	26,163	65,785	29,490	81,742	47,357
Beans	1,188,678	743,218	1,147,705	774,363	1,131,565	668,916	1,268,568	750,152	1,219,960	860,973
Cowpea (Grains)	242,110	166,604	244,494	182,359	235,984	125,442	199,920	115,608	249,384	171,803
Green grams	305,324	185,752	280,718	207,941	269,447	121,031	253,464	110,963	308,388	182,260
Pigeon Peas (Grain)	136,550	107,645	133,329	123,074	126,646	103,879	266,104	159,927	300,807	183,651
Irish Potatoes	212,669	2,026,446	204,555	1,939,677	215,729	2,109,646	231,525	1,831,809	239,336	2,309,915
Sweet Potatoes	57,535	739,139	54,007	671,093	56,916	666,485	55,124	703,818	58,529	683,211
Cassava	59,624	796,776	61,789	879,703	61,201	711,541	70,884	947,000	76,354	1,137,469

Source: *Ministry of Agriculture and Livestock Development*

** Provisional*

Release of Chemical Substances

Chemical fertilizers to enrich soils and pesticide use in protecting plants and animals from disease are covered here. Other chemicals accelerate the growth of biota and preserve and enhance the quality, size and appearance of biological products. Environmental effects are generated by the diffusion of chemicals through cycling systems and build-up of contaminants in water, land and living organisms (through the food chain). The statistics include the amount of natural and chemical fertilizers and pesticides used by type of active ingredients, the area under application and the method employed. These statistics serve as a proxy or the basis for estimating the chemicals that remain in the environment and affect environmental quality.

Table 2.12 shows the quantity of fertilizer imports for the period . NPK's, DAP & CAN are the imported to Kenya. Comparing the imports for the past four years shows that the top 5 imports have been consistent throughout. Urea imports increased to 8 per cent of the total imports in 2015 as compared to previous year of 5 per cent. Other fertilizers includes products like; Phosphate Rock, SOP, MOP, Potassium nitrate.

Table 2. 12: Fertilizer Imports, 2012-2022, Tonnes

Fertilizer Name	2012	2013	2014	2015	2017	2018	2019	2020	2021	2022
NPK's	139 578	129 540	136 880	166 342	186 377	143 621	193 057	127 143	177 117	210 751
DAP	126 470	273 939	144 450	127 672	261 939	252 199	262 897	319 039	294 696	164 435
CAN	**53 616**	**101 201**	**87 900**	**99 120**	**198 806**	**100 950**	**118 268**	**132 900**	**127 223**	**59 276**
NP Compounds	12 028	20 853	35 594	65 295	87 383	15 894	8 843	31 768	15 176	20 828
Urea	66 804	114 515	25 117	43 584	66 720	68 045	89 996	152 537	96 865	74 809
Others fertilizers	**46 684**	**49 983**	**64 779**	**54 419**	**49 178**	**22 271**	**60 729**	**40 610**	**51 087**	**78 338**
Total	**445 180**	**690 032**	**494 720**	**556 432**	**850 403**	**602 980**	**733 790**	**803 997**	**762 164**	**608 437**

Source: *Economic Survey 2022*

Comments:

NPK's, DAP & CAN accounted for 71% of the total fertilizers officially imported to Kenya. Comparing the imports for the past four years shows that the top 5 imports have been consistent throughout. Urea imports increased to 8% of the total imports in 2015 as compared to previous year of 5%. Other fertilizers include products like; Phosphate Rock, SOP, MOP, Potassium nitrate, etc

Table 2.13: Agricultural and Non-agricultural Uses/ Industrial/Mines, 2012-2023

Usage	2012		2013		2014		2015		2018	
	Volume	%	Volume	%	Volume	%	Volume	%	Volume (MT)	%
Agriculture	445,180.0	99.9	690,032.0	99.8	494,720.0	99.8	556,432.0	99.9	626,418.0	1.0
Industrial/Mines	396.0	0.1	1,134.0	0.2	793.0	0.2	804.0	0.1	1,750.0	0.0
Total (mt)	**445,576.0**	**100.0**	**691,166.0**	**100.0**	**495,513.0**	**100.0**	**557,236.0**	**100.0**	**628,168.0**	**1.0**
Usage	**2019**		**2020**		**2021**		**2022**		**2023**	
	Volume (MT)	%	Volume (MT)	%	Volume (MT)	%	Volume (MT)	%	Volume (MT)	%
Agriculture	766,126.0	1.0	834,549.0	1.0	792,670.0	1.0	657,730.0	1.0	426,038.0	1.0
Industrial/Mines	1,298.0	0.0	578.0	0.0	528.0	0.0	552.0	0.0	132.0	0.0
Total (mt)	**767,424.0**	**1.0**	**835,126.0**	**1.0**	**793,198.0**	**1.0**	**658,283.0**	**1.0**	**426,170.0**	**1.0**

Source: *Ministry of Agriculture 2022*

Some fertilizer products can be used for both agricultural and industrial purpose. The bulk of fertilizer imported are used for agricultural purposes as shown in Table 2.13.The trend in fertizer consumption is shown in Table 2.14.

Table 2. 14: Fertilizer Apparent Consumption, 2010-2018, Tonnes

Metric Tonnes

Fertilizer type	2010	2011	2012	2013	2014	2015	2016	2017	2018
Ammonium Sulphate	8,633	9,200	13,181	15,931	20,922	5,743	15,178	6,766	12,441
Calcium Ammonium Nitrate	40,937	131,363	53,000	99,888	87,021	98,940	108,118	198,293	98,655
Calcium Cyanamide	-	-	21	-	-	-	-	-	-
Calcium Nitrate	4,472	10,371	7,843	16,056	20,869	23,684	23,338	24,043	13,676
Diammonium Phosphate	156,202	176,531	125,344	267,988	141,553	117,859	198,105	252,548	234,823
Magnesium Nitrate	-	53	50	692	-	495	595	-	-
Magnesium Sulphate	-	1	352	-	-	-	-	-	-
Monoammonium Phosphate	457	-	677	878	1,863	973	1,650	1,589	1,884
Monopotassium Phosphate	78	-	50	-	-	300	-	-	292
Muriate of Potash	3,235	1,882	4,405	6,010	6,195	12,057	4,756	3,835	8,228
NPK 17-17-17	8,758	4,406	10,217	9,467	20,658	29,771	28,978	41,386	1,442
NPK 23-23-0	12,305	12,945	10,041	16,056	35,409	64,218	37,945	83,470	9,072
NPK 26-5-5	52,354	70,372	64,215	63,966	70,750	35,238	74,581	82,084	70,041
Organic Fertilizer	-	-	104	337	551	577	545	485	494
Other Nitrogen	-	491	215	82	-	1,039	507	1,960	-
Other NPKs	43,130	38,297	61,788	51,112	42,651	88,694	32,422	30,326	34,522
Other phosphate	-	-	-	-	-	-	911	839	-
Other Potash fertilizer	-	-	-	-	-	-	-	51	-
Phosphate Rock	3,532	6,550	2,241	4,578	1,104	1,235	2,984	7,601	1,686
Potassium Nitrate	729	1,646	1,685	1,122	5,032	541	315	178	140
Single Super Phosphate	-	754	749	596	2,500	2,958	2,580	2,500	-
Sulfate of Potash	1,851	712	1,133	834	2,623	3,038	3,340	2,956	3,730
Triple Super Phosphate	1,565	486	3,825	552	2,367	1,857	6,879	-	-
Urea	60,500	27,293	63,407	110,838	22,941	37,105	53,297	61,506	54,547
Grand Total	**398,738**	**493,353**	**424,543**	**666,983**	**485,009**	**526,322**	**597,024**	**802,416**	**545,673**

Source: *Ministry of Agriculture and Livestock Development*

Table 2.15: Total Area Equipped for Irrigation, 2011/12 - 2022/23

	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
Mwea												
Hectares cropped	10,629	10,629	10,629	10,629	10,629	17,146	23,076	25,710	25,911	25,026	25,570	25,709
Number of plots-holders	7,176	7,178	7,178	7,178	7,178	7,178	7,684	7,684	7,684	9,504	10,024	11,488
Paddy yields (Tonnes)	50,476	64,672	70,416	91,624	78,760	59,291	89,960	120,996	141,920	148,670	137,769	153,654
Ahero												
Hectares cropped	1,215	1,215	1,249	1,687	939	718	670	1,255	1,255	1,340	1,340	..
Number of plots-holders	946	946	946	946	566	899	899	911	911	5,600	5,600	..
Paddy yields (Tonnes)	7,484	8,326	7,405	7,942	6,494	7,752	4,596	8,473	9,600	8,338	9,268	23,920
Bunyala												
Hectares cropped	682	607	618	694	694	658	631	753	803	832	1,277	..
Number of plots-holders	253	253	253	253	1,394	1,393	1,393	1,415	1,495	1,500	1,500	..
Paddy yields (Tonnes)	4,666	4,278	4,289	4,600	4,522	3,632	3,741	3,686	3,492	5,751	8,831	9,454
West Kano												
Hectares cropped	1,299	484	387	387	670	892	739	855	931	535	781	..
Number of plots-holders	780	780	780	780	817	817	817	817	817	894	894	..
Paddy yields (Tonnes)	5,994	5,165	4,345	2,039	4,634	4,083	4,527	9,423	5,704	3,169	5,404	6,561
All schemes												
Hectares cropped[1]	21,101	18,600	19,411	13,988	14,586	21,949	27,383	32,324	31,591	32,028	44,255	38,939
Number of plot -holders[2]	15,828	15,828	15,828	13,055	13,055	16,326	14,028	15,688	17,020	23,634	30,238	31,702
Paddy yields (Tonnes)	80,244	90,703	96,029	116,473	101,510	81,198	112,608	160,585	180,890	186,000	192,299	229,064

Source. *Economic Survey 2023*

[1]Includes North Kano, Southwest, Kano, Bura, Tana and Lower Kuja Irrigation Schemes

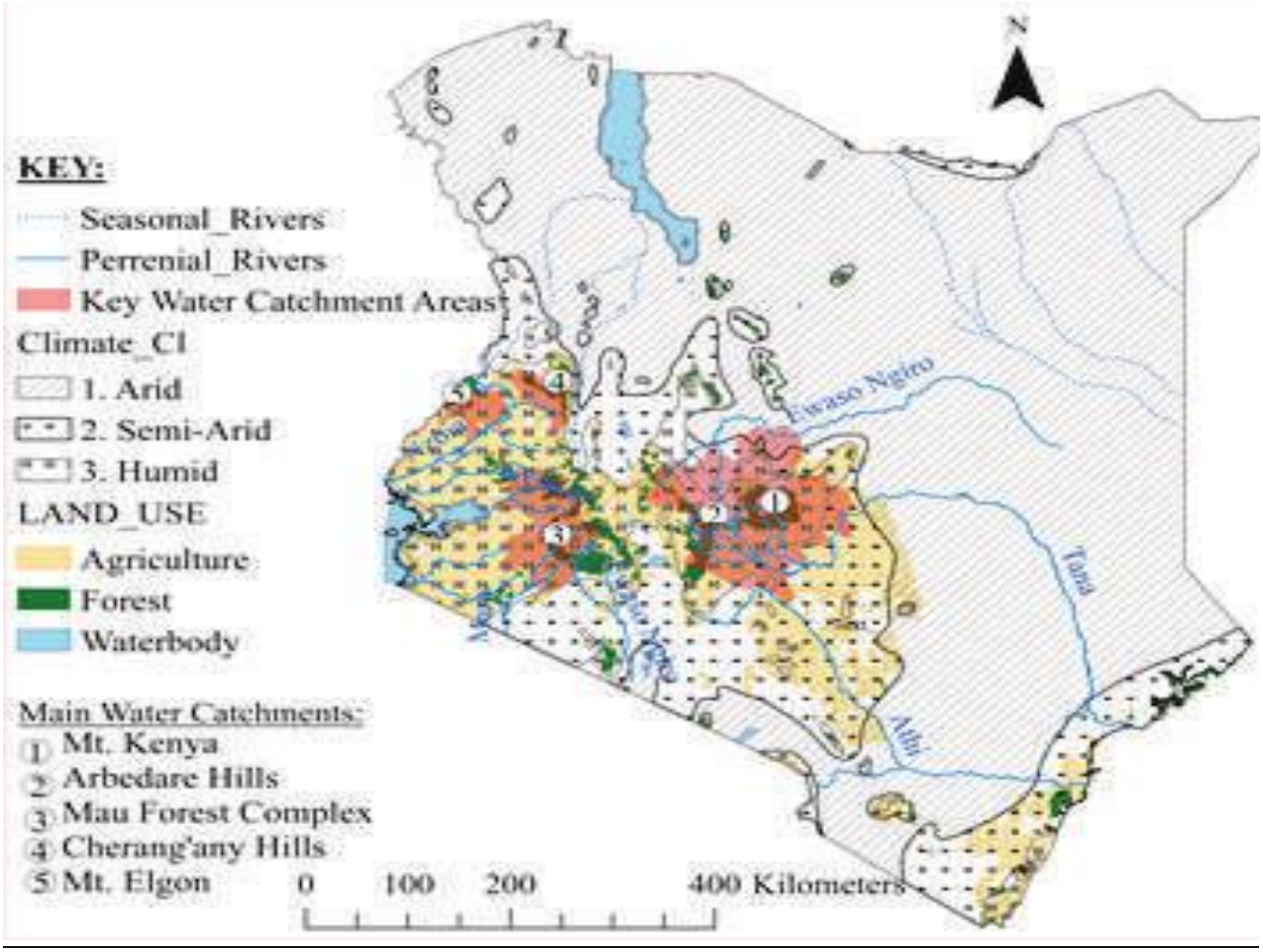
[2]Includes North Kano, Southwest, Kano, Bura, Tana and Lower Kuja Irrigation Schemes

.. Data Missing

2.3.3. Water Resources

Kenya's natural renewable water resources depend on the fragile catchments covered by montane forests in the country's highland areas where humid climate zone is prevalent. They are the catchments of Kenya's main rivers that make up the five basin areas which include Mt. Elgon, Cherangani Hills, Mau Forest Complex, Aberdare Ranges and Mt. Kenya as illustrated in Figure 2.4.

Figure 2.4: Main Water Catchment Areas of Kenya



Source: *National Water Master Plan 2030*

Water Catchment Areas and Basins .

Kenya has five major basins namely, Lake Victoria, Rift Valley, Athi, Tana and Ewaso Ng'iro North. The largest is Ewaso Ng'iro North with a drainage area of 210,223 sq km , i.e 25 per cent of Kenya, followed by Rift Valley with a drainage area of 130,452 sq km . Tana, Athi and Lake Victoria basins constitute 126,026 sq km, 58,639 sq km and 31,734 sq km respectively.

Table 2.16: Available Water Resources by Basins (Units in Million m³ /year)

Catchment Area	Area (sq.km)	2010	2030	2050
Lake Victoria North Catchment Area	18,374	4,742	5,077	5,595
Lake Victoria South Catchment Area	31,734	4,976	5,937	7,195
Rift Valley Catchment Area	130,452	2,559	3,147	3,903
AthiRiver Catchment Area	58,639	1,503	1,634	2,043
TanaRiver Catchment Area	126,026	6,533	7,828	7,891
Ewaso Ng'iro North Catchment Area	210,226	2,251	3,011	1,810
Total	**575,541**	**22,564**	**26,634**	**28,437**

Source: *National Water Master Plan 2030*

Table 2.17 presents the water demand in Kenya estimated for the years 2010, 2030 and 2050. The total water demand in 2010 was 3,218 million m³ /year against available 22,564 million m³ /year. The demand will rise to 221,468 million m³ /year in the year 2030 against available 26,634 million m³ /year. Although there seem to be sufficient water to meet the demand, available water resources in Athi basin barely met the demand in the base year of 2009. Because of human activities and climate variability, water availability in space and time has not been guaranteed in the recent years and hence the need to manage and conserve the resource.

Table 2.17: Water Demand per Basin (Units in Million m³ /year)

Catchment Area	Area (sq.km)	2010	2030	2050
Lake Victoria North Catchment Area	18,374	228	1,337	1,573
Lake Victoria South Catchment Area	31,734	385	2,953	3,251
Rift Valley Catchment Area	130,452	357	1,494	1,689
AthiRiver Catchment Area	58,639	1,145	4,586	5,202
TanaRiver Catchment Area	126,026	891	8,241	8,476
Ewaso Ng'iro North Catchment Area	210,226	212	2,857	2,950
Total	**575,541**	**3,218**	**21,468**	**23,141**

Source: *Water Resources Authority*

The total renewable water resources of Kenya is estimated to be 76.6 billion m³/year, of which approximately 20.6 billion m³/year is surface water and 55.973 billion m³/year is ground water. The total water demand for the various sectors is projected to increase from 1,616.0 million m³ / year in 2018 to 3,429.0 million m³ /year in 2030 and is expected to grow to 5,093.0 million m³ /year in 2050, as shown in Table 2.18.



76.6 billion m³/year

The total renewable water resources of Kenya is estimated to be 76.6 billion m³/year

20.6 billion m³/year
surface water

55.973 billion m³/year
ground water



3,429.0 million m³/year

The total water demand for the various sectors is projected to increase from 1,616.0 million m³ /year in 2018 to 3,429.0 million m³ /year in 2030

Table 2.18: Current and Projected Water Demand in Kenya by Sub-sector, 2018-2050, Million m^3/year

Sub Sector	2018	2020	2025	2030	2050
Domestic	1,186	1,415	1,988	2,561	3,657
Industrial	125	151	216	280	613
Livestock	255	295	396	497	710
Wildlife	8	8	8	8	8
Fisheries	42	47	63	74	105
Total	**1,616**	**1,916**	**2,671**	**3,420**	**5,093**

Source: *National Water Master Plan 2030*

** Mainly refers to aquaculture*

Surface and groundwater resources' distribution and water abstraction levels for each of the six drainage basins is presented in Table 2.19. Lake Victoria North and South basins cover about 8.0 per cent of the total area of Kenya but accounts for over 51.0 per cent of the national freshwater

Table 2.19: Water Resources by Drainage Basins, 2022

Drainage basin	Area	Annual rainfall	Surface water	Surface water abstracted	Ground water	Total water	% of total water resources potential
	(km^2)	(mm)	mn m^3	mn m^3	mn m^3	mn m^3	%
L. Victoria North	18,374	1,548	4626	105.1	116	4,742	24.9
L. Victoria South	31,734	1 280	4773	1,022	203	4,976	26.1
Rift Valley	130 452	562	2 784	745	126	2,910	15.2
Athi River	66 837	739	1 152	177.7	87 1	2,023	10.6
Tana River	126 026	697	3 744	2969	147	3 891	20.4
Ewaso Ng'iro North	210 226	411	339	65.7	142	481	2.5

Source: *Water Resources Authority*

Precipitation: Rainfall is the main source of water in Kenya. The long-Term Average (LTM) gives an indication of availability of this natural resource. Renewable water resources presented in Table 2.20 is the available maximum amount of water resources. It is estimated by multiplying the value of annual precipitation minus actual annual evapotranspiration.



Table 2.20: Renewable and Available Water Resources in Kenya, 2010-2050

Item	Unit	2010	2020	2030	2050
Precipitation(P)*	Bn m^3/y	400	421	442	479
Evapo-transpiration**	Bn m^3/y	358	378	397	426
Renewable WR (P - E)	Bn m^3/y	42	43	44	46
Renewable SW	Bn m^3/y	21	23	25	27
GW Recharge	Bn m^3/y	22	20	19	19
Sustainable Yield of GW***	Bn m^3/y	2	2	2	2
Available Water Resources	Bn m^3/y	23	25	27	28
Population Projected	million	39	48	68	97
Per Capita RWR	m^3/y/capita	1093	640	653	475
Per Capita Available WR	m^3/y/capita	586	450	393	293

Source: *GOK (2015). Kenya-Second National Communication to the United Nations Framework Convention on Climate Change*

**Multi-model ensemble analysis of 11 GCMs for 2030 and 2050*

***Estimation by FAO Penman-Monteith method*

****10% of GW recharge excluding river and riparian areas*

GCM-General Circulation Model

GW-Ground Water

Bn m^3/y – Billion M^3 per year

Water Resources per Capita. The per capita available water resource is calculated by using the renewable surface water resources and sustainable groundwater yield as shown in Table 2.21. The per capita renewable and available water resources have much decreased toward year 2030.

Water abstracted and availability, The volume of water abstracted under permit is an indicator of water availability to the population. The trend in abstraction/water usage in the country is presented in Table 2.22. The trend shows a gradual but not steady increment in water abstraction.

Water Abstraction have been increasing steadily from 2016 to date, due to awareness created by Water Resources Authority (WRA), on the need for the abstractors to use water as stipulated in the Water Act 2016 and enforcement of the same. There is increased demand for irrigation water due to unreliable rainfall and climate change occurrence.

Water abstraction have increased form 32.34 Million to 32.42 Million cubic meters per year from 2016 to 2022. Surface water accounts for 99.28% of the total abstractions while the rest are from ground water. It is worth noting that Kenya depends highly on Hydropower hence power generation takes slightly over 96% of all abstractions followed by irrigation and public use in that order.



Table 2.21: Annual Volume of Water Abstracted Under Permit, 2016-2023 Cubic Meters per Year ('000M³/Yr.)

'000M³

Source of Water	2016	2017	2018	2019	2020	2021	2022	2023
Surface Water	30,674,394.70	30,743,836.93	31,195,297.97	32,075,259.05	32,097,490.25	32,120,664.30	32,198,967.60	32,216,763.03
Ground Water	102,942.71	140,637.56	175,552.35	211,677.09	227,591.28	220,394.08	230,806.80	243,932.60
Total	**30,777,337.41**	**30,884,474.49**	**31,370,850.32**	**32,286,936.14**	**32,325,081.53**	**32,341,058.38**	**32,429,774.40**	**32,460,697.60**

Source: Water Resources Authority

Table 2.22: Total Volume of Water Abstracted under Permit (Cumulative), 2017-2023 (M³/Year)

Source of Water	2017	2018	2019	2020	2021	2022	2023
Surface Water	91,931,626.28	123,126,924.25	155,202,183.30	187,299,673.55	219,420,337.85	219,498,641.16	219,516,436.58
Ground Water	321,174.62	496,726.97	708,404.05	935,995.33	1,156,389.41	1,166,802.13	1,179,927.89
Total	**92,252,800.90**	**123,623,651.22**	**155,910,587.35**	**188,235,668.88**	**220,576,727.26**	**220,665,443.29**	**220,696,366.49**

Source: *Water Resources Authority*



Table 2.23: Lake Victoria North Basin

Type of Water Resources	Water users Categories	2016	2017	2018	2019	2020	2021	2022
Surface water	Public Use	20,324.3	25,740.5	32,148.1	32,148.1	32,175.5	32,175.8	32,175.8
	Domestic Use	1,154.9	2,344.4	2,935.7	3,157.6	3,179.5	3,223.4	3,666.6
	Irrigation	1,745.8	2,924.0	3,225.1	3,252.5	3,298.9	4,047.1	4,047.1
	Industrial Use	16,618.8	19,335.9	19,638.8	19,638.8	19,686.6	19,686.6	45,019.8
	Hydropower	44,776.0	44,776.0	44,776.0	150,199.7	150,199.7	150,199.9	150,199.9
	Livestock	309.2	659.9	709.2	731.1	732.9	747.8	747.8
	Total annual allocation in '000 M^3 per year	**84,928.9**	**95,780.7**	**103,433.0**	**209,127.8**	**209,273.1**	**210,080.7**	**235,857.0**
Ground Water	Public Use	23.7	184.7	184.7	244.6	300.4	334.9	334.9
	Domestic Use	460.6	3,328.1	3,737.6	4,001.9	4,857.4	5,367.2	5,947.0
	Irrigation	14.6	70.8	70.8	74.5	89.1	98.7	106.0
	Industrial Use	8.2	31.8	31.8	39.8	61.7	68.4	83.0
	Hydropower	-	-	-	-	-	-	-
	Livestock	8.8	61.0	62.8	69.4	75.6	78.3	80.8
	Total annual allocation in '000 M^3 per year	**515.9**	**3,676.3**	**4,087.6**	**4,430.0**	**5,384.1**	**5,947.6**	**6,551.7**

Source: *Water Resources Authority*

Table 2.24: Lake Victoria South Basin

'000 M^3

Type of Water Resources	Water users Categories	2017	2018	2019	2020	2021	2022
Surface water	Public Use	4,331.82	36,108.72	37,590.62	37,590.62	37,590.95	38,233.34
	Domestic Use	922.36	1,328.60	1,701.63	2,296.22	2,391.82	2,422.78
	Irrigation	5,961.91	6,359.03	7,527.03	7,694.93	7,746.30	6,256.45
	Industrial Use	5,827.59	6,129.08	7,104.73	7,759.54	7,867.35	8,803.93
	Hydropower	1,449.05	336,753.75	965,969.95	965,969.95	965,970.31	965,970.31
	Livestock	3.65	4.02	4.38	4.38	4.15	4.14
	Total annual allocation in '000 M^3 per year	**18,496.38**	**386,683.19**	**1,019,898.33**	**1,021,315.63**	**1,021,571.14**	**1,021,690.95**
Groundwater	Public Use	43.44	50.74	57.31	57.50	68.29	79.23
	Domestic Use	873.45	1,196.11	1,418.03	1,601.30	2,067.45	2,211.62
	Irrigation	27.74	27.74	40.88	193.80	196.92	196.91
	Industrial Use	50.37	63.15	76.65	76.86	112.79	112.78
	Hydropower	-	-	-	3.66	3.65	3.65
	Livestock	4.38	14.24	18.98	21.08	21.02	28.32
	Total annual allocation in '000 M^3 per year	**999.37**	**1,351.96**	**1,611.84**	**1,954.19**	**2,470.12**	**2,632.51**

Source: *Water Resources Authority*

Table 2.25: Rift Valley Basin

'000M³

Type of Water Resources	Water users Categories	2016	2017	2018	2019	2020	2021	2022
Surface water	Public Use	25,247.05	19,537.72	24,647.72	24,983.52	16,199.43	25,247.40	30,722.39
	Domestic Use	3,922.66	3,224.78	3,602.19	3,821.92	2,898.10	4,369.84	4,371.67
	Irrigation	102,041.96	72,417.46	85,339.92	147,037.33	52,786.30	106,616.91	105,172.21
	Industrial Use	13,997.02	5,139.57	5,549.10	13,691.88	3,170.39	13,989.00	13,989.00
	Hydropower	26.28	26.28	26.28	26.28	26.28	26.55	26.54
	Livestock	59.86	55.12	55.12	59.86	59.86	60.01	60.01
	Total annual allocation in '000 M³ per year	**145,294.82**	**100,400.92**	**119,220.32**	**189,620.79**	**75,140.36**	**150,309.71**	**154,341.82**
Ground-water	Public Use	18,428.12	12,659.30	13,025.76	13,223.59	15,172.32	21,722.50	21,874.34
	Domestic Use	30,462.17	16,761.53	21,164.53	26,794.29	12,466.21	35,395.99	37,521.20
	Irrigation	10,948.91	9,179.39	9,912.67	10,627.34	8,184.03	11,762.00	11,446.27
	Industrial Use	10,527.70	5,443.61	7,457.68	8,603.42	4,321.97	11,021.88	11,504.77
	Hydropower	532.17	532.17	532.17	532.17	532.17	539.47	539.47
	Livestock	748.62	412.45	471.58	496.77	242.36	861.62	893.37
	Total annual allocation in '000 M³ per year	**71,647.68**	**44,988.44**	**52,564.38**	**60,277.56**	**40,919.06**	**49,447.06**	**83,779.42**

Source: *Water Resources Authority*

Table 2.26: Athi Basin

Type of Water Resources	Water users Categories	2016	2017	2018	2019	2020	2021	2022
Surface water	Public Use	25,247.05	19,537.72	24,647.72	24,983.52	16,199.43	25,247.40	30,722.39
	Domestic Use	3,922.66	3,224.78	3,602.19	3,821.92	2,898.10	4,369.84	4,371.67
	Irrigation	102,041.96	72,417.46	85,339.92	147,037.33	52,786.30	106,616.91	105,172.21
	Industrial Use	13,997.02	5,139.57	5,549.10	13,691.88	3,170.39	13,989.00	13,989.00
	Hydropower	26.28	26.28	26.28	26.28	26.28	26.55	26.54
	Livestock	59.86	55.12	55.12	59.86	59.86	60.01	60.01
	Total annual allocation in '000 M³ per year	**145,294.82**	**100,400.92**	**119,220.32**	**189,620.79**	**75,140.36**	**150,309.71**	**154,341.82**
Ground-water	Public Use	18,428.12	12,659.30	13,025.76	13,223.59	15,172.32	21,722.50	21,874.34
	Domestic Use	30,462.17	16,761.53	21,164.53	26,794.29	12,466.21	35,395.99	37,521.20
	Irrigation	10,948.91	9,179.39	9,912.67	10,627.34	8,184.03	11,762.00	11,446.27
	Industrial Use	10,527.70	5,443.61	7,457.68	8,603.42	4,321.97	11,021.88	11,504.77
	Hydropower	532.17	532.17	532.17	532.17	532.17	539.47	539.47
	Livestock	748.62	412.45	471.58	496.77	242.36	861.62	893.37
	Total annual allocation in '000 M³ per year	**71,647.68**	**44,988.44**	**52,564.38**	**60,277.56**	**40,919.06**	**49,447.06**	**83,779.42**

Source: *Water Resources Authority*

Table 2.27: Tana Basin

'000 M³

Type of Water Resources	Water users Categories	2016	2017	2018	2019	2020	2021	2022
Surface water	Public Use	113,968.70	1,175,382.13	121,216.50	121,216.50	123,998.90	148,848.90	148,848.89
	Domestic Use	24,832.41	25,618.99	173,179.73	175,832.91	177,696.24	177,759.53	178,192.52
	Irrigation	148,488.94	194,647.20	195,644.38	201,321.96	214,315.59	222,076.33	341,251.70
	Industrial Use	3,890.54	3,927.04	3,928.86	3,928.86	3,936.53	4,087.77	4,400.51
	Hydropower	29,444,624.46	29,444,624.46	29,301,308.67	29,301,308.67	29,301,308.67	29,389,609.57	29,429,218.90
	Livestock	1,215.09	1,277.14	1,337.36	1,381.53	1,381.53	1,348.54	1,354.82
	Total annual allocation in '000 M³ per year	**29,737,020.12**	**30,845,476.94**	**29,796,615.50**	**29,804,990.42**	**29,822,637.44**	**29,943,730.62**	**30,103,267.34**
Ground-water	Public Use	3,907.69	3,907.69	3,907.69	3,907.69	3,911.34	3,911.39	3,913.87
	Domestic Use	1,664.40	2,034.51	2,368.49	2,562.67	2,816.71	3,474.50	3,959.40
	Irrigation	155.13	215.35	279.59	300.76	370.84	492.17	690.00
	Industrial Use	21.90	21.90	29.93	42.71	42.71	42.89	50.19
	Hydropower	-	-	-	-	-	-	-
	Livestock	51.83	94.54	116.80	116.80	133.23	157.43	185.53
	Total annual allocation in '000 M³ per year	**5,800.95**	**6,273.99**	**6,702.50**	**6,930.62**	**7,274.82**	**8,078.37**	**8,798.99**

Source: *Water Resources Authority*

Table 2.28: Ewaso Ng'iro North Basin

'000 M³

Type of Water Resources	Water users Categories	2016	2017	2018	2019	2020	2021	2022
Surface water	Public Use	5,342.87	7,185.03	7,310.22	11,167.18	11,167.18	11,167.43	11,167,430.50
	Domestic Use	9,068.06	11,652.26	12,969.91	13,922.93	15,943.93	16,286.16	16,550,403.05
	Irrigation	18,962.48	22,698.62	25,788.71	33,068.64	35,570.71	36,926.99	37,185,261.95
	Industrial Use	481.44	594.59	627.44	665.40	1,561.11	1,561.21	1,600,740.35
	Hydropower	66.43	66.43	66.43	66.43	66.43	66.51	66,513.95
	Livestock	1,961.88	2,249.50	2,273.95	2,279.43	2,312.28	2,322.11	2,372,127.70
	Total annual allocation in '000 M³ per year	**35,883.15**	**44,446.42**	**49,036.66**	**61,169.99**	**66,621.63**	**68,330.41**	**68,942,477.50**
Ground-water	Public Use	759.57	771.98	794.24	798.26	458.71	809.31	812,964.50
	Domestic Use	1,318.38	1,712.95	2,023.93	2,202.41	2,481.47	2,865.49	3,170,798.80
	Irrigation	2,120.29	3,549.26	4,305.91	5,741.82	6,942.63	7,780.43	8,008,917.60
	Industrial Use	71.91	71.91	93.81	211.34	236.44	247.47	258,420.00
	Hydropower	-	-	-	-	25.62	25.55	25,550.00
	Livestock	152.21	185.06	250.76	297.84	276.92	339.60	361,043.40
	Total annual allocation in '000M³ per year	**4,422.34**	**6,291.14**	**7,468.63**	**9,251.66**	**10,421.78**	**12,067.86**	**12,637,694.30**

Source: *Water Resources Authority*

The Tana Basin Area allocates the biggest amount of surface water mostly for hydropower generation followed by Rift Valley Basin area. Water abstraction by Water Service Providers in major towns across the country is presented in Table 2.27. It is important to note that the difference between the total water produced and supplied through the water distribution system and the total water billed to customers which is referred to as non-revenue water which have remained relatively stagnant between 41 per cent and 47 per cent for the last 10 years is as a result of the physical losses like water leakage, and apparent losses such as illegal connections and meter inaccuracies. Effort are being made to reduce the Non-Revenue Water to 25 per cent to close the supply and demand gap without the need to build costly infrastructure or exploit new water sources (which are dwindling). Additionally, reducing water losses increases revenue for utilities while also reducing operating costs linked to producing and pumping water, thus unlocking savings that can be used to expand access and improve service delivery.

Table 2.29: Total Water Abstraction by Size of Water Supply Company, 2023

Water Company	Total Water Produced ($000m^3$)	Total Water Billed ($000m^3$)	Turnover (Ksh)mn	Water Company	Total Water Produced ($000m^3$)	Total Water Billed ($000m^3$)	Turnover (Ksh)mn
Very Large (≥35,000 connections)				**Medium (5,000-9,999 connections)**			
Nairobi	180.82	95,380	10,574	**Machakos**	0.97	660	105
Eldoret	14.89	8,286	769	**Tuuru**	1.59	261	27
Mombasa	11.31	5,469	767	**Nyandarua**	0.88	477	51
Nakuru	11.97	8,464	1,090	**Kibwezi Makindu**	1.48	940	85
Thika	14.14	9,577	914	**Narok**	1.21	509	103
Ruiru-Juja	13.18	7,989	1,018	**Embu**	1.12	796	32
Kisumu	11.72	7,330	1,038	**Tana**	1.84	651	28
Nzoia	8.19	4,221	420	**Migori**	0.53	302	20
Embu	7.51	4,607	409	**Kapsabet Nandi**	1.24	778	53
Gatundu	5.22	3,521	142	**Kirandich**	1.70	576	30
Nyeri	7.80	6,493	644	**Murugi Mugumango**	3.61	1,914	14
Kakamega	4.57	2,856	334	**Chemususu**	0.88	392	23
Kericho	3.91	1,836	195	**Samburu**	0.42	216	8
Murang'a South	2.16	3,373	211	**Small (<5000 connections)**			
Kirinyaga	6.21	2,618	172	**Lamu**	0.59	301	23
Kilifi Mariakani	10.28	5,674	562	**Kiambere Mwingi**	0.93	605	120
Othaya Mukurweni	6.41	4,129	192	**Iten Tamboch**	0.73	495	34
Malindi	6.91	5,313	509	**Mandera**	0.53	280	19
Large (10,000-34,999 connetions)				**Kakamega Rural**	0.29	185	13
Mathira	2.02	1,275	105	**Ol Kalou**	0.55	345	42
Nakuru Rural	7.45	4,080	325	**Olkejuado**	0.26	143	12
Tavevo	6.12	3,545	321	**Muthambi 4K**	0.74	558	9
Gusii	3.58	1,231	231	**Kapenguria**	0.34	221	21
Nanyuki	4.04	2,818	383	**Rukanga**	0.22	185	12
Murang'a	5.81	3,652	382	**Naromoru**	0.32	229	14
kikuyu	2.84	1,731	832	**Elwak**	0.15		11

Table 2.29: Total Water Abstraction by Size of Water Supply Company, 2023 *(Continued)*

Water Company	Total Water Produced (000m³)	Total Water Billed (000m³)	Turnover (Ksh)mn	Water Company	Total Water Produced (000m³)	Total Water Billed (000m³)	Turnover (Ksh)mn
Nyahururu	3.24	1,995	236	Wajir	0.20	80	10
Meru	3.37	2,723	236	Yatta	0.34	215	28
Garissa	5.55	3,469	301	Kathiani	0.12	83	11
Bomet	3.63	1,238	96	Kiamumbi	0.47	401	23
Kwale	4.63	2,167	200	Matungulu Kangundo	0.16	100	15
Tetu Aberdare	2.57	1,651	69	Wote	0.43	310	38
Imetha	1.19	723	48	Mbooni	0.04	30	3
Ngandori Nginda	2.72	1,785	79	Nyasare	0.13	86	7
Sibo	2.53	1,102	140	Tochasis	0.38	285	4
Mavoko	1.17	785	201	Runda	0.86	691	84
Kitui	3.18	1,630	158	Mwala	0.06	41	8
Nithi	3.51	1,449	80	Tatu City	0.33	311	99
Oloolaiser	1.64	1,065	121				
Gatamathi	3.29	1,359	77				
Isiolo	2.15	1,507	107				
Kiambu	3.36	2,202	257				
Limuru	1.86	1,286	144				
Karuri	1.38	991	85				
Ngagaka	1.12	714	40				
Naivasha	2.23	1,667	226				
Homaby	0.73	426	55				
Busia	1.00	464	63				
Kyeni	0.68	326	16				
Gatanga	1.84	1,210	63				

Source: *16 WASREB Impact Report 2022-2023*

Access to Water and Sanitation services

The water coverage in regulated areas increased by three percentage points from 62 per cent to 65 per cent. mainly because of population served with water increasing at a rate of 10.8 per cent compared to a 5.7 per cent increase of the population within the Service Area.



65%

The water coverage in regulated areas increased by three percentage points from 62 per cent to 65 per cent.

Table 2.30: Accessbility to Water and Sanitation, 2023

Parameter	2019/20 (a)	2020/21 (b)	2021/22 (c)	2022/23(d)	Variance % (d-c)
Total Population in Service Area	25,660,154	26,271,419	26,731,200	28,266,927	5.7
Total Population Served with water	14,677,969	15,679,774	16,473,785	18,248,634	10.8
Population Served with sewer	3,922,437	4,093,204	4,324,983	4,437,279	2.6
Population Served with Sanitation	22,650,723	24,376,379	24,878,702	26,280,303	5.6
Total water produced, m^3	449,572,682	455,313,593	459,361,145	453,532,187	-1.3
Total water billed, m^3	237,825,974	249,998,802	254,261,544	257,995,383	1.5
Total water billed (domestic), m^3	166,452,523	172,704,926	164,284,639	166,030,354	1.1
Total revenue ,Kshs	22,796,171,562	23,171,877,070	24,624,564,304	26,448,013,664	7.4
Per capita production/c/d	83.9	79.6	76.4	71.2	-6.9
Per capita consumption/c/d	31.1	30.2	28.3	26.0	-7.1
Total number of water connections	1,306,743	1,268,209	1,359,577	1,415,656	4.1
Total number of sewer coonections	419,258	340,131	370,220	389,835	5.3

Source: *16 WASREB Impact Report 2022-2023*

Water Use and Expenditure by Economic Activity

Water use and its value by economic activities is presented in Table 2.31. In 2019, total volume of water used amounted to 11.5 million cubic meters. Sectors with the highest volume of water use includes electricity, gas, steam, and air condition, and manufacturing.

Table 2.31: Water Use and Expenditures by Economic activities, 2019

Industry	Quantity(m	Value
	mn m^3	KSh million
Mining and quarrying	12.3	2,525.0
Manufacturing	408.8	52,168.4
Electricity, gas, steam and air conditioning supply	10,995.9	5,076.4
Water supply; sewerage, waste management and remediation activities	57.8	2,985.6
Construction	8.2	1,362.0
Total	**11,483.0**	**64,117.3**

Source: *Census of Industrial Production Report, 2019*

Water and Sewerage Companies (WASCOs) were the main source of water for most economic sectors as presented in Table 2.32. The mining and quarrying sector sourced most of the water from lakes, rivers, borehole, wells, and dams.

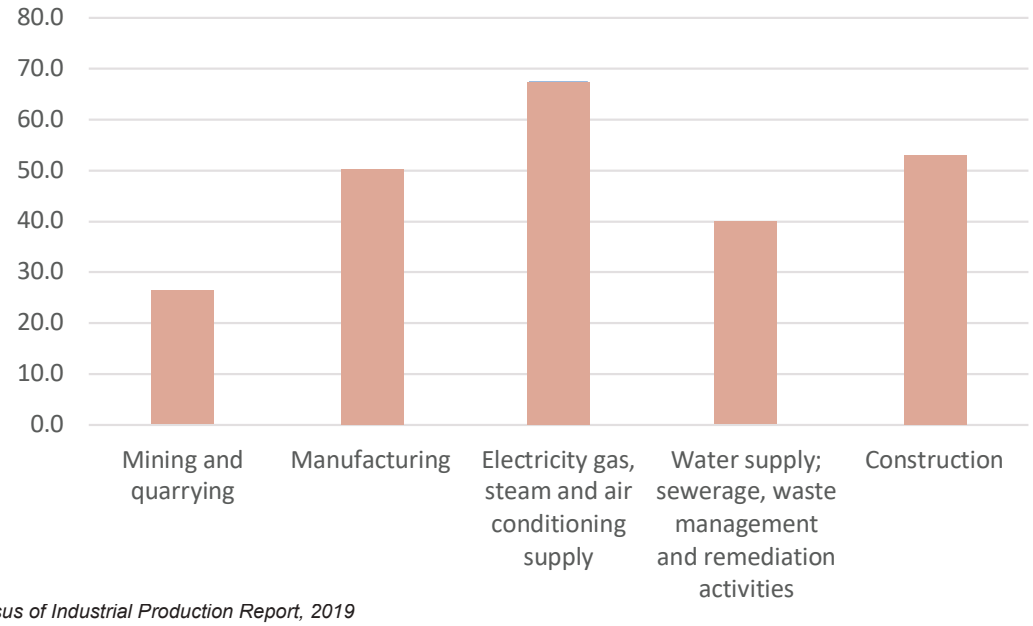
Table 2.32: Proportion of Water Used by Economic Activity by Source

Per cent

Economic Activity	WASCO	Vendor	Rain water	Lakes/ rivers/ boreholes/ wells or dams
Mining and quarrying	26.3	8.9	8.0	56.9
Manufacturing	50.1	9.2	2.1	38.7
Electricity gas, steam and air conditioning supply	67.5	32.5	0.0	20.0
Water supply; sewerage, waste management and remediation activities	39.9	5.7	2.0	52.3
Construction	53.0	27.4	2.5	17.2

Source: *Census of Industrial Production Report, 2019*

Figure 2.5: Proportion of Water from WASCO by Sectors



Source: *Census of Industrial Production Report, 2019*

2.3.4. Conclusion

This second chapter is closely related to the asset and physical flow accounts of the SEEA-CF .It gathered statistics on natural resources, such as subsoil resources (mineral and energy), soil resources, biological resources and water resources, and land. They may be naturally renewable (e.g., fish, timber, or water) or non-renewable (e.g., minerals). For Kenya, statistics are provided by Water Resources Authority, Ministry of Agriculture, KNBS etc. The next chapter will present statistics on residues.



03
RESIDUALS

3.0. Introduction

This component contains statistics on amount and characteristics of residuals generated by human production and consumption processes, their management, and their final release to the environment. Residuals are solid, liquid, and gaseous materials that are discarded, discharged, or emitted through processes of production, consumption and accumulation. Residuals may be discarded, discharged, or emitted directly to the environment or be captured, collected, treated, recycled, or reused. The main groups of residuals are emissions, wastewater, and waste.

3.1. Emissions to Air

The summary of Green House Gases (GHGs) emissions, which are the drivers of climate change is presented in Table 3.1. Kenya's total GHG emissions in 2010 were 69.6 million metric tons of carbon dioxide equivalent (MtCO2e), totalling 0.13 per cent of global GHG emissions. The agriculture sector emitted 61.1 per cent of total emissions, followed by the energy sector (30.4 per cent), industrial processes sector (4.6 per cent), and waste sector (3.9 per cent).

Table 3.1: Summary of Greenhouse Gas Emissions and Removals by Sectors

Sector	GHG Emission ($MtCO^2e$)				
	1995	2000	2005	2010	2015
Forestry (LULUCF)	10	21	18	21	26
Electricity Generation	0	1	1	1	1
Energy Demand	4	5	5	6	7
Transportation	4	4	4	7	9
Agriculture	24	23	26	30	32
Industrial Processes	1	1	1	2	3
Waste	1	1	2	2	2
Total	**44**	**56**	**57**	**69**	**80**

Source: *Government of Kenya 2015. Kenya Second Communication to the UN Framework Convention on Climate Change*

The two main types of greenhouse emissions are direct and indirect greenhouse gas emissions.

Direct greenhouse gases. Direct GHGs emissions are emissions from sources that are owned or controlled by the reporting entity as shown in Table 3.2. The direct greenhouse gases are carbon dioxide (CO2), nitrous oxide (NO2), and methane (CH4). As shown in Table 3.2, the highest was from methane (CH4) with a total of 15,768 Gg. Carbon dioxide emission had negative 22,750 Gg while Nitrous Oxides had 448.17 Gg during the same period.

Direct GHGs emissions

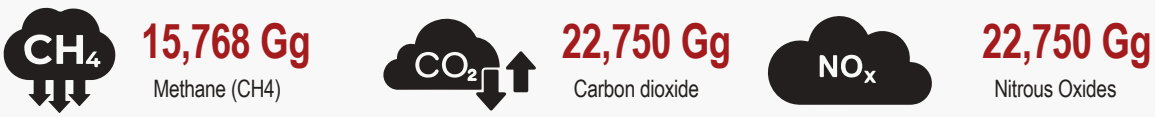


Table 3.2: Emissions of Direct Greenhouse Gases

Indicator	Gas	2010
Emissions of direct greenhouse gases	Carbon Dioxide	22,750
	Methane	15,768
	Nitrogen Dioxide	448.17
	Agregates GHGs	6,533.83

Source: *Government of Kenya 2015. Kenya Second Communication to the UN Framework Convention on Climate Change*

Indirect gas emission. Indirect GHGs emissions are as a consequence of the activities of the reporting entity but occur at sources controlled by another entity. The indirect greenhouse gases are Non-Methane Volatile Organic Compounds (NMVOCs), nitrogen oxides (NOx) comprising of nitrogen monoxide (NO) and nitrogen dioxide (N2O), sulphur dioxide (SO2), and carbon monoxide (CO) as shown in Table 3.3.

Table 3.3: Emissions of Indirect Greenhouse Gases (SO2, NOx, CO, NMVOC), 000 Metric Tons

GHG Inventory in (CO^2 eq-Gg)			
Gas	**1994**	**2000**	**2010**
HFCs		118	86
Nox	50.9*		
CO	1656.8*		
NMVOC	6.0*		
SO2			

Source: *GoK 2015. Kenya Second Communication to the UN Framework Convention on Climate Change*

Note *1. 1 Gg = 1000 metric tons*

2. Start Year on record and Last Inventory Year vary.

3. Total emissions include LULUCF/LUCF (Land Use, Land-Use Change and Forestry).

Activities in the LULUCF sector can provide a relatively cost-effective way of offsetting emissions, either by increasing the removals of greenhouse gases from the atmosphere (e.g. by planting trees or managing forests), or by reducing emissions (e.g. by curbing deforestation). However, there are drawbacks as it may often be difficult to estimate greenhouse gas removals and emissions resulting from activities of LULUCF.

Table 3.4 shows emissions of Carbon dioxide by sectors. The road transport is the main emitting sector contributing over 58 per cent of emissions in 2010 followed by manufacturing/construction and energy industries at 13.6 per cent and 10.7 per cent, respectively.

Table 3.4: Carbon Dioxide Emissions by Sectors in Kenya

Source	Energy Sub-Sector	CO_2 Emissions (Gg)				% Change 2005-2010
		1995	2000	2005	2010	
Combustion emissions	Energy Industries	773	978	1,188	1,253	5.5
	Manufacturing Industries & Construction	876	948	1,117	1,604	0.6
	Civil Aviation	360	348	447	433	0.2
	Road Transport	3,069	3,357	3,821	6,830	1.2
	Railways	10	11	14	24	1.4
	Navigation	47	56	51	50	0.1
	Commercial/Institutional	279	402	399	496	0.8
	Residential	685	1,059	878	952	0.4
	Agriculture/Forestry/Fishing	51	68	79	111	1.2
Fugitive Emissions	Refining and Storage	-	-	-	-	0.0
Total Energy Emissions		**6,149**	**7,228**	**7,994**	**11,755**	**0.9**

Source: *Government of Kenya 2015. Kenya Second Communication to the UN Framework Convention on Climate Change*

3.2. Consumption of Ozone Depleting Substances

Ozone depleting substances (ODS) are substances or chemicals that are harmful to the ozone layer in the upper atmosphere. This indicator is used to monitor the reduction in the usage of Ozone Depleting Substances (ODSs) as a result of the Montreal Protocol. The Montreal Protocol is mandated to monitor the use and phasing out of these substances. Reducing consumption ultimately leads to reductions in emissions since most uses of ODSs finally lead to the substances being emitted into the atmosphere. As there are several ODS, the target is to phase out first the most harmful ones. Table 3.5 shows the depleting substances commonly in use and year the substance was phased out.



Table 3.5: List of Ozone Depleting Substances

Name of Ozone Depleting Substances	Description	Any other information
Chlorofluorocarbons (CFCs)	- CFCs are organic compounds that contain carbon, chlorine and fluorine - CFCs have been banned - Before CFCs were banned, they were used in aerosols, refrigerators, air conditioners, foam food packaging, and fire extinguishers	CFCs were phased out in the year 2010
Halons	- Halons are chemical compounds formerly used in fire fighting - A group of compounds containing bromine and fluorine and one or two carbons	Phased out in the year 2010
Carbon Tetrachloride (CTC)	- Listed as an ozone depleting substance (ODS) in 1990 - Used as a solvent - Used as a refrigerant	Phased out in the year 2010
Methyl Chloroform	- Listed as an ozone depleting substance (ODS) in 1990 - Used as a solvent	Phased out in the year 2015
Hydro chlorofluorocarbons (HCFCs)	- HCFCs are a group of man-made compounds containing hydrogen, chlorine, fluorine and carbon - HCFCs are chemicals that are mainly used as refrigerants - HCFC commonly called R22 is often used in air conditioning equipment	The Montreal Protocol set the year 2013 as the time to freeze the consumption and production of HCFCs, reduce consumption and production by 10% in 2015, and a further reduction in consumption by 35% in the year 2020. The goal is to phase out HCFCs completely by 2030
Hydro bromofluorocarbons (HBFCs)	- Historically used in fire suppression systems and fire fighting	Phased out in the year 1996 Not used in Kenya
Bromo	- Listed as an ozone depleting substance (ODS) in 1999	Phased out in the year 2002
chloromethane (CBM)	- CBM was once used in fire extinguishers	Not used in Kenya
Methyl Bromide	- A fumigant used to control pests in agriculture and shipping - Used to treat perishable commodities and buildings	Methyl Bromide use in soil fumigation was phased out in 2015 except for critical use exemption Use of methyl bromide in quarantine and pre-shipment (QPS) treatment is not controlled by the Montreal Protocol

Source: *Ministry of Environment and Forestry*

3.3. Generation and Management of Wastes

Statistics on the amount and characteristics of waste, defined as discarded material for which the owner or user has no further use, generated by human activities in the course of production and consumption processes, are considered here. To reduce the amount of waste generated and increase the share of waste that is recycled and reused as material or energy source are central to sustainable consumption and production and natural resource management. The final disposal of waste in the environment, even if in a controlled manner, creates pollution and occupies considerable land areas.

Solid Waste

Waste collection is a critical step in managing waste. Volume of solid waste generated and collected to designated sites by the four cities of Nairobi, Mombasa, Kisumu and Nakuru is presented in Table 3.6.

Table 3.6: Total Amount of Municipal Solid Waste Generated, '000 Tonnes

County		2018	2019	2020	2021	2022	2023*
Nairobi+	Generated	730.0	839.5	876.0	1,095.0	1,095.0	1,191.5
	Collected	345.6	668.8	657.4	1,415.6	813.5	1,025.2
Mombasa+	Generated	804.0	879.0	914.0	920.0	1,000.0	1,200.0
	Collected	450.0	405.0	420.0	520.0	650.0	700.0
Kisumu	Generated	215.8	220.4	216.5	220.3	224.1	227.9
	Collected	64.7	66.1	65.0	66.1	67.2	68.4
Nakuru	Generated	-	-	-	-	383.3	400.0
	Collected	-	-	-	-	230.0	240.0

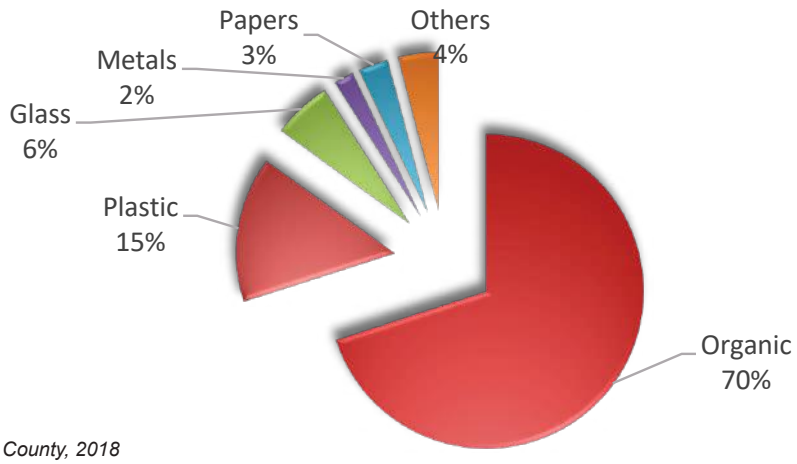
Source: *Nairobi City, Kisumu , Mombasa & Nakuru County Governments*

** Provisional*

+ Revised

Waste Composition. The overall composition of wastes in Nairobi is as shown in Figure 15. Organic waste which is also known as biodegradable waste, is produced mainly from living organisms, either plant or animal. These wastes include food waste, human waste, sewage, paper waste, manure, green waste, and slaughterhouse waste comprise of 70 per cent of total waste generated in Nairobi county.

Figure 3.1:Composition of Solid Waste



Source: *Nairobi City County, 2018*

3.4. Clinical/Medical Waste

Data on clinical/medical waste is available in three (3) microwave/shredding technology sites in Kenya. These are Kenyatta National Hospital, Moi Teaching & Referral Hospital and Nakuru Level-5 hospital. The daily microwaved/shredded waste from the three sites in 2018 is as shown in Table 3.7.

Table 3.7: Daily Clinical Waste

Name of Hospital	Status of Hospital	Daily Waste Microwaved/shredded/kg
Kenyatta National Hospital	National	2,100
Moi Teaching & Referral Hospital	National	1,800
Nakuru Level-5 Hospital	County Referral	1,800

Source: *Ministry of Health, 2018*

Total amount of solid waste generated by industrial and construction sectors in 2017 was 81.6 million tonnes. The manufacturing sector contributed the largest quantity of solid waste generated at 79.2 million tonnes. Waste generated by type of waste and economic activity is shown in Table 3.8.

Table 3.8: Waste Generated by Type of Waste and Economic Activity

Sector	Solid Waste (tons)	Hazardous Waste (kg)	eWaste (kg)	Liquid waste/Waste water (cubic metres)
Mining and quarrying	895.0	733.0	-	66,101.0
Manufacturing	79,207,012.0	4,259,071.0	15,527.0	179,692,217.0
Electricity, gas, steam and air conditioning supply	45	-	-	30.0
Water supply; sewerage, waste management and remediation activities	1,340,998.0	-	16.0	8,061,803.0
Construction	1,099,085.0	2,037.0	1,546.0	9,495,343.0
Total	**81,648,035.0**	**4,261,840.0**	**17,090.0**	**197,315,494.0**

Source: *Kenya National Bureau of Statistics (Census of Industrial Production Report, 2019)*

Table 3.9 shows the number of waste treatment facilities by economic activity in 2017. The number of waste treatment facility were 2,403 in manufacturing sector.

Table 3.9: Number of Waste Treatment Facilities by Economic Activity in 2017

Economic Activity	Number Waste Treatment Facility
Mining and Quarrying	30
Manufacturing	1527
Electricity, Gas, Steam, air conditioning	12
Water Supply, Sewerage, Waste management and remediation activities	117
Construction	717
Total	**2403**

Source: *Kenya National Bureau of Statistics (Census of Industrial Production Report, 2019)*

3.5. Conclusion

The third chapter above contains statistics on the amount and characteristics of residuals generated by human production and consumption processes, their management, and their final release to the environment. Statistics in this chapter are provided by KNBS, Nairobi City County, the Ministry of Health, the Ministry of Environmentand Forestry,etc.





04

NATURAL EXTREME EVENTS AND DISASTERS

4.0. Introduction

This component organizes statistics regarding the occurrence and impacts of extreme events and disasters on human wellbeing and on the infrastructure of the human sub-system.

4.1. Occurrence of Natural Extreme Events and Disasters

Over the years, Kenya has been exposed to various forms of disasters such as droughts, fires, floods and industrial accidents. Some of these have slow-onset while others have rapid-onset characteristics. Slow-onset disasters are cyclical in nature, they impinge on large human populations and their effects can be predicted, controlled and prevented. Rapid-onset disasters affect fewer people; they take place at any time, may be violent and require a quick response. To address these challenges, the government established the National Disaster Operation Centre (NDOC) which documents and finds solutions to national disaster.

4.1.1. Type of Natural Extreme Events and Disasters

Kenya experiences several natural hazards, the most common being weather related, including floods, droughts, fires, landslides, traffic accidents and disease outbreaks.

Droughts:

Kenya has experienced several episodes of drought, both short-term (2 years and below) and long-term (above two years). Between 1993 to date, the government has declared 7 national disasters out of which 5 were drought related. These declarations followed the droughts of 1992-93, 1996-97, 1999-2000, 2005-06 and 2008-09. Some of the notable droughts occurred in 2004 and 2008 -2011. 2014-2016 and 2019 as in Table 4.1.

Table 4.1: Chronology of Drought Incidences in Kenya Since 1883

1883	Coast Province	Worst famine in 30 Years
1889 - 1890	Coast Province	One year of drought and famine
1894 - 1895		Information not available
1896 - 1900	Coast Province	Severe drought
1907 - 1911	Countrywide	Failure of three consecutive rainy seasons, human deaths
1913 - 1919	L. Victoria, Machakos, Kitui and Coastal Regions	Minor food shortages
1921	Eastern and Coastal regions	Impacts exacerbated by warfare
1925	Rift Valley, Central and Coast Provinces	Local food shortages, Crop and Livestock losses (50% in Baringo District)
1938 - 1939	Northern Rif Valley and Central Province	Heavy loss of livestock, Lorain swamp dried up and deaths occurred
1942 - 1944	Countrywide	Food shortages, about 200 deaths reported
1947 - 1950	Central, Coast, Eastern, Nyanza, Western and Rift Valley Provinces	Significant drought.
1952 - 1955	Eastern Province, South/North of Rift Valley Province	Droughts followed by floods, cattle mortality at about 70 - 80% in Maasai land
1960 - 1961	Widespread	Rains about 50% long-term mean, Nairobi water shortage, Wildlife death in the Nairobi National Park.
1972	Most of Kenya	Human and Livestock death in the Northern districts, Maasai cattle losses about 80%
1973 - 1974	Eastern, Central, Northern regions	Crop production paralyzed

Table 4.1: Chronology of Drought Incidences in Kenya Since 1893 *(Continued)*

1974 - 1976	Central, Eastern, Western, coast	Famine in eastern province Water shortages, migration of people and livestock. Large food deficits
1980	Eastern province	Famine in eastern province Water shortages, migration of people and livestock. Large food deficits
1981 - 1983	Countrywide	Severe food shortages in Eastern province
1984	Central, Rift Valley, Eastern and North Eastern	Moderately Severe in Eastern Province, Relief food imported.
1987	Eastern and Central	4.7 million people dependent on relief power and water rationing
1992 - 1994	Northern, Central, Eastern Provinces	Ethnic violence after the 1992 elections
1999 - 2000	Countrywide except west and coastal belt	Droughts, floods and landslides
2004	Pastoral communities	About 3 million people in need of relief aid for 8 months to March 2005 70% loss of livestock in some pastoral communities
2005	Pastoral communities	2.5 million people close to starvation
2006	Widespread	40 human lives lost and about 40%cattle, 27% sheep and 17% goats lostDeclared a national disaster
2007-08	Widespread	4.4 million people affected, 2.6 million people at risk of starvation, up to 70% loss of livestock in some dpastoral communities 3.5 million in need of food by September
2009	Widespread	70-90% loss of livestock by Maasai pastoralists
2011	Garissa, Isiolo, Wajir,Mandera, Mombasa,Marsabit, Nairobi, Samburu andTurkana Counties	4.3 million people were in dire need of food
2012	Widespread	3.75 million people in dire need of food
2016-2017	widespread	Nearly 2.7 million people were estimated to be in need of food aid,
2019	widespread	1.1 to 2.5 million people in need of food

Source: *National Drought Management Authority*

Floods and Landslides:

Floods can be describes as excess flows exceeding the transporting capacity of rivers, lakes, ponds, dams and any other water body where water inundates outside the water body Aris MM (2003). Many factors and conditions contribute to the occurrence of floods in Kenya. The country has in the past experienced flash floods, river floods and coastal floods. In some cases, the human interference with watersheds, drainage basins, riparian zones and flood plains may cause floods. Floods have occurred in the river basins even with normal rains because of excess surface water runoff occasioned by deforestation, poor cultivation methods and land degradation upstream. Kenya is affected by floods following torrential rainfall. These forces thousands of people living in the lowlands to move to higher grounds for safety. The people affected are mostly in Western, Nyanza provinces (Budalangi) and Tana River district. However, slum dwellers in towns like Nairobi who have erected informal structures near rivers have not been spared either due to poor drainage systems.

The record of the flood disasters in Kenya as shown in Table 4.2 identifies the worst floods recorded in 1961- 62 and 1997-98, the latter ones being the most intense, most widespread and the most severe. During 1997-98, the flooding was associated with the El Nino phenomenon.

Landslides on the other hand are a form of soil erosion that results from a downward and outward movement

of slope-forming materials including rocks, soils, and artificial fills. Landslides are among the major natural disasters in mountainous regions of Kenya having the highest number of recorded incidences of landslides. Negative impacts of landslides include soil erosion, land degradation, loss of land value, loss of life, loss of property, destruction of infrastructure including roads and bridges, displacement of people, boundary conflicts, and siltation of rivers. Landslides occurrence is closely related to rainfall, land slope, land cover, soil type and geology. Major landslide triggers include heavy continuous rainfall in soils with infiltration rates greater than internal drainage, deforestation of steep slopes, slope instability caused by man-made cuts in hills during road construction or excavation of toe-slope and gullies. Some of the areas prone to landslides in Kenya include Muranga and Elgeyo Marakwet counties as shown in the landslide risk maps below. Subsequently effects of floods and landslides are shown in Table 4.2.

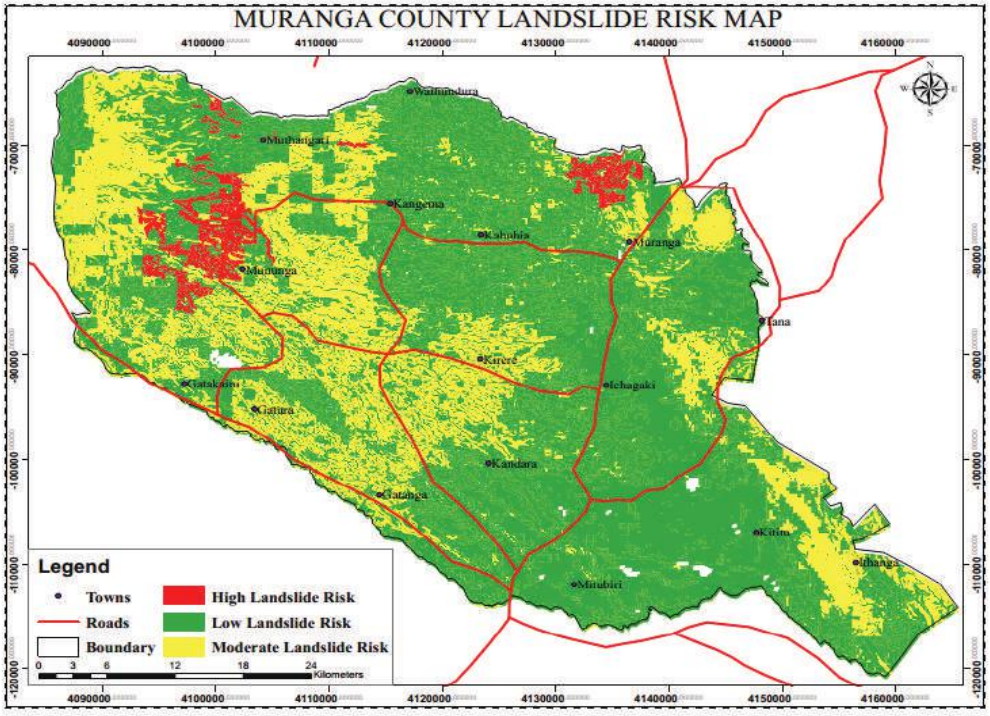


Table 4.2: Recent Floods and Landslides and Their Effects in Kenya

Year	Disaster type	Location	Effects
2023	El~Nino	Widespread	120 people killed, 546,000 people displaced
2018	solai dam tragedy	Nakuru	48 people killed
2015	Floods	Widespread	15 people killed and thousands displaced Infra-structure destroyed
	Landslides	Muranga County	Landslides
	Floods	Tana River County	82,000 people displaced
2013	Landslides	Nyeri, Murang'a, Kisii	2,000 people displaced
2012	Floods	Nyanza/Western	84 people killed, 30,000 displacedAbout 280,000 people affectedcountrywide
	Landslides	ElgeyoMarakwet County	10 people killed, hundred displaced
2010	Floods	Budalangi, Tana river, Turkana	73 killed, 14,585 people affected
	Landslides	Bududa, Mt Elgon , Samburu	3000 people buried, property destroyed
2008	Floods	Rift valley, Kitale, Makueni,Mwala/ Kibwezi, Bundalangi	24 people killedwith 2396 affected
	Mudslides	Pokot central	11 people killed
2007	Mudslides	TaitaTaveta County	3 dead
2006	Floods	Widespread	7 deaths, 6,500 people displaced
2005	Storm	Merti – Isiolo	4,000 people cut-off between Isiolo and Merti for 7 days
2004	Floods/ Land Slides	Nyeri/OthayaKihuri	5 people dead
2003	Floods	Nyanza, Busia, Tana River	170,000 people affected by severe floods
2002	Floods	Nyanza, Busia, Tana River	150,000 people affected
	Landslides	Meru Central, Murang'a, Nandi	2,000 people affected
1997-98	El Nino Flood	Widespread	1.5 million affected
1985	Floods	Nyanza, Western Province, Tana River	10000 Persons affected
1982	Floods	Nyanza	4000 Persons affected

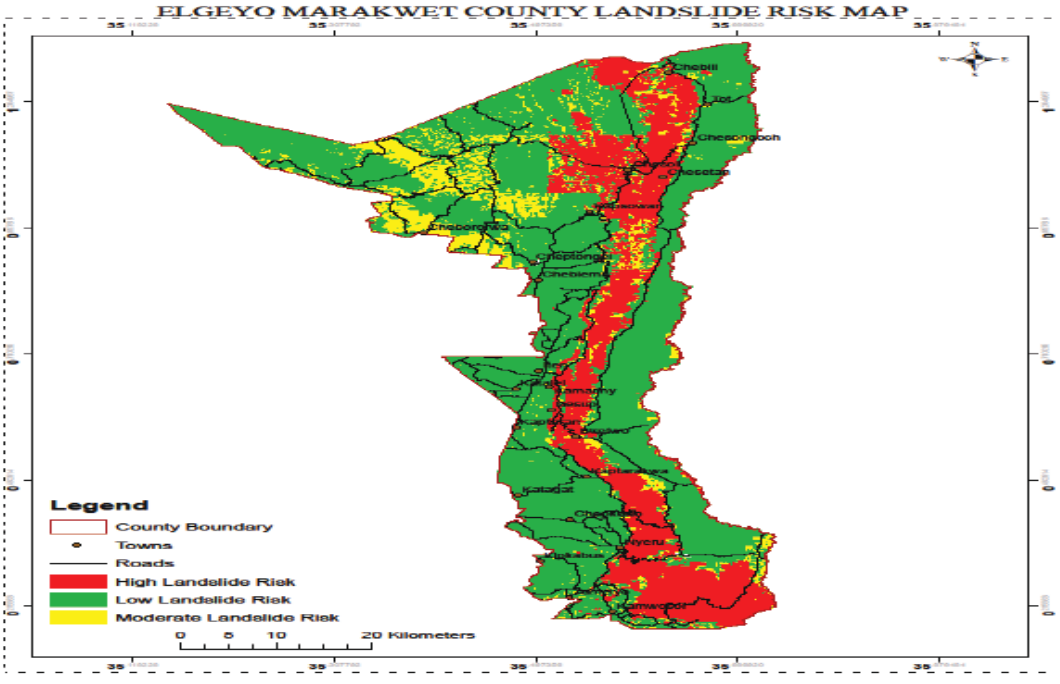
Source: *National Disaster Operation Centre*

Figure 4.1: Muranga County Landslide Risk



Source: *DRSRS 2016*

Figure 4.2: Elgeyo Marakwet County Landslide Risk Areas



Source: *DRSRS 2017*

Table 4.3: Landslide Occurrence in Elgeyo-Marakwet County

Constituency	Ward	No. of landslides recorded	Landslide types	Terrain	Rainfall	Land-use/land-cover
Marakwet East	Embombut/ Embolot	64	Earthflow, soil creep, mudflow, rock-fall	Extremely steep	900-1400	Crop farming, grazing, forestry, open shrubs, shrubbed woodland
	Sambirir	23	Earthflow, soil creep, mudflow, rock-fall	Very steep	900-1400	Crop farming, grazing, forestry, open shrubs, shrubbed woodland
	Endo	2	Earthflow, soil creep, mudflow, rock-fall	Very steep	900-1400	Crop farming, grazing, forestry, open shrubs, shrubbed woodland
Marakwet West	Kapsowar	6	Earthflow, soil creep, mudflow, rock-fall	Very steep/ steep	900-1400	Crop farming, grazing, forestry, open shrubs, shrubbed woodland
Keiyo North	Emsoo	6	Earthflow, soil creep, mudflow, rock-fall	Very steep/ steep	700-1000	Crop farming, grazing, forestry, open shrubs, shrubbed woodland
	Tambach	16	Earthflow, soil creep, mudflow, rock-fall	Very steep/ steep	700-1000	Crop farming, grazing, forestry, open shrubs
Keiyo South	Soy North	15	Earthflow, soil creep, mudflow, rock-fall	Very steep/ steep	700-1000	Crop farming, grazing, forestry, open shrubs
	Chepkorio	1	Earthflow, soil creep, mudflow, rock-fall	Very steep/ steep	700-1000	Crop farming, grazing, forestry, open shrubs
	Soy South	12	Earthflow, soil creep, mudflow, rock-fall	Very steep/ steep	700-1000	Crop farming, grazing, forestry, open shrubs
	Metkemei	2	Earthflow, soil creep, mudflow, rock-fall	Very steep/ steep	700-1000	Crop farming, grazing, forestry, open shrubs
	Kabiemit	2	Earthflow, soil creep, mudflow, rock-fall	Very steep/ steep	700-1000	Crop farming, grazing, forestry, open shrubs

Source: *DRSRS 2017*

Fires

Fire accidents have the most diverse causes of all the disasters. Fire disasters are very common in both developed and developing countries. They have diverse causes which are either man-made or natural. However, most of the fire disasters are man-made and include electrical faults (mostly due to overloading and short circuits), pantry area (cooking gas leaks, cooking oil, overheating of cooking medium), smoking (in/around combustible medium, falling hot ashes from the cigarette on a flammable material) and arsonist attacks.

Wildfires as a result are a common occurrence in the arid ASALS due to the high temperatures experienced during the drought season. The extent of damage, however, depends on the type of fire (nature of the material ablaze), the meteorological conditions (wind) and the effectiveness of the intervention. Table 4.4 shows some of the fire disasters in Kenya in the recent past.

Table 4.4: A Summary of the Major Fire Disasters

Disaster	Year	Cause	Effects
Oil spill from an overturned fuel truck	2009	Likely causes, static electricity, accidentally discharged cigarette	Mortality cases-113, Critical injuries- over 200 , Considerable environmental damage
Sachangwan, Oil tanker fire	2020	Victims were siphoning fuel from the overturned fuel tanker	Mortality cases- 4, Critical injuries - 50
Fire inside Nakumatt Nairobi town supermarket	2009	Likely from power systems default in the building	Mortality cases- 30, Several injuries and missing persons
Kenya Pipeline Company Fire outbreak in one of the Eastland's estates of Nairobi (Sinai Case)	2011	The state owned Kenya Pipeline Company had one of its fuel tank with a massive leak	Mortality cases - over 100, Several injuries, Massive property damage
Kyanguli Boys school	2001	Suspected arson	68
Bombolulu girls school	1998	Suspected arson	25
City Hall Nairobi	2004	Suspected arson	70 M none
Lamu	1982 1990	unknown	No record
Free market Nairobi	2001	unknown	Millions worth of merchandise

Source: *National Disaster Operation Centre*

Locust Invasion

The desert locust is a winged insect that travels in swarms, consuming almost every leaf of green vegetation in its wake. Kenya experienced its worst locust invasion in 70 years in 2020.

Structural Collapse

Disasters associated with collapse of buildings have been on the rise in the recent past in Kenya becoming death traps and causing huge financial losses. Such disasters occur due to structural failure as presented in Table 4.5.

Table 4.5: A Summary of the Major Structural Collapse Disasters

Year	Location	Effects
2006	Five-storey building under construction in the central business district in Nairobi	killed 11 and trapping over 200 workers under the debris
2009	Kiambu town	Data not available
2010	Kiambu town	Data not available
2011	Embakasi	Data not available
2011	Langata Southern Bypass	Data not available
2011	Luanda	Data not available
2012	Mlolongo along Mombasa Road	5 people killed and 10 injured
2013	Nairobi CBD	11 people killed and 200 trapped
2014	Nairobi	1 person killed
2015	Mukuru Fuata Nyayo area of South B	9 people killed

Source: *National Disaster Operation Centre*



4.2. Technological disasters

Road Transport

More Kenyans lose their lives in road traffic crashes every year as shown in Table 4.6. Many of these people are vulnerable road users–pedestrians, motorcyclists, and cyclists. In addition, nearly one-third of deaths are among passengers, many of whom are killed in unsafe forms of public transportation. The number of accidents ranges between 5,000 to over 10,000 annually as in Table 4.6.

Table 4.6: Technological Disasters Road Transport Accidents (Numbers)

Description	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Total Number of Reported												
Accidents	8193	6917	5 672	5 310	5 296	4 452	5 158	7 184	8919	10 210	9 976	9 960
Persons Killed and Injured:												
Killed	3020	3141	2 907	3 057	2 965	2 919	3 158	3 586	3 975	4 579	4 690	4 324
Seriously Injured	647	434	5 140	4 731	4 661	3 943	4 673	6 952	8026	10 050	9 931	10 762
Slightly Injured	7144	5037	3 971	4 350	5 533	4 353	5 046	5 209	4 969	5 996	7 137	7 799
Total	**19004**	**15529**	**12 018**	**12 138**	**13159**	**11215**	**12 877**	**15747**	**16970**	**20 625**	**21758**	**22 885**

Source: *National Police Service, Traffic Department*

Economic Survey 2024

4.3. Conclusion

This chapter organized statistics on the occurrence of extreme events and disasters and their impacts on human well-being and the infrastructure of the human sub-system. The most common data providers are National Disaster Operation Centre, national police service and DRSRS. The next will organise statistics on human settlements and environmental health.



05

HUMAN SETTLEMENTS AND ENVIRONMENTAL HEALTH

5.0. Introduction

This component presents statistics on the built environment in which humans live, particularly with regard to population, housing, basic services, living conditions and environmental health. These statistics are important for the management and improvement of conditions related to human settlements, shelter conditions, safe water, sanitation, and health. This is critical in the context of rapid urbanization, increasing pollution, environmental degradation, disasters, extreme events, and climate change.

5.1. Human Settlements – Urban and Rural Population

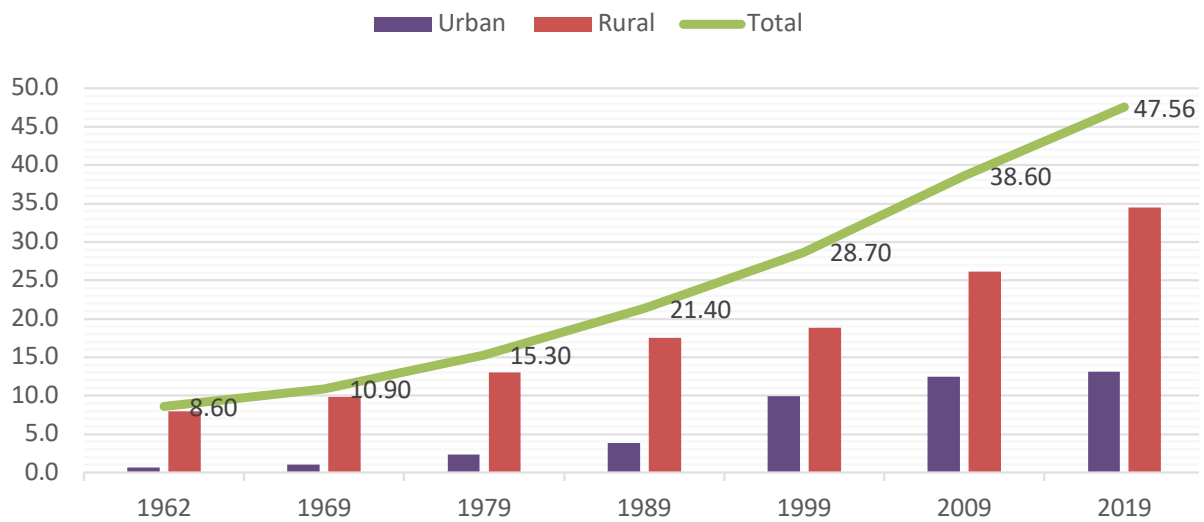
Population and its related statistics denote the pressure on the environment out of the activities carried out, including habitations. Tables 5.1 and Figure 5.1 show varying population sizes and facilities accessible to the people.

Table 5.1: Population in Millions and Population Density, 1962 – 2019 (People Per sq. km of Land Area) [1]

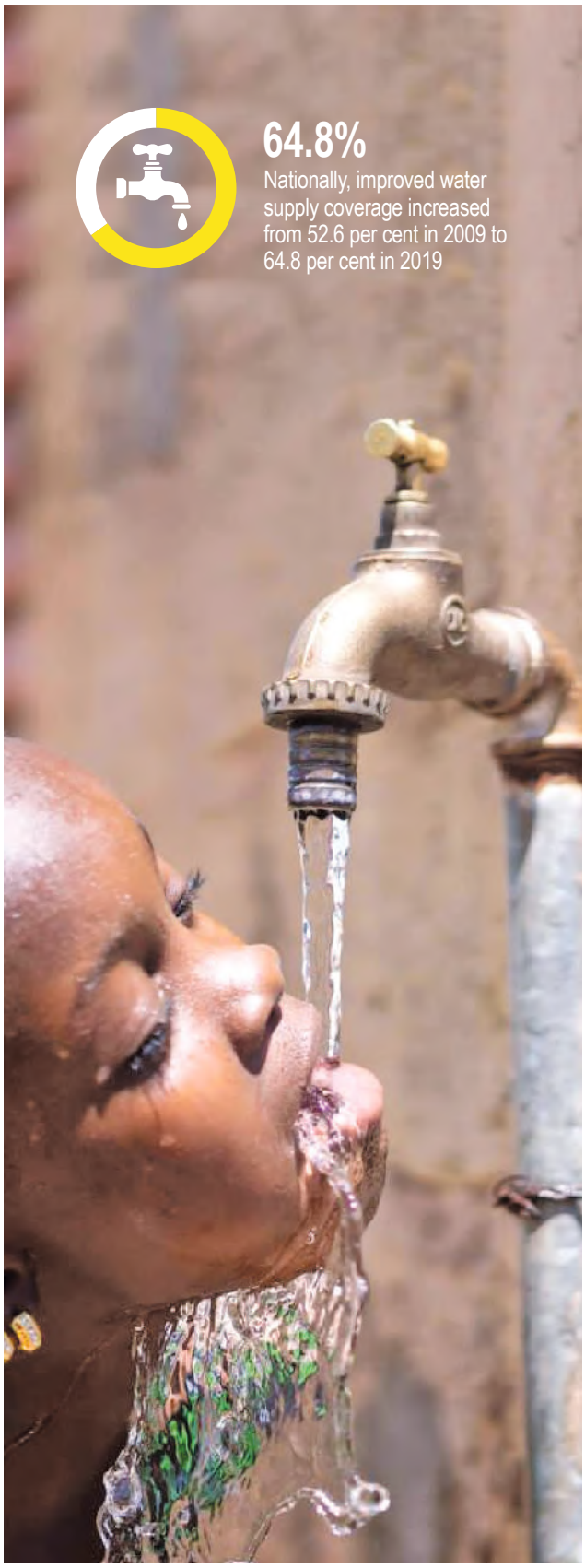
Year	Urban	Rural	Total	Population density
1962	0.63	7.97	8.6	14.81
1969	1.07	9.82	10.9	18.77
1979	2.31	12.99	15.3	26.35
1989	3.88	17.52	21.4	36.86
1999	9.9	18.8	28.7	49.43
2009	12.5	26.1	38.6	66.48
2019	13.1	34.48	47.56	81.91

Source: *[1]-Kenya Population and Housing Census*

Figure 5.1: Trend of Kenya Human Population Growth in Million persons



Source: *Kenya Population and Housing Census,2019*



5.2 Access to Selected Basic Services

Basic services such as electricity and energy, water and sanitation, refuse and waste removal are critical services to improve the lives of people.

Definition of Terms

Population using basic drinking water service- Is the population using an improved drinking water source/ facility with a total collection time of 30 minutes or less for a round trip, including queuing.

Population using safely managed drinking water services- Is the population using an improved source of drinking water (improved source of drinking water include: piped water into dwelling yard or plot, borehole or tube wells, protected dug wells, protected spring, rainwater and packaged or delivered water) which is located on premises, available when needed and free of (faecal and priority chemical) contamination.

Population using basic sanitation services- Population using an improved sanitation facility (improved sanitation facilities include: flush/pour flush to piped sewer system, septic tank or latrine; ventilated improved pit latrine, composting toilet or pit latrine with slab) which is not shared with other households.

Population using safely managed sanitation services-Population using improved sanitation facilities (improved sanitation facilities include: flush or pour flush to piped sewer systems; septic tanks or pit latrine; ventilated improved pit latrine; composting toilet or pit latrine with slab) which is not shared with other household and where excreta are treated and disposed in situ or transported and treated offsite

5.2.1. Access to Water by Households by Type of Source in Kenya

Nationally, improved water supply coverage increased from 52.6 per cent in 2009 to 64.8 per cent in 2019 as shown in Table 5.2. In 2009 and 2019, Urban areas had more water source coverage (71.7 per cent and 78.9 per cent) compared to rural areas where more than half of the households (56 per cent and 44.1 per cent) obtained water from unprotected sources. The data shows that piped water (i.e. piped & piped into dwelling) is the main source of water for urban residents while streams/rivers is the main source for the majority in rural areas.

Table 5.2: Access to Water by Households by Type of Source in Kenya in 2009 - 2019 (%)

Source	2009 [1]			2014 [2]			2016 [3]			2019 [1]		
	Overall	Urban	Rural	Overall	Urban	Rural	Overall	Urban	Rural	Overall	Urban	Rural
Unprotected Well	6.9	2.9	8.7	5.8	1.7	8.8	3.5	1.2	5.3	2.6	0.5	4
Water vendor	5.2	11.8	2.2	1.8	3.1	0.8	3.7	6.2	1.8	8.5	16.7	3.3
Unprotected Spring	5	1.9	6.4	3.7	1.2	5.5	5.0	1.3	7.9	2.4	0.3	3.7
Pond	2.7	0.9	3.6							1.6	0.2	2.4
Dam/lake	3.6	1.2	4.7	15.6	4.1	24.0	13.8	3.5	21.8	3.3	0.8	4.9
Stream/River	23.2	9.2	29.6							16.8	2.6	25.8
Other	0.4	0.1	0.5	1.7	1.7	1.7	1.0	0.6	1.4	-	-	-
Total Unimproved Sources	**47.4**	**28.3**	**56**	**28.6**	**11.8**	**40.8**	**27**	**12.8**	**38.2**	**35.2**	**21.1**	**44.1**
Piped (shared/ yard tap)	19.2	34.9	12.1	27.8	45.5	15	20.6	28.8	14.2	14.1	23.9	7.8
Piped into Dwelling	5.9	14.7	1.8				9.8	18.9	2.7	10.1	18.1	5.1
Piped (Public tap/ Stand pipe)	-	-	-	15.8	24.8	9.3	13.9	21.7	7.9	9.9	15.6	6.4
Borehole	11.6	10.7	12	6.3	3.8	8.2	6.6	4.6	8.2	9.9	6.8	11.8
Protected Well	7.7	6.8	8.1	7.6	3.9	10.3	6.4	3.5	8.6	7.0	4.0	9.0
Protected Spring	7.6	4	9.2	8.2	3.4	11.6	9.2	3.7	13.5	7.1	1.8	10.5
Rainwater Collection	1.9	1	2.3	3.7	2.6	4.5	4.6	2.2	6.5	3.9	2.0	5.0
Bottled Water	-	-	-	1.9	4.3	0.2	1.5	3.3	0.2	2.8	6.7	0.3
Total Improved Sources	**52.6**	**71.7**	**44.0**	**71.3**	**88.3**	**59.1**	**72.6**	**86.7**	**61.8**	**64.8**	**78.9**	**55.9**

Source: [1] Kenya Population and Housing Census
[2] Kenya Demographic and Health Survey
[3] Kenya Integrated Household Budget Survey

Table 5.3: Access to Sanitation by Households by Type of Source in Kenya in 2009 - 2019 (Per cent)

Type of Sanitation	2009 [1]			2014 [2]			2016 [3]			2019 [1]		
	Overall	Urban	Rural	Overall	Urban	Rural	Overall	Urban	Rural	Overall	Urban	Rural
Main Sewer	7.7	19.5	0.2	8.5	22.7	0.2	10.6	24.0	0.2	9.7	24.6	0.3
Septic tank	3.4	8.0	0.5	6.2	13.2	1.1	5.7	11.2	1.4	9.2	21.1	1.7
Cess pool	0.3	0.7	0.1	0.6	1.5	0.0	0.2	0.5	0.0	0.3	0.6	0.1
VIP Latrine	4.9	5.9	4.3	15.6	16.3	15.0	11.8	13.1	10.8	11.9	12.5	11.5
Pit latrine covered/ uncovered	69.6	62.5	74.1	58.0	45.3	66.8	59.4	43.6	71.6	60.6	38.8	74.2
Bucket latrine	0.3	0.6	0.1	0.1	0.2	0.0	0.3	0.6	0.0	0.8	1.2	0.5
Open/ Bush	13.7	2.6	20.7	9.9	1.4	16.0	8.4	1.4	13.9	7.4	0.8	11.5
Bio-septic tank/ Biodigester	0.1	0.2	0.0	0.2	0.2	0.1	0.2	0.1	0.2	0.2	0.3	0.1
Not Stated	0.0	0.0	0.0	0.5	0.9	0.1	0.3	0.5	0.2	0.0	0.0	0.0

Source: [1] Kenya Population and Housing Census
[2] Kenya Demographic and Health Survey
[3] Kenya Integrated Household Budget Survey

Table 5.4: Percent Distribution of Households by Source of Drinking Water and by Time to Obtain Drinking Water

	Households			Population		
Characteristic	**Urban**	**Rural**	**Total**	**Urban**	**Rural**	**Total**
Source of drinking water						
Improved source	94.4	70.9	80.4	93.9	67.7	76.5
Piped into dwelling/yard/plot	40.1	15.3	25.3	38.3	12.7	21.3
Piped to neighbor	6.2	4.4	5.1	6.1	3.8	4.6
Public tap/standpipe	16.9	7.2	11.1	16.1	7.3	10.3
Tube well or borehole	4.2	10	7.6	4.7	10	8.2
Protected dug well	3.1	8.7	6.5	3.6	9.2	7.3
Protected spring	1.5	11.7	7.6	1.9	12.5	9
Rain water	2.8	11.5	8	3	10.3	7.9
Tanker truck/cart with small tank	3.6	1.4	2.2	4.6	1.3	2.4
Bottled water	16.1	0.9	7	15.7	0.5	5.6
Unimproved source	4.2	8.6	6.8	4.3	9.3	7.6
Unprotected dug well	0.4	2.9	1.9	0.5	3.3	2.4
Unprotected spring	0.4	5.1	3.2	0.5	5.5	3.8
Other	3.4	0.6	1.7	3.3	0.4	1.4
Surface water	1.4	20.4	12.8	1.8	23	15.9
Total	**100**	**100**	**100**	**100**	**100**	**100**
Time to obtain drinking water (round trip)						
Water on premises[1]	72.5	40.3	53.3	71.6	35.3	47.5
30 minutes or less	24	37.7	32.2	24.2	39.5	34.4
More than 30 minutes	2.7	21.5	13.9	3.3	24.7	17.5
Don't know	0.8	0.5	0.6	0.9	0.4	0.6
Total	**100**	**100**	**100**	**100**	**100**	**100**
Number of households/population	15,277	22,634	37,911	47,732	94,294	142,026

Source: *KNBS (KDHS 2022)*



Table 5.5: Percent Distribution of Households by Type of Toilet/Latrine Facilities.

Percent distribution of households and de jure population with a toilet/latrine facility by location of the facility

Type and location of toilet/latrine facility	Households			Population		
	Urban	Rural	Total	Urban	Rural	Total
Improved sanitation facility	92.6	57.7	71.8	91.7	53.9	66.6
Flush/pour flush to piped sewer system	29.2	0.4	12	28.1	0.3	9.6
Flush/pour flush to septic tank	19.6	2.5	9.4	20.1	2	8.1
Flush/pour flush to pit latrine	5.7	1.7	3.3	5.6	1.5	2.9
Flush/pour flush, don't know where	1.9	0.1	0.8	1.7	0	0.6
Ventilated improved pit (VIP) latrine	10.1	13	11.8	10	11.9	11.2
Pit latrine with slab	26	39.9	34.3	26.2	38.2	34.2
Composting toilet	0	0.1	0.1	0	0.1	0.1
Unimproved sanitation facility	6.8	33.8	22.9	7.4	35.6	26.1
Flush/pour flush not to sewer/septic tank/ pit latrine	1.8	0.1	0.8	1.7	0.1	0.6
Pit latrine without slab/open pit	4.8	33.5	21.9	5.3	35.3	25.2
Bucket	0.2	0	0.1	0.4	0	0.1
Hanging toilet/hanging latrine	0	0.1	0.1	0	0.1	0.1
Other	0	0.1	0.1	0.1	0.1	0.1
Open defecation (No facility/bush/field)	0.6	8.5	5.3	0.9	10.4	7.2
Total	**100**	**100**	**100**	**100**	**100**	**100**
Number of households/population	15,277	22,634	37,911	47,732	94,294	142,026
Location of toilet facility						
In own dwelling	32.7	7	17.9	35.4	6.2	16.7
In own yard/plot	62.2	86	75.9	60.1	87.2	77.5
Elsewhere	5.1	7	6.2	4.5	6.5	5.8
Total	**100**	**100**	**100**	**100**	**100**	**100**
Number of households/population with a toilet/latrine facility	15,186	20,699	35,885	47,323	84,446	131,769

***Source**: KNBS (KDHS 2022)*



Table 5.6: Percent Distribution of De Jure Population by Drinking Water Service Ladder, According to County

County	At least basic service[1]	Limited service	Unim-proved	Surface water	Total	Number of persons
Mombasa	52.4	7.5	39.7	0.4	100	3,480
Kwale	46.7	11.9	10	31.5	100	2,359
Kilifi	66.2	7.3	3	23.5	100	4,293
Tana River	48.7	10	1.6	39.7	100	864
Lamu	65.9	14.5	14.4	5.2	100	470
Taita Taveta	68.3	12.1	4.5	15.2	100	1,128
Garissa	70.8	14.1	12.5	2.5	100	1,516
Wajir	52.9	24.6	11	11.5	100	920
Mandera	54	21.7	1.7	22.6	100	1,302
Marsabit	41.3	43.4	1.7	13.7	100	795
Isiolo	72.1	13.9	4.3	9.7	100	680
Meru	73.7	7.2	7.6	11.5	100	4,568
Tharaka-Nithi	61.1	1.8	2.9	34.2	100	1,345
Embu	73	7.1	2.2	17.7	100	1,685
Kitui	21.2	14.6	5.6	58.6	100	3,479
Machakos	68.1	11.6	4.8	15.4	100	4,250
Makueni	46	15.1	9.5	29.5	100	2,903
Nyandarua	89.5	3	2.1	5.4	100	1,846
Nyeri	90.7	0.1	1	8.2	100	2,138
Kirinyaga	76.2	1.7	1.9	20.2	100	1,940
Murang'a	80.6	1.7	7.2	10.4	100	3,155
Kiambu	94.2	1.6	0.6	3.5	100	7,889
Turkana	41.7	24.5	24.8	9.1	100	1,854
West Pokot	38.1	4	2.4	55.4	100	2,266
Samburu	28.6	13.8	16.7	40.8	100	863
Trans Nzoia	72.2	12.6	5.6	9.6	100	3,219
Uasin Gishu	79	1.9	15	4	100	4,090
Elgeyo-Marakwet	64.2	1.4	5.7	28.6	100	1,279
Nandi	46.2	0.8	28.5	24.5	100	2,681
Baringo	38.7	15.4	5.2	40.7	100	1,967
Laikipia	69.7	3.8	4.3	22.2	100	1,467
Nakuru	72.6	5.7	8.9	12.8	100	6,850
Narok	48.2	11.1	7.5	33.3	100	3,740
Kajiado	73.8	14.8	1.6	9.8	100	3,761
Kericho	62.5	5	16.1	16.5	100	3,135
Bomet	73.5	6.1	2.8	17.6	100	2,869
Kakamega	74.4	12.7	7.1	5.8	100	6,047
Vihiga	75.2	10.4	7.7	6.7	100	1,762
Bungoma	70	17.9	6.9	5.3	100	5,226
Busia	57.1	14.3	14.1	14.6	100	3,042
Siaya	48.5	7	1.8	42.7	100	2,703
Kisumu	71.5	8.5	3.4	16.6	100	3,477
Homa Bay	57.2	7.5	2.1	33.2	100	3,393
Migori	52.9	2.6	11	33.5	100	3,341
Kisii	44.4	23.6	27.8	4.2	100	3,722
Nyamira	55.6	21.9	6.2	16.4	100	1,653
Nairobi	98.6	1.4	0	0	100	14,614
Total	**67.9**	**8.7**	**7.6**	**15.9**	**100**	**142,026**

Source: *Kenya Demographic and Health Survey 2022*



Table 5.7: Percentage of De Jure Population using Various Methods to Treat Drinking Water

Percentage using an appropriate treatment method, according to residence, according to background characteristics, Kenya DHS 2022

Background characteristic	Boil	Bleach/ chlorine added	Strain through cloth	Ceramic, sand or other filter	Solar disinfection	Let it stand and settle	Cover the water container	Other	Don't know	No treatment	Percentage using an appropriate treatment method[1]	Number of persons
Residence												
Urban	21.6	14.4	0.6	1.3	0	0.5	0.8	0.1	0	65.9	33.5	47,732
Rural	19.9	17.6	2.4	1.1	0.1	2.1	2.6	0.1	0	61.3	35.4	94,294
Source of drinking water												
Improved	21.1	16.2	1.5	1.2	0	1.5	1.9	0.1	0	62.8	35	108,706
Unimproved	18.9	15.4	3	0.8	0.1	2.3	3.7	0.1	0.1	63.9	32.2	10,788
Surface	18	18.7	2.9	1.1	0.1	1.7	1.5	0	0	62.8	34.4	22,532
Wealth quintile												
Lowest	10.8	11.3	2.2	0.8	0.1	1.4	1.5	0	0.1	76	21.2	28,409
Second	17.2	19.1	3.2	1.1	0	2.5	2.9	0	0	61.1	34.6	28,408
Middle	22.2	18.6	2.1	1	0	1.9	2.7	0.1	0	58.8	38.5	28,404
Fourth	25.6	16.1	1	0.9	0	1.5	1.9	0	0.1	59.6	38.9	28,406
Highest	26.5	17.3	0.6	1.9	0	0.5	0.7	0.2	0	58.9	40.4	28,400
Total	**20.5**	**16.5**	**1.8**	**1.1**	**0**	**1.6**	**2**	**0.1**	**0**	**62.9**	**34.7**	**142,026**

Source: *Kenya Demographic and Health Survey 2022*



Table 5.8: Percentage of De Jure Population using Various Methods to Treat Drinking Water

Percentage using an appropriate treatment method, according to residence, according to county, Kenya DHS 2022

County	Boil	Bleach/ chlorine added	Strain through cloth	Ceramic, sand or other filter	Solar disin-fection	Let it stand and settle	Cover the water container	Other	Don't know	No treatment	Percentage using an appropriate treatment method	Number of persons
Mombasa	10	24.2	0.5	0.4	0	0.2	0	0.3	0	68.4	31	3,480
Kwale	5.2	14	0.9	0.1	0	1.2	0	0	0	81.8	16.8	2,359
Kilifi	3.8	6.9	0.6	0.1	0	0.6	3.3	0.1	0	86	10.3	4,293
Tana River	0.9	8.5	0.1	3.7	0	0	0.1	0	0	87.2	12.8	864
Lamu	7.3	13.6	0.5	0	0	1.1	0.7	0.5	0.2	79	19.4	470
Taita Taveta	13.9	16.8	0.2	0.2	0	1.7	0.6	0.2	0	70.3	28.3	1,128
Garissa	2	1.7	0	0	0	0	0	0.1	0	96.8	3.1	1,516
Wajir	2.2	3.4	0	0	0	0	0.1	0	0	94.5	5.5	920
Mandera	0.6	9.5	0	0.2	0	1	0	0	0	89.7	10.3	1,302
Marsabit	2.4	16.7	0	0	0	0	0	0	0.1	81.8	18.2	795
Isiolo	12.5	18.1	0.5	0.5	0	0.1	0.4	0	0	72.8	27	680
Meru	39.2	4.4	0.2	0	0	1.3	0	0.2	0.1	57.9	41.4	4,568
Tharaka-Nithi	28	4.7	0	0	0.1	1	0.3	0	0	68.2	31	1,345
Embu	19.4	4.3	0	0.5	0.3	0.3	3.5	0	0	76.3	23.3	1,685
Kitui	7.8	12.3	0.3	0.3	0	1.5	0	0	0	79.3	19.2	3,479
Machakos	13.5	14.2	0.6	0.5	0	0.8	0	0.2	0	72.3	26.7	4,250
Makueni	14.1	16.5	0	0.4	0	0.2	0	0	0	72.3	27.7	2,903
Nyandarua	39.5	5.9	0.1	0.5	0	0.4	0.4	0	0	56.6	42.9	1,846
Nyeri	35.3	8.3	0	0.4	0.3	2.7	3.3	0	0.3	54.6	42	2,138
Kirinyaga	21.9	11.5	0	1	0	1.5	1.3	0	0	67.7	30.9	1,940
Murang'a	26.4	8.8	1.6	0.6	0	10.7	10	0.2	0	58.4	34.4	3,155
Kiambu	28.4	9.8	0	0.4	0	0.2	0	0	0.1	64.2	35.5	7,889
Turkana	6.8	12	0.6	0.1	0.1	2.3	7	0.7	0	80.3	16.4	1,854
West Pokot	10.3	5.9	0.7	0.3	0	0.1	0	0	0	83.8	15.3	2,266
Samburu	7.1	7.5	0.1	1.7	0	0.7	0	0	0	84	15.1	863
Trans Nzoia	26.4	27.4	1.2	0.4	0	3.9	3	0	0	51.1	46.1	3,219
Uasin Gishu	42.7	18.7	1.3	0.9	0	0.4	10.5	0.3	0	41	57.7	4,090
Elgeyo-Marakwet	26.4	2.8	0.3	0.5	0	0.6	0.2	0	0	70.3	28.9	1,279
Nandi	38.9	8.5	2.3	0.2	0	3.2	3.2	0	0	52.7	46.3	2,681
Baringo	27.6	6.1	0.2	0.3	0	0.8	0.5	0	0	67	32.7	1,967
Laikipia	31.3	6.1	0	0.2	0	0.5	0	0.3	0	63.3	35.9	1,467
Nakuru	26.3	8.6	0.6	5.5	0	0.7	0.2	0	0.1	63.7	35.7	6,850
Narok	16.8	11.3	0.1	0.6	0.3	0	5.1	0	0.2	68.7	26.7	3,740
Kajiado	19.1	12.9	1	2.8	0	0.1	0	0	0	69.8	30	3,761
Kericho	10.3	2.8	0	2.9	0	0	5.7	0.1	0.1	79.7	15.8	3,135

Table 5.8: Percentage of De Jure Population using Various Methods to Treat Drinking Water *(Continued)*

Percentage using an appropriate treatment method, according to residence, according to county, Kenya DHS 2022

County	Boil	Bleach/ chlorine added	Strain through cloth	Ceramic, sand or other filter	Solar disin-fection	Let it stand and settle	Cover the water container	Other	Don't know	No treatment	Percentage using an appropriate treatment method	Number of persons
Bomet	17.2	5.8	0.1	3.5	0	0.9	1.8	0.2	0	72.3	25.7	2,869
Kakamega	13.7	30.1	2	1.9	0	1.6	0.8	0.2	0	55.4	41.6	6,047
Vihiga	16.5	26.5	2.3	2.4	0.1	7.9	5.2	0.1	0	51.6	40.8	1,762
Bungoma	11.7	30.6	5.3	2.7	0	2.9	2.6	0	0	52.6	41.7	5,226
Busia	12.4	56.5	5.8	0.9	0.1	0.9	0.8	0.2	0	33	63.8	3,042
Siaya	17.6	53.1	2.1	0.1	0.5	0.2	1.9	0	0	36.3	62.5	2,703
Kisumu	22.1	41.2	8.8	0.5	0	0.6	0.2	0.2	0.1	44.3	53.9	3,477
Homa Bay	26.9	41.9	14.6	0.5	0.3	2.9	1.5	0	0	33.6	60.4	3,393
Migori	20.2	41.5	15.1	0.5	0	3.3	0.9	0	0	31.1	55.7	3,341
Kisii	19.5	3.5	1.6	1.1	0	11	12.4	0	0.2	64.9	23.3	3,722
Nyamira	35.5	4	0.4	1.5	0	1	3.7	0.3	0	59.1	38.6	1,653
Nairobi	25.6	13.8	0.5	1.3	0	0.3	0	0	0	63.5	36.2	14,614
Total	20.5	16.5	1.8	1.1	0	1.6	2	0.1	0	62.9	34.7	142,026

Source: *Kenya Demographic and Health Survey 2022*



Table 5.9: Percent Distribution of De Jure Population in Households with Septic Tanks and Improved Latrines

By method of emptying and removal, and percentage of on-site sanitation facilities for which excreta was safely disposed of in situ, percentage of on-site sanitation facilities for which excreta was disposed of unsafely, and percentage of on-site sanitation facilities for which excreta was removed for treatment, according to background characteristics, Kenya DHS 2022.

Background characteristic	Removed by a service provider to treatment plant	Removed by a service provider, don't know where	Buried in a covered pit	To uncovered pit, open ground, water body or elsewhere	Other	Don't know where wastes were taken	Never emptied	Don't know if ever emptied	Total	Excreta was safely disposed of in situ1	Excreta was disposed of unsafely	Excreta was removed for treatment	Number of persons with improved on-site sanitation facilities
Sanitation facility type													
Flush to septic tank	4.2	17.5	0.1	0.1	0	1.8	65.7	10.6	100	76.4	0.1	23.5	11,448
Latrines and other improved facilities	0.6	2.3	1.2	0.1	0	0.4	92.8	2.6	100	96.6	0.1	3.3	68,682
Flush to pit latrine	2	6.2	1	0	0	0.3	87.4	3.2	100	91.6	0	8.4	4,103
Ventilated improved pit latrine	0.5	3.3	1.1	0	0	0.6	90.8	3.6	100	95.5	0	4.4	15,953
Pit latrine with slab	0.6	1.6	1.3	0.1	0	0.3	93.9	2.3	100	97.4	0.1	2.5	48,548
Composting toilet	0	0	0	0	0	0	97.8	2.2	100	100	0	0	78
Residence													
Urban	2.8	10.5	0.6	0.1	0	1.4	77.1	7.6	100	85.3	0.1	14.6	29,558
Rural	0.2	0.9	1.3	0	0	0.1	95.8	1.5	100	98.7	0	1.3	50,573
Wealth quintile													
Lowest	0	0.5	0.9	0	0	0.1	97.3	1.2	100	99.4	0	0.6	6,358
Second	0.1	0.6	2	0.2	0	0	96.2	1	100	99.2	0.2	0.7	13,717
Middle	0.2	0.9	1.3	0	0	0.2	95.7	1.6	100	98.7	0	1.3	20,516
Fourth	1.5	4.2	0.9	0.1	0	0.6	88	4.7	100	93.6	0.1	6.3	22,725
Highest	3.1	13.8	0.3	0	0	1.7	72.8	8.3	100	81.3	0	18.6	16,813
Total	**1.2**	**4.5**	**1.1**	**0.1**	**0**	**0.6**	**88.9**	**3.8**	**100**	**93.7**	**0.1**	**6.2**	**80,130**

Source: *Kenya Demographic and Health Survey 2022*

Table 5.10: Percent Distribution of De Jure Population by Management of Excreta from Household Sanitation Facilities

Using improved on-site sanitation facilities										
Background characteristic	Connected to sewer	Safe disposal in situ of excreta from on-site sanitation facilities	Unsafe disposal of excreta from on-site sanitation facilities	Removal of excreta for treatment off-site	Using improved sanitation facilities, on-site status unknown	Using unimproved sanitation facilities	Practicing open defecation	Total	Percentage connected to sewer, safely disposed of on-site, or removed for treatment off-site	Number of persons
Residence										
Urban	28.1	53	0.4	8.5	1.7	7.4	0.9	100	89.6	47,732
Rural	0.3	53.1	0.1	0.5	0	35.6	10.4	100	53.8	94,294
Wealth quintile										
Lowest	0	22.3	0	0	0	45.4	32.2	100	22.4	28,409
Second	0.4	48	0.1	0.2	0	48	3.3	100	48.6	28,408
Middle	1.5	71.5	0.1	0.6	0.1	25.6	0.6	100	73.6	28,404
Fourth	10	75.1	0.3	4.5	1.1	8.9	0	100	89.7	28,406
Highest	36.4	48.3	0.4	10.5	1.8	2.6	0	100	95.1	28,400
Total	**9.6**	**53**	**0.2**	**3.2**	**0.6**	**26.1**	**7.2**	**100**	**65.9**	**142,026**

Source: *According to background characteristics, Kenya DHS 2022*

Access to basic services includes facilities accessible to the people such as access to drinking water and basic sanitation facilities. Good infrastructure services especially water supply, sanitation, and solid waste management remain a challenge in rapidly urbanising Kenya. Nationally, population covered by the main sewer improved from 7.7 per cent in 2009 to 9.7 per cent in 2019 as presented in Table 5.3. Population using open defaction reduced from 13.7 per cent in 2018 to 7.4 per cent in 2019.

5.2.2. Population Using Safely Managed Drinking Water Services

Safely managed drinking water services includes measures for protecting supplies and ensuring water is safe to drink. Households are considered to have access to safely managed drinking water service when they use water from a basic source on premises. The proportion of population as at 2017 using safely managed drinking water services is 22.6 per cent while basic water services is 37.9 per cent.

Access to basic services includes facilities accessible to the people such as access to drinking water and basic sanitation facilities. Good infrastructure services especially water supply, sanitation, and solid waste management remain a challenge in rapidly urbanising Kenya.



5.2.3. Population Using Safely Managed Sanitation Services, Including a Hand-Washing Facility with Soap and Water

The overall objective of the government of Kenya is to achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations. In 2017, proportion of population using safely managed sanitation services was 20 per cent while those using basic sanitation services was 5 per cent. The data shows that 22.8 per cent of the population had limited sanitation services while 40 per cent and 12.5 per cent of the total population were using unimproved sanitation services and open defaction.

5.2.4. Proportion of Wastewater Safely Treated

The Government aims to improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally. In 2016, the total volume of waste water/ sewerage reaching treatment plants was estimated to be about 80,045,795 m^3, out of which only 53 per cent was treated to national standards as shown in Table 5.11.

Table 5.11: Proportion of Wastewater Safely Treated, 2016

	Proportion
Proportion of improved piped to sewers which Reach treatment plants	80%
Proportion of WW reaching treatment plants which is treated to standards	53%
Total volume sewerage to be treated (m^3)	80,045,795
Volume treated (m^3)	42,384,311
Volume not treated (m^3)	37,661,480

Source: *Ministry of Water, Sanitation and Irrigation*

5.2.5. Integrated Water Resources Management.

In 2016, the degree of implementation of Integrated Water Resources Management (IWRM) was 43.3 per cent thus signifying medium implementation of IWRM in Kenya as shown in Table 5.12.

Table 5.12: Degree of Integrated Water Resources Management Implementation, 2016

Section	Average Score
Enabling Environment	55
Institutions and Participation	48.2
Management Instruments	37.8
Financing	32
Indicator	0.433

Source: *Ministry of Water, Sanitation and Irrigation*

5.2.6. Transboundary Basin Area With an Operational Arrangement for Water Cooperation.

The proportion of transboundary basins' area with an operational arrangement for water cooperation.in Kenya is 26 per cent as illustrated in Table 5.13.

Table 5.13: Proportion of Transboundary Basin Area with an Operational Arrangement for Water Cooperation

	Surface area (in km²)
Total surface area of transboundary basins / sub-basins of rivers and lakes covered by operational arrangements within the territory of the country ((in km²) [A] (do not double count sub-basins) - Lake Victoria Basin & Sio Malaba Malakisi River Basin	53,000
Total surface area of Transboundary basins/sub-basins of rivers and lakes NOT covered by operational arrangements within the territory of the country ((in km²) (Lake Turkana, Lakes Chala & Jipe and Umba River Basins and Daua River Basins)	94,600
Total surface area of Transboundary basins of rivers and lakes within the territory of the country (in km²) -[B] (do not double count sub-basins)	147,600
Total surface area of transboundary aquifers covered by operational arrangements within the territory of the country (in km²) [C]	0
Total surface area of transboundary aquifers within the territory of the country (in km²) [D]	50,500

Source: *Ministry of Water, Sanitation and Irrigation*

Notes: *The areas for aquifers are generated from shape files from tba_map 2015 provided by UNESCO. Further, the above map did not include shape files for Kiunga aquifer shared between Kenya and Somalia and the aquifer basin around Lake Victoria... Indicator value for the country ((A + C) / (B + D)) x 100% and is: (53,000/198,100) x 100% = 26%*

Table 5.14: Lake Victoria Basin Drainage Networks

River Basin	Percentage	Flow Rate in M³/Sec	Flow rate in Million M³/ Year
Shared rivers	37.1	298.6	9,423
Kenya	36.5	294.2	9,284
Tanzania	22.1	178.6	5,636
Uganda	4.2	33.8	1,067
Total	**100**	**805.2**	**25,410**

Source: *Ministry of Water, Sanitation and Irrigation*

Table 5.15: Inflows into Kenya

River Basin	Percentage	Flow Rate in M³/Sec	Flow rate in Million M³/ Year
Tanzania	22.1	178.6	5,636
Uganda	4.2	33.8	1,067
Kagera	32.4	261.1	8,240
Total	**58.7**	**473.5**	**14,943**

Source: *Ministry of Water, Sanitation and Irrigation*

Table 5.16: Outflows from Kenya

River Basin	Percentage	Flow Rate in M³/SEC	Flow rate in Million M³/ Year
Kenya	36.5	294.2	9,284
Mara	4.7	37.5	1,183
Total	**41.2**	**331.7**	**10,467**

Source: *Ministry of Water, Sanitation and Irrigation*

Table 5.17: Lake Victoria Basin River Drainage Networks

Country	River Basin	Flow in M^3/ second	%	Flows annualy in Million m^3
Kenya	Sio	11.4	1.4	360.0
	Nzoia	116.7	14.5	3,683.0
	Yala	37.7	4.7	1,190.0
	Nyando	18.5	2.3	584.0
	North Awach	3.8	0.5	120.0
	South Awach	5.9	0.7	186.0
	Sondu	42.2	5.2	1,332.0
	Gucha-Migori	58.0	7.2	1,830.0
Tanzania	Grumeti	11.5	1.4	363.0
	Mbalageti	4.3	0.5	136.0
	Eastern Shore Streams	18.6	2.3	587.0
	Simiyu	39.0	4.8	1,231.0
	Magogo-Maome	8.4	1.0	265.0
	Nyashishi	1.6	0.2	50.0
	Issanga	31.0	3.9	978.0
	Sourthern Shore Streams	25.7	3.2	811.0
	Biharamulo	17.8	2.2	562.0
	Western Shore Streams	20.7	2.6	653.0
Uganda	Bukora	3.1	0.4	98.0
	Katonga	5.1	0.6	161.0
	Northern Shore Streams	25.6	3.2	808.0
Shared Rivers	Kagera	261.1	32.4	8,240.0
	Mara	37.5	4.7	1,183.0
Total		**805.3**	**100.0**	**25,411.0**

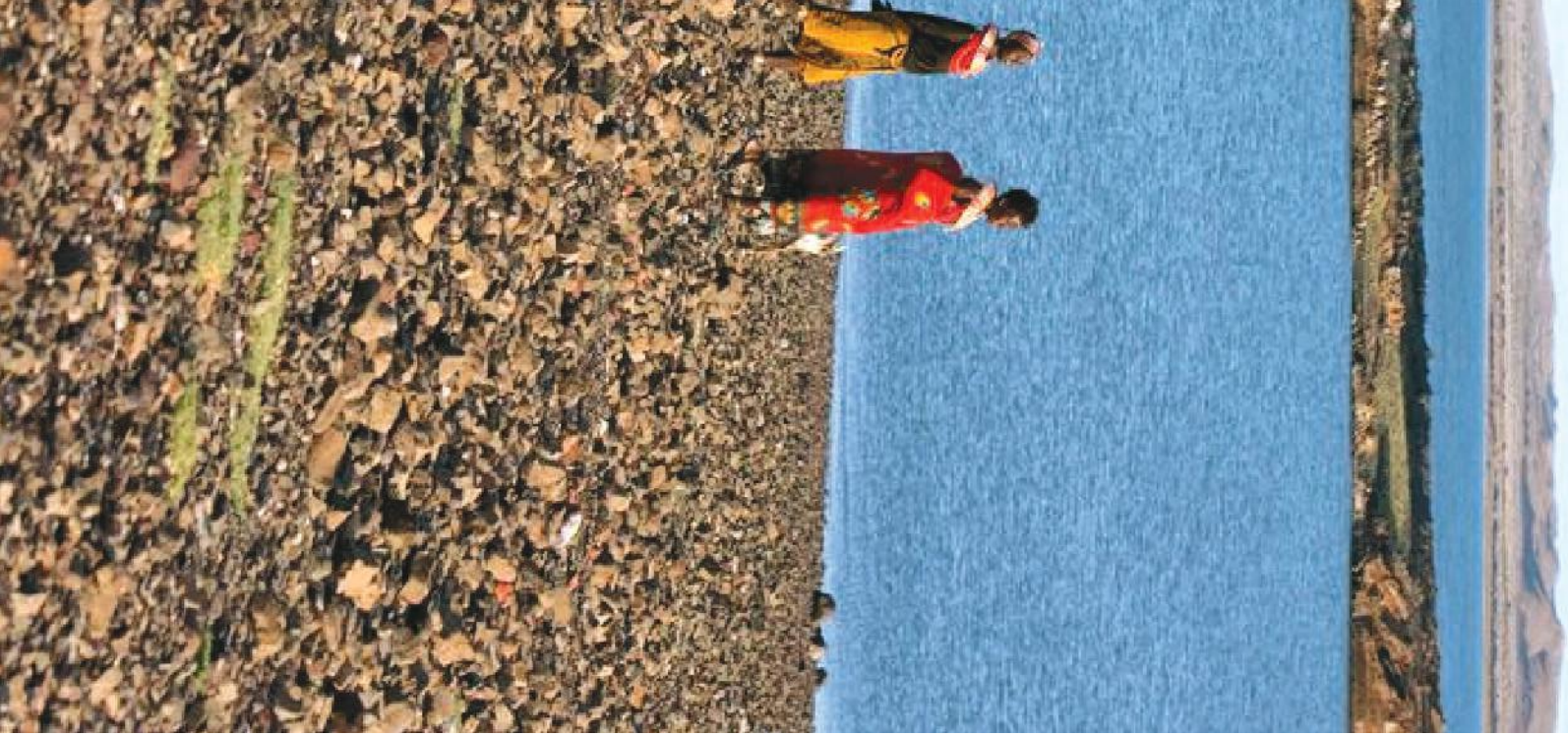
Source: *Ministry of Water, Sanitation and Irrigation*

Table 5.18: Lake Turkana and its River Basin

River Basin	Flow Rate in M^3/Sec	Annual Flow Rate in Millions M^3
Kenyan rivers(Inflows into Kenya)	6.02	190
Omo river(Outflows from Kenya)	54.18	1710
Total	**60.2**	**1900**

Source: *Ministry of Water, Sanitation and Irrigation*





5.3. Environmental Health

Environmental health refers to aspects of human health (including quality of life) that are determined by physical, chemical, biological, social and psychosocial factors in the environment.

Table 5.19: Number of Registered Deaths by Major Causes

Cause	2011	2012	2013	2014	2015	2016
Malaria	26,652	24,772	23,789	22,948	20,691	16,000
Pneumonia	22,632	22,051	22,918	21,640	22,473	21,295
Cancer	11,527	12,574	13,720	14,175	15,714	15,762
HIV/AIDS	11,274	11,111	11,448	12,235	11,131	9,471
Tuberclosis	11,149	10,611	11,186	10,986	10,183	4,735
Anaemia	7,984	8,169	8,124	8,469	8,472	8,165
Road traffic accidents	4,382	4,997	4,942	4,710	5,488	4,809
Other accidents	4,726	4,630	4,857	4,187	3,887	4,166
Heart disease	4,404	5,188	4,544	5,030	5,799	5,353
Menengitis	4,497	4,480	4,265	4,555	4,499	4,374
Total	**109,227**	**108,583**	**109,793**	**108,935**	**108,337**	**94,130**

Source: *Ministry of Health*

5.3.1 Vector -borne Diseases

The World Health Organization(2017) has defined vector borne diseases as illnesses caused by parasites, viruses and bacteria that are transmitted by mosquitoes, sand flies, triatomine bugs, black flies, ticks, tse tse flies, mites and lice. Vector borne diseases account for 17% of all infectious diseases, causing more than 700,000 deaths annually, worldwide. More than 3.9 billion people in over 128 countries are at risk of contracting dengue, with 96 million cases estimated per year. Malaria causes more than 400 000 deaths every year globally, most of them children under 5 years. Other diseases such as chagas disease, leishmaniasis and schistosomiasis affect hundreds of millions of people world wide. Many of these diseases are preventable through informed protective measures (WHO, 2017). The burden of these diseases is highest in tropical and sub-tropical areas and they disproportionately affect the poorest populations. Since 2014, mafor outbreaks of dengue, malaria, chikungunya, yellow fever and zika have afflicted populations, claimed lives and overwhelmed health systems in many Countries (WHO, 2017). Disease causation by vector is hereby given(WHO, 2017) as: Mosquitoes, Aedes - Chikungunya, Dengue fever, lymphatic filariasis, Rfr VALLEY FEVER, yellwo fver, zika, Anopheles - Malaria, Lymphatic filariasis, Culex - Japanese encephalitis, Lymphatic filariasis, West Nile fever, Sandflies, Leishmaniasis, Sand fly fever (Phelebotomus fever), Ticks, Crimean-Congo heamorrhagic fever, Lyme disease, Relapsing fever, Rickettsial diseases (Spotted fever & Q fever), Tick-borne encephalitis, Tularaemia, Triatomine bugs, Chagas disease (American trypanosomiasis), Tsetse flies, Sleeping sickness (African trypanosomiasis), Fleas,Plague,Rickettsiosis, Black flies, Onchocerciasis (river blindness), Aquatic snails, Bilharzia (schistosomiasis), Lice,Typhus & louse-borne relapsing fever.

In Kenya, vector-borne diseases have been reported through the health facilities -centralized DHIS (District Health Information System, MOH) system.

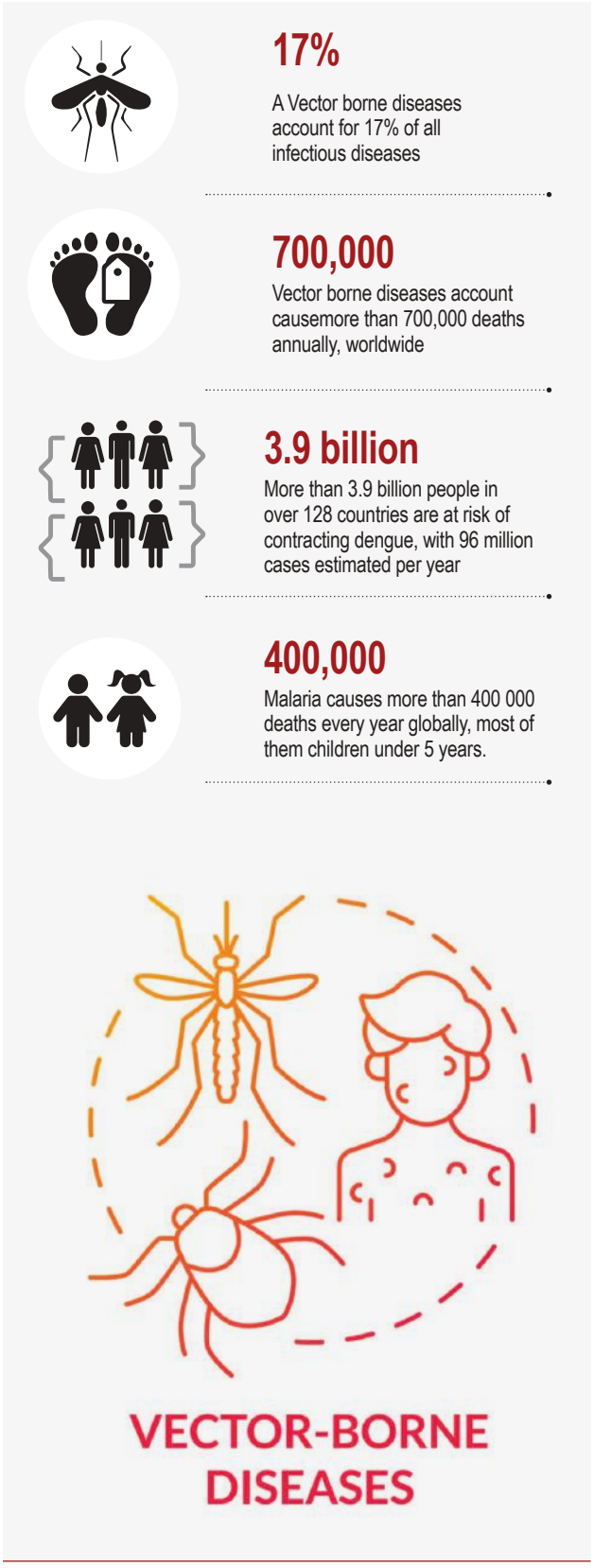


Table 5.20: Vector borne Diseases Incidences by County, 2020

National/ County	Bilharzia	Confirmed Malaria (only Positive cases)	Malaria in pregnancy	Suspected Malaria	Plague	Dracunculo-sis (Guinea Worm)	Kalazar (Leish-maniaisis)	Viral Haemor-rhagic Fever	Yellow fever cases
Kenya	**41,429**	**3,944,155**	**74,258**	**6,833,647**	**390**	**-**	**1,009**	**155**	**19**
Baringo	117	42,503	1,507	60,765	-	-	129	-	-
Bomet	148	2,143	112	17,170	-	-	-	-	-
Bungoma	187	300,490	8,850	432,781	-	-	2	-	2
Busia	314	411,763	6,892	812,183	-	-	-	-	-
E/Marakwet	26	13,437	207	11,508	-	-	-	-	-
Embu	116	3,473	104	6,521	-	-	-	1	-
Garissa	1,891	8,538	427	2,954	-	-	-	-	-
Homa Bay	1,143	228,142	3,926	209,744	-	-	1	4	-
Isiolo	145	7,327	231	5,510	-	-	51	-	-
Kajiado	262	9,350	1,131	15,826	-	-	2	-	-
Kakamega	249	564,528	7,500	1,149,225	-	-	2	-	2
Kericho	163	27,077	621	36,317	-	-	-	-	-
Kiambu	395	5,111	847	9,452	-	-	5	-	-
Kilifi	5,870	151,250	1,346	50,472	14	-	7	35	-
Kirinyaga	362	118	140	1,427	-	-	46	-	3
Kisii	73	62,635	1,366	179,162	-	-	-	-	-
Kisumu	460	360,739	5,076	683,447	12	-	9	-	-
Kitui	2,850	5,606	392	31,055	-	-	3	-	-
Kwale	7,889	245,181	3,024	628,544	-	-	1	9	1
Laikipia	147	1,999	396	4,435	-	-	1	-	-
Lamu	1,905	1,023	81	666	-	-	-	-	-
Machakos	955	2,993	239	31,386	1	-	-	-	-
Makueni	545	1,317	151	27,509	-	-	-	-	-
Mandera	318	2,060	802	16,776	-	-	-	35	-
Marsabit	92	3,419	144	4,510	-	-	5	-	-
Meru	1,057	12,946	597	19,941	-	-	-	-	1
Migori	1,176	243,779	3,638	436,237	-	-	22	-	-
Mombasa	876	65,698	1,149	62,071	-	-	1	-	-
Muranga	969	386	25	743	10	-	-	4	-
Nairobi	1,415	42,280	3,114	49,170	-	-	-	3	7
Nakuru	769	25,474	1,317	55,861	-	-	8	3	-
Nandi	211	62,025	1,666	135,085	-	-	1	2	-
Narok	41	11,446	545	46,748	-	-	-	-	-
Nyamira	100	16,054	286	15,670	-	-	-	-	-
Nyandarua	312	546	82	3,239	10	-	-	-	-
Nyeri	189	292	34	425	-	-	-	-	-
Samburu	172	15,155	219	1,834	-	-	-	-	2
Siaya	1,541	493,122	6,478	934,197	-	-	-	-	1
Taita Taveta	460	2,518	69	4,251	114	-	46	59	-
Tana River	3,697	10,597	371	7,230	-	-	-	-	-
Tharaka Nithi	973	8,186	229	11,952	-	-	-	-	-
Trans-Nzoia	122	83,596	2,335	46,506	4	-	-	-	-
Turkana	131	173,843	3,008	65,681	-	-	287	-	-
Uasin Gishu	283	32,490	914	41,548	-	-	-	-	-
Vihiga	50	134,060	1,500	404,807	-	-	-	-	-
Wajir	210	456	126	2,342	225	-	45	-	-
West Pokot	53	46,984	1,044	58,764		-	335		

Source: *Ministry of Health*

Table 5.21: Vector Borne Diseases by County, 2017

National/ County	Bilhar-zia	Confirmed Malaria (only Positive cases)	Dracunculo-sis (Guinea Worm)	Kalazar (Leishma-niaisis)	Malaria in pregnancy	Plague	Suspected Malaria	Trypono-somiasis	Viral Hae-morrhagic Fever	Yellow fever cases
Kenya	**28,688**	**4,103,691**	**0**	**1,107**	**77,047**	**246**	**3,861,793**	**665**	**99**	**27**
Baringo	42	32,845	-	161	990	-	50,601	2	-	-
Bomet	351	3,046	-	-	190	-	17,013	10	-	-
Bungoma	175	363,062	0	-	7,679	-	345,963	-	-	-
Busia	225	319,961	-	-	6,182	-	467,187	1	-	-
Elgeyo-Marak-wet	24	12,584	0	-	237	-	7,329	-	-	-
Embu	498	3,293	0	-	73	-	5,195	-	-	-
Garissa	1,209	7,560	0	-	218	-	2,513	-	-	-
Homa Bay	782	370,412	0	-	6,780	-	129,472	44	-	-
Isiolo	56	4,296	0	152	102	-	2,518	-	-	1
Kajiado	151	11,848	-	-	386	-	16,018	6	-	-
Kakamega	480	767,768	0	2	9,678	1	1,112,242	4	-	1
Kericho	137	25,881	0	-	768	-	30,220	-	-	-
Kiambu	1,129	6,005	0	-	912	-	9,669	49	-	-
Kilifi	3,725	78,648	0	2	850	80	14,371	62	16	-
Kirinyaga	334	135	-	45	161	-	2,227	-	-	-
Kisii	45	81,936	0	-	1,856	-	89,214	-	-	-
Kisumu	252	318,711	-	1	4,347	-	174,098	4	-	-
Kitui	577	5,615	0	1	451	18	18,569	1	1	-
Kwale	5,117	114,955	0	2	1,810	-	67,794	-	2	-
Laikipia	127	2,828	0	-	316	-	4,304	4	-	-
Lamu	1,288	1,227	-	-	44	-	257	-	-	-
Machakos	840	3,748	-	-	146	-	5,549	-	-	-
Makueni	464	1,208	0	-	105	-	20,092	9	-	-
Mandera	388	820	0	-	508	-	8,955	-	-	-
Marsabit	85	6,908	0	18	86	-	7,301	1	-	-
Meru	1,014	18,111	0	-	792	3	11,095	17	2	3
Migori	518	253,416	0	2	3,502	-	305,614	1	-	7
Mombasa	527	58,695	0	-	1,376	124	44,092	24	23	11
Muranga	500	208	-	-	28	1	333	-	-	-
Nairobi	1,420	48,374	0	-	4,312	19	35,857	275	4	1
Nakuru	385	33,549	0	18	1,671	-	55,990	-	3	-
Nandi	74	56,534	-	-	1,032	-	122,763	7	-	-
Narok	154	13,211	0	-	580	-	32,987	-	4	-
Nyamira	141	27,717	-	2	339	-	11,694	76	2	-
Nyandarua	7	712	-	2	50	-	2,025	-	-	2
Nyeri	72	501	0	-	41	-	666	-	8	-
Samburu	17	5,853	0	-	203	-	1,524	-	-	-
Siaya	633	428,438	0	3	6,296	-	264,919	23	-	-
Taita Taveta	389	2,265	0	-	114	-	4,391	31	-	-
Tana River	2,806	8,365	-	-	538	-	6,795	-	33	-
Tharaka Nithi	417	8,950	0	2	167	-	10,453	-	-	-
Trans-Nzoia	78	100,600	-	-	2,383	-	41,175	-	-	-
Turkana	137	193,374	0	477	3,301	-	82,704	3	-	1
Uasin Gishu	225	53,505	0	1	806	-	58,796	10	-	-
Vihiga	21	184,722	0	1	3,572	-	114,729	1	1	-
Wajir	652	877	-	35	93	-	2,297	-	-	-
West Pokot	-	60,414	0	180	976	-	42,223	-	-	-

Source: *MOH-DHIS 2019- Vector Borne Diseases -2017 Cases*

5.4. Conclusion

This fifth chapter contains statistics on the environment in which humans live and work, particularly with regard to living conditions and environmental health. These statistics are important for the management and improvement of conditions related to human settlements, shelter conditions, safe water, sanitation and health, particularly in the context of rapid urbanization, increasing pollution, environmental degradation, disasters, extreme events and climate change. The country must take protective measures fot their people. Information needed are provided by Ministry of Health, Ministry of Water, Sanitation and Irrigation etc. The sixth chapter will gather statistics on environmental protection, management and engagement.



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06

ENVIRONMENTAL PROTECTION, MANAGEMENT AND ENGAGEMENT

6.0 Introduction

This Chapter discusses information on environmental protection and conservation, stakeholder engagement and natural resources expenditure. It aims at improving the utilization of the environment and natural resources for socioeconomic development, and sustaining the health of ecosystems. Statistics about environmental governance, institutional strengthening, enforcement of regulations and extreme event preparedness are also considered.

6.1 Environmental Protection and Resource Management Expenditure

Environmental protection is the practice of protecting the natural environment by individuals, organizations and governments. Its objectives are to conserve natural resources and the existing natural environment and, where possible, to repair damage, restore and reverse environmental degradation.

6.1.1 Annual Government Environmental Protection Expenditure

Annual government environmental protection expenditure provides how much the government spends on activities aimed at environmental protection, conservation, elimination of pollution and strenghthening environmental governance.

Table 6.1: Expenditures by the National and the 47 County Governments

	2014/15	2015/16	2016/17	2017/18
County Governments	5,277.20	13,724.10	10,164.80	13,758.70
National Government	17,234.50	18,105.00	11,303.90	20,065.80
Total	**22,511.70**	**31,829.10**	**21,468.70**	**33,824.50**

Source: *County Governments*

6.2 Environmental Governance and Regulations

Environmental governance refers to the decision-making processes involved in the control and management of the environment and natural resources. It is a system of laws, norms, rules, policies, and practices that dictate how regulatory bodies should manage and oversee the affairs of any environment-related regulatory body responsible for ensuring sustainability and managing all environmental resources. Kenya is a member of and participates in standards development and related activities of International Organizations for Standardization (ISO). The fields of standardization cover the following: Food, agriculture, chemical, environment, electrical/electronic engineering, metrology (measurement) standards, textile, leather, bamboo products, and other service sectors including health, education and tourism. Some of the benefits of standardization is to drive efficiency in business operations and reduce waste and environmental pollution as well as provide best practices, performance and safety reference points for regulators, researchers and industry. The lead agency for Standardization is the Kenya Bureau of Standards (KEBS) that works closely with other environmental protection, conservation and regulartory agencies to ensure quality of products and strengthen environmental governance.

The government has policy elements at National and County levels (Nairobi, Mombasa, Nakuru and Kisumu Cities). For the Cities, policy elements include: Combustion of fossil fuels, protection of water catchment areas, and climate financing while the National Government has water harvesting and storage, fforestation and reforestation, emission limit and target, collaboration and partnerships. Others are Natural disaster, clean environment, biodiversity conservation and infrastructure resilience. On smart governance, policy elements include public private partnership initiatives, multi-sector collaboration, transparent governance, e-government models, platforms and services e.g. Common Government services Paybill 222222.

The Kenya Environmental law describes the legal rules in

Kenya relating to the environment, and more broadly the social, economic, philosophical and jurisprudential issues raised by attempts to protect, conserve and reduce the impacts of human activity on the Kenyan environment. They include the following;

1. **Environmental Management and Coordination (Waste Management Regulations 2006):** These Regulations apply to all categories of waste. These include: industrial waste, hazardous and toxic waste, pesticides and toxic substances, biomedical waste and radio-active substances. These regulations outline requirements for handling, storing, transporting, and treatment/ disposal of all waste categories. The regulations make provisions for disposal of waste by NEMA licensed companies.

2. **The Environmental Management and Coordination (Wetlands, Riverbanks, Lakeshores, And Seashores Management Regulations 2009):** This regulation seeks to ensure wetland resources are utilized in a sustainable manner compatible with the continued presence of wetlands and their ecological goods and services. The sustainable use of wetlands should be integrated into the national and local land use plans to ensure sustainable use and management of the resources. The main purpose is to provide for the conservation and sustainable use of wetlands and their resources in Kenya. Environmental Impact Assessment and Environmental Audit as required under the EMCA shall be mandatory for all activities likely to have adverse impact on the management of wetlands.

3. **The Environmental (Impact Assessment and Audit) Regulations, 2003:** Environmental Impact Assessment (EIA) is a critical examination of the effects of a project on the environment. The EIA must be conducted before the commencement of the project. The goal of an EIA is to ensure that decisions on proposed projects and activities are environmentally sustainable. It guides policy makers, planners, stakeholders and government agencies to make environmentally and economically sustainable decisions. It is therefore a legal requirement to carry out an EIA before commencement of the project. The EIA process requires that a proponent shall seek views of persons who may be affected by the project. The proponent shall be issued with an EIA license before commencement of the project.



4. **Environmental Audit (EA):** This is the systematic documentation, periodic and objective evaluation of activities and processes of an ongoing project. The purpose of EA is to determine the extent to which the activities and programs conform to the approved environmental management plan.

5. **Environmental Management and Co-ordination (Water Quality) Regulations, 2006:** This regulation applies to water used for domestic, industrial, agricultural, and recreational purposes; water used for fisheries and wildlife purposes, and water used for any other purposes. Different standards apply to different modes of usage. These regulations provide for the protection of lakes, rivers, streams, springs, wells and other water sources. The objective of the



regulations is to prohibit discharge of effluent into the environment contrary to the established standards. The regulations further provide guidelines and standards for the discharge of poisons, toxins, noxious, radioactive waste or other pollutants into the environment.

6. **Environmental Management and Co-ordination (Controlled Substances) Regulations, 2007:** These Regulations aim to regulate the production, trade and use of controlled substances and products; provide for a system of data collection to facilitate compliance with relevant reporting requirements under the Montreal Protocol on Substances that Deplete the Ozone Layer; promote the use of ozone friendly substances, products, equipment and technology; and ensure the elimination of substances and products that deplete the ozone layer.

7. **The Environmental Management and Co-Ordination (Conservation of Biological Diversity and Resources, and Access to Genetic Resources and Benefits Sharing) Regulations, 2006:** The regulations were developed to protect biological diversity and resources. These Regulations apply to access to genetic resources or parts of genetic resources, whether naturally occurring or naturalised, including genetic resources bred for or intended for commercial purposes within Kenya or for export, whether in in-situ conditions or ex-situ conditions. They do not apply: to plants listed in the Agriculture Act Cap 318; the exchange of genetic resources where the exchange is done

by a local community among themselves and for their own consumption; or where the exchange is certified to be purely for food or other consumptive purposes as prescribed by the relevant laws.

8. **The Environment Management and Co-Ordination (Air Quality) Regulations:** The objective of the Regulations is to provide for prevention, control and abatement of air pollution to ensure clean and healthy ambient air. It provides for the establishment of emission standards for various sources such as mobile sources (e.g. motor vehicles) and stationary sources (e.g. industries) as outlined in the Environmental Management and Coordination Act, 1999.

9. **The Environment Management and Co-Ordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009:** These Regulations aim at ensuring the maintenance of a healthy environment for all people in Kenya; the tranquillity of their surroundings and their psychological wellbeing by regulating noise levels and excessive vibration. The Regulations elevate the standards of living of the people by prescribing acceptable noise levels for different facilities and activities and provide for the control of noise and mitigating measures for the reduction of noise.

10. **Note:** The above EMCA Regulations are currently undergoing revision in the financial year 2023/2024.

6.2.1 Institutional Strengthening

The Environment and Land Court is a superior court established by Article 162(2) of the Constitution of Kenya. The Environment and Land Court Act no.19 of 2011 (ELCA) gives effect to Article 162(2) of the Constitution and the court was established to hear and determine disputes relating to the environment and the use and occupation of, and title to land. The court exercises jurisdiction throughout Kenya. The court has powers to deal with disputes relating to land administration and management. It is also empowered to hear cases relating to public, private and community land and contracts, choses in action or other instruments granting any enforceable interests in land.

Institutions Established under the Environmental Management and Coordination Act (EMCA), No.8 1999

In Kenya, Environmental Management and Co-ordination Act (EMCA 1999), is an overaching legal document for the protection and management of the environment. EMCA 1999 was revised in 2015 to align it to the Constitution of Kenya 2010 after devolution of environmental issues to the County Government. The Act provides for the establishment of an appropriate legal and institutional framework for environmental management. The Act is undergoing review in the current financial year 2023/2024.

1. **National Environmental Management Authority (NEMA)** is mandated to exercise genral supervision and coordination over all matters related to the environment. It is further mandated to be the principal instrument of government in implementation of all policies relating to the environment. Following the Constitution of Kenya, 2010 it has presence in 47 Counties and the NEMA Headquarters in Nairobi. However, some of the counties are too large for NEMA's regulartory services and stakeholder collaboration hence requiring more staff to be appointed and deployed to the Sub – Counties. NEMA is using Information Communiation Technology and Geographical Information Systems (GIS) to automate environmental licencing and compliance as well as upsacling its services across the country.

2. **National Environment Tribunal (NET):** The National Environment Tribunal is established under Kenya's Framework Environment Law to receive, hear, and decide appeals arising from decisions of the National Environment Management Authority on issuance, denial, or revocation of environmental impact assessment licenses, among other issues.

3. **County Environment Committees (CECs):** The CECs are the principal avenues through which County Governments formulate policies, strategies and plans on the implementation of their devolved environmental functions. These functions include: County Health Services that include refuse removals, refuse dumps and solid waste disposal; Control of air pollution, noise pollution, and other public nuisance; implementation of national government policies on natural resources and environmental conservation including soil & water conservation and forestry. Devolved Environmental Functions obligated to

Counties under the Environmental management and Coordination Act, 1999 include the following:

a) The County Environment Committee shall be responsible for the proper management of the environment within the county for which it is appointed

b) The County Environment Committee shall develop a County Strategic Environmental Action Plan every five years

c) The respective County Executive Committee members of every county shall submit the county environment action plan referred to in subsection (1) to the Cabinet Secretary for incorporation into the national environment action plan referred to in section

d) Every County Environment Committee shall identify the hilly and mountainous areas under their jurisdiction which are at risk from environmental degradation

e) Each County Environment Committee shall notify the Authority of the hilly and mountainous areas it has identified as being at risk from environmental degradation under subsection

f) Every County Environment Committee shall specify which of the areas identified in accordance with section 45(1) are to be targeted for afforestation or reforestation

g) Every County Environment Committee shall take measures, through encouraging voluntary self-help activities in their respective local community, to plant trees or other vegetation in any area specified under subsection (1) which are within the limits of its jurisdiction

h) Where the areas specified under subsection (1) are subject to leasehold or any other interest in land including customary tenure, the holder of that interest shall implement measures required to be implemented by the County Environment Committee including measures to plant trees and other vegetation in those areas

i) The County Environment Committee shall be responsible for ensuring that the guidelines issued and measures prescribed under subsection (2) in respect of their counties are implemented

j) Any person who contravenes any measure prescribed by the Authority under this section or who fails to comply with a lawful direction issued by a County Environment Committee under this section shall be guilty of an offence (CEC can issue lawful direction to 47.3, and it is an offence not to comply)

k) A County may make legislation in respect of all such matters as are necessary or desirable that are required or permitted under the Constitution and this Act.

l) Contribute to decentralization of environmental management and enable participation of local communities.

4. **National Environmental Complaints Committees (NECC)**: It is the body charged with the task of investigating complaints or allegations regarding the condition of the environment in Kenya and suspected cases of environmental degradation. The NECC also undertakes public interest litigation on behalf of the citizens in environmental matters hence provides the administrative mechanism for addressing environmental harm.

5. **National Environment Trust Fund (NETFUND)**: It collaborates and partners with stakeholders in the mobilization of financial and technical resources through development of bankable proposals for environmental management and promotion of best practices in the environment sector. Best practices are recognized at individual, corporate and industry levels through an environmental award scheme. Other forms of support include award of scholarships and grants, capacity building and environmental publications to create environmental awareness and education. NETFUND hosts conferences, trade fairs, commemoration of environmental days

6.2.2 Environmental Regulations and Instruments

The regulations prohibit certain forms of pollution and give guideline on levels of pollution that are permissible.

Table 6.2: List of Regulated Pollutants

Name of regulated pollutants	Description	Remarks
Pesticides: aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, hexachloro-benzene, mirex, toxaphene;	2004. banning or sever restriction	For Unintentionally produced Pops ensure Minimization of emissions
Industrial chemicals: hexachlorobenzene, polychlorinated biphenyls (PCBs); and		
By-products: hexachlorobenzene; polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans (PCDD/PCDF), and PCBs.		
alpha hexachlorocyclohexane;		
beta hexachlorocyclohexane;		
chlordecone;		
hexabromobiphenyl;		
hexabromodiphenyl ether and heptabromodiphenyl ether;		
lindane;		
pentachlorobenzene;		
perfluorooctane sulfonic acid, its salts and perfluorooctane sulfonyl fluoride; and		
tetrabromodiphenyl ether and pentabromodiphenyl ether.		
Rotterdam Convention On prior Informed Consent Procedures for toxic Industrial chemicals and Pesticides in International Trade		
1. ,4,5-T and its salts and esters Pesticide		
2. Alachlor	15972-60-8 Pesticide	
3. Aldicarb	116-06-3 Pesticide	
4. Aldrin	309-00-2 Pesticide	
5. Azinphos-methyl Binapacryl	86-50-0 Pesticide	
6. Captafol	485-31-4 Pesticide	
7. Carbofuran	2425-06-1 Pesticide	
8. Chlordane	1563-66-2 Pesticide	
9. Chlordimeform	57-74-9 Pesticide	
10. Chlorobenzilate	6164-98-3 Pesticide	
11. DDT	510-15-6 Pesticide	Full list in the Draft Chemicals Regu-lation
12. Dieldrin	50-29-3 Pesticide	
13. Dinitro-*ortho*-	60-57-1 Pesticide	
14. Lindane	cresol (DNOC) and its salts	
15. Mercury compounds, including inorganic mercury com-pounds,	(such as ammonium salt, potassium salt	
16. Methamidophos	and sodium salt)	
17. Monocrotophos	56-38-2 Pesticide	
18. Parathion	87-86-5* Pesticide	
19. Pentachlorophenol and its salts and		
20. esters		
21. Toxaphene 8001-35-2 Pesticide		
22. Trichlorfon 52-68-6 Pesticide		

Source: *National Environment Management Authority*

Table 6.3: Restricted Chemicals and Materials for Industrial Use

No.	Chemical Name	CAS. No.	HS No (Pure Substance)	Status	Remarks (Extent of Use
1.	Asbestos				
	- Crocidolite	12001-28-4	2524.10	Restricted	
	- Actinolite	77536-66-4	2524.90	Restricted	
	- Anthophyllite	77536-67-5	2524.90	Restricted	
	- Amosite	12172-73-5	2524.90	Restricted	
	- Tremolite	77536-68-6	2524.90	Restricted	
2.	Polybrominated biphenyls(PBB)	1336-36-3 (hexa-) 27858-07-7(octa-) 13654-09-6 (deca-)		Restricted Restricted Restricted	
3.	Polychlorinated biphenyls (PCB)	1336-36-3		Restricted	
4.	Polychlorinated terphenyls (PCT)	61788-33-3		Restricted	
5.	Tetraethyl lead	78-00-2	2931.1	Restricted	
6.	Tetramethyl lead	75-74-1	2931.1	Restricted	
7.	Tris (2,3-dibromopropyl) phosphate Tributyl tin compounds	126-72-7, 56-35-9, 4342-36-3, 1461-22-9, 1983-10-4, 24124-25-2, 2155-70-6, 85409-17-2	2919.10 2931.20	Restricted Restricted	
8.	Commercial octabromodiphenyl ether including:	36483-60-0		Restricted	
	Hexabromodiphenyl ether	68928-80-3		Restricted	
9.	Commercial pentabromodiphenyl ether including:	40088-47-9		Restricted Restricted	
	Tetrabromodiphenyl ether, Pentabromodiphenyl ether	32534-81-9			
10.	Perfluorooctane sulfonic acid, Perfluorooctane sulfonates, Perfluorooctane sulfonamides and Perfluorooctane sulfonyls including:				-Phase-out date for chlor-alkali production using mercury - Year 2025 -Phase-out date for acetaldehyde production using mercury or mercury compounds as catalyst – 2018 -Vinyl chloride monomer production to reduce use of mercury per unit production by 50% by the 2020 against 2010 use -Sodium or Potassium Methylate or Ethylate production to; i). phase-out use of mercury within 10 years of entry into force of the Convention, and ii). reduce emissions and releases of mercury per unit production by 50% by 2020 against 2010 use. -Polyurethane production to phase-out use of mercury catalysts within 10 years of entry into force of the Convention.
	- Perfluorooctane sulfonic acid	1763-23-1		Restricted	
	- Potassium perfluorooctane sulfonate	2795-39-3		Restricted	
	- Lithium perfluorooctane sulfonate	29457-72-5		Restricted	
	- Ammonium perfluorooctane sulfonate	29081-56-9		Restricted	
	- Diethanolammonium perfluorooctane sulfonate	70225-14-8		Restricted	
	- Tetraethylammonium perfluorooctane sulfonate	56773-42-3		Restricted	
	-Didecyldimethylammonium perfluorooctane sulfonate	251099-16-8		Restricted	
	- N-Ethylperfluorooctane sulfonamide	4151-50-2		Restricted	
	- N-Methylperfluorooctane sulfonamide	31506-32-8		Restricted	
	- N-Ethyl-N-(2-hydroxyethyl) perfluorooctane sulfonamide - N-(2-Hydroxyethyl)	1691-99-2		Restricted	
	-N-methylperfluorooctane sulfonamide	24448-09		Restricted	
	- Perfluorooctane sulfonyl fluoride	307-35-7		Restricted	

Source: *National Environment Management Authority, 2019*



Table 6.4: Banned Chemicals for Industrial Use

No.	Chemical Name	CAS. No.	Status	Remarks (Extent of Use)
1	Hexabromobiphenyl	36355-01-8	Banned	
2	Hexabromocyclododecane (HBCDD)	25637-99-4	Banned	
3	Pentachlorobenzene	608-93-5	Banned	
4	Decabromodiphenyl ether	1163-19-5	Banned	
5	Hexachlorobutadiene	87-68-3	Banned	

Source: *National Environment Management Authority, 2019*

6.2.3. Participation in Multilateral Environmental Agreements (MEAs) and Environmental Conventions.

International Treaties and Agreements. Kenya is a party to many international treaties, agreements and protocols on biodiversity, ecosystems and the environment. Multilateral Environmental Agreements are internationally negotiated and agreed upon environmental governance instruments and treaties. They are vital in the general environmental protection, conservation and management especially in the face of environmental challenges against the backdrop of globalisation. These challenges include: uncontrolled growth in the context of inadequate governance; competitiveness problems; rising energy demand and climate change; the spread of invasive alien species; the spread of consumerism and cultural diversity loss; and concentration of power, information and financial resources and enhancing communication possibilities.

Kenya is a signatory to the following international conventions and protocols that address environmental challenges:

Table 6.5: Multilateral Environment Agreements (MEAs) Ratified, Signed and Acceded by Kenya

No.	Name of the meas/any other global convention	Description	Date of signing/ratification
1	African Convention On The Conservation Of Nature And Natural Resources, 1969		Signed1968, Ratification/Accession 1969
	Agreement On The Application Of Sanitary And Phytosanitary Measures (Sps) And Agreement On Technical Barriers To Trade (Tbt), 2000		Party 1995
	Agreement On The Conservation Of African-Eurasian Migratory Waterbirds, 2010		Party 2001
	Bamako Convention On The Ban Of The Import Into Africa And The Control Of Transboundary Movement And Management Of Hazardous Wastes Within Africa, 1991		Signed 2003
2	Basel Convention On The Control Of Transboundary Movements Of Hazardous Wastes And Their Disposal, 1989		Accepted 2000
	Convention For The Protection Of The Ozone Layer, 1994		Accession 1988
	- Montreal Protocol, 1989		Ratification 1988
	Convention Of The Protection, Management And Development Of The Marine And Coastal Environment Of The Eastern African Region, Nairobi, 1985/ Amended Nairobi Convention For The Protection, Management And Development Of The Marine And Coastal Environment Of The Western Indian Ocean, 2010		Convention of 1984: Ratified 1990, Amendment signed 2010
	- Protocol For The Protection Of The Marine And Coastal Environment (Lbsa Protocol), 2010		Signed 2010

Table 6.5: Multilateral Environment Agreements (MEAs) Ratified, Signed and Acceded by Kenya *(Continued)*

No.	Name of the meas/any other global convention	Description	Date of signing/ratification
	- Protocol Concerning Protected Areas And Wild Fauna And Flora In The Eastern African Region, 1985		Signed 1985
	- Protocol Concerning Co-Operation In Combating Marine Pollution In Cases Of Emergency In The Eastern African Region, 1985		Signed 1985
	- Protocol For The Protection Of The Marine And Coastal Environment Of The Western Indian Ocean From Land-Based Sources And Activities, 2010		Signed 2010
	United Nations Convention On Biological Diversity (Cbd), 1992		Ratified 1994
	- Cartagena Protocol, 2000		Ratified 2003
	- Nagoya Protocol On Access And Benefit-Sharing, 2010		Ratified 2014
	Convention On International Trade In Endangered Species Of Wild Fauna And Flora (Cites), 1989 And 2004		Ratified 1978
	Convention On The Conservation Of Migratory Species Of Wild Animals, 1979		Party 1999
	Convention On The Prevention Of Marine Pollution By Dumping Of Wastes And Other Matter (London Convention), London, 1972		Party
3	East African Community Transboundary Ecosystems Management Bill, 2010		Party, enacted 2010
4	Horn Of Africa Wildlife Law Enforcement Network (Ha-Wen)		Party
5	Indian Ocean Tuna Commission, 1967		Accepted 2004
6	International Convention For Straddling And Highly Migratory Fish Stocks, 2001		Ratified 2004
7	International Convention For The Protection Of New Varieties Of Plants, 1961		Member 1999
8	International Plant Protection Convention (Ippc), 1951		Adherence 1974
9	International Treaty On Plant Genetic Resources For Food And Agriculture, 2001		Accession 2003
10	Lusaka Agreement & Task Force, 1994		Party 1994
11	Ramsar Convention (Formally, The Convention On Wetlands Of International Importance, Especially Known As Waterfowl Habitat), 1971		Entry into Force 1990
12	South West Indian Ocean Fisheries Commission		Party
13	Stockholm Convention On Persistent Organic Pollutants, 2001		Signature 2001, Ratification 2004
14	The International Animal Health Code, 2000		Party
15	Transboundary Environmental Assessment Guidelines For Shared Ecosystems In East Africa, 2005		Party, enacted 2005
16	Un Framework Convention On Climate Change, 1992		Ratified 1994
17	Kyoto Protocol, 1997		Ratified 2005
18	United Nations Convention On The Law Of The Sea (Unclos), 1982		Signed 1982, Ratification/ accession 1989
a.	Agreement On Part Xi, 1994		Ratification/ accession 1994
b.	Un Fish Stocks Agreement, 1995		Ratification/ accession 2004
19	Un Convention To Combat Desertification, 1994		Ratified 1997
20	World Heritage Convention, 1977		Accepted 1991
21	Wto Agreement On Sanitary And Phytosanitary Measures, 1995		Member 1995

Source: *Ministry of Environment, Climate Change and Forestry*

Table 6.6: International Conventions and Multilateral Agreements Signed, Ratified, and Acceded to by Kenya

Multilateral Environmental Agreement	Ratification/Accession	Responsible Institution
Stockholm Convention on POPs	Ratified on 24/09/2004	ME&F
Basel Convention on the Trans-boundary Movement of Hazardous Waste and their Disposal	Ratified on 01/06/2000	ME&F
Ban Amendment to the Basel Convention	Acceded on 09/09/2009	ME&F
Rotterdam Convention on Prior Informed Consent for Certain Chemicals and Pesticides in International Trade	Ratified on 03/02/2005	ME&F
Minamata Convention on Mercury	Signed on 10/10/2013	ME&F
Global Harmonized System of Classification and Labelling of Chemicals	Not addressed	Not decided
Vienna Convention	Ratified on 09/11/1988	ME&F
Montreal Protocol	Ratified on 09/11/1988	ME&F
London Amendment to the Montreal Protocol	Ratified on 27/09/1994	ME&F
Copenhagen Amendment to the Montreal Protocol	Ratified on 27/09/1994	ME&F
Montreal Amendment to the Montreal Protocol	Ratified on 12/07/2000	ME&F
Beijing Amendment to the Montreal Protocol	Ratified on 09/10/2013	ME&F
Development of a National Profile on chemicals management (SAICM implementation)	National profile developed in August 2011	ME&F
UN Framework Convention on Climate Change	Ratified on 30/08/1994	NCCC
Kyoto Protocol	Ratified on 25/02/2005	ME&F
UN Convention to Combat Desertification	Ratified on 17/07/2005	ME&F
Convention on Biological Diversity	Ratified on 24/1994	ME&F
Cartagena Protocol on Bio-safety	Signed in May 2000	National Council on Science and technology
Convention on Chemical Weapons	Ratified on 25 April, 1997	Government Chemist Department

Source: *Ministry of Environment and Forestry*

The following is a thematic illustration on each specific environmental problem addressed and the relevant Multilateral Environmental Agreement.

- **Air:** -Geneva Convention on Long-Range Transboundary Air Pollution (CLRTAP) (1979) and its protocols.
- **Biotechnology:** Cartagena Bio Safety Protocol (2000) to the Rio Convention on Biological Diversity (1992).
- **Chemicals:** Rotterdam Convention on Prior Infirmed Consent (PIC) 1998, Stockholm Convention on Persistent Organic Pollutants- POP (2001), Minamata Convention on Mercury (2013).
- **Climate Change and Ozone Depletion:** Framework Convention on Climate Change (1992) and Kyoto Protocol (1997),Vienna Convention for the Protection of the Ozone Layer (1985) and the Montreal Protocol as amended.
- **Industry:** Helsinki Convention on Industrial Accidents (1992).
- **Nature and Biodiversity:** Convention on Biological Diversity (1992), Convention on Wetlands of International Importance (RAMSAR) (Kenya has signed and ratified the Convention).
- **Soil:** UNCCD Convention to Combat Desertification (1994). (Kenya signed the Convention in 1994 and ratified in 1997)
- **Waste:** Basel Convention on Hazardous Wastes (1989) (Kenya signed and assented to the Convention in the year 2000)
- **Water:** Helsinki Convention on Watercourses and International Lakes (1992)

6.2.4. Environmental Impact Assessment

Environmental Impact Assessment (EIA) is a process of evaluating the likely environmental impacts of a proposed project or development, taking into account inter-related socio-economic, cultural and human-health impacts, both beneficial and adverse.

The Environment Management and Coordination Act provides for Environment Impact Assessment before any major developments are undertaken that have a bearing on natural resources and the environment. Table 6.7 shows the EIAs by sectors from 2015 to 2023.

Table 6.7: Number of Environment Impact Assessments(EIA) by Sector, 2015-2023

Sector	2015	2016	2017	2018	2019	2020	2021	2022	2023
Transport and Communication	607	636	522	1,044	215	8	12	240	121
Energy	298	422	501	436	222	11	11	98	207
Tourism	14	11	8	14	6	2	2	20	15
Mining and Quarrying	18	28	51	66	65	3	11	89	290
Human settlements and Infrastructure	505	545	434	495	302	34	49	669	187
Agriculture and Forestry	26	21	31	38	28	9	4	31	19
Commerce and Industry	135	150	228	269	193	8	10	282	182
Water Resources	51	61	67	94	46	8	16	175	35
TOTAL	**1,654**	**1,874**	**1,842**	**2,456**	**1077**	**83**	**115**	**1,604**	**1,056**

Source: *National Environment Management Authority (NEMA)/Economic Survey,2024*



6.2.5. Other Legal Frameworks

Constitution of Kenya 2010

The enactment of the 2010 Constitution of Kenya marked an important chapter in Kenya's environmental policy development. Hailed as a "Green" Constitution, it embodies provisions to secure future sustainable development, ranging from the environmental principles of Multilateral Environmental Agreements (MEAs) to the right to a clean and healthy environment, including water, food, and shelter.

Kenya's commitment to sustainable environment and environmental management is clearly expressed in its new 2010 Constitution. Chapter Five addresses land and environment and Articles 66, 69, 70, 71, and 72 are dedicated to environmental and natural resource management (ENRM) issues. The chapter highlights the importance of sound conservation and protection of ecologically sensitive areas and the elimination of gender discrimination in land and environment management practices. In addition, Article 69 details the obligations on the state to implement the sustainable exploitation, utilization, management, and conservation of the environment and natural resources, and equitable sharing of benefits accruing from such.

Vision 2030

Vision 2030 provides Kenya with a development blueprint covering the period between years 2008 to 2030 and implemented in five-year medium-term plans. It aims to transform Kenya into a newly industrialized middle-income country in which citizens enjoy a high quality of life in a clean and secure environment. Vision 2030 recognizes that the environment and natural resources (ENR) are critical to achieve the socioeconomic and political development objectives that it sets out. It consists of three pillars.

(1)The economic pillar ,aimed at maintaining a sustainable economic growth of 10 percent per annum over the years covered in the blueprint.

(2)The social pillar ,aimed at ensuring a just and cohesive society that enjoys equitable social development in a clean and secure environment and

(3)The political pillar aimed at ensuring an issue-based, people-centered, and result-oriented democratic political environment.

National Environment Policy (2013)

The National Environment Policy, adopted in 2013, aims to enhance the ecological perspective and strengthen the connections between green policy and poverty reduction. The three main objectives of the policy are to:

(1)Ensure sustainable management of Kenya's environment and natural resources.

(2)Provide a framework for an integrated approach to planning and sustainable management of the environment and natural resources.

(3)Strengthen the legal and institutional framework for good governance, and effective coordination and management of the environment and natural resources.

The National Environment Policy promotes and enhances cooperation, collaboration, synergy, partnerships, and participation in the protection, conservation, and sustainable management of the environment and natural resources.

6.2.6. Conclusion

This chapter organizes information on environmental protection and resource management expenditure to improve the environment and maintain ecosystem health. Statistics on environmental governance, institutional strength, enforcement of regulations and extreme event preparedness are also considered. This component also includes information on a wide variety of programmes and actions to increase awareness, including environmental information and education, as well as private and community activities aimed at diminishing environmental impacts and improving the quality of local environments. The last chapter presents the embition of Kenya , challengers and future plan for developing environment statistics.





07

AMBITION OF KENYA, CHALLENGES AND FUTURE PLANS FOR DEVELOPING ENVIRONMENT STATISTICS

7.0. Introduction

The Kenya Vision 2030 specifies that the country aims to be a nation that has a clean, secure and sustainable environment by 2030 by;

(i) Increasing forest to a minimum of 10% by 2030; and
(ii) Reducing by half all environment-related diseases.

Specific strategies should promote environmental conservation in order to provide better support to the economic pillar flagship projects and for the purposes of achieving the SDGs; improving pollution and waste management through the design and application of economic incentives; and the commissioning of public-private partnerships (PPPs) for improved efficiency in water and sanitation delivery. Kenya should also enhance disaster preparedness in all disaster -prone areas and improve the capacity for adaptation to global climatic change. In addition, the country should harmonise environment-related laws for better environmental planning and governance. However, to reach these objectives statistics are needed on the status of environment. To support Kenya's ambitions,international agencies and organisations such as UNSD, EAC, Secretariat and Statistics Sweden (SCB) and COMESA provided some funds for implementing the (FDES 2013) wich is a flexible, multi-purpose conceptual and statistical framework that is comprehensive and integrative in nature. The FDES provides an organizing structure to guide the collection and compilation of environment statistics at the national level. It brings together data from the various relevant subject areas and sources. It is broad and holistic in nature, covering the issues and aspects of the environment that are relevant for policy analysis and decision making.

7.1. Results of Online assessment

An online assessment done in november 2022 by using of the Environment Statistics Self Assessment Tool(ESSAT), Kenya implemented the FDES by only two out of four crtical phases were completed namely :Preparatory Stage and Foundational stage as showed the table below. Noted that the same assessment revealed that data are stored in databases.

Table 7.1: Countries at the Different Critical Phases of Implementation

Country	preparatory stage	Foundational stage	Operational stage	Consolidation stage
Liberia	No	No	No	No
Ethiopia	Yes	Yes	No	No
Malawi	Yes	Yes	No	No
Ghana	Yes	Yes	Yes	Yes
Kenya	Yes	Yes		
Gambia	Yes	yes	Yes	Yes
Sudan	Yes	Yes	Yes	Yes
Lesotho	Yes	Yes	Yes	Yes
Somalia	No	No	No	No
Siera Leone	No	No	No	No
Zambia	Yes	Yes	Yes	No
Rwanda	Yes	Yes	Yes	No
Zimbamb-we	Yes	Yes	yes	Yes
Uganda	Yes	Yes	yes	Yes



Source: *Environment Statistics Self Assessment Tool(ESSAT)*

1. The preparatory stage concerns the creating of a national team, establishing the leadership and responsibilities; establishing the modes of collaboration with other institutions and within each institution; reviewing of the legal framework, mandate and national policy priorities related to the environment, information and development; establishing policy and user needs; developing of a national strategy for establishing an environment statistics programme; reviewing of methodological resources, available in appropriate languages and including the FDES and the Core Set of Environment Statistics.
2. Foundational Stage concerns the assessment of data availability and sources for producing environment statistics at the national level; applying the Self-Assessment tool based on the Core Set of Environment Statistics to identify possible data gaps that are important to the country; engaging in technical capacity building activities such as training, study tours and workshops; formalizing and supporting inter- and intra-institutional collaboration mechanisms and focal points and defining the environment statistics product(s) mostly required within a long-term timeframe.
3. Operational Stage regarding the adaptation the FDES and the Core Set of Environment Statistics to the country's needs and priorities; defining a set of environment statistics to be produced at the national level; developing collaboration with national scientists and experts on specific realms of the environment to consult as needed; developing data compilation and collection instruments and undertaking these processes;carrying out data validation;developing metadata;preparing publications; preparing launch events;disseminating environment statistics products and obtaining feedback.
4. Consolidation Stage concerns the institutionalization and strengthening of environment statistics units; formalizing national inter-institutional collaboration platforms; allocating budget and staff resources dedicated to environment statistics; connecting with and participating in regional and global expert groups, networks and resources; maintaining and further developing environment statistics' coverage and timeliness and ensuring statistical quality.

This completed first edition of the compendium allows to Kenya to achieve the third stage regarding the Operational Stage. Although Kenya is yet compile all these fours phases, the countriy has the inter-institutional working group to coordinate the production of Environment Statistics under the coordination of KNBS jointly with NEMA.

Table 7.2: Countries with Committee, Inter-institutional Working Group on Environment Statistics

Country	Yes or No	Country	Yes or No
Anglophone		Lesotho	Yes
Liberia	No	Somalia	No
Ethiopia	No	Siera Leone	Yes
Malawi	Yes	Zambia	No
Ghana	Yes	Rwanda	No
Kenya	Yes	Zimbambwe	Yes
Gambia	Yes	Uganda	Yes
Sudan	Yes		

Source: *Environment Statistics Self Assessment Tool(ESSAT)*

7.2. Challenges

As other countries, Kenya is faced with several barriers to collaboration among institutions, for the production of Environment Statistics. The main barriers faced by kenya are: the lack of finance for the functioning of the committee , the lack of resources for regular meetings and the overlapping responsibilities of institutions.

7.3. Way forward

Kenya have at least initiated the implementation of the FDES. Currently, it is needed to:

1. Update the Technical Working Group for covering all institutions involved in the productions of environment statistics,
2. Initiate the implementation of the global set of climate change statistics and indicators by producing the report on climate change statistics ,
3. Review the National Strategies for the Development of Statistics by including the environment and climate change statistics,
4. Elaboration of methodologies,
5. Join the development partners, requesting the technical support on the environment and climate change statistics and on the related areas such as diseasters related statistics. The support will be oriented in (capacity building , trainings, including e-training, and study tours, regular meeting, data collection etc).

ANNEX 1: Major Rivers Water Quality Status

Malewa River

Station _ID	Station Name	Date & Time Sampled	Temp	pH	DO	Turbid-ity	Iron	Mn	Cond	T. Hard	PO4	Ca	F	Nitrate
2GB5	Malewa River	11/22/2013	23.9	7.5	-	133	1.93	0.097	100	44	0.32	6.4	0.01	0.36
2GB1	Malewa River	11/22/2013	23.3	7.4	-	77.2	1.9	0.086	288	52	0.31	6.4	0.01	0.58
2GB3	Malewa River	11/21/2013	22.6	7.6	-	4.3	0.32	0.058	33	20	0.27	11.2	<0.01	1.18
2GB6	Malewa river	6/10/2014	22.2	7.2	-	11.4	-	-	112	20	-	3.2	-	-
2GB1	Malewa River	10/13/2014	24.5	7.5	-	35	-	-	128	30	-	12	-	-
misce	Malewa Bay	6/8/2014	20.3	7.6	-	-	-	1.63	-	1211	-	2.88	-	412
misce	Malewa river at bridge along kinangop olka-lou road	4/9/2014	22.5	7.2	-	-	-	21.2	-	50	-	3.84	-	40
2GB6	Malewa river	6/10/2014	22.2	7.2	-	-	-	11.4	-	112	-	6.72	2.86	-
2GB1	Malewa River	10/13/2014	24.5	7.5	-	-	-	35	-	128	-	NIL	0.22	-
2GB1	Malewa	10/2/2015	-	7.66	-	-	0.06	0.5	-	56	0.12	21.6	1.4	0.7
2GB03	malewa river	4/22/2015	15.9	7.31	6.4	-	-	-	-	36	0.81	5.6	0.92	0.1
2GB08	Malewa river	4/21/2015	17.6	7.83	5.35	-	-	-	-	44	1.05	12.8	1.86	0.03
2GB01	Malewa river	4/23/2015	17.4	6.83	-	-	-	-	-	36	-	11.2	0.75	-
2GB05	Malewa river	4/23/2015	-	6.92	-	-	-	-	-	56	-	12.8	0.49	-
2GB03	Malewa river	6/4/2015	21.2	6.6	-	37	0.55	-	64	28	-	9.6	-	-
2GB05	Malewa river	6/5/2015	21.4	6.6	-	249	Nil	-	91	22	-	26.4	-	-
2GB01	Malewa river	6/5/2015	21.4	6.5	-	161	2.83	-	97.4	14	-	26.4	-	-
2GB03	Malewa River	8/18/2015	19.9	6.87	5.98	6.13	-	-	68	24	1.3	9.6	0.22	1.7
2GB01	Malewa River	8/19/2015	19.9	6.87	5.68	67.4	-	-	110.4	42	1.56	11.2	0.47	1
2GB05	Malewa River	8/19/2015	19.6	6.74	5.8	57.8	-	-	101.3	24	1.69	9.6	0.3	0.6
2GB05	Malewa River	9/10/2015	18.9	7.34	6.92	75.2	1.3	-	100	40	-	8	-	1.3
2GB08	Malewa River	9/10/2015	14.2	7.16	-	68.1	1.35	-	88.1	44	-	6.4	0.66	0.7
2GB03	Malewa River	9/24/2015	15	6.29	6.87	52.8	-	-	70.8	38	-	15.2	-	-
2GB05	Malewa River 2GB05	3/31/2016	21	-	-	27.4	-	-	212.8	12	-	12	0.89	-
2GB08	Malewa River 2GB08	3/31/2016	21.1	-	-	9.12	-	-	142.4	14	-	9.6	0.42	-
2GB01	Malewa River 2GB01	3/31/2016	20.4	-	-	11.76	-	-	176.7	14	-	12	0.39	-
2GB03	Malewa River 2GB03	4/1/2016	20.8	-	-	5.8	-	-	78.9	14	-	6.4	0.18	-
2GB03	Malewa River	5/20/2016	20.4	-	-	8.96	-	-	22.1	6	-	4.8	1.31	-
2GB05	Malewa River	6/16/2016	19.8	-	-	17.3	-	-	125.9	12	-	9.6	0.55	-
2GB03	Malewa River	6/20/2016	19.5	-	-	28	-	-	55.1	12	-	4.8	0.1	-
Misce	Malewa River	6/20/2016	19.4	-	-	93.5	-	-	88.3	20	-	5.6	Nil	-
2GB05	Malewa River	02.08.2016	19.5	-	-	101	-	-	82.7	8	-	30.4	-	-
2GB01	Malewa River	02.08.2016	19.6	-	-	104	-	-	81.9	6	-	15.2	-	-
2GB03	Malewa River	21.11.2016	14.9	5.9	-	7.94	-	-	64.6	8	-	4.8	0.86	-
2GB08	Malewa River	21.11.2016	15	5.9	-	8.31	-	-	84.7	6	-	7.2	1.72	-
2GB05	Malewa River	22.11.2016	16.9	6.2	-	8.32	-	-	107.4	6	-	8.8	0.36	-

ANNEX 1: Major Rivers Water Quality Status *(Continued)*

Station _ID	Station Name	Date & Time Sampled	Temp	pH	DO	Turbid-ity	Iron	Mn	Cond	T. Hard	PO4	Ca	F	Nitrate
2GB01	Malewa River	22.11.2016	17.8	6.4	-	14.97	-	-	115	10	-	16	0.06	-
2GB03	Malewa River	25.04.2017	20.7	8.8	-	3.65	-	-	85.5	14	-	2.24	-	-
2GB05	Malewa River	26.04.2017	22.7	7.3	-	6.16	-	-	300	10	-	1.6	-	-
2GB08	Malewa River	26.04.2017	22.7	7.2	-	7.86	-	-	157.5	12	-	1.92	-	-
2GB08	Malewa River	26.05.2017	20.1	-	-	9.31	-	-	104.5	6	-	16.8	-	-
2GB03	Malewa River	29.05.2017	19.6	-	-	8.93	-	-	81.7	10	-	15.2	-	-
2GB05	Malewa River	29.05.2017	19.6	-	-	15.59	-	-	146.3	18	-	14.4	-	-
2GB01	Malewa River	7/25/2017	20.9	7	-	37.5	-	-	116	30	-	24	-	-
2GB03	Malewa River	7/26/2017	19.4	6.9	-	6.29	-	-	36	14	-	5.6	-	-
2GB8	Malewa River	7/31/2017	18.5	-	-	21.4	-	-	74.7	34	-	13.6	-	-
2GB5	Malewa River	7/31/2017	18.5	-	-	62.3	-	-	80.2	66	-	26.4	-	-
2GB3	Malewa River	8/28/2017	17.2	-	-	4.24	-	-	35.7	44	-	17.6	-	-
2GB8	Malewa River	8/29/2017	16.8	-	-	60.1	-	-	73.8	46	-	18.4	-	-
2GB1	Malewa River	8/30/2017	20.3	-	-	32.3	-	-	87.1	84	-	33.6	-	-
2GB5	Malewa River	8/30/2017	20.1	-	-	43.7	-	-	81.6	72	-	28.8	-	-
2GB1	Malewa River	9/27/2017	19	-	-	46.2	-	-	98.5	62	-	24.8	-	-
2GB5	Malewa River	9/29/2017	18.1	-	-	365	-	-	92.4	66	-	26.4	-	-
2GB8	Malewa River	9/29/2017	17.6	-	-	22.4	-	-	74.4	42	-	16.8	-	-
2GB3	Malewa River	9/29/2017	17.5	-	-	4.4	-	-	40.2	56	-	22.4	-	-
2GB8	Malewa River	10/23/2017	19.5	-	-	32.2	-	-	62.4	74	-	29.6	-	-
2GB1	Malewa River	10/24/2017	19.1	-	-	39.2	-	-	80.6	66	-	26.4	-	-
2GB3	Malewa River	10/24/2017	19.1	-	-	3.27	-	-	27.2	50	-	20	-	-
2GB5	Malewa River	10/24/2017	19.1	-	-	39.1	-	-	67.7	54	-	21.6	-	-
2GB2	Malewa River	10/24/2017	19.2	-	-	56.6	-	-	81.3	54	-	21.6	-	-
2GB8	Malewa River	11/27/2017	16.1	-	-	17.8	-	-	99.7	70	-	28	-	-
2GB5	Malewa River	11/27/2017	16.1	-	-	45.2	-	-	100.1	52	-	20.8	-	-
2GB3	Malewa River	11/27/2017	16.6	-	-	4.51	-	-	46.6	70	-	28	-	-
2GB1	Malewa River	11/27/2017	16.3	-	-	46.1	-	-	111.4	40	-	16	-	-
2GB3	Malewa River	12/21/2017	15.6	-	-	10.76	-	-	85.1	94	-	37.6	-	-
2GB8	Malewa River	12/21/2017	15.8	-	-	10.1	-	-	124.2	112	-	44.8	-	-
2GB5	Malewa River	12/21/2017	15.8	-	-	14.47	-	-	141	98	-	39.2	-	-
2GB1	Malewa River	12/21/2017	15.9	-	-	14.64	-	-	163.3	72	-	28.8	-	-
2GB03	Malewa River	7/26/2018	17.9	-	-	3.29	-	-	52.1	72	0.3	18.4	-	-
2GB08	Malewa River	7/30/2018	21.4	-	-	25.93	-	-	109.2	50	0.66	8.8	-	-
2GB05	Malewa River	7/30/2018	21.4	-	-	25.99	-	-	110.3	70	0.58	7.2	-	-

ANNEX 1: Major Rivers Water Quality Status *(Continued)*

Station _ID	Station Name	Date & Time Sampled	Temp	pH	DO	Turbid-ity	Iron	Mn	Cond	T. Hard	PO4	Ca	F	Nitrate
2GB03	Malewa River	8/29/2018	20.1	-	-	105	-	-	100.6	22	-	6.4	-	-
2GB08	Malewa River	8/30/2018	20.5	-	-	126	-	-	86.1	44	-	8.8	-	-
2GB05	Malewa River	8/30/2018	20.5	-	-	211	-	-	88.1	32	-	7.2	-	-
2GB01	Malewa River	8/30/2018	20.6	-	-	119	-	-	105.2	44	-	0.6	-	-
2GB03	Malewa River	9/25/2018	18.8	-	-	3.77	-	-	61.3	34	-	2.4	-	-
2GB08	Malewa River	9/25/2018	18.8	-	-	11.65	-	-	111.8	40	-	4	-	-
2GB08	Malewa River	10/24/2018	19.3	-	-	12.98	-	-	56	50	-	16.8	-	-
2GB03	Malewa River	10/24/2018	19.5	-	-	5.15	-	-	21	26	-	7.2	-	-
2GB05	Malewa River	10/24/2018	19.5	-	-	16.47	-	-	61	50	-	6.4	-	-
2GB01	Malewa River	10/26/2018	20.3	-	-	17.46	-	-	73	48	-	5.6	-	-
2GB05	Malewa River	11/20/2018	22	-	-	12.01	-	-	88	50	0.99	4.8	-	-
2GB08	Malewa River	11/20/2018	22	-	-	8.45	-	-	77	42	1.21	10.4	-	-
2GB03	Malewa River	11/20/2018	21.9	-	-	5.49	-	-	38	56	0.75	4.8	-	-
2GB01	Malewa River	11/21/2018	23.5	-	-	15.53	-	-	96	38	0.79	8	-	-
2GB03	Malewa River	12/17/2018	-	-	-	6.84	-	-	-	46	-	5.6	-	-
2GB05	Malewa River	12/17/2018	-	-	-	17.57	-	-	-	52	-	8.8	-	-
2GB08	Malewa River	12/17/2018	-	-	-	11.36	-	-	-	40	-	7.2	-	-
2GB01	Malewa river	12/19/2018	-	-	-	35.63	-	-	-	-	-	-	-	-
2GB08	Malewa River	1/31/2019	22.4	-	-	6.03	-	-	160.6	74	-	11.2	-	-
2GB01	Malewa River	2/19/2019	21.1	-	-	11.22	-	-	339	106	1.26	11.2	-	0.3
2GB03	Malewa River	2/20/2019	22	-	-	3.95	-	-	90.3	74	2.2	0.8	-	2
2GB08	Malewa River	2/20/2019	21.9	-	-	5.61	-	-	252	104	0.49	14.4	-	1.8
2GB05	Malewa River	2/20/2019	22.1	-	-	5.61	-	-	365	82	0.61	10.4	-	0
2GB01	Malewa River	3/27/2019	20.4	-	-	5.18	0.19	-	407	82	0.76	13.12	-	0.4
2GB03	Malewa River	3/28/2019	-	-	-	4.65	0	-	-	62	0.78	14.4	-	0
2GB05	Malewa River	3/28/2019	-	-	-	5.64	0.02	-	-	74	1.18	16	-	0.2
2GB3	Malewa river	4/29/2019	-	-	-	5.52	0.02	-	-	26	0.32	28.8	-	1
2GB5	Malewa River	4/29/2019	-	-	-	11.32	0.02	-	-	100	0.58	16.8	-	1
2GB1	Malewa River	4/29/2019	12.6	-	-	12.6	0.79	-	-	184	0.25	17.2	-	1
2GB8	Malewa River	4/30/2019	12.32	-	-	12.32	0	-	-	46	0	10.4	-	0
Average			**19.46**	**7.06**	**6.14**	**37.60**	**0.75**	**8.75**	**107.27**	**58.31**	**0.78**	**13.87**	**-**	**19.50**
Minimum			**12.32**	**5.9**	**5.35**	**3.27**	**0**	**0.058**	**21**	**6**	**0**	**0.6**	**0.01**	**0**
Maximum			**24.5**	**8.8**	**6.92**	**365**	**2.83**	**35**	**407**	**1211**	**2.2**	**44.8**	**2.86**	**412**

Source: *Water Resources Authority*

Chania River

Station_ID	Station Name	Date & Time Sampled	Temp	pH	DO	Turbidity	Cond	Nitrate(-NO_3)
4AC4	Chania	4/17/2013	17.9	6.8	4.5	6.33	36.1	
4CA2	Chania	4/19/2013	17.8	6.4	4.8	41.3	49.6	
4AC4	Chania	4/19/2013	17.8	6.3	5.5	2.3	34.1	
4AC4	Chania	10/5/2013	17.8	6.4	4.9	1.44	43.9	
4CA New	Chania	6/18/2014 9:40	15.4	8.08		156		
4CA3	Chania	12/11/2014 09:45:20HRS	15.5			38.3		
4CA2	Chania	17/11/2014 09:40:26HRS	19.2			19.2		
4AC4	Chania	20/11/2014 16:50:48HRS	16.2			24.4		
4CA3	Chania River	13/01/2015 18:30:25HRS	17.2	6.78		6.3		
4CA2	Chania River	14/01/2015 10:23:15HRS	19.7	7.02		9.9		
4CA3	Chania at Matara Bridge.	19/02/2015 13:19:34HRS	17.5	7.93		39.1	62.6	
4CA2	Chania	19/02/2015 14:55:20HRS	21.3	7.72		17.4	57.1	
4AC4	Chania	24/02/2015 12:00:45HRS	21.9	8.46		15.4	113.1	
4CA02	Chania	5/14/2015	19	7.8		153	52	
4CA03	Chania	5/20/2015	16.9	7.54		36.5	47.1	
4CA2	Chania at Blue post	14/08/2015 15:05:20HRS	20	7.65		79	17.3	
4AC4	Chania at Kiawara / King'ong'o foot Bridge	18/08/2015 16:08:45HRS	19.26	8.45		18.2	100	
4AC	Chania before confluence with Sagana	19/08/2015 12:30:23HRS	18.66	8.81		14.1	182	
4CA2	Chania	09/08/2016 15:20:10HRS	20.26	7.9	4.9	25.1	194	
4CA3	Chania at Matara Bridge.	29/08/2016 13:19:34HRS	13.55	7.79	7.38	6.3	46	
4CA2	Chania	26/08/2016 14:55:20HRS	18.26	8.28	7.2	16	85	
4AC4	Chania	31/08/2016 13:40:52HRS	13.8	8.28	5.58	16.9	100	
4AC	Chania before Confluence with Sagana	02/09/2016 12:00:45HRS	15.93	8.25	7.46	15.9	188	
4AC4	Chania	10/03/2017 11:17:40HRS	18.85	9.1	9.06	9.3	169	
4CA3	Chania	30/03/2017 12:36:57HRS	21.79	8.46	5.39	62.9	86	
4CA2	Chania	31/03/2017 08:52:29HRS	22.29	8.45	3.79	1.4	140	
4CA3	Chania	16/05/2017 11:40:17HRS	16.9	9.05	2.19	14.3	62	
4CA2	Chania	17/05/2017 13:40:13HRS	20.63	8.08	4,54	45.6	65	
4CA3	Chania at Kariminu Bridge.	25/08/2017 13:50:08HRS	16.53	9	2.99	3.5	47	1.7
4CA2	Chania at Blue Post	24/08/2017 15:21:59HRS	21.12	8.84	4.13	3.3	111	1.8
4AC4	Chania	28/08/2017 15:21:31HRS	19.32	8.8	3.67	18.9	90	8
4AC	Chania before Confluence with Sagana	30/08/2017 14:26:17HRS	19.73	8.02	7.05	22.4	172	4.3
4CA2	CHANIA	18/07/2017 8:20:10HRS	18.5	8.02	1.56	5.6	106	
4CA3	Chania at Kariminu Bridge.	25/08/2017 13:50:08HRS	16.53	9	2.99	3.5	47	1.7
4CA2	Chania at Blue Post	24/08/2017 15:21:59HRS	21.12	8.84	4.13	3.3	111	1.8
4AC4	Chania	28/08/2017 15:21:31HRS	19.32	8.8	3.67	18.9	90	8

Station_ID	Station Name	Date & Time Sampled	Temp	pH	DO	Turbidity	Cond	Nitrate(-NO_3)
4AC	Chania before Confluence with Sagana	30/08/2017 14:26:17HRS	19.73	8.02	7.05	22.4	172	4.3
4CA3	Chania at Kariminu Bridge.	25/08/2017 13:50:08HRS	16.53	9	2.99	3.5	47	1.7
4CA2	Chania at Blue Post	24/08/2017 15:21:59HRS	21.12	8.84	4.13	3.3	111	1.8
4AC4	Chania	28/08/2017 15:21:31HRS	19.32	8.8	3.67	18.9	90	8
4AC	Chania before Confluence with Sagana	30/08/2017 14:26:17HRS	19.73	8.02	7.05	22.4	172	4.3
4CA2	Chania	16/11/2017 13:18:07HRS	19.68	8.54	4.63	55	68	
4CA3	Chania	20/11/2017 11:38:15HRS	14.72	7.6	4.94	10	52	
4CA3	Chania at Kariminu Bridge.	24/11/2017 13:58:09HRS	16.14	8.41	3.81	11.6	36	2.6
4CA2	Chania at Blue Post	27/11/2017 12:55:31HRS	19.9	8.15	5.84	35.4	73	2.6
4AC4	Chania	30/11/2017 10:53:40HRS	16.04	7.94	2.53	27.6	75	2
4AC	Chania before Confluence with Sagana	04/12/2017 13:00:55HRS	19.79	8.17	5.65	58	156	0.8
4CA3	Chania	26/04/2018 17:20:22HRS	16.78	7.46	3.44	126	85	
4CA3	Chania	16/05/2018 10:48;24HRS	16.43	9.95	1.81	93.4	89	
4CA3	Chania	22/05/2018 12:41:37HRS	15.58	6.65	1.99	82	67	
4CA2	Chania	29/05/2018 18:10:51HRS	18	8.4	2.51	117	57	
4CA3	Chania	16/05/2018 10:48;24HRS	16.43	9.95	1.81	93.4	89	
4CA3	Chania	22/05/2018 12:41:37HRS	15.58	6.65	1.99	82	67	
4CA2	Chania	29/05/2018 18:10:51HRS	18	8.4	2.51	117	57	
4CA3	Chania	07/08/2018 12:16:18HRS	15.65	10.08	4.49	9.27	68	
4CA3	Chania	07/08/2018 12:16:18HRS	15.65	10.08	4.49	9.27	68	
4CA3	Chania at Kariminu Bridge.	11/23/2018	17.2	7.52		15.4	40	3.3
4CA2	Chania at Blue Post	11/26/2018	22.8	7.32		10.44	93	1.5
4AC4	Chania	11/28/2018	17.3	8.13		31.1	78	4.1
4AC	Chania before Confluence with Sagana	11/27/2018	20.2	8.12		28.33	163	2.1
4CA3	Chania	20/02/2019 17:211:37HRS	19			7.72		
4CA3	Chania	27/03/2019 11:17:00HRS	13.5			8.2		
4CA2	Chania	2/04/2019 13:34:09HRS	10			3.02		
4AC4	Chania	5/04/2019 12:06:40HRS	21.1			8.94		
4CA3	Chania	05/06/2019 12:31:04HRS				40.7		
4CA3	Chania	06/06/2019 12:31:36HRS				40.4		
4CA3	Chania	06/06/2019 12:31:36HRS				40.4		
	Average		**18.1**	**8.163158**	**4.39439**	**32.88597**	**88.46111**	**3.32**
	Minimum		**10**	**6.3**	**1.56**	**1.4**	**17.3**	**0.8**
	Maximum		**22.8**	**10.08**	**9.06**	**156**	**194**	**8**
		Greater than the average values						

Source: *Water Resources Authority*

Sagana River

Station_ID	Station Name	Date & Time Sampled	Temp	pH	DO (mg/l)	Turbidity	Cond	Nitrate (NO_3)
4AA5	Sagana	4/16/2013	17.8	6.5	5.8	17.38	69.9	
4AC3	Sagana	4/16/2013	17.7	6.5	5.2	47.4	67.8	
4AA5	Sagana	9/5/2013	17.9	6.5	4.8	19.5	79.3	
4AC3	Sagana	9/5/2013	17.8	6.3	4.3	5.27	82.3	
4AA1	Sagana River	6/25/2014 9:45	15.6	8.33		7.74		
4AA5	Sagana	18/11/2014 10:20:00HRS	15.8			15.6		
4AC3	Sagana	20/11/2014 12:23:40HRS	16.8					
4AA5	Sagana	20/11/2014 13:40:00HRS	18.8			87		
4AA3	Sagana River	16/01/2015 08:55:15HRS	16.7	7.6		5.76		
4AA1	Sagana River	16/01/2015 16:30:05HRS	21	8.86		5.96		
4AD	Sagana at Karatina/ Mukurweini bridge	23/02/2015 09:00:30HRS	23.8	8.39		25	126.3	
4AC3	Sagana	25/02/2015 16:34:20HRS	20	8.6		27.8	111.8	
4AD	Sagana (DS Gura Confluence) at Karatina/Mukurweini BDG	20/08/2015 09:00:30HRS	23.8	8.39		25	126.3	
4AD	Sagana at Karatina/ Mukurweini bridge	30/08/2016 09:00:30HRS	17.68	8.33	8.2	15.2	137	
4AA1	Sagana	09/03/2017 13:23:03HRS	22.2	11.05	11.32	10.8	245	
4AA5	Sagana	10/03/2017 13:29:29HRS	23.5	9.42	10.55	6.6	399	
4AC3	Sagana	10/03/2017 15:00:46HRS	21.5	8.33	8.2	15.2	137	
4AA5	Sagana	28/03/2017 09:33:48HRS	21.98	8.27	7.32	4	289	
4AA1	Sagana	28/03/2017 13:32:35HRS	26.38	11.51	8.92	3.4	455	
4AC3	Sagana	19/05/2017 15:28:25HRS	19.96	8.1	3.94	60.9	141	
4AA5	Sagana	19/05/2017 15:59:42HRS	21.24	8.42	5.7	53.3	166	
4AA1	Sagana	20/05/2017 13:53:47HRS	21.64	9.14	7.2	7.6	150	
4AD	Sagana at Karatina/ Mukurweini bridge	28/08/2017 10:02:52HRS	18.53	7.95	2.57	21.4	140	0.8
4AA	Sagana after Sagana/ Nairobi Confluence	30/08/2017 13:32:57HRS	21.17	8.44	6.94	24.6	312	2.3
4AD	Sagana at Karatina/ Mukurweini bridge	28/08/2017 10:02:52HRS	18.53	7.95	2.57	21.4	140	0.8
4AA	Sagana after Sagana/ Nairobi Confluence	30/08/2017 13:32:57HRS	21.17	8.44	6.94	24.6	312	2.3
4AD	Sagana at Karatina/ Mukurweini bridge	28/08/2017 10:02:52HRS	18.53	7.95	2.57	21.4	140	0.8
4AA	Sagana after Sagana/ Nairobi Confluence	30/08/2017 13:32:57HRS	21.17	8.44	6.94	24.6	312	2.3
4AA5	Sagana	21/11/2017 17:42:35HRS	18.48	7.39	5.39	43.3	180	
4AA	Sagana at Karatina/ Mukurweini bridge	29/11/2017 13:21:31HRS	20.37	8.44	7.44	54.5	114	1
4AA	Sagana after Sagana/ Nairobi Confluence	30/11/2017 14:11:39HRS	18.15	7.79	8.64	114	224	1.5
4AA5	Sagana	20/04/2018 13:49:21HRS	17.6	8.47	3.28	187	156	
4AA1	Sagana	20/04/2018 15:49:21HRS	16.59	7.54	3.6	173	103	

Station_ID	Station Name	Date & Time Sampled	Temp	pH	DO (mg/l)	Turbidity	Cond	Nitrate (NO_3)
4AC3	Sagana	23/04/2018 14:09:56HRS	18.15	9.44	2.35	176	132	
4AA5	Sagana	23/04/2018 15:19:49HRS	17.8	9.1	3.58	70.8	143	
4AA1	Sagana	23/04/2018 17:19:27HRS	16.79	7.71	4.5	25.8	94	
4AA1	Sagana	05/07/2018 14:47:28HRS	18.49	9.88	4.24	8.8	178	
4AA5	Sagana	05/07/2018 15:25:06HRS	17.18	8.67	1.63	26.2	267	
4AA5	Sagana	10/08/2018 10:20:46HRS	18.44	7.74	2.92	20.1	820	
4AA1	Sagana	10/08/2018 13:51:19HRS	19.71	9.78	5.1	19.7	989	
4AA5	Sagana	10/08/2018 10:20:46HRS	18.44	7.74	2.92	20.1	820	
4AA1	Sagana	10/08/2018 13:51:19HRS	19.71	9.78	5.1	19.7	989	
4AA5	Sagana	21/09/2018 10:35:23HRS	23.7	12.4	2.35	19.5	635	
4AA1	Sagana	21/09/2018 10:45:29HRS	19.8	10	3.35	71.2	278	
4AD	Sagana at Karatina/ Mukurweini bridge	11/27/2018	17.9	8.15		21.6	102	2.8
4AA	Sagana after Sagana/ Nairobi Confluence	11/27/2018	20.3	8.29		32.4	213	5.5
4AC3	Sagana	21/02/2019 16:55:56HRS	22			5.91		
4AA5	Sagana	21/02/2019 17:45:51HRS	23.2			5.9		
4AA1	Sagana	22/02/2019 10:45:29HRS	18.5			10.1		
4AA5	Sagana	4/04/2019 12:31:37HRS	21.9			3.43		
4AA1	Sagana	5/04/2019 09:30:12HRS	17.1			4.79		
Average			**19.58784**	**8.512093**	**5.324857**	**34.7648**	**264.3925**	**2.01**
Minimum			**15.6**	**6.3**	**1.63**	**3.4**	**67.8**	**0.8**
Maximum			**26.38**	**12.4**	**11.32**	**187**	**989**	**5.5**

Source: *Water Resources Authority*

Nyando River

Sample source	Date Sampled	pH (range)	Turbidity (NTU)	Conductivity (µs/cm)	Nitrate (mg/l)
NYANDO RIVER 1GD 01	7/9/2017	7.95	2,708.00	147.90	0.02
NYANDO RIVER 1GD 03	7/9/2017	7.73	2,528.00	147.80	0.04
NYANDO RIVER 1GC 03 (KIPCHORIAN)	8/9/2017	7.97	248.00	142.60	0.14
NYANDO RIVER 1GC 06	8/9/2017	7.89	218.00	136.30	0.27
Nyando River at Ogilo	1/25/2018	7.80	43.56	340.00	0.42
Nyando at 1GD 07 (KY-13)	2/22/2018	-	8.21	-	0.01
Nyando at Ahero (KY-6)	2/22/2018	-	73.90	-	0.67
Nyando River Downsream of Ahero Town	4/27/2018	6.80	626.00	160.00	0.61
Nyando at Awasi-Chemelil Bridge D/S of Muhoroni Sugar F/E	4/27/2018	6.40	682.00	130.00	0.31
Nyando River D/S of ACFC & U/S of Muhoroni Sugar 1GD 07	4/26/2018	7.50	246.00	170.00	0.69
Nyando U/S of ACFC at Muhoroni Water Supply	4/26/2018	6.80	211.00	160.00	0.70
Nyando River U/S of ACFC (Also at Muhoroni W/S Intake)	5/24/2018	6.60	276.00	140.00	1.00
Nyando D/S of ACFC (Also D/S of Muhoroni)	5/24/2018	7.90	307.00	180.00	0.70
River Nyando at Awasi-Chemelil Bridge (Also D/S of Muhoroni Sugar Factory	5/23/2018	6.70	521.00	140.00	0.40
Nyando River D/S of Ahero Bridge	5/23/2018	5.40	647.00	160.00	1.00
Nyando D/S of ACFC Final Effluent	6/20/2018	8.13	240.00	180.00	0.33
Nyando at Muhoroni W/S Upstream of ACFC F/E	6/20/2018	8.50	232.00	180.00	0.46
Nyando River at Awasi-Chemelil Bridge	6/21/2018	7.75	274.00	190.00	0.17
River Nyando D/S of Ahero Bridge (1GD 01)	6/21/2018	7.93	490.00	202.00	0.67
Average		**7.40**	**556.82**	**170.98**	**0.45**
Minimum		**5.40**	**8.21**	**130.00**	**0.01**
Maximum		**8.50**	**2,708.00**	**340.00**	**1.00**

Source: *Water Resources Authority*

Tana River

Station Name	Date & Time Sampled	Temp 0C	pH range	DO (mg/l)	Turbidity (NTU)	Cond (µs/cm)	Nitrate (NO3)
Tana Grand Falls	3/23/2012 12:55	-	7.38	-	60.1	121.8	-
Tana Grand Falls	5/18/2012 9:32	26.6	7.31	7.98	-	105.8	-
Tana Grand Falls	4/10/2012 09:30:00Hrs	24.3	7.35	3.55	-	118	-
Tana Grand Falls	17/04/2013 15:15:00Hrs	27.7	6.11	0	-	95.7	-
Tana Rukanga	4/16/2013 0:00	17.9	6.8	6.1	342	55.2	-
Tana Grand Falls	10/05/2013 09:30:00Hrs	26.6	7.35	3.55	-	108	-
Tana Grand Falls	19/03/2014 14:40:00AM	28.3	6.25	3.27	-	125.4	-
Tana river at Garissa Bridge	26-11-015 11:20:00	32.3±0.9 (n=3)	7.1±0.01 (n=3)	0.085±0.1 (n=3)	885.7±3.79 (n=3)	157.1±3.6 (n=3)	-
Tana river at Korakora Water Treatment Plant	12/8/2015 0:00	35.5	7.14	0.69	596±1.0 (n=3)	178.2	-
Tana river at Garissa	18-03-016 09:20:00	34.6±0.3 (n=3)	7.7±0.01 (n=3)	0.085±0.1 (n=3)	230.7±1.4 (n=3)	138.7±1.2 (n=3)	-
Tana River at Garissa		28.7	7.62	-	258	164	-
Tana River 4G01	6/4/2020 0:00	25.3	8.2	-	-	396	-
Tana River 8.5km U/S of 4G01	6/5/2020 0:00	24	7.4	-	-	196.2	-
Tana River 10km D/S of 4G01	6/6/2020 0:00	25	7.4	-	-	-	-
Average		**26.35454545**	**7.1925**	**3.591428571**	**220.0333333**	**151.3**	
Minimum		**17.9**	**6.11**	**0.69**	**258**	**55.2**	**0**
Maximum		**35.5**	**8.2**	**7.98**	**342**	**396**	**0**

Source: *Water Resources Authority*

Athi at Munyu

Station Name	Date & time Analysed	pH (range)	Turbidity (NTU)	Cond (µs/cm)	Nitrate (mg/l)
ATHI at Munyu	3/3/2007	8.3	327	388	0.18
ATHI at Munyu	8/25/2007	8	5	280	0.09
ATHI at Munyu	12/19/2007	7.3	8	392	0.02
ATHI at Munyu	18/03/2010	8.1	95	483	0.87
ATHI at Munyu	2/8/2008	8.1	29	616	0.07
ATHI at Munyu	18/03/2010	-	95	483	0.87
ATHI at Munyu	3/2/2008	8	69	299	0.4
ATHI at Munyu	8/29/2008	8	18	650	0.26
ATHI at Munyu	25/05/2010	8.1	201	166	2
ATHI at Munyu	12/14/2011	8.3	92.7	171.9	2.1
ATHI at Munyu	8/3/2012	7.87	12.5	578	0.7
ATHI at Munyu	2/6/2011	7.54	21	537	2.1
ATHI at Munyu	1/12/2010	7.45	28.3	-	-
ATHI at Munyu	2/10/2010	7.5	17.1	-	-
ATHI at Munyu	5/1/2013	-	83	-	5
ATHI at Munyu	7/28/2016	-	37	398	-
ATHI at Munyu	2/23/2017	-	119	935	-
ATHI at Munyu	3/30/2017	-	117	925	-
Average		**7.9**	**76.4**	**486.8**	**1.1**
Min		**7.3**	**5**	**166**	**0.02**
Maximum		**8.3**	**327**	**935**	**5**

Source: *Water Resources Authority*

Athi at Baricho

Station Name	Date & Time Sampled	pH (range)	Cond (µs/cm)	Nitrite (mg/l)	Nitrate (mg/l)
Athi R Baricho	7/10/2008	-	554.0	-	1.2
Athi R Baricho	5/2/2010	-	517.0	0.0	0.3
Athi R Baricho	10/5/2010	-	296.0	0.2	3.7
Athi R Baricho	2/23/2011	8.0	130.0	-	-
Athi R Baricho	5/2/2011	8.4	644.0	-	-
Athi R Baricho	6/3/2011	7.0	601.0	-	-
Athi R Baricho	11/9/2011	8.1	582.0	-	-
Athi R Baricho	1/31/2011	8.2	660.0	-	-
Athi R Baricho	1/21/2013	-	-	-	5.0
Athi R Baricho	4/4/2013	8.2	302.9	-	-
Athi R Baricho	7/12/2013	6.2	101.5	-	-
Athi R Baricho	1/28/2014	8.7	-	-	-
Athi R Baricho	2/13/2014	8.7	-	-	-
Athi R Baricho	3/13/2014	8.7	-	-	-
Athi R Baricho	2/23/2017	9.3	782.0	-	-
Athi R Baricho	3/28/2017	8.8	2,033.0	-	-
Athi R Baricho	5/26/2017	9.2	547.2	-	-
Average		**8.3**	**596.2**	**0.1**	**2.5**
Minimum		**6.2**	**101.5**	**0.0**	**0.3**
Maximum		**9.3**	**2,033.0**	**0.2**	**5.0**

Source: *Water Resources Authority*

Nyando

Sample source	Date Sampled	pH (range)	Turbidity (NTU)	Conduct (µs/cm)	Nitrate (mg/l)
NYANDO RIVER 1GD 01	7/9/2017	7.95	2,708.00	147.90	0.02
NYANDO RIVER 1GD 03	7/9/2017	7.73	2,528.00	147.80	0.04
NYANDO RIVER 1GC 03 (KIPCHORIAN)	8/9/2017	7.97	248.00	142.60	0.14
NYANDO RIVER 1GC 06	8/9/2017	7.89	218.00	136.30	0.27
Nyando River at Ogilo	1/25/2018	7.80	43.56	340.00	0.42
Nyando at 1GD 07 (KY-13)	2/22/2018	-	8.21	-	0.01
Nyando at Ahero (KY-6)	2/22/2018	-	73.90	-	0.67
Nyando River Downsream of Ahero Town	4/27/2018	6.80	626.00	160.00	0.61
Nyando at Awasi-Chemelil Bridge D/S of Muhoroni Sugar F/E	4/27/2018	6.40	682.00	130.00	0.31
Nyando River D/S of ACFC & U/S of Muhoroni Sugar 1GD 07	4/26/2018	7.50	246.00	170.00	0.69
Nyando U/S of ACFC at Muhoroni Water Supply	4/26/2018	6.80	211.00	160.00	0.70
Nyando River U/S of ACFC (Also at Muhoroni W/S Intake)	5/24/2018	6.60	276.00	140.00	1.00
Nyando D/S of ACFC (Also D/S of Muhoroni)	5/24/2018	7.90	307.00	180.00	0.70
River Nyando at Awasi-Chemelil Bridge (Also D/S of Muhoroni Sugar Factory	5/23/2018	6.70	521.00	140.00	0.40
Nyando River D/S of Ahero Bridge	5/23/2018	5.40	647.00	160.00	1.00
Nyando D/S of ACFC Final Effluent	6/20/2018	8.13	240.00	180.00	0.33
Nyando at Muhoroni W/S Upstream of ACFC F/E	6/20/2018	8.50	232.00	180.00	0.46
Nyando River at Awasi-Chemelil Bridge	6/21/2018	7.75	274.00	190.00	0.17
River Nyando D/S of Ahero Bridge (1GD 01)	6/21/2018	7.93	490.00	202.00	0.67
Average		**7.40**	**556.82**	**170.98**	**0.45**
Minimum		**5.40**	**8.21**	**130.00**	**0.01**
Maximum		**8.50**	**2,708.00**	**340.00**	**1.00**

Source: *Water Resources Authority*

Nzoia River

Sample source	Date Sampled	pH (range)	Turbidity (NTU)	Conductivi-ty (µs/cm)	Total Alkalinity (mgCaCO3/l)	Nitrate (mg/l)	Total Phosphorus (mg/l)
Nzoia at Nzoia Mkt	9/27/2017	6.35	380.00	91.00	22.00	2.53	1.18
R. Nzoia at Nzoia mkt	11/14/2017	6.72	197.00	97.50	28.00	0.54	0.64
Nzoia at Ruambwa	11/14/2017	7.01	226.00	96.50	24.00	2.13	0.64
R.Nzoia at Webuye	2/28/2018	7.61	33.30	130.00	78.00	-	-
R.Nzoia at Nzoia market	3/1/2018	6.89	33.18	120.00	64.00	-	-
R. Nzoia at Webuye	3/17/2018	7.56	808.00	180.00	40.00	3.88	1.79
R. Nzoia at Mumias	3/17/2018	7.15	865.00	80.00	38.00	4.75	1.70
Nzoia at Nzoia market	3/18/2018	7.36	790.00	70.00	26.00	4.32	1.62
Nzoia at Mumias	5/23/2018	7.34	449.00	82.00	22.00	3.69	1.39
Nzoia at nzoia market	5/24/2018	7.17	393.00	91.00	34.00	4.41	1.65
Nzoia at Ruambwa	5/24/2018	7.75	380.00	87.80	40.00	4.21	1.53
Nzoia at Ruambwa	3/4/2019	7.00	77.00	130.00	-	1.47	0.40
Nzoia at Moi's Bridge-1BB01	6/6/2019	7.71	741.00	199.00	-	1.90	-
NZOIA River Ruambwa	9/2/2019	6.80	938.00	72.60	34.00	3.78	-
R. Nzoia at Ruambwa -	11/14/2019	-	-	-	-	-	-
R. Nzoia at Ruambwa	2/28/2020	6.60	76.00	96.90	76.00	-	-
R. Nzoia at Moi's Bridge	3/4/2020	6.40	444.00	250.80	-	-	-
Nzoia at Ruambwa	5/12/2020	6.10	479.00	120.00	-	-	-
Average		**6.64**	**406.08**	**110.84**	**29.22**	**2.09**	**0.70**
Minimum		**6.10**	**33.18**	**70.00**	**22.00**	**0.54**	**0.40**
Maximum		**7.75**	**938.00**	**250.80**	**78.00**	**4.75**	**1.79**

Source: *Water Resources Authority*

Ewaso Ngiro River

Station Name	Date & Time Sampled	pH (range)	DO (mg/g)	Cond (µs/cm)	TP (ppm)	Nitrite (mg/l)	Nitrate (mg/l)
Ewaso Ngiro	8/2/2017	7.95	4.00	183.70	-	-	-
Ewaso Ngiro	11/9/2017	8.24	4.00	128.80	-	-	-
Ewaso Ngiro	1/31/2018	7.20	-	575.00	-	-	-
Ewaso Ngiro	7/31/2018	7.32	-	233.40	1.40	-	13.50
Ewaso Ngiro	10/15/2018	8.50	4.20	434.00	-	-	-
Ewaso Ngiro	1/31/2019	8.20	-	387.00	-	-	-
Ewaso Ngiro	6/12/2019	7.90	5.20	200.80	0.40	-	-
Ewaso Ngiro	9/13/2019	7.90	4.80	225.00	0.10	-	-
Ewaso Ngiro	11/12/2019	7.50	-	137.40	0.20	-	-
Ewaso Ngiro	2/20/2020	7.90	-	126.80	0.50	0.01	8.00
Ewaso Ngiro	6/17/2020	7.40	-	215.00	0.20	0..68	-
Average		**7.82**	**4.44**	**258.81**	**0.35**	**0.01**	**2.69**
Minimum		**7.20**	**4.00**	**126.80**	**-**	**-**	**-**
Maximum		**8.50**	**5.20**	**575.00**	**1.40**	**0.01**	**13.50**

Source: *Water Resources Authority*



Annex 2: Environment and Natural Resources Sector- Outcome and Output indicators

(a) Outcome Indicators

Outcome	Indicators	Unit	Baseline Year	Baseline/ Values	Targets		Data Source	Respon-sible Agency	Link to SDG
					2023/24	2027/28			
Reduced GHG Emissions	GHG Emission per year	CO2eMt	2022/23	98	97	90	Nationally Determined Contributions (NDCs) Report	SDECC	13
Improved sus-tainability of environmental Ecosystems	Area of mountain ecosystems sus-tainably conserved and managed	Hectares	2022/23	940,576	940,576	940,576	Kenya Forest Service (KFS) Annual Progress Reports	MECCF	15.4.1, 15.4.2
	Area of inland freshwater ecosys-tems and wetlands protected	Acres	2022/23	11	10	7	NEMA Annual Progress Reports	MECCF	15.1.2
	Area of land re-claimed	Hectares	2022/23	17,101	18,000	20,000	KWTA Annual Progress Reports	MECCF	15.4.1
	Area of water tow-ers rehabilitated/ protected	Hectares	2022/23	142,601	142,601	300,000	KWTA Annual Progress Reports	MECCF	15.3
	Proportion of de-graded landscapes restored (2.6 million Ha)	%	2022/23	-	4	20	KFS progress report	MECCF	15.3.1
Riparian areas rehabilitated and protected	Length of riparian reserves rehabil-itated	KM	2022/23	100	100	100	NEMA Annual Progress Reports	SDECC	15
Improved So-cial Inclusion and sustainable livelihoods	Green jobs created	No.	2022/23	2,700	20,000	20,000	KFS progress report	MECCF	8.3.1, 8.9.2, 9.2.2
Improved solid waste manage-ment country-wide	Quantity of solid waste collected	Tonnes	2022/23	0	20	60	NEMA Annual progress reports	SDECC	11.6.1
	County dumpsites with ten minimum points established	No.	2022/23	1	4	10	NEMA Annual Progress Reports	NEMA	11.6.1
	Landfill/wastes disposal sites screened for climate change impacts	No.	2022/23	0	1	1	NEMA Annual Progress Reports	SDECC	13.2.2.2
Improved sus-tainability of forest related Ecosystems	Tree cover	%	2022/23	12.13	12.92	21.07	KFS Annual Progress Reports	KFS, SDF	15.1.1
	Forest cover	%	2022/23	8.83	10	17	KFS Annual Progress Reports	KFS, SDF	15.1.1
	Area of land cov-ered by invasive species managed	Hectares	2022/23	10,000	2,000	2,000	KFS Annual Progress Reports	KFS SDF	15.8.1
	Development of forest and allied natural resources technologies	No. of technolo-gies de-veloped	2022/23	200	40	40	Kenya Forestry Research Institute (KEFRI) Annual Progress Reports	KEFRI	15

Source: *GOK,2024 (Edited)*

(b) Output Indicators

Priority Project	Output	Indicator	Targets		Lead Agency	Supporting Agency
			2023/24	2027/28		
National Tree Growing and Restoration Programme	500 tonnes of tree seeds collected, processed and distributed	Quantity of seeds (Tonnes)	100	100	KEFRI	SDF
	5 billion Tree seedlings produced	No. of tree seedlings (Billions)	0.6	1.2	KFS	SDF
	3.5 million Ha of degraded forests areas and landscape, rehabilitated thro protection of natural regenerations and planting (5.2 billion seedlings)	Area rehabilitated (Million Ha	0.3	1.0	SDF	SDF
	Trees planted (70% survival rate is assumed)	No. of Trees (Billions)	1	2	SDF	MECCF
Agroforestry woodlots in ASALs	1 million Ha of Agroforestry developed in 23 ASAL Counties; (Melia woodlots, gums & resins, sandalwood etc.)	Area (Ha) rehabilitated	50,000	350,000	KFS	SDF
Sustainable "green" charcoal value chain and alternative domestic energy	Draft charcoal regulations gazetted and operationalized	No. of regulation gazetted	1	0	SDF	MECCF
	Sensitization regional meetings for law enforcement agencies on implementation of charcoal regulations to decriminalize production and trade in charcoal and charcoal products, conducted.	No. of regional sensitization meetings conducted	1	2	SDF	MECCF
	300 Charcoal Producers Associations (CPAs), established and supported, on adoption of efficient technology, branding and marketing	No. of CPAs established and strengthened	300	300	KFS	SDF, CGs
	500 youth groups supported and mentored in briquette charcoal production enterprise	No. of youth groups supported & mentored	50	110	KFS	KEFRI, SDF, MECCF
	2,500 public schools and institution transit to adoption and use LPG	No. of schools and institutions	500	500	SDP	SDF, MECCF
Modernization and commercialization of the charcoal value chain	Clean cooking technologies adopted	No. of clean cooking technologies adopted	2	2	MECCF	SDF
Waste management infrastructure	Waste Collectors cooperatives registered	No. of Waste cooperatives	20	14	NEMA	MECCF
	Waste Material Recovery Facilities constructed in all Counties	No. of Waste Material Recovery Facilities	5	100	MECCF	NEMA Counties
	Community-Based/ owned plastic recycling value chain established	No. of plastic recycling value chains	200	350	NEMA	MECCF
Pollution Management	Waste service providers trained on waste recovery	No. of service providers trained	10	10	SDECC	NEMA
	Air quality in 6 urban areas monitored	No. of air quality reports	5	5	SDECC	NEMA
Thwake River Upstream Clean up Pollution Control and Catchment Management	Effluent discharges and solid waste flow in the Athi-Galana-Sabaki river system reduced.	% of illegal dump sites along the river removed	20	75	SDECC	NEMA
	Length of riparian area of areas of Athi-Galana-Sabaki river system rehabilitated	KM of riparian areas rehabilitated	100	100	SDECC	SDARD SDF
Climate Change Finance	Carbon market frameworks and regulations developed	Framework and regulations	1	-	SDECC	TNT
	Amount of revenue raised from carbon market	Kshs. Billions	1	1	SDECC	TNT
	Amount raised from green and blue bonds	Kshs. Billions	1	0	SDECC	TNT

Priority Project	Output	Indicator	Targets		Lead Agency	Supporting Agency
			2023/24	2027/28		
Wildlife Conservation and Management	Anti-poaching of illegal trade in wildlife enhanced	No. of threatened and endangered species protected	25	70	KWS	SDW
	Area of wildlife habitats restored	Ha of habitats restored	25	770	KWS	SDW
	Modern security equipment, technologies, mobile service vehicles acquired	No. of new technologies/ modern equipment and mobile vehicles acquired	381	-	KWS	SDW
	GoK parks and reserves fences constructed / rehabilitated/maintained	Km of fences constructed/ rehabilitated/maintained	730	360	SDW	KWS TNT
	Human wildlife conflict claims disbursed	% of verified Human wildlife compensation claims settled	100	100	KWS	SDW TNT
	Human-wildlife conflict insurance scheme operationalized	HWC Insurance scheme	2	2	SDW	KWS TNT
Wildlife Revenue	Revenue management systems digitized in all parks	% of operationalization	8	34	KWS	SDW
	Guest houses, bandas and tented camps leased	No. of guest houses, bandas and private camps leased	5	-	KWS	SDW
Green and Blue Jobs initiatives	Women and youth tree nursery associations registered	No. of youth and women associations	8,348	8,350	SDW	SDF
	Additional wildlife rangers recruited	No. of rangers recruited	1500	-	KWS	SDW
	Contracts for community wildlife scouts renewed	No. of community scouts	1,100	1,100	SDW	KWS
	People employed to plant and grow trees	No. of people employed No. of people employed	800	800	SDW	SDW
	Community Forest Guards recruited	No. of Community Forest Guards recruited	2,800	-	KFS	SDF
	Fishing crew trained	No. of fishing crew trained	1,000	1,000	SDBEF	SDW
	Youth reskilled on STCW courses and placed on international ships	No. of youths	600	600	SDW	SDW
	Youth trained on Climate adaptation under the Kenya Green Army	No. of youth trained	200,000	200,000	MECCF	SDYA
	Hospitality graduates placed on jobs abroad annually	No. of graduates placed	20	20	MOFDA	MoTW SDL
	Charcoal associations registered	No. of charcoal associations registered	2,000	2,000	SDF	SDC
Tourism and Wildlife Training and Research	KUC upgraded and modernized	% completion	20	100	Kenya Utalii College	SDT
	Ronald Ngala Utalii College phase 2 completed	% completion	0	55	Tourism Fund (TF)	SDT
	Kisumu Hospitality and Tourism Training College established	% completion	20	100	TF	SDT
	Wildlife Research and Training Institute infrastructure developed	% completion	48	-	TF	SDW
	Wildlife Research Centers constructed and equipped	No. of wildlife research centers constructed and equipped	0	-	SDW	KWS, WRTI
	National Integrated Wildlife Database developed	Operational wildlife database	1	-	SDW	KWS, WRTI
Tourism Niche Experiences	Sports Safari events held	No. of Sports Safari events held	7	7	SDS	MTW
	Forest tourism products developed (Adventure, Camping and Bird Watching)	No. of Circuits developed	1	1	SDT	SDF

Priority Project	Output	Indicator	Targets		Lead Agency	Supporting Agency
			2023/24	2027/28		
Inclusive Nature Tourism Beaches	Beach operators Sacco established	No. of Saccos	0	0	SDT	MSMFEs
	Cruise terminus constructed	Operational cruise terminus	-	1	MTW	MMPE&MA
	Kisumu Lake front Redesigned and developed	% completion	-	100	MTW	MMPE&MA
	Mombasa Aquarium Theme Park developed	% completion	-	100	SDT	MTW
	Mama Ngina Waterfront Phase II completed	% completion	-	100	SDT	MTW
Wildlife (Safari) Products	Signature parks revamped	No. of signature parks revamped	1	1	KWS	MTW
	Marine parks ecosystem and infrastructure rehabilitated	No. of marine parks rehabilitated	1	1	KWS	MTW
	New tourism products developed	No. of new products developed	2	2	KTB	MTW
	Parks repositioned and themed	No. of parks repositioned and themed	2	2	KWS	MTW KTB
Business and Conference Tourism	Conferences held	No. of Conference participants	11,614	16,863	MTW, KICC, KNCB	MTW
	KICC refurbished and modernized	% completion	79	-	KICC	MTW
	MICC constructed	Operational MICC	1	-	MTW	KTB
	Great Rift Convention Centre constructed	Operational Great Rift Convention Centre	1	-	SDT	MTW
Resort Cities	Land acquired	Hectares of land acquired	400	189	LAPSSET	Lamu, Isiolo and Turkana County Governments
Tourism Revenue promotion	Affordable and secure accommodation regulated	% completion	-	100	SDT	KTB
	Desert and pastoral tourism circuits promoted and commercialized	No. of tourism circuits	8	8	SDARD	SDT
	Kenya Safari TV channel operationalized	Operational TV	-	-	SDT	SDW, SDCH, SDS
	Targeted consumer engagement programmes developed	No. of programmes	4	4	SDT	SDW, SDCH SDS
	Tourism desks established at foreign missions	No. of tourism desks	-	4	SDT	MFDA
	Key and emerging source markets reactivated	No. of new markets	2	2	SDT	MFDA
	Marketing materials developed and translated in six foreign languages	No. of marketing materials translated into foreign languages	-	-	SDT	MFDA
Tourism Promotion and Marketing	Brand awareness created	Brand awareness Index	30	-	KTB	MTW
	Priority markets reached	No. of Priority markets reached	2	4	MTW	KTB
	African markets source Diversified	No. of Tourism from African region	20	40	KTB	MTW MFDA
	Tourism desks established in foreign missions	No. of tourism desks established	-	2	MFDA	KTB
	Marketing and promotional media contents developed	No. of Marketing and promotional media contents developed	2	3	KTB	MTW

Priority Project	Output	Indicator	Targets		Lead Agency	Supporting Agency
			2023/24	2027/28		
Conservation of Culture and Heritage	Insect farming Promotion in ten (10) Counties	No. of insect farms established	1	4	NMK	SDCH
	Meliponi culture and apiculture farms established	No. of farmers trained and supported	200	200	SDCH	CGs
		No. of meliponiculture and apiculture farms established	1	5	NMK	SDCH
	Mushroom farms established	No. of Mushroom farms established	1	1	SDCH	CGs
	Production of under-utilized indigenous food crop revitalized	No. of farmers trained and supported	500	900	NMK	SDCH
	Cultural practitioners trained	No. Cultural practitioners trained.	10	10	SDCH	CGs
	Cultural exchange programmes	No. of Cultural exchange programmes undertaken	1	4 SDCH	NMK	SDCH
	Indigenous languages Mapped and documented	No. of Indigenous languages Mapped and documented	1	1	SDCH	CGs
	Integrated National Cultural and Creative Industries Information Management System established	% establishment	20	100	SDCH	SDICT&DE
	National Arts Gallery Established	% completion	50	-	SDCH	NMK
	Development of Sanaa App (Cultural e-commerce Platform	% completion	10	100	SDCH	SDICT&DE
	Patriotism, integration and cohesion promoted;	No. of artists participating in the festival	200	200	SDCH	SDT CGs
	Capacity Building & Production Tools for 10 Counties	No. of people capacity build	3,000	3,000	SDCH	CGs
	Establishment of Kenya Heroes Fund	Kshs. Million	-	300	SDCH	TNT
Underwater Natural Resources	Underutilized marine and freshwater aquaculture resources domesticated and commercialized	No. of oyster species (Pearl), snail and prawn farms established	1	4	NMK	SDCH
		No. of aquaculture resources products commercialized	1	1	NMK	SDCH
Natural Product Industry Initiative	Indigenous Knowledge Management System developed	% of operationalization	20	100	NMK	SDCH
	A national and 47 County digital repositories established	No. of Digital repositories established	5	12	NMK	SDCH
	Cottage industries established	No. of cottage industries	1	1	SDCH	NMK
	The Innovation Bank of Kenya established	% of establishment Innovation Bank of Kenya	20	100	NMK	SDCH
Promotion of culture and heritage tourism	Cradle of humankind Parks Developed	No. of Parks developed	2	5	NMK	SDCH
	Best Monuments identified and developed.	No. of monuments identified and developed.	10	31	NMK	SDCH
	Malindi Gede Ruins Complex reconstructed	% completion	20	100	CGs	SDCH
	Old PC's office in Kisumu rehabilitated	% completion	-	1	NMK	SDCH
	Vasco Da Gama Walkways upgraded -	% completion	-	-	NMK	SDCH
	Cultural festivals held.	No. of Cultural festivals held.	2	2	NMK	SDCH
	Art and food ways exhibitions and national handcraft shows held	No. of Art and food ways exhibitions held.	3	5	NMK	SDCH
	NAICEC constructed	% completion	-	100	NMK	SDCH
	Construction of Heritage collection	Centre % completion	-	100	NMK	SDCH
	Integrated Public Records and Information Management System (IPRIMS)	% completion	20	100	NMK	SDCH

Priority Project	Output	Indicator	Targets		Lead Agency	Supporting Agency
			2023/24	2027/28		
National and County archival services and public records Management	Multi-purpose National Archives constructed in Nairobi and County archives established	% of completion	-	100	KNADS	SDCH
	Archive materials Digitized	% of digitized archival materials	20	100	KNADS	SDCH
		% of records digitized in the records management unit	16	-	RMD	SDCH
	Migrated archives retrieved	% of migrated archives to Kenya	20	100	KNADS	SDCH
	Integrated Public Records and Information Management System (IPRIMS) strengthened	No. of Ministries using IPRIMS System	22	100	RMD	SDICT&DE
Accelerated Rangeland development	Rangeland ecosystem infrastructure developed (trees, bamboo, water pans, boreholes and dams)	No. of Infrastructure developed	285	25	SDARD	SDF, CGs
	Rangeland GIS and knowledge Management Centre	Operational Centre	-	-	SDARD	CGs NDMA
	Social and cultural integration of communities	No. of communities integrated	9	10	SDARD	NDMA
Disaster Management Institutions Development	Disaster Risk Management Centers of Excellence and model schools established	% completion	10	100	NDMA	SDARD
	Disaster Risk Management Emergency Operation Centers established	% completion	30	100	NDOC	SDARD
Formalization of Artisanal Mining Operations	ASM Saccos established	No. of Saccos established	100	100	State Department for Mining	(SDM) CGs
	ASM Cooperative Registered	No. of ASM Cooperatives	100	100	SDC	SDM
Mineral Value Addition and processing	Mineral Value Addition Centres	No. of Mineral Value Addition Centres established	2	3	SDM	CGs
Mineral resource Development and Commercialization	Strategic minerals explored and commercialized	Quantity of minerals (MT)	4	2	NMC	CGs
Online Transactional Mining Cadastre System	An online transactional mining cadastre system upgraded	An operational online transactional mining cadastre system	4	3	SDM	SDICT&DE
Formalization of Artisanal fisheries operations	Artisanal fishermen mobilized into cooperatives	No. of Artisanal fishermen	15,000	15,000	SDC	SDF, KFMA; BMUs
Fisheries Management and Conservation	Specific fisheries management plans for marine and inland fisheries developed	No. of Plans	1	2	KeFS	SDBEF, CGs
	Fisheries critical habitats identified, mapped and gazetted	No. of Fisheries critical habitats	10	10	KeFS	SDBEF, CGs
	Created awareness on Eat more fish campaign	Level of awareness created	5	100	SDBEF	SDISNA, CGs

Priority Project	Output	Indicator	Targets		Lead Agency	Supporting Agency
			2023/24	2027/28		
Blue Economy Investment and Development	Developed ultra-modern tuna fish hub at Liwatoni	Level of development ultra-modern tuna fish hub at Liwatoni	50			
	Developed Lamu Fish Processing Plant	% level of completion	-	-	SDBEF	SDPW, SDLPP, SDWS, SDE, SDR, NLC
	Kabonyo Fisheries and Aquaculture Service and Training Centre of Excellence (KFASTCE) developed	% level of completion	5	100	SDBEF	SDPW, SDLPP, SDWS, SDE, SDR, NLC, SDT-VET
	Kenya Marine Fisheries and Socio-Economic Development (KEMFSED) implemented	% completion	50	-	SDBEF	SDPW, TNT, SDLPP, SDWS, SDE,SDR, NLC,CGs
	Rural households engaged in aquaculture farming and provided with fish production materials	No. of rural households;	3,000	-	SDBEF	SDPW, TNT, SDLPP, SDWS, SDA, SDR, NLC, CGs
		No. of farmers	3,000			
Fisheries Resources Development and Utilization	Developed and rehabilitated inland fish landing sites	No. of fish landing sites	-	-	SDBEF	SDPW, SDLPP, SDWS, SDE, SDR, NLC
	Developed Maritime Spatial Plan	% of completion	-	-	SDSMA	SDBEF, SDWS, SDLPP, NLC
	Seaweed drying sheds and storage constructed	No. of drying sheds and storage facilities	-	-	SDBEF	SDPW, SDWS, SDE
	Marine fisheries infrastructure developed/ rehabilitated	No. of marine fisheries infrastructure	2	1	SDBEF	SDLPP, SDWS, SDE, SDR, NLC
	Deep-sea industrial fishing developed	No. of acquired/ reflagged national fishing and merchant vessels / boats	30	70	SDBEF	TNT, SDSMA
	Marine Stock Assessment Surveys conducted	No. Assessment Surveys	1	1	KMFRI	SDBEF, SDISNA
	Youth capacity built on fisheries and aquaculture skills	No. of youth	500	1,000	SDBEF	SDYA
	Support Common Interest Groups (CIG) members	No. of CIGs supported	1,600	-	SDBEF	SDBEF
	Kalokol fish processing plant constructed	% of completion	20	-	SDARD	SDARD
Kenya National Shipping Line	Vessels acquired	No. of vessels acquired	-	-	SDSMA	SDSM
	Shipping vessels chartered	No. of vessels chartered	4	-	SDSMA	SDSM
	Container equipment acquired	No. of container equipment acquired	-	-	SDSMA	SDSM

Priority Project	Output	Indicator	Targets		Lead Agency	Supporting Agency
			2023/24	2027/28		
Integrated Fish Resource Development	Acres of mangrove cover restored	Acres of mangrove cover	500	500	SDSMA	SDFBE
	Acres coral reef conserved	Acres of coral reef	30	30		
	Fish farms and processing plants established	No. of fish farms and processing plants	-	-	SDARD	COG, CGs
Lake Victoria Basin Cold Storage Facilities Development	Cold storage facilities with a capacity of 600m3 constructed	No. of cold storage facilities constructed	-	1	SDARD	TNT, SDBEF

Source: *GOK,2024 (Edited)*



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