TURKANA COUNTY STRATEGIC ENVIRONMENT ACTION PLAN
JULY, 2020 - JULY, 2024

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ACRONYMS AND ABBREVIATIONS

ASAL	Arid and Semi-Arid Lands
LAPSSET	Lamu Port Southern Sudan-Ethiopia Transport Corridor
CEAP	County Environment Action Plan
NGOs	Non-Governmental Organizations
WRMA	Water Resources Management Authority
NEMA	National Environment Management Authority
UNHCR	United Nations High Commission for Refugees
MOA	Ministry of Agriculture
EMCA	Environment Management and Coordination Act
EIA	Environmental Impact Assessment
KMD	Kenya Metrological Department
EAP	Environment Action Plan
SoE	State of environment
TCG	Turkana County Government
TCEC	Turkana County Environment Committee

FOREWORD

The 1992 Earth Summit held in Rio De Janeiro came up with various recommendations, among them Agenda 21, a Global Environmental Action Plan. The theme of the Summit was on how nations could attain the sustainable development objective. The Government of Kenya embraced this noble idea when it developed the first National Environment Action Plan (NEAP) in 1994 and the second one in 2009.

The country has also prepared the National Development Plans of 1974 that ensured that there was not only a chapter on Environment and Natural Resources but also environmental concerns were integrated in all the chapters of the Development Plans.

Further, there have been a number of sectoral policies on environment in fields such as Agriculture, Livestock, Water, Energy, Food, Industry, Trade, Arid Lands, Disaster Management and the Draft Sessional Paper No.6 of 1999 on Environment and Development.

The Environmental Management and Coordination Act (EMCA, 1999) provides for the integration of environmental concerns in national and County policies, plans, programmes and projects. In this regard, EMCA 1999 provides for the formulation of National and County Environment Action Plans every five years. The County Environmental Action Planning (CEAP) is a tool that aims at integrating environmental concerns into development planning. This CEAP process was participatory, involving various stakeholders from institutions and sectors, including the public, private, NGOs and key partners in the County. These consultative meetings provided the basis for formulation of the CEAP Framework.

This CEAP report addresses environmental issues from various sectors in an integrated manner at the county level and their significance in development planning. It proposes strategies for achieving sustainable development in line with Kenya's quest to meet the Sustainable Development Goals (SDGs), Vision 2030 and Medium Term Plan (MTP). The report has identified actions to be taken by government agencies, civil society and individuals and more for incorporation into sectoral developments plans and programmes. Its implementation will be monitored through the Annual County Environmental Reporting.

The 2020-2024 CEAP report will provide harmony in funding and implementation of environmental interventions at County level for sustainable development as envisaged in Vision 2030 and the constitution.

Mr. Chris Aletia Imana
Chairperson, Turkana County Environment Committee/
County Executive Committee Member
(Water Services, Environment and Mineral Resources)
TURKANA COUNTY

PREFACE

County Environment Action Plan is multi-sectoral process that calls for participatory approach in its preparation and implementation. Many institutions and individuals have contributed to the completion of this CEAP.

Turkana County faces a myriad of environmental issues, including deforestation, soil erosions, desertification, water catchment destruction, poaching, domestic and industrial pollution, land degradation, loss of biodiversity, degradation of aquatic ecosystems and resources, droughts, flash floods and invasive alien species.

Further, climate change issues have been highlighted in the global agenda as it affects all spheres of human activity. Our commitment to ensure environmental management is critical, hence the need for the National Development Plans and sectoral policies to mirror the recommendations for the CEAP framework.

I commend the Directorate of Environment, Turkana County Government and the National Environment Management Authority (NEMA) for continuous implementation of various provisions of the Environment Management and Coordination Act (EMCA) of 1999, among them the preparation of the State of Environment reports and coordinating the County Environment Action Plans technical meetings.

The participatory approach adopted in the CEAP process enhanced environmental awareness among various stakeholders including the legal fraternity, provincial Administration, institutions of learning and Community Based Organizations (CBOs), therefore underpinning their relevance in sustainable development.

I look forward to all institutions, public and private partnerships, civil society and the general public to appreciate the need for implementing this plan in order to achieve sustainable development in the country.

Mr. Moses Natome,
County Chief Officer
Water Services, Environment and Mineral Resources,
TURKANA COUNTY

ACKNOWLEDGEMENT

The process of preparing this environmental action plan (EAP) benefited from the support and guidance of various governmental agencies, NGOs, County Environment committee and individuals who formed the county's environmental action plan committee. In particular, the process gained from the County Directorate of planning who have experience in preparations and data gathering for the National and County Development Plans.

The Environmental Action Plan Secretariat has ensured that this EAP is produced in the most cost-effective manner. The Department of Environment Planning and Research coordination at NEMA headquarters provided the initial building blocks and foundation for the process and the requisite vision that has now been realized. The secretariat was instrumental in training the technical sub-committees at the county level.

I acknowledge the efforts made by all persons who contributed directly or indirectly to the preparations of this EAP. In particular, I pay special tribute to the technical team at the county, who spent several days collecting data and compiling the draft report, hence enriching the report and making it quite relevant to the county's development agenda.

We look forward for the CEAP report to contribute in integrating environmental issues to the country's sustainable development and guide appropriately the processes of development planning. I urge the policy makers, all institutions, expert and individuals from various sectors to make good use of this document

Sign:

County Director of Environment (CDE)

TURKANA COUNTY

EXECUTIVE SUMMARY

Economic growth and environment are closely intertwined in Kenya. Environmental Action Planning is a tool that aims at enhancing the integration of environment into development planning. In this regard, the Environment Management Coordination Act 1999 provides for the formulation of Environment Action Plans every five years. This is the second Environment Action Plan (EAP) for the county and will succeed the EAPs for the period 2013-2018.The drafting of the EAP was undertaken through a participatory process both in the public, private and civil sectors. The EAP highlights priority themes and activities for the County towards achieving sustainable development. The report is divided into eleven chapters.

Chapter 1; gives the Introduction and presents the Environment and Economic Development.

Chapter 2; Describes the Socio-Economic status, poverty, gender and Environment: Analysis of resource use by different gender and major environmental issues and proposed interventions.

Chapter 3: details the Climate Change/Variability issues pattern of change of natural resources. how climate change affects other thematic areas; Adaptation and mitigation measures.

Chapter 4: Addresses biodiversity issues, status and trends, challenges, areas of research on biodiversity, tourism and wildlife and proposes mitigation actions.

Chapter 5: Discusses Forests, Woodlands and Grasslands, Conservation and utilization of forests woodlands and grasslands, alternative livelihood threatened species. Challenges facing forests woodlands and grasslands and proposes mitigation actions.

Chapter 6: Covers Land, Agriculture, Livestock and Fisheries. It provides highlights of different practises, challenges and proposes mitigation actions.

Chapter7: Covers issues related to Water Resources in the County. The challenges and their mitigation measures.

Chapter 8: Covers Health and Environment issues. It provides linkage of some prevalent diseases to poor sanitation and environment management access to clean water e.t.c. It identifies challenges...in provision of health services and incident of environmental related diseases and proposes mitigation actions

Chapter 9: Covers, emerging issues Refugees issues, Invasive species, oil exploration and how they impact on environment.

Chapter 10: Covers the Future of the County Environment and issues of governance. Policies and approaches of mitigating specific impacts on the environment

Chapter 11: Presents Policy Analysis and options for Action: The available policies and how they are implemented as a measure to mitigate the environmental degradation.

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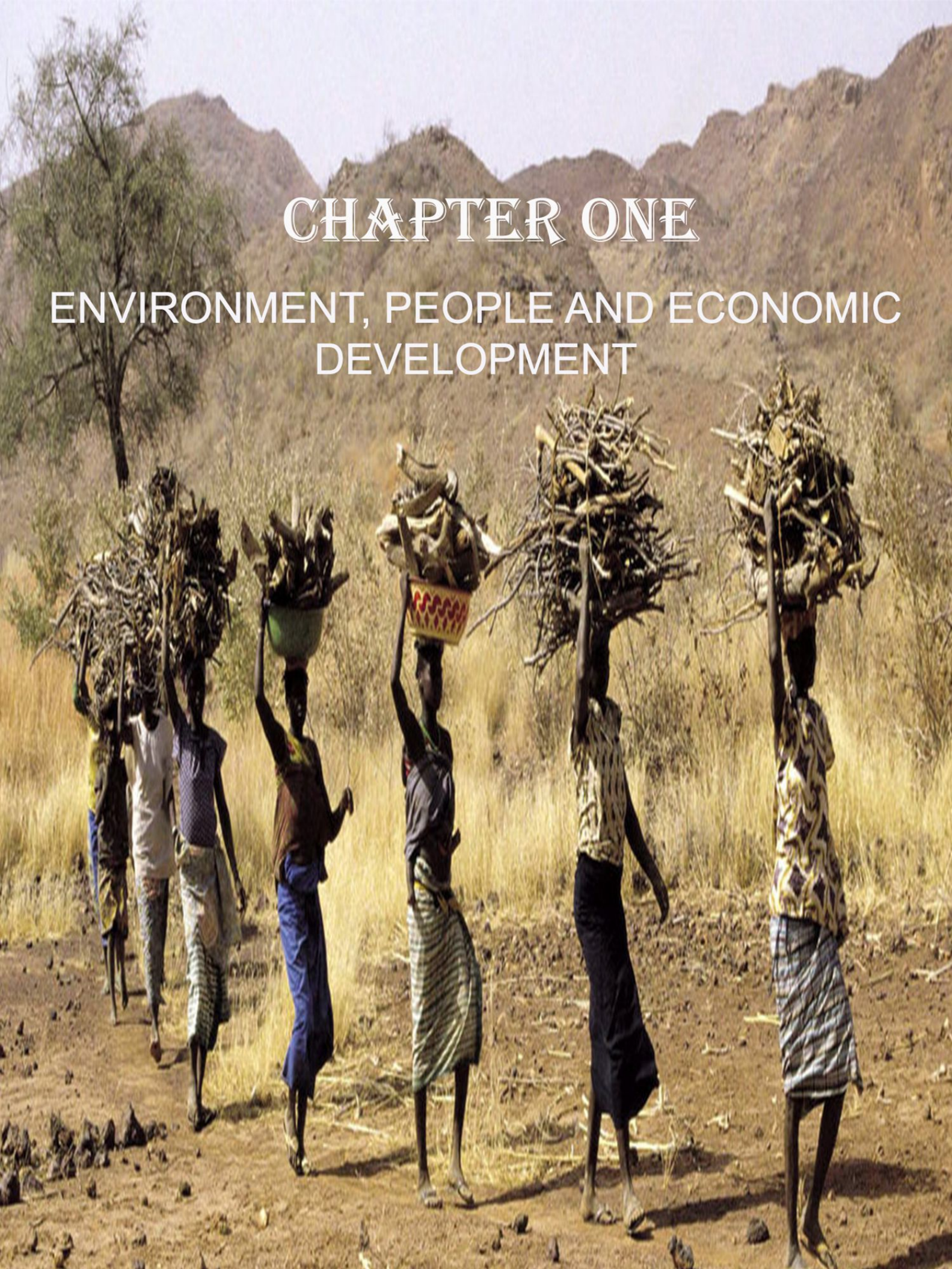
CHAPTER ONE

ENVIRONMENT, PEOPLE AND ECONOMIC DEVELOPMENT



PART 1: ENVIRONMENT, PEOPLE AND DEVELOPMENT

CHAPTER 1

ENVIRONMENT, PEOPLE AND ECONOMIC DEVELOPMENT

1.0 Introduction

This chapter gives a profile of Turkana County, environmental resources available in the county and their uses, human settlement patterns both urban and rural, current trends in environmental research and available opportunities for sustainable development. Unsustainable patterns of production and consumption are driving resource scarcity, environmental degradation and rapid changes in the critical natural systems that sustain life. This is observed to exacerbate adverse impacts of Climate Change in the County.

Economic growth and environment are closely intertwined in Kenya's development process. Development activities take place within the environment that serves as a habitat for flora and fauna. The process of development impacts on the environment both positively and negatively. In order to foster sustainable development, it's a requirement for development proposals to integrate environmental concerns in the development process. This is achieved through environmental action planning which aims at integration of environment into development planning.

1.1 County Profile

1.1. 1 Geographical Location and Size

Turkana County is situated in the North Western part of Kenya. It lies between Longitudes 34° 30' and 36° 40' East and between Latitudes 1° 30' and 5° 30' North. It is the second largest county in the republic of Kenya covering an area of approximately 77,000 km^2 which is 13% of the country's total land area (Turkana County Investment Plan, 2016-2020; Turkana County CIDP II, 2018-2022). The County shares international boundaries with three countries namely the Republic of Uganda to the West, Southern Sudan to the North West and Ethiopia to the North East. Internally, the county borders Marsabit county to the East, Baringo county to the South East and West Pokot county to the South West.

The County is administratively divided into 7 sub-counties namely, Turkana South, Turkana East, Turkana Central, Turkana West, Turkana North, Loima and Kibish. It has 30 wards, 56 locations that are further sub-divided into 156 sub-locations (Figure 1).

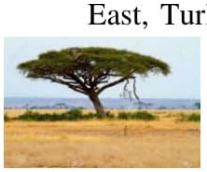


Figure 1. A Map of Turkana County Administrative Blocks

1.1.2 Urban and Rural Settlement

According to the census reports of 2019, Turkana county has a population of 926, 976 people which is an increase of 8.4 % from the previous population county of 2009 (KBNS, 2019). According to the CIDP II report for (2018-2022), approximately 250, 000 of Turkana residents reside in the urban centres of Turkana County namely: Lodwar, Lokichar, Kainuk, Kakauma, Lokichogio, Kapedo, Lomelo, Kalokol, Lokitang, Lorugum, Lowarengak and Kalobeyei refugee settlement. The rest of the population which is about 680,000 people are settle in the rural areas practicing pastoralism's which is the main economic livelihood in the area.

The major causes for urbanization in Turkana County has been attributed to refugee influx and

settlement especially in Turkana West, Labour migration and climate change which has seen most youth migrating to the urban centres as well as decentralization and devolution of resources.

In the rural, the settlement pattern is nucleated living in homestead called kraals and usually placed near the resources. The people settle in temporary group manyattas for rapid response in case of attack. Being pastoralist in nature, the community settle in places where there is pasture while fishermen live near water bodies while those practicing agro-pastoralism dwell in areas with fertile soils.

1.1.2.1 Impacts of the Urban Settlement on the Environment

Mushrooming of unplanned informal settlements in parts of Lodwar, Lokichar, Kalokol, Kakuma, Kainuk, Lokori, Lorugum, Lokichogio and other urban centres. The Kraals and slums settlements lack infrastructural facilities like latrine/toilet, water points thus exposing the population to health hazards. Inadequate amenities/facilities as a result of progressive population increase. Overexploitation of natural resources that leads to decline of biodiversity. Encroachment of the riparian and shorelines by settlements and hotel development hasvled to pollution. Increased generation of waste that has superseded the County's capacity of managing the waste resulting into uncontrolled dumping. Lack of sewer line infrastructure to handle the liquid. The malfunctioning septic tanks and soak pits infrastructure causes leakage and seepage of effluents into underground water thus causing contamination.

1.1.3 Environmental Resources in the County

- Land-arable and non-arable, rangeland
- Forests- Loima, Kailongol, Loriu, Songot, Prosopis forest, Riverine Forest
- Minerals- Gold deposits, garnet, sapphire, limestone, copper, sand, quarry, Building sands and stones
- Biodiversity- flora & fauna (Rare bat species); Wildlife at Turkana South National Reserve, Lotikipi and Central Island.
- Grasslands/rangelands
- Surface -and underground water including springs, rivers, lake
- Landscapes/sceneries/physical features-mountains hills, valleys
- Hotsprings and Geysers.

- Energy potential e.g in Kapedo- Geothermal, Wind and solar energy potential
- Oil and Gas in Turkana South
- Fish in Lake Turkana

1.1.4 Key environmental issues in the county

Over 80 per cent of Turkana County is Semi-arid and environmental resources play a critical role in supporting livelihoods and reducing poverty. Environmental degradation in the county is caused by overgrazing, indiscriminate cutting of trees for fuel, non-protection of water catchment areas and poor farming practices. The topography of the county accelerates soil erosion, as it is hilly in most places. When it rains, most of the soils are swept into Lake Turkana which exacerbates the problem of silting in the water storage facilities and the dams. Most farmers seem to be unaware of the importance of environmental conservation, and hardly take conservation measures seriously. Some of the land is not adjudicated and this encourages shifting cultivation, with serious consequences on the environment. Environmental pollution could also become a problem if not checked. Measures will be taken to sensitize farmers and other residents on the importance of conserving the environment. The environmental degradation can be mitigated through: Improved environmental education, strong enforcement of legislations, community participation as well as strong institutions at local level in the county.

1.1.4.1 Positive environmental issues include:

- Closed canopy forests provide habitat for wild life, act as catchment areas, educational and research areas and act as gene pool, water conservation and climatical moderations.
- Biodiversity/Large diversity of wildlife/landforms
- Huge land resources
- Availability of water e.g. rivers, dams, Lake
- Availability of minerals resources
- Wetlands

1.1.4.1 Key environmental issues in the county (Negative)

Includes;

- Unsustainable charcoal production and logging in water catchment areas

- Trade on endangered Species-*Aloe turkanensis*
- Soil erosion-gullies as a result of land degradation
- Human-wildlife conflicts
- Natural resource use conflicts
- Uncontrolled cutting of indigenous trees
- Encroachment of protected forest areas e.g. Gazetted Loima Forest, Turkana South National Reserve, Lotikipi National Reserve
- Degradation of riparian areas
- Unsustainable quarrying for building stones
- Overgrazing/Over stocking leading to land degradation and illegal grazing in protected areas
- Forestry-Wildlife Conflicts-Destruction of trees by wildlife in South Turkana ecosystem
- Pollution of water bodies point and non -point sources.
- Poor crop and animal husbandry leading to degradation of land
- Climate related disasters-floods, droughts, diseases
- Invasive species-*Prosopis juliflora* invasion

Table 1: Provide a mitigation plan for the identified environmental issues

	Environmental Issue	**Mitigation Plan**
1	Destruction of watersheds	• Identification of the catchment areas • Support Water Resource User Associations [WRUAs] and Community Forest Association [CFAs] in restoration of the catchment areas • Seek support from other stakeholders on rehabilitation of the catchment areas
2	Water pollution from point and non - point sources	• Undertake Pollution Surveys to identify potential polluters • Undertake sensitization meetings using relevant Policies • Seek alternative sites and methods for waste disposal for these polluters • Enforce development and Implementation of Waste Management Plans/Systems for developers • Ensure compliance to Effluent Discharge Control Plans [EDCPs] to waste water

		dischargers through Environmental Regulations eg EMCA, Water Act 2002, Water Resource Management Rules 2007, Public Health Act CAP 242 etc
3	Illegal water abstractions along the main rivers	• Undertake Water Abstraction Surveys [WAS] • Develop Water Allocation Plans [WAPs] for various rivers • Empower WRUAs to undertake monitoring of water use along their water regimes • Enforce relevant environmental policies
4	Riparian land degradation	• Undertake sensitization meetings along rivers with the Land Owners • Use WRUAs to monitor encroachment and further sensitization to community members • Enforce relevant rules, policies and regulations on Riparian conservation • Undertake rehabilitation of degraded areas with indigenous trees
5	Deforestation	• Afforestation and reforestations of degradaded areas • Rehabilitation of watersheds/catchment areas • Formation of CPA and empowering of CFA's
6	Encroachments of gazetted forests	• Evictions and rehabilitation of degraded areas • Undertake development & protection of water points like springs
7	Droughts	• Identify drought prone areas and preparedness strategies • Development of contingency plans/ Develop Early Warning Systems to warn people of impending droughts in prone areas • Weather related preparedness • Response strategies
8	Frequent floods	• Construction of check dams to control floods in hotspots • Develop Early Warning Systems to warn people of impending floods in prone areas • Reclamation of degraded areas.
9	Soil erosion	• Reseeding and re-afforestation of degraded areas • Promotion of extension services targeting good agricultural and livestock husbandry practices
10	Land degradation	• Development of a land use plan
11	Quarrying	• Identification, mapping and rehabilitation of abandoned quarries

12	Human-wildlife conflicts and other natural resource use conflicts	• awareness creation on co-existences • Development of natural resource use plan • Securing wildlife corridors

1.2 County resources (Industry, Quarrying &Mining)

Despite being placed in a geographical region perceived to be disadvantaged, Turkana county is endowed with a number of environmental resources which offers a huge potential for industrial investments in uncounted promising fields, like transport industry, agriculture, the fishing industry, geothermal and wind power production, water bottling or housing and real estate business.

The tourism sector is up for growth and ready for investments in the hospitality and catering industry to build much needed hotels, restaurants and conference facilities.

The county is endowed with mineral resources such as, soda ash, Fluorspar, Titanium, Nobium, Gold, Coal, Mercury, Iron Ore, Limestone, Manganese, Diatomite, a variety of gemstones, Gypsum, Copper, Graphite, Silica, Silver, Trona, Sand among others. It is also endowed with both the surface water (Rivers and Lake Turkana) as well as underground water reserves.

The county is also emerging as a major source of electric power in Kenya, with Kengen's Turkwel Hydro Power Plant located in South-western Turkana County producing 67MW of hydroelectric power which is connected to the national power grid at Lessos (Turkana County Resource Mapping, 2015).

The county also has the largest wind power station (Lake Turkana Wind Power Project) which has a capacity of generating 310MW enough to power more than one million homes (Cookson & Kuna, 2017).

Crude oil exploration and drilling is currently taking place in the County. The discovered oil wells are estimated to hold at least 250 million barrels (Johannes et al., 2015). The county is also considered to have a great potential of Solar power and geothermal power. Currently the county has 3 solar mini-grids located in Ngurunit locality (28kWp), Kalobeyei Locality (20kWp) and Kalobeyei refugee camp (60KwP).

1.2.1 Types of Waste generated

Smoke, Liquid waste water, Dust, Solid waste, Oil spill, Sewage, Organic waste, synthetic Oil based mud cuttings and contaminated drilling water. Method of waste disposal in use includes the following; Chimney/ stack, Oil- water separator, Septic tank and soak pits, Illegal dumping sites, Incineration, Composting, Venting and flaring of gas, Disposing Oil and gas drilling water through evaporation pits and Dispose through burning/incineration

1.2.2 Environmental issues related to industry;

The following are the general environmental impacts attributed to various industrial/mining concerns.

1. Air and water pollution from mining sites
2. Emissions of greenhouse gases from industry.
3. Discharge of pollutants into the water with a health risk, often as result of inadequate waste water management by operators.
4. Disposal of solid waste on land contributing to land degradation. Land degradation in the County is also manifested in form of abandoned open cast mining sites. Some excavated land areas have not been reclaimed and pose danger to human life from hanging cliff and collection of water pools which serve as mosquitoes breeding sites and expose children and animal to risks of drowning.
5. Land use conflicts, arising from increased industrial development competing with the other land uses like pastoralism.

1.2.3 Mitigation Action

The following mitigation actions are proposed to address environmental issues arising from industrial, quarrying and mining activities.

1. Enforcement of various laws and regulation on environment.
2. Installation of appropriate technology by industries to deal with various forms of pollution.
3. Industries should be compelled to reduce, reuse and recycle their waste.
4. Industries should develop environmental management systems to address

pollution issues.

5. Reclamation of abandoned quarries by back filling and tree planting.

1.3 Environmental Research

In reference to the many environmental challenges faced in Turkana county, there is need to carry out a good number of environmental research to be able to solve the experienced challenges. The county is located in the ASAL areas where the resident entirely depends on livestock and fish from the lake for their livelihood since the area rainfall cannot support substantive crop production. With the experienced global warming around the world, the area conditions are worsened by high evaporation of waters in the lake and rivers, emergence of new diseases as well as emergence of invasive alien plant species that are leading to the loss of the plant biodiversity in the region.

Areas of environmental research and innovations include;

- Identification of biological methods to control and/or utilize alien species such as *prosopis juliflora*
- Production of biogas from landfills that utilize small areas of land
- Affordable rainwater harvesting systems
- Electronic tools for communication of knowledge on clean production systems
- Methods for reuse and recycling of solid waste
- Improved burners such as jikos
- Tapping of harmful emissions to the air from factories
- Cheap waste water treatment systems
- Water purification systems
- Innovation of cheap and portable solid waste treatment systems
- ASAL crops to come up with varieties that can tolerate the dry condition of the region and save the locals from the pangs of hunger and starvation.
- Research on new and efficient ways to save the water bodies from dry due to high heat causing evaporation needs to be urgently done to save the locals from water shortage and the negative impacts on the fishing industry.

- ❖ Research on ASAL plants for instance *Prosopis* which has turned out to be very invasive and has negatively affected the population of the indigenous plant diversity in the region.
- ❖ Tropical, animal and human diseases which have emerged due to the experienced global warming leading to great effects on the social economic factors of the locals.
- ❖ The harnessing and distribution of the large underground water reserve should be fast tracked to easen pressure on water resources available and also to enhance irrigation agriculture that need up scaling in its bid to improve food security situation in the county.
- ❖ The county has massive potential of solar energy that has not yet been fully tapped. If harvesting of the resource is given priority it will greatly relieve stress on forest resources besides reducing pollution due its nature of clean energy that is in line with green economy lobby globally.

Table 2: Areas of environmental research and technological innovation

Environmental research	**Technological innovation**
Solid waste management	- Compositing - Technologies to reduce, reuse and - recycle waste - Sanitary landfill - Affordable incineration - Plastic waste re-use and recycling
Renewable energy exploitation	- Solar and tidal wave harnessing technologies (green energy) - Energy saving jikos technologies - Biogas energy production from human waste and livestock manure
Environmental disease incidences Monitoring	- Epidemiological survey and mapping by use of GIS technology
Electronic waste management	- Safe disposal technologies
Asbestos waste management	- Deactivation and mobilization technology for safe disposal

Indigenous knowledge identification system and documentation	- Satellite radio
Air pollution	- Efficient fuel combustion technologies and efficient emission arrestor
Water pollution control	- Environmental safe house hold sewage management technology
Plastic pollution	- Household recycling technology
Dumping site	- Landfills
Disaster management	- Early warning system
Land use planning	- Land zonation
Ground water contamination	- Survey of extent contamination
Management of sewage from	- Decentralization of the sewage treatment
Handling and disposal of hazardous	- Treatment before disposal

1.3.1 Dissemination of research information

- Mass media
- Workshop training
- Barazas
- Posters
- Demonstrations
- Environmental events e.g. World Environment Day (WED), World Wetland Day (WWD)

1.3.2 Mitigation plan

- Enforcement of regulation and plans
- Awareness creation
- Social disaster management plan
- Enhance advance treatment for waste
- Polluter pay principle for pollution should be imposed.

1.4 Opportunities for Sustainable Development

Fiscal incentives for adoption of the EAP include awards to businesses that use innovative and clean production systems, development of innovative methods that reduce carbon foot prints through use of virtual space such as online applications and softcopies, development of forums for knowledge exchange and information sharing on EAP, issuance of penalties to polluters and easements to entities that do not comply with environmental law. Assessment and dissemination of information on individual carbon foot prints and methods of reducing the same. Other methods include offering financial incentives and subsidies for adoption of livelihoods that enhance forest cover in the county. The incentives proposed should be more specific and able to commit the private sector towards.

Existing environmental management interventions for economic development in the county include promotion of rain water harvesting systems such as development of water pans and dams, efforts towards relocation of Lodwar airstrip from town, development of water purification systems, drilling of boreholes and adoption of synthetic water supply systems that do not rust. For sustainable development, the following interventions are key;

- Payment for ecosystem services (PES) programmes
- Adopt 'Carbon credits'
- Soil and water conservation fund
- award them tenders to undertake implementation of these projects
- incorporate them while implementing key mitigation measures
- provide forums for information dissemination on prevailing conditions
- conservation of forests in farms
- Subsidized energy saving jikos
- Locally led climate change financing
- Introduction of value addition industries/equipment's to improve the forest products
- Registration of privately owned forests with KFS to be able to access financial assistance from banking institutions.
- Awards for Best Environmental practices
- Capacity builds communities and pupils on silvicultural practices.

- The pastoralists should be able to adopt other sources of livelihood, they should also be able to destock the cattle during droughts to reduce the number

For the EAP to be fully implemented there is need to adequately engage all stakeholders to participate. The county administration shall endeavor to provide a conducive environment for the business community to participate and invest in environmentally friendly development. The following measures should be put in place: -

- Provide tax waiver or exemption for business community investing in waste management like Ecosan toilets and CLTS.
- Set aside land for investment of environmentally friendly projects.
- Provide incentives and awards to best business investor or environmentalists adhering to best solid management and air quality regulations.
- Zero rating eco-friendly construction/building materials.

Table 3: SWOT Analysis for Environment Conservation and Management

Strengths	Weaknesses	Opportunities	Threats
Existence of law and regulations e.g. EMCA of 1999; Political goodwill; Cooperation from local leaders.	Non-adherence to existing laws; Inadequate personnel to enforce the laws; Poor management of natural resource due to illiteracy; Destruction of forests and catchments.	Programmes for rehabilitation of catchments and a forestation of degraded areas; Training opportunities for community environment committees.	Droughts; High Demand of charcoal and Sand in the County and outside.

1.5 Economic livelihood of Turkana county

Turkana experiences arid climate and soil conditions that render most of its terrain unsuitable for growing crops, so almost all of the county's 1 million inhabitants practice pastoralism. The locals also depend on Lake Turkana for fishing as an income generator while agriculture, concentrated along River Turkwel and irrigation schemes, continues to play a significant part in getting the

county food secure. Despite being the major source of livelihood, this factors also play a great role influencing the environmental impacts as shown in Table 4

All economic activities affect the environment in some way whether it is done intentionally or unintentionally. These could be positive or negative effects. Most of the time, they are negative. Most activities usually end up harming ecosystems or just polluting the environment. Economic activities can range from mining all the way to farming. Below is a summary of how different types of economic activities affect the environment.

The first effect on the environment is the over harvesting of species. This is mainly caused due to hunting, fishing and forestry. Hunting occurs in many parts of the world to provide food and animal products. Among the many uses of animal products are skin and feathers for clothing, ornaments and souvenirs. Sometimes animal body parts are used for making medicines. Sometimes, people kill wild animals that are a threat to people or their crops and livestock. Some people who live a partly traditional lifestyle consider hunting an essential part of keeping their culture alive. Not all hunters kill the animals but some capture them for live sale which has the same effect of reducing the wild population. Fishing provides an important food supply for many people, and is a popular sport and recreational pastime. The problem is that indigenous fishing like the use of herbs and mosquito nets as fishing nets involves technology that harvests the oceans so effectively that the number of species can reduce massively. Seventy percent of fish being harvested are being removed at a higher rate than at which they can reproduce. Fishing in this way is unsustainable, and other parts of the aquatic ecosystems are damaged as the food supply for some species is reduced.

If foresters are not careful, the harvesting of valued tree species will also become unsustainable. Forest trees take hundreds of years to mature, and with modern machinery, trees can be chopped down at a much faster rate than they can grow back.

Sand is the major natural resource available in almost all the rivers and streams. Sand harvesting however, remains illegal in the County and this makes it hard to get the data on amount harvested and personnel employed this informal sector.

1.5.1 Existing environmental management interventions for economic development

- Waste management (garbage management, sewerage, sanitation)

- ❖ Building code review (zoning, adherence)
- ❖ Air pollution and regulation (matatu regulation, noise control)
- ❖ Water reticulation and argumentation
- ❖ Resettlement and housing upgrading
- ❖ Environmental impact assessment
- ❖ Capacity building
- ❖ Tree planting (riparian, streets, schools and other public schools:
- ❖ Disaster mitigation and management (flush flood control, fire, road carnage)

1.5. 2 Actions for promoting intergenerational and intergenerational equity in the use of natural resources

- ✓ Adapt and promote modern environmentally friendly technologies like biogas, solar, Ecosan toilets and Community led total sanitation.
- ✓ Provide incentives to investors in ecosystem activities.
- ✓ Strict penalties to non-compliance to EMCA 1999
- ✓ In the early generation, the women were not empowered but now they are empowered by the government to be able to do farming and other agribusiness in that they are given loans with small interest.
- ✓ The property right is now equal to every member of the family unlike in the past thus they are able to utilize the natural resources.
- ✓ The youth are now offered with loans from the government, thus they are using the funds to utilize the natural resources.
- ✓ The older generation were strict in following and conservation of culture thus utilization of the natural resources.

1. 5.3 Key economic activities in the county with adverse impacts on the environment.

- Livestock keeping
- Fishing
- Agriculture
- Extractives

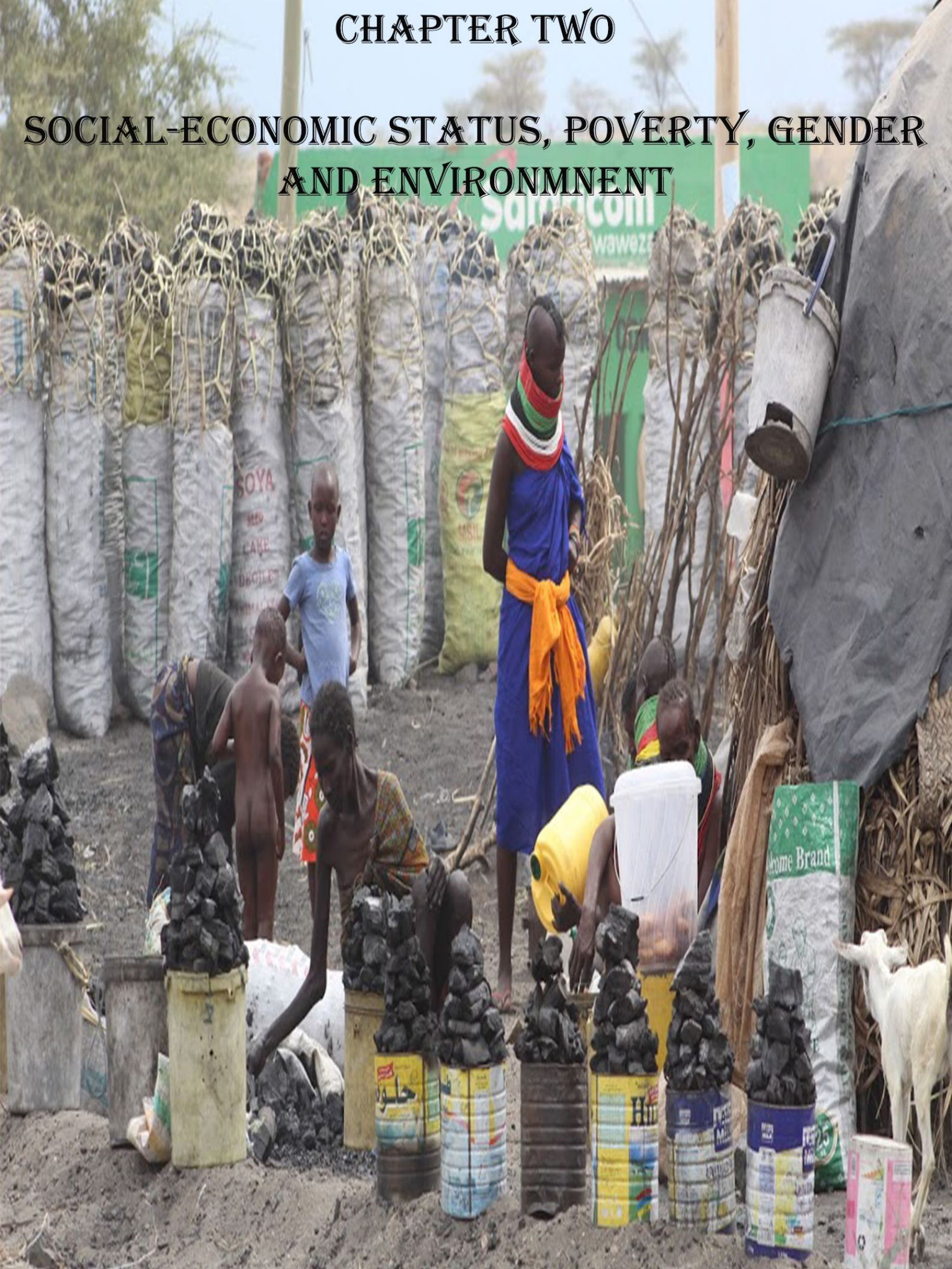
Table 4: Illustration of key economic activities and their impact on environment and mitigation measures

Economic activity	Contribution to economy Kshs./annum	Impacts on environment	Mitigation measures (action to be taken)	Responsible Agency	Costs. Kshs.
Livestock keeping (Goats, Cattle, Camels sheep, poultry & Bees)	~ Ksh 5.9 billion (Turkan County livestock Plan 2013-2017)	✓ Loss of vegetation cover. ✓ Soil erosion ✓ Increased accumulation of greenhouse gases	✓ Control of the Animal Stock. ✓ Putting up mechanisms for the availability of diverse animal feeds to reduce pressure on the natural vegetation	County Department of Livestock, Environment & NEMA	**545 M**
Fishing	Has a potential of contributing about Ksh 1 billion annually	✓ Loss of fish diversity ✓ Water pollution (Oil spillage by oil boats	✓ Controlling overfishing ✓ Controlling spillage	County Fisheries Department, Department of Environment	**210 M**
Agriculture	Over 280 million shillings per year (Turkana County CIDP II 2018-2022)	✓ Loss of soil fertility ✓ Biodiversity loss ✓ Water & land pollution.	✓ Minimize the use of chemicals in the irrigated farms ✓ Proper handling of farm waste before releasing to the environment ✓ Climate smart agriculture, Practice appropriate land use planning and management, safe use of agrochemicals, use of organic manures to conserve soil.	National and County department of Agriculture, Environment, WRA, NGO'S, CBOs & NEMA	**720M**

Extractives	Approximately Ksh. 2.5 Billion per year	✓ Deforestation ✓ Air and water pollution ✓ Land degradation, ✓ Damage to landscapes ✓ Noise pollution ✓ Dust and deterioration in water quality. ✓ Harmful chemicals	✓ Afforestation ✓ Dump site ✓ Waste treatment facility ✓ Environmental monitoring ✓ Compliance and Enforcement	International Oil Company, Directorate of Environment, NEMA, Natural Resources, Forestry, Mineral Resources	**320M**

CHAPTER TWO

SOCIAL-ECONOMIC STATUS, POVERTY, GENDER AND ENVIRONMNENT



CHAPTER 2

SOCIO-ECONOMIC STATUS, POVERTY, GENDER AND ENVIRONMENT

2.1 Community composition

The population of Turkana County is made up principally of the Turkana people, a Nilotic community who have traditionally made their living from pastoralism, with a focus on nomadic cattle herding (Turkana County CIDP II, 2018-2022). Pokot, Tugen, Samburu, and Borana communities inhabit areas of Turkana County, mainly along the border areas. Members of the Somali community are important actors in the Turkana economy, predominantly, running shops and other business in Lodwar and other urban centers. Recent years have seen increased levels of migration into Turkana from other parts of Kenya seeking economic opportunities since the discovery of oil and gas in the Lokichar Basin.

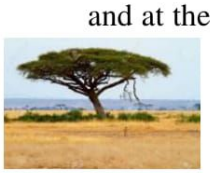
2.2 Economic Livelihood

Historically, the Turkana relied upon nomadic pastoralism for their livelihoods. For the past 400 years, mobile livestock herding offered the most appropriate production system to manage the harsh and variable environmental conditions found in the County. Livestock are able to exploit the scarce available resources - primarily pasture and shrubs – and transform those resources into products suitable for human consumption and sale in the market place, such as milk, blood, meat, hides and bones (Turkana County CIDP II, 2018-2022). Those living along the shows of Lake Turkana hugely depend on fishing for food and as source of income from the sales, while those living along the banks of river Turkwel practice irrigation farming to produce food for consumption within the county.

2.3 Types of livelihoods;

2.3.1 Crop Cultivation

Due to cultivation, the environment is affected in that pollution is caused by the excessive use of pesticides and fertilizers. Cultivation also affects the environment in that the farmer usually cut all the trees clearing the forest so as to be able to have enough space for cultivation thus causing soil erosion due to the land that was left bare. We should come up with a way of planting trees and at the same time cultivating in the farm. We should be able to seek specialists on the ratio of fertilizers and pesticides in the farms.



2.3.2 Livestock rearing

With the many cattle in the county, the land is overgrazed thus leading to soil erosion. The pastoralists should be educated in that they can involve in the cultivation of crops and still earn a living, they should also be taught the destocking of the cattle during draught.

2.3.3 Charcoal burning

Charcoal burning is a livelihood practiced by a large number in the county. Due to poverty and lack of education, they are not able to access other like the use of cow dung and bio-gas. The county should educate people on the types of livelihood that do conserve the environment.

2.3.4 Use of herbs

The herbalist usually destroys most of the trees when harvesting the herbs. They should be taught on the proper way of harvesting and be given certificate after the training to avoid destroying the trees.

2.4 Environmental awareness and education methods for sustainable socio-economic development and propose action;

Environmental awareness & education methods;

- Among the students through education. Environmental education must be imparted to student's right from the childhood stage.
- Among the masses through the mass media. Media can play an important role to educate the masses on environmental issues through articles, environmental rallies, plantation campaigns, street plays, real eco-disaster stories and success stories of conservation efforts.
- Among the planners, decision makers and leaders. Since this elite section of the society plays the most important role in shaping the future of the society, thus important to give them necessary orientation and training.

2.4.1 Proposed action;

- ❖ Developing of materials for awareness.
- ❖ Collecting and gathering materials that is appropriate to priority environmental issues.
- ❖ Sharing and disseminate pertinent information among stakeholders.

- Improving of infrastructure.
- Developing of relevant materials.
- Developing of resource centers.
- Poverty alleviation programmed and education
- Community sensitization and awareness.
- Reach out to people in inaccessible areas.
- Infrastructure rehabilitation.
- Community training and education.
- Enhancing technology transfer through demonstrations
- Provision of extension services

2.4.2 Proposed interventions enhancing community resilience to environmental threats and disasters

- Communities to avoid cultivating in the water catchment areas.
- come up with the disaster preparedness and recovery plan.
- The farmers should practice both farming and livestock keeping, considering the crops and livestock that are being favored in the region.
- The community must be educated and sensitized on the proper way of conserving the environment.
- Materials should be created for environment development awareness and distributing them to the communities.
- Sensitizing on community measures to come up with projects that conserve the environment.
- The government should chip in in funding of project water related and the construction of the irrigation.
- Communities should be educated on harvesting of water during the rainy season, to be able to use in the future.

2.4.3 Research areas in socio-economic issues impacting negatively on environment and promote use of research findings

- Charcoal burning- Burning of charcoal as affected the conservation of environment

- Agriculture
- Livestock keeping/pastoralism

2.4 4 Infrastructure of the area, its impacts on environment and mitigation action

- The infrastructure of the county is very poor, comparing the urban and the rural, most of the rural areas have a temporary road while in the urban the road is tarmac but it is in a very poor condition.
- There are few paved roads in the entire county, which is not sufficient. When constructing roads, the trees and vegetation are usually cleared.
- There is pollution of the environment from the vehicles exhaust fumes
- Clearing of trees to pave way for the connection of electricity.

Resources towards the construction of tarmac roads in the county and opening of roads should be increased so as to ease transportation problems.

2.5 Poverty and Environment

According to the Kenya National Bureau of Statistics, Turkana is ranked as the poorest county in Kenya. It is estimated that 92% of its population live below the poverty line, compared to a national average of 31.6% (SID 2013 & KBNS Economic Survey, 2018). Households and communities suffer from low availability of and access to food resources, resulting in high levels of chronic and acute food insecurity and malnutrition. Most sub-counties in Turkana experience levels of Global Acute Malnutrition (GAM) that exceed emergency levels on an almost annual basis.

The low developmental growth and high poverty levels in the county are hugely attributed to:

- ❖ Prolonged droughts which has become a common occurrence in the county.
- ❖ Inadequate water supply for domestic used, livestock and crop irrigation as the area receives an average of 200mm of rain per year.
- ❖ Insecurity-access to pasture and cattle rustling has become a major source of conflicts lead to destruction of social amenities, loss of economic opportunities and lives.
- ❖ Poor and inadequate infrastructural facilities
- ❖ Inadequate marketing systems
- ❖ livestock diseases

- ❖ Low literacy levels

The impacts of drought, climate change, environmental degradation and population growth on the pastoralist economy have also been reported as the major factors contributing to the poverty levels in the county.

While pastoralism remains an important part of the Turkana economy, the role livestock herding plays in the County is changing rapidly. Poorer households now tend to have very small herds mainly of goats that cannot maintain a sustainable livelihood. Many of these households are either dropping out of pastoralism's or choosing alternative livelihood option. Unfortunately, in their search of alternatives to pastoralism, many poor Turkana households have been forced to engage in livelihoods that negatively impact on environment. For instance, cutting of trees for fuel wood or charcoal destroying the scarce available vegetation and exposing the land to adverse environmental conditions such as soil erosion and prolonged droughts and loss of vegetation for animals (Watson and Binsbergen, 2008, Opiyo et al., 2015).

2.6 Gender and Environment

Poverty, food insecurity and the difficulty of making a livelihood from pastoralism are causing many Turkana to adopt alternative livelihoods (Opiyo et al 2015). In particular women, who are more traditionally linked to small-scale manufacturing and petty trade, and youth who do not have access to livestock assets, demonstrate aspirations to engage in alternative livelihoods. Examples include crop production (particularly using irrigation), charcoal production and sale, manufacture and sale of handicrafts (especially baskets), petty trade (especially of household goods and small livestock), honey production, the sale of other nature-based products and casual labour (Watson and Binsbergen 2008; Save the Children 2016).

The alternative options for instance charcoal burning are directly associated with deforestation and degradation of land exposing the area to adverse climatic conditions.

Improper irrigation farming has also resulted in water pollution due to overuse of agrochemicals affecting the quality of the water downstream affecting the aquatic biodiversity Irrigation has also led to siltation of the few available rivers threatening their future.

To address poverty there are several registered groups that engage in environmental conservation activities. Numbers of these registered groups has risen considerably in recent years. There are also incentives to support the youth, women and other vulnerable groups. These initiatives and incentives include direct cash transfer to vulnerable groups such as cash Transfer to Children and Vulnerable persons. There are efforts geared at empowering the youth through access to financial support. These include the Uwezo fund initiative and a reserve of a percentage of government tenders to the youth.

Climate change often affects women, vulnerable groups and children the most. Vulnerable groups such as the physically hand-capped are physically incapacitated and this exposes them to a limitation of access to opportunities and services. Women are normally involved in household chores such as looking for and fetching firewood and water. This sector of the community also has restricted rights, limited mobility and a muted voice in shaping decisions. This makes them highly vulnerable to climate change. This vulnerability varies widely, but climate change has magnified the existing patterns of inequality (both gender, generational and inter and intra-generational inequality). However, in spite of these disadvantages, women play an important role in supporting households and communities to mitigate and adapt to climate change. This is based on the nature of their fundamental and basis roles in sustaining livelihoods.

Ways of mainstreaming gender in natural resource utilization include enactment of legislation that recognize women and youth in land ownership and tenure, recognition of women in inheritance rights, providing financial incentives to vulnerable groups, support and strengthening of institutions. Other incentives include award of both tourism facilities/industries that comply with environmental regulations, and recognition of environmental groups and CBOs. For this purpose, the total number of registered self-help groups in the whole of Turkana County today stands at about 2500. However, this is still low.

Other incentives are inclusion of women in innovative projects such as the county monthly clean ups and tree planting exercises. This project is based on community participation in re-afforestation, and is designed to empower communities especially women to improve and sustainably manage, in an inclusive and consultative manner, the resources upon which they base their livelihoods, health, and food security. The project is aimed at directly benefitting women and children who will no longer need to walk long distances in search of firewood,

water and alternative income thus reducing exhaustion from long distances travelled in search of the aforementioned products and reduced risks associated with being far from their homesteads. This will in the long run boost food security and resilience to shocks of communities from climate change effects.

Mitigation actions include education and awareness, strengthening of institutions, offering financial incentives to registered environmental groups, enactment of laws that recognize the voice of women and the youth in protection and ownership of natural resources.

Table 5: SWOT Analysis for Gender and Inequality

Strengths	**Weaknesses**	**Opportunities**	**Threats**
Existence of a and Ministry of Sports and Youth; Existence of MYWO; Existence of Women and Youth empowerment; programmes e.g. KWFT, K-Rep, Youth fund and Women Fund; Adult education programmes.	Non-recognition and representation of women in major forums and County committees; Entrenched cultural practices.	Existence of Gender awareness based NGOs creating awareness on Gender and providing support programmes; Increasing enrolment of Girls in school.	Increase in poverty level.

Table 6: Illustration of Poverty and Environment Issues and Mitigation Actions

Issue	**Impact on the environment**	**Mitigation measures (action to be taken)**	**Responsibility**	**Cost Kshs. In million**
High Illiteracy	- Destruction and mismanagement of the environment due to lack of knowledge and skills of managing it. - Also due lack of skill to seek formal employment, there will be over-reliance of natural resource due to lack of diversified livelihood.	- More emphasis should be put on formal education especially for the youth. - Community trainings and sensitization on the importance of protecting the environment	- Ministry of education (National and County) - County Department of environment - NEMA - Natural Resources - KFS - KEFRI - FBO - Non state actors	800 M
Poverty	- Over-utilization of resources	- Family planning, affordable credit, diversification of livelihoods	Ministry of Planning, Ministry of Health, County Government	450M
Land tenure systems	- Unplanned settlements, no regard to resource use, uncontrolled development	- Issuance of title deeds, settlements of internally displaced persons	Ministry of Lands, County Government, Ministry of Interior	500 M
Lack or inadequate sewerage system	- Pollution of water bodies as a result of effluent discharge.	- Establishment of sewerage system	County government Min. of public health. County department of Environment NEMA.	320M
Cultural and traditional beliefs	- Destruction of environment through soil erosion, devegetation, overgrazing etc.	- Creation awareness campaign be done to advocate for adoption of modern technology alongside behavioral change.	Min. of environment and natural resources. KFS Min.of livestock and pastoral economic	120M
Congested settlement/ Unplanned settlement	- Pollution of environment due to waste generation - Over utilization of natural resource due to high population surpassing carrying capacity of environment.	- Creation of proper waste disposal facility. - Physical planning of the settlement especially the urban	Min. of public health Physical planning office, TCEC	300M

Poor sanitation	- Contamination of environment	- Installation of garbage collection. - Practice good hygiene.	Min. of public health. County government, TCEC	230M
Over exploitation of natural resources e.g. firewood, wildlife.	- Endangering of some species, - Destruction of biodiversity, - Environmental degradation, - Soil erosion, - Climate change	- Protection of natural habitat. - Community be sensitized on sustainable exploitation of the natural resources. - Only exploitation with permit be allowed to take place - Reduce environmental degradation and improve environmental conservation through afforestation, reforestation and agro-forestry. - Increase area under farm forestry - intensify reforestation campaigns	KFS KWS NEMA MEENR, TCEC	250M
Drought and famine	- Loss of life and livelihoods, Malnutrition among the under-fives. - High dependency rates and high school dropout rates.	- increase awareness on proper farming practices - Reduce environmental degradation and improve environmental conservation - Integration of indigenous knowledge - Upscale early warning systems on disaster preparedness	County Government, NDMA, Water Department, Disaster Department, Livestock Department, Health, NG-Devolution and ASALs, Environment, NEMA, KFS, TCEC, MET,INTERIOR	740M

Pollution (air and water)	- Loss of life - Disease outbreaks Upper Respiratory Tract Infections (URTI)	- increase number of households with piped water - increase the number of shallow wells - reduce distance from nearest water point from the current 10kms to 4kms - increase rural water supply - increase capacity building on water use and management	County Government; Water Department, Livestock Department, Health, NG-Devolution and ASALs, Environment, NEMA, KFS, TCEC, Water service providers	160M

Efforts have been put to increase agricultural productivity through various programmes in the County. The revival and expansion of extension services has facilitated the transfer of modern technologies in agriculture and livestock. The County Government has been issuing subsidized fertilizer through the agriculture department and supporting farmers through farm mechanization program. This combined with the stabilized prices of cereals through the National Cereals and Produce Boards (NCPBs) is meant to reduce the cost of production and increase returns for the farmers.

Other programmes in agriculture and livestock including NARIGP, Water Programs and National Agriculture and Livestock Extension Programme(NALEP) which have been ongoing designed to ensure that the County is food secure and that farmers get maximum returns from their farming enterprises. The Cash Transfer Programme (CTP) for the elderly, orphaned and vulnerable children (OVC) and persons with severe disability has ensured that the vulnerable members of the society afford to meet basic needs and supplement the income they get from other sources.

County wide co-operation is needed to replace environmentally damaging production technologies with environment friendly ones, as well as to take care of the global commons. Support to municipalities and community organizations, particularly in the field of waste management can create jobs and reduce the pressure on the environment.

CHAPTER THREE

CLIMATE CHANGE/VARIABILITY

CHAPTER 3
CLIMATE CHANGE/VARIABILITY

3.1 Introduction

Climate change is what we experience when the climatic conditions permanently shift either upwards or downwards of the average. Shifts in the start or end of the rainfall season, the length of the season, the number of rainy days, the number, length and intensity of dry spells, or changes in the total seasonal rainfall, among others, can also signify climate change. Climate change is hence not always a shift in the mean climatic conditions, but can also exhibit itself as a change in the intensity and frequency of extreme climate events, such as drought, floods, storms, and strong winds, among others.

The **United Nations Framework Convention on Climate Change (UNFCCC)** defines climate change as a ***"change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods".*** Climate change being a global phenomenon extend into the local environment of Turkana County. Climate change phenomena affects the environment, natural resources, socio-economic welfare and economic development. Climate Change is the most challenging developmental issue in the present age. Climate Change affects nearly all sectors of human endeavours and wellbeing. Water quality and availability, human health, food security, energy, air quality, climate and weather, availability of resources for economic development, occurrence and intensity of disasters, and many other issues are all influenced by climate change.

Turkana County is largely Arid and Semi-Arid, receiving annual rainfall as low as 80 mm per annum. Kenyan government data indicates a trend of rising average temperatures in Turkana County. According to the Human Rights Watch (2015) the minimum and maximum air temperatures in Turkana has been increasing by between 2°C and 3°C between 1967 and 2012. Increased temperatures result in increased levels of evaporation and evapotranspiration that negatively impact water availability and plant growth.

Precipitation patterns have also changed with the long rainy season becoming shorter and drier, and the short rainy season becoming longer and wetter, affecting the ability of pasture to grow effectively (Turkana County CIDP II, 2018-2022).

Climate change/variability and the weather vagaries present a big challenge and are the biggest risk factors in agriculture and most socio-economic activities in Baringo. Performances of seasonal rains are characterized by the onset and cessation dates; intensity, frequency and distribution of wet and dry spells; and, the seasonal amounts. Within a season, these characteristics are independent of each other (Camberlin et al, 2009) and constitute the information that is useful in the planning of agricultural activities.

3.2 Drought and Floods

Drought conditions occur frequently in the county causing livestock deaths and loss of farm produce. This is due to low rainfall pattern. Other major disasters include, floods, natural resource-based conflicts, animal disease outbreaks, plant diseases in irrigated lands, cattle rustling, boundary disputes/land disputes, land/ mudslides, flash floods and lightning strikes. To mitigate the effects of drought, more resources are to being diverted to save lives of both humans and livestock through the provision of water, relief food, disease control, provision of human health services and food supplements. Improving irrigation in the dry areas will provide a long-term solution to curb this problem.

The environmental effects of the cycles of rainfall, floods and drought in Turkana County are seen in:

(a) the bush clearing and burning, just before the start of the rainfall season, for millet and sorghum planting;

(b) intensified charcoal burning as the main economically viable activity during the dry / drought season;

(c) massive erosion, land degradation and sediment laden water bodies during the rainy season

(d) dust storms before the rainfall onset; especially in Turkana Central. This loads the air with much suspended particles increasing air pollution.

The growth of the economy of the county is strongly correlated to rainfall patterns. There is a growing need to achieve a position where agricultural production is not determined by rainfall patterns. Water harvesting, irrigation, value addition, reduction of post-harvest losses are some of the activities that can help bring this delinking.

The tourism sector is also affected by drought due to wildlife migration in search of food and water. At the same time, human-wildlife conflicts and poaching incidences increase dramatically due to competition for water at the few perennial water sources.

The impacts of climate change which results from global warming, has been confirmed to be real (IPCC, 2007). Its environmental and socio-economic impacts have been experienced and documented in Kenya (MEMR, 2010). These can be said to have contributed to the decline in agricultural productivity, hence increase in food insecurity. This has led to a rise in poverty levels that is said to stand at over 70% in Turkana County. Due to rapidly rising human population, climate change can also be said to immensely contribute to environmental degradation (MSPND&V, 2011). IPCC (2007). The predictions are that vagaries of climate change which include high climatic variability, frequency, intensity and extreme events (droughts, floods, adverse weather such as hailstones, destructive winds etc) are expected to be more ferocious. Thus, in order to alleviate the economic conditions of communities, there is a need to enhance the use of climate and weather information into socioeconomic activities and in the development plans for the county. Vagaries of climate manifesting as high inter-annual variability in rainfall experienced in the recent decades, is the environmental condition that has caused decline in agricultural productivity, increase in food insecurity and rise in poverty levels. The rapid rise in human population, compounded by poor performing economy results in increased pressures on environmental resources which leads to exacerbation in its degradation.

3.3 Cause of Climate change and Variability

Turkana County is subject to the impacts of climate change, contributed to by Deforestation, land use and land cover changes, Conversion of forests areas into grasslands, agriculture lands and settlements, Overgrazing of livestock and poor management of pastures, Pollution; Burning of fossil fuels-in transport, in land preparation, planting, pest control, aerial sprays, cooking,

heating, lighting and in agro- processing plants Pollution from landfills and burning of plastics, Livestock rearing- emissions of methane (CH4) ranges from 70-120kg per cow per year, quarrying activities and Overexploitation of woodlands for fuel wood, lack of alternative sources of energy.

3.4 Local Socio-economic Activities and Climate Change in Turkana

3.4.1 Agriculture

Agriculture has been shown to produce significant effects on climate change, primarily through the production and release of greenhouse gases such as carbon dioxide, methane, and nitrous oxide to the atmosphere. Most of the County's agricultural productions are done under irrigation schemes established along the banks of the Tarach, Kerio, Malimalite and Turkwel rivers. Moderately fertile soils are found in the central plains of Lorengippi, upper Loima and the lowlands of Turkwel, Nakaton and Kawalathe drainage, along the lake at Todonyang plains, the lower Kalokol and Turkwel-Kerio River, and a portion of Loriu plateaus.

3.4.2 Livestock farming

Pastoralism is the main economic livelihood practiced by over 80% of the total population of Turkana County. Cumulatively the huge herds own by individual pastoralist not only lead to destruction of the scare vegetation and exposing the land to the agents of erosion but are also a major source of greenhouse gases for instance methane contributing to the effects of global warming.

3.4.3 Deforestation and charcoal burning

In search of alternatives to livestock keeping people have turned to deforestation and charcoal burning to earn a living. Those living along the major rivers destroy the vegetation cover to get land to grow crops. Trees and other vegetation are known to act as carbon sinks thus deforestation and removal of vegetation cover contributes to global warming due to accumulation of carbon dioxide.

3.4.4 Mining

Though mining has not been active in the county but due to the recent discovery of oil and natural gas reserves, the sector has become another potential contributor of greenhouse gases that compound to climate change. Mining of oil allows methane to escape from the earth. Moreover,

anytime the soil is disturbed, stored gases make their way into the environment. Venting and flaring of greenhouse gases from oil exploration and production may contribute to ozone layer depletion thus rise in temperatures.

3.4.5 Population increase

The county is experiencing rapid increase in population both from natural birth and influx of immigrants from other parts. This has been contributed by the recent discovery of oil and natural gas. The county is also experiencing robust development in infrastructure, housing among others. All these are geared towards meeting the present need and rising demand of modern services by the ballooning population. In order to create space for development, land is cleared for settlement, agriculture and infrastructure. There is also increased consumption of energy, electricity, food, transport services, waste generation thus increasing emission of greenhouse gases that graduate to global warming.

3.5 Impacts of climate change on the economy of Turkana County

Climate change has not only brought about the adverse climatic changes but has also affected the economic livelihood of Turkana residents and the entire Turkana County economy. Almost every sector of the economy in Turkana county has been affected as in the table below.

Table 7: Impacts of climate change on the economy of Turkana County

SNO.	SECTOR	IMPACT
1	Tourism and recreation	Loss of species as a result of changed climate Destruction of the natural habitat.
2	Agriculture	Reduced acreage of agricultural land due to desertification, loss of soil fertility
3	Livestock farming	Loss of livestock as a result of lack of water, pasture leading to Increased resource conflict due to scarcity
4	Fisheries	Decreased fish size and abundance Gradual reduction of water bodies in the county
5	Forestry	Loss of tree species due to weather change making other species unable to cope with the new climate. Reduced forest cover due to desertification.
6	Trade	The market sector will be unpredictable causing difficulty in making prediction and future projection. Different estimates of development trends lead to reversal from predicted positive.
7	Infrastructure	Roads, airport runways, pipelines, water mains etc. will require increased maintenance and renewal as they become subject to greater temperature

		variation and exposure to new temperature.
8	Extractives	Emission of greenhouse gases

Turkana County has experienced a noticeable climate change in the last 40 years. This is evidenced by general rise in the minimum and maximum temperatures over the last several decades as shown in the figures above.

Climate change poses serious threats to sustainable development, resilience to economic shocks and sustenance of sustainable livelihoods. In the county the following are some of the impacts of climate change:

- Increased investment costs and capital
- Increased poverty due to effects of disasters such as drought which leads to death of livestock and poor crop yields.
- Increased incidences of conflicts. This can either be human to human conflicts over natural resources such as access to water resources and land or human-wildlife conflicts.
- Proliferation of harmful alien species
- Food insecurity due to environmental disasters such as drought and flooding.
- Change in weather patterns (high temperatures experienced in the county)
- Increased incidences and preferences of diseases.

3.5.1 Analysis of the Shift in the Uses of the Resources Due To Climate Change

- Shifting cultivation –to permanent cultivation
- Nomadism –to sedentary life
- Communal use of resources to individual resource e.g. watering and grazing areas
- Communal use of resources to individual resource e.g. watering and grazing areas digging of shallow wells
- Construction of underground water tanks to store for prolonged periods

- Adoption of water treatment technologies as a result of water pollution
- Protection and development of water sources

3.5.2 Impact of climate change on gender (Sex, equity, access, benefit sharing accountability, and decision making) and use of natural resources

The County residents heavily rely on the natural resources for their livelihood; from pastoralists, agriculturalists, bee keepers to day today food and energy needs. During the now frequent drought spells, much time is spent by women and children on the labour and time consuming exercise of fetching water and food for their households. Men also move their livestock in search of pasture and water. Milk and livestock products are out of reach for the women and children. This further exacerbates the malnutrition and health situation of the young and old. Exposures to high temperatures and elements of the weather away from homes also compromise the health of the pastoralists. Search for fuel wood take a toll on the time of women and children. Charcoal burning is considered an income earner in the County and the men are great beneficiaries of the proceeds but it is spent inordinately in local brew drinking. It rarely put food on the table for the families involved. Bee keeping is also a man's activity and women are involved in retailing the products. This brings food to the few households who do the retailing.

3.6 Gender Impact of Climate Change

Analysis of the impact of climate change on gender (sex, equity, access, benefit sharing accountability, and decision making) and use of natural resources;

- Young girls get affected in education as they search of water
- Floods destroy structures like bridges, hence people trek long distances
- There is loss of social economic value after floods to family units
- Men trek for long distances in search of water and pasture thus neglecting their roles as heads of families hence women take lead in decision making at household level
- Population declines
- Young boys absent themselves in school while searching for pastures and water

3.7 Impact of Climate Change on Intergenerational and intra-generational issues

It cut across the intergenerational and intra-generational since all are affected by climate change. Climate change is expected to create intergenerational and intra-generational issues in the future. This is manifested in the loss of livelihoods, poor public health due to increased incidence and prevalence of diseases, degradation of public amenities, loss of wildlife heritage, loss of lives, increased water scarcity, increased poverty, increased incidences of environmental disasters such as droughts, reduced food security, increased cost of foods and natural resource degradation and depletion;

- Poor public health
- Degradation of public amenities
- Loss of wildlife heritage
- Loss of lives
- Increased water scarcity
- Increased poverty
- Increased incidences of drought
- Reduced food security
- Increased cost of food security
- Further natural resource degradation

3.8 Legal and Policy Approaches to Climate Change

Legal and policy approaches in addressing climate change in the county include an adoption of a climate change response strategy, mainstreaming climate change issues in the development agenda, adoption of environmental studies in the school curriculum, promotion of climate change interventions and support to vulnerable groups to adapt faster to climate change. Legal and policy approaches dealing with climate change on the environment: i.e. EMCA, EIA regulations, REDD, UNFCCC, SDG'S, VISION 2030, NEAP, NCCAP, NCCRS, Turkana County Climate change Policy, Turkana County Climate Change Action Plan, Turkana County Climate change Bill 2020, Turkana County Environment Policy and Turkana County Environment Management Bill, 2020 (Not yet Act).

- Kenya Constitution, 2010: - in the Preamble, the people of Kenya shall be respectful of the environment which they recognize as their heritage with determination to sustain it for the benefit of future generations. Article 10 (2) recognizes sustainable development in the list of national values and principles of governance; Article 42 of the constitution of Kenya provides for a clean and healthy environment, which includes the right—(*a*) to have the environment protected for the benefit of present and future generations through legislative and other measures, particularly those contemplated in Article 69; and (*b*) to have obligations relating to the environment fulfilled under Article 70. Article 6**6** provides the State with powers to regulate the use of any land, or any interest in or right over any land, in the interest of defense, public safety, public order, public morality, public health, or land use planning.
- Vision 2030 –The social pillar seeks to build a just and cohesive society with social equity in a clean and secure environment.
- SDGs – No.13 **'Climate actions'**
- EMCA, 1999- The Environment Management and Coordination Act (EMCA), 1999 provides for the establishment of an umbrella legal and institutional framework under which the environment in general is to be managed. EMCA is implemented by the guiding principle that every person has a right to a clean and healthy environment and can seek redress through the High court if this right has been, is likely to be or is being contravened. EMCA has created institutions as outlined in part 3 that are mandated to implement the ACT. Article 54 of EMCA gives power to the Minister in consultation with the relevant lead agencies, by notice in the Gazette, to declare any area of land, sea, lake or river to be a protected natural environment for the purpose of promoting and preserving specific ecological processes, natural environment systems, natural beauty or species of indigenous wildlife or the preservation of biological diversity in general issue guidelines and prescribe measures for the management and protection of any area of environmental significance declared to be a protected natural environment area. Part 4 of

EMCA addresses issues of environmental planning while part 5 talks about protection and conservation of the environment.

- Kenya National Environment Policy, 2012- The overall goal of the Sessional Paper no.6 of 1999, Draft Environmental Policy, revised is to ensure that environmental concerns are integrated into the national planning and management processes and provide guidelines for environmentally sustainable development. The objectives are to conserve and manage the natural resources of Kenya including air, land, flora, and fauna and promote environmental conservation with regard to soil fertility, soil conservation, biodiversity, and to foster afforestation activities; and to protect water catchment areas. More importantly the policy emphasizes the enhancement of public awareness and appreciation of the essential linkages between development and environment, involving NGOs, private sector, and local communities in the management of natural resources and their living environment
- **United Nations Framework Convention on Climate Change (UNFCCC)** - Is an international treaty that supports an intergovernmental negotiating process among countries (called 'Parties') with a view to limit dangerous anthropogenic (human) interference with the earth's climate. Came into force on 21st March, 1994 and is ratified by 192 countries
- **KYOTO Protocol** -Kyoto Protocol was put in place in 1996 to implement the UNFCCC. The Kyoto Protocol sets the overall Greenhouse Gas emissions reductions to be achieved by developed countries. Was adopted on 11th December, 1997 and came into force on 16th February, 2005 and has been ratified by 184 countries
- **The Conference of Parties (COP)** is the supreme body of the UNFCCC and is comprised of countries that have ratified or acceded to the UNFCCC. It is the executive body or organ of UNFCCC that takes and adopts decisions. Its meetings are held on an annual basis in various locations of the world.
- **National Climate Change Response Strategy (NCCRS) 2010** – A strategy to domesticate the UNFCCC and the Kyoto Protocol and focuses on ensuring that adaptation

and mitigation measures are integrated in all government planning and development objectives.

- **National Climate Change Action Plan (2017-2022)-**The NCCAP addresses the options known as Nationally Appropriate Mitigation Actions **(NAMAS)** for a low-carbon climate resilient development pathway as Kenya adapts to climate impacts and mitigates growing emissions. The plan also addresses the enabling aspects of finance, policy and legislation, knowledge management, technology requirements and monitoring and reporting.
- **Convention on the Wetlands of International Importance Especially the Waterfowl Habitat (Ramsar Convention)**: adopted in Iran in 1971but ratified in Kenya in 1990 with the purpose of preserving and protecting wetlands of international importance (there are several Ramsar sites in Kenya already)
- **International Convention on Substances that Deplete the Ozone Layer of 1985** and its Montreal Protocol of 1987 also called the Vienna Convention was concluded in March 1985. It encourages intergovernmental cooperation on research, systematic observation of the ozone layer, monitoring of CFC production, and exchange of information. The Montreal Protocol, adopted in1987, was intended to allow the revision of phase out schedules on the basis of periodic scientific and technological assessments.
- **ASDS, 2010-2020** – Stipulates commitment of all ten Agriculture Ministries to implement NCCRS
- **Agriculture Farm Forestry Rules, 2009** – Stipulate compulsory farm tree cover of at least 10% to promote environmental services
- **United Nations Convention to Combat Desertification, UNCCD**: adopted in 1994 and came into force in 1996 to address the problem of land degradation by desertification and the impact of drought especially in the ASALs
- **ISO 14000 Series**- These are International Standards covering environmental management with an overall aim of supporting environmental protection and prevention of environmental pollution and degradation against an internationally accepted criteria. ISO 14000 Series specifies requirements for Environmental Management Systems applicable to all types and sizes of organizations in diverse geographical, cultural and

social conditions. Among the ISO 14,000 series is ISO 14001 which addresses the international specification for an Environmental Management System (EMS) or basically what an organization does to minimize harmful effects on the environment caused by its activities. ISO 14064-1:2006 is on Greenhouse gases – Part 1: Specification with guidance at the organization level for the description, quantification and reporting of greenhouse gas emissions and removals

3.8.1 Environmental Research Institutions

- Climate change and variability research in Turkana County is done by the following government and semi-autonomous government organizations and institutions:

1. Kenya Agricultural Research Institute (KARI)

2. Kenya Forest Research Institute (KEFRI)

3. Kenya Meteorological Services (KMS) of the Ministry of Environment, Water and Natural resources

4. Climate Change Research and Advisory Center

5. KMFRI

6. Kenya Forest Service (KFS)

7. Universities (Turkana University College)

3.8.2 Other independent organizations involved in climate change research and monitoring in the country Include;

- World Wide Fund for Nature, WWF

- International Livestock Research Institute, ILRI

- United Nations (UN)

- CSOs, NGO's and FBO's

3.8.3 Incentives Interventions to cope with the effects of climate change

- Adoption of environmentally friendly livelihoods such as bee keeping

- Adoption of livelihoods that is less dependent on rain-fed agriculture
- Grown god drought resistance crops such as Cassava, Sorghum, Sweet potatoes.
- Increased environmental awareness and education programs on climate change adaptation and mitigation
- Provision of financial incentives through microfinance institutions.
- Promotion of afforestation programmes.
- Awareness programmes
- Sensitization of communities on the need to protect, conserve and sustainably utilize forest resources.
- Awareness creation through radio programs
- Increased afforestation and reafforestation.
- Construction of rain water harvesting structures such as water pans and dams.
- Enhance use of renewable resources of energy such as solar and wind energy.
- Creating awareness on climate change, its effects, adaptation and resilience.
- Policy interventions such as legal need for as 10% forest cover on private land
- Diversification of crop and livestock production.
- Increased research to come up with drought resistant crops and animal breeds.
- Adoption of clean technology.
- Carbon credit
- Adoption of energy saving technologies
- Giving loans to people with forests as collateral
- Awarding people who have conserved environment
- Providing alternative sources of livelihood especially income generating activities.

3.9 Adaptation and mitigation interventions

Kenya must adapt to climate change through making the necessary adjustments while putting in place the relevant mitigation measures to avert the magnitude of effects. There is need for Turkana County to seize the opportunities offered through clean development mechanisms (CDM) and carbon trade. These will promote green economy through the use of alternative approaches in all sectors. It is also on this basis that the rallying call, 'together we can tackle climate change in Kenya' has been developed and adopted to mobilize stakeholders to address climate change at all levels. Some of the recommended actions across sectors aimed at mitigating climate change are as discussed below

Agriculture sector is extremely important to the economy of the county and the country at large and the livelihoods of the people. There is need to develop technologies and innovations that are geared towards increased food production. These include development of fast growing crops, drought tolerant crops, early maturing crops such as Katumani maize composite. Other areas of focus include; irrigation, conservation agriculture and sustainable land management practices.

Forestry sector must scale afforestation and re-forestation efforts in order to increase our tree cover and subsequently enhance carbon sinks. This will enable the county and the country at large to achieve the anticipated 10% tree cover which is the minimum requirement by the United Nations (UN) standards and also in the vision 2030.

Water sector must embrace water conservation strategies such as drip irrigation, construct water harvesting technologies such as water pans to trap storm water, recycling of waste water while reducing water wastage through leakages of burst pipes and unsustainable uses such as current car washing technologies which uses clean water from taps as opposed to recycled water.

Health sector has equally suffered the effects of climate change through resurgence of disease in areas they did not occur before due to global warming. For instance, highland malaria is now common in previously cooler highlands where they could not survive before. Increase in temperatures though global warming has created new warmer habitats that are conducive to the

survival of pests and diseases. The sector should embark on research to develop the methods and strategies of prevention and the cure of diseases in such areas.

Energy sector should adapt to climate change through enhanced use of alternative energies to minimize Green House Gasses (GHGs) emissions and subsequently reduce global warming. The hydroelectric power provides the major source of energy in the county. However, climate change has led to reduced amounts of rainfall and its reliability often resulting in failed seasons. The level of hydroelectric power generation in existing facilities has fallen far below the national requirements. Therefore, there in need for diversification in power supply and use of renewable energy sources to satisfy the national needs. These include, use of alternative energy sources such as biogas, solar, wind, geothermal, coal, improved stoves, bio-fuels as well as up-scaling the use of other renewable energy sources. The sector should enhance public awareness campaigns on the use of alternative renewable energy sources and modern energy saving technologies.

Industrial sector is dependent on the availability of raw materials and energy for sustained production to support economic growth. However, the sector is among the leading in emission of greenhouses gases to the atmosphere contributing to global warming and climate change. Industries must adopt cleaner production and energy efficient technologies in industrial production. These will ensure maximum use of raw materials for production while minimizing waste generations at the end of the pipe. There is need to promote environmentally friendly technologies and practices such as recycling and enhanced compliance to environmental regulations and standards.

Early warning data and information should be availed and disseminated in order to enhance disaster preparedness. The application of weather data and information is very critical in mitigation of climate change. This information guides farmers on the expected time and quantities of rainfall as well as the recommended type of crops to be planted.

3.10 Climate change Legal and policy approaches on environment

To enhance effectiveness in Climate Change Governance in Turkana County, the department of Environment in liaison with other departments aim to develop the following policies:

- ✓ Develop County Laws and Plans on Climate Change.
- ✓ The Laws and policies should be informed by traditional environmental conservation mechanisms.
- ✓ The laws and policies to provide for climate change committees from village to county level
- ✓ Develop laws to provide punitive measures on those who cut trees.
- ✓ Have the county forests gazetted.
- ✓ Include Climate Change as an underlying factor in the County Integrated Development Plan.
- ✓ Annual Budgets to allocate funds to Climate Change interventions.

Other mitigation measures to the experienced impacts of climate change are as capture in Table 8.

Table 8: Illustration of Adaptation and Mitigation Measures on Effects of Climate Change

Climate change related issue	Impacts on the environment	Adaptation/mitigation action to be taken	Responsibility	Costs kshs. In millions/5yrs
Frequent droughts	- Famine; - Reduced food production. - Lowers water table	- Development of Dams and other water reservoirs,	County Departments of Agriculture, Water &Environment, NDMA, Devolution and ASAL	230M
	- Reduced pastures, - Livestock deaths,	- Diversification of Pasture. - Planting of drought tolerant pasture and crops - Range reseeding - Reduction of Animal Stock	County Departments of Livestock, Agriculture & Environment	150M
	- Emergence of invasive plant species (e.g. Prosopis).	- Getting advance modern technologies to manage the species	County Department of Environment, NRM, NEMA, KEFRI,KFS, Partners, TCEC	112M
	- Loss of biodiversity (Plant species, Animals &Birds	- Protection of the endangered plants, animals and bird species	County Department of Tourism & The department of Environment, NEMA, KFS	134M
Increased Atmospheric Temperatures	- Decreased water in the lake and rivers affecting fishing and other aquatic life	- Afforestation - Reduction of greenhouse gasses emission to the atmosphere	Department of Environment, Industrialization NEMA	90M
Flooding	- Reduced land available for agriculture, leaching	- Dams, - Tree planting, - appropriate cultivation practices and resettlements	Agriculture, Water, finance, Infrastructure, Environment	200M
High climate Variability	- Land degradation - Poor soil fertility - Reduced water	- Water harvesting, - Irrigation, - Monitoring	Environment, agriculture, Meteorological, Environment	200M

	availability	- Early warning information dissemination		
Emerging diseases and pest for Livestock and Crops	- Livestock death - Loss of livelihood - Deteriorating human and livestock health	- Surveillance, - Early warning, - Diversification of livelihoods, - Vaccination for disease control surveillance, - Imposing quarantine	Health, veterinary, agriculture, Livestock dept, NDMA, Agric dept, Water, NGOs	100M
Cattle rustling and increased Human-wildlife conflicts and poaching	- Land degradation, - reduced tree cover, - reduced biodiversity	- Livelihood diversification - Increased security - Public education - Benefits sharing with communities from tourism, dams	Agriculture, security, forest veterinary, finance, culture wildlife, education, Peace, TCEC	180M
Decline in agricultural productivity	- Land degradation, - Reduced CO2 sequestration	- Irrigation - enhance use of farmyard manure - crop diversification	Agriculture, culture, environment	150M
Charcoal burning and bush clearing	- Reduced tree cover - Air pollution - Land degradation	- Improved charcoal burning kilns, - Increased tree planting, - Introduction of other economic activities	Forest, wildlife, agriculture, Environment, Cooperatives Administration, TCEC, NEMA	100M
Rise in Lake Turkana Water level	- Submersion of beaches and infrastructure	- Strategic planning of - Infrastructure - Early warning - Relocation - Pegging of the lake	KFS, NEMA, local community, county government, KEMFRI, KMD, TCEC,WRA	400M
Invasive species	- Reduction of grazing field - Death of livestock	- Clearing of invasive species - Controlling further spread by cultivating	Livestock dept., NDMA, Agric dept., Water, NGOs, County Government, KFS,	100M

	- Overgrazing	- Establishing pasture - Correct stocking density.	NEMA, KEFRI, TCEC	
Change in livestock seasonal migration pattern.	- Introduction and spread of livestock diseases	- Establishment of pasture and conservation to be used during drought to reduce migration.	Livestock dept., NDMA, Agric dept., Water, NGOs, County Government, KFS, NEMA, KEFRI	70M

PART 2:CHAPTER FOUR
ENVIRONMENT AND NATURAL RESOURCES

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CHAPTER 4

BIODIVERSITY

4.1 Introduction

Biodiversity originates largely from ecology (the study of the relationship between organisms and their environment). Biodiversity is the degree of variation of life. The more varied the ecosystem is, i.e. the greater the biodiversity, the greater its resistance to environmental stress will be. The loss of even only one species often can provoke a decrease in the capacity of the system to remain preserved in case of degradation. Biodiversity is like a large tank, from which humans can draw food, pharmaceutical products and even cosmetics etc. Despite the area being arid and semi-arid, the county is rich with various classes of fauna and flora some of which can be classified as threatened or endemic. For instance, *Aloe turkaniensis* species *Osiris lanceolata* species (sandal wood).

Turkana County is endowed with a rich biodiversity heritage with many different ecological systems from Riverine forests, dry forests, prosopis forest, savannah grasslands, rivers, salty lake, semi deserts and shrub lands.

These ecosystems holds a number of known species including insects, mammals, amphibians, birds, reptiles, Livestock, fish etc. Turkana County biodiversity has over the years been harnessed for development of its economy and to sustain the social cultural system. “Biodiversity and nature’s contributions to people are our common heritage and humanity’s most important life-supporting ‘safety net’.

Biodiversity touches every aspect of our lives in that in addition to playing a critical role in providing food, forage, fibre, water, energy, medicines and other genetic materials,

biodiversity is equally important in regulating climate, water quality, pollution, pollination, flooding and storm surges.

4.2 Land and vegetation

Turkana County Land is approximately 77,000 sq. kms. Turkana County is the second largest county in size after Marsabit County in Kenya. The land is Turkana is mostly community land. The physiographic features in the county include low lying open plains, mountain ranges and river drainage patterns. Lake Turkana is at an elevation of 360 meters (1,181 feet) while the surrounding basin is anywhere from 375-914 meters (1,230-3,000 feet). The open lying plains consist of the Kalapata and Lotikipi Plains. The plains form part of the arid area in the County and receive the lowest amount of rainfall of around 180 mm per annum. These plains are dominated by dwarf shrub and grassland, which provide forage for livestock during and shortly after the rainy season. Rivers Tarach, Kerio, Kalapata, Malimalite and Turkwel are the major rivers in the county making them the most important with a potential of producing large amounts of food for the county, if properly utilized.

Lake Turkana is the largest and most saline of the Rift Valley lakes. There is no outlet, and with reduced inflows and high evaporation, this results into depositing of salt in the soil and capping on the surface. The water level is subject to three to four metres seasonal fluctuations. In total, the water level dropped 10m between 1975 and 1992. River Omo from Ethiopia, which is permanent, drains into Lake Turkana. The lake is situated on the eastern part of the county, has northern island, and is endowed with a variety of wild animals namely: hippos, crocodiles and waterfowls. Fishing is the major activity in the lake.

Soils in Turkana County are not well developed due to aridity and constant erosion by water and wind. Often stone mantles cap them Alluvial soils tend to be reddish over the basement system and generally grey buff or white over the volcanoes. Aeolian soils are dune sands either active or fossil; Alluvial soils range from coarse sands to flash flood silts, while black or brown clays occur locally in areas of impended drainage. Vegetation cover in Turkana is classified into three ecoclimatic zones which are influenced by climate, topography and soil structure (Turkana County, 2015). Tree cover in Turkana County stands at 4.06% against the minimum constitutional requirement of 10%.The main contributors of this coverage are Prosopis spp., riverine forests, woodlands, and dry montane forests such as Loima, Songot, Kailongokol, etc.

These are predominantly Acacia with *Hyphaene coriacea* (Doum palm) scattered all over the county mostly along the lake Turkana, rivers and seasonal river valleys. Some of the over 45 tree species commonly found in Turkana include *Acacia tortilis* (Ewoi), *Acacia nubica* (Epetet), *Acacia Senegal* (Ekunoit), *Acacia reficiens* Eregae), *Salvadora persica* (Esekon), *Cordia sinensis* (edome), *Tamarindus indica* (Epeduro), *Balanites aegyptiaca* (Eroronyit), *Azadirachta indica* (Neem), *Moringa oleifera* (Moringa), and *Zyzyphus* mauritiana (Ekalale) The forest cover in the county is held in trust by the Local Government where communities utilize all natural resources without many restrictions. Loima is the major gazetted forest attached with an integrated management plan. Hills and mountains support dwarf trees and shrubs including species of desert cacti. A total of 19,739.20 Ha of Loima Forest has a montane type of climate and support species such as *Podocarpus falcatus, Juniperus procera* and *Croton megalocarpus*, among others. *Prosopis Juliflora* have invaded most parts of the county particularly Kerio, Lokangae, Kanam, Katilu, Katilia, Letea and some parts of Turkana South.

1. **Ecoclimatic zone VI** - the very arid parts of Turkana County found in the low plains of Turkana Central, Turkana East and Turkana South Sub-counties. These are rangelands of low agricultural potential characterized by dwarf grassland or shrub grassland with *Acacia reficiens* often confined to water courses and depressions with barren land in between.
2. **Ecoclimatic zone V**- the arid environment. The land is suitable for agriculture only where fertile soils coincide with very favourable distribution of rainfall or receive run off. These are typical rangelands dominated by *Commiphora* and *Acacia* woodlands. This zone is found in Turkana west Turkana North and Kibish Sub-counties.
3. **Ecoclimatic zone IV** - the semiarid lands of Turkana. This is the semi evergreen bushland of marginal agricultural potential mainly savannah woodlands characterized by *Acacia-Themeda –Brachystegia* woodlands.

Though the soils in the area are a bit dry and moderately infertile, it can support subsistence agriculture where sorghum, maize, cowpeas and green grams are grown. Other crops grown in the region include; dates, palm, mangoes, local vegetables, kales, spinach, bananas and tomatoes.

Turkana County also is endowed with thick forest cover found around the high elevations in mountain ranges (Montane forest) e.g. forests found on Loima hills, Mogila hills, Songot hills, Pelekech Hills, Lorionotum, and Lokanamur and along the rivers (riverine forests) e.g. the riverine forest along river Turkwel, Kerio and Tarach. In flood plains, riverine forests are extensive *and Maerua crassifolia,* which is an evergreen shrub, marks the extent of the floods. Dominant species are *Acacia tortilis* and *Ziziphus mucronata* (Turkana County Resource Mapping, 2015).

Lotikipi plains and Eliye springs are covered with grassland savannahs as well as *Acacia reficiens, Aristida mutabilis, Mallugo cerviana* and *Jatropha villosa.* Bushland vegetation dominated by grass species such as *Digitaria milanjiana, Panicum maximum, Sporobolus conjinis* and *Echinochloa haploclada* are found in the south of the County and along the border with Uganda.

Prosopis juliflora is another main vegetation in the area that has become invasive affecting the socio-economic status of the locals.

4.3 Wildlife

Turkana County has one gazetted National Reserve called South Turkana National Reserve [STNR] which covers an area of 1091 KM2 and is jointly managed by TCG and KWS. The county Government is in the process of gazetting lotikipi National Reserve. Apart from the reserve, the county has a central highland National Park managed by Kenya Wildlife Service.

According to a census conducted by KWS in March 2015, there are over 600 elephants roaming within the ecosystem covering Turkana South and East and Nasolot. South Turkana National Reserve also harbours numerous species of wildlife including cheetah, hyena, jackal, leopard, oryx, pangolin, dik-dik, grants gazelle, warthog, lesser kudu, baboon, monkey, honey badger, and hundreds of birds' species. The reserve's vegetation is typified by tropical riverine desert forests, various species of acacia, and thorn bush scrublands.

Nine species of mammals were counted during an aerial survey of Lotikipi Plain in 2016. These included Grant's gazelle (n = 1,779 animals), Oryx (n = 466 animals), Gerenuk (n = 45 animals), Lesser Kudu (n = 38 animals), Dik Dik (n = 5), Vervet Monkeys (n = 4 animals), and Warthogs (n = 2). In addition, common ostriches (n = 58) and secretary birds (n = 30) were also sighted during the aerial survey. A total of 18,531 livestock (shoats: 9,670; cattle: 8,788; donkey: 63; camel: 10) were counted in the proposed reserve.

Apart from the domesticated animals such as cattle, sheep, goats, camels and Donkeys, Turkana County is also endowed with a number of wildlife forms managed by KWS. For instance, Lake Turkana is an important site for water birds with up to 220,000 congregants having been recorded at one time and 84 water bird species, including 34 Palearctic migrants, known from the lake (BirdLife International, 2017).

Other aquatic animals in the ecoregion include *Hippopotamus amphibius, Crocodylus* spp. and an endemic freshwater turtle, the recently discovered and imperilled Turkana mud turtle (*Pelusios broadleyi*).

The county is endowed with the Lake, which is a UNESCO world heritage site. Lake Turkana is situated on the eastern part of the county. It has three Islands: the northern, central and southern, and is endowed with a variety of wild animals namely: hippos, crocodiles and waterfowls. Fishing is the major activity in the lake. Lake Turkana is also a main fishing ground in the region with over 50 species of fish having been reported from the lake of which currently 11 species are endemic.

Other wildlife found in the region include; cheetahs and Hyenas found on the Muruiris Hills, whereas Lions, Ostriches, gazelle's elephants are found in Turkana South Sub-County. Tortoises are found in Todonyang area. The three National Parks of the lake serve as a stopover for migrant waterfowl and are major breeding grounds for the Nile crocodile, hippopotamus and a variety of venomous snakes. The Koobi Fora deposits, rich in mammalian, molluscan and other fossil remains, have contributed more to the understanding of paleo-environments than any other site on the continent. Lake Turkana region is home to hundreds of species of birds native to Kenya and is also an important flyway passage and stopover for migrating birds. These beautiful

creatures are essentially supported by plankton masses in the lake, which also feed the fish. A total of 84 water bird species, including 34 Palearctic migrants, have been recorded around our lake. Lake Turkana supports different species of organisms. The Lake has several breeding sites for Birds, Fish and Crocodile. The crocodile breeding sites are Lokwar alolobkai, Lobolo, Longech (Ekwar DC), Furguson gulf (Namakat and Natirai), Nariemit (Loporoto), Central Island National Park and Southern Island National Park. Some of the fish breeding sites include; Ferguson gulf, Kalimapus Gulf Lokwar alolobkai, Lobolo, Longech (Ekwar DC), Furguson gulf, Natirai/Lokwar Kateit, Nariemit (Loporoto), Central Island National Park and Southern Island National Park, North Island. The Important Birds Areas (IBA) and birds breeding sites include; Central island National Park, Lobolo (Napasin), Namakat (Lochilet)

4.4 Biodiversity Status and Trends in Turkana county

There is growing evidence of escalating biodiversity losses worldwide. Extreme wildlife losses have recently been documented for large parts of Africa, including western, Central and Eastern Africa. For the last 30 years Turkana County has experienced massive loss of its biodiversity. The declines occur both inside and outside protected areas and have been variously attributed to rapid human population growth, land use and cover changes, infrastructural development, poaching for bushmeat, climate change and variability, outbreaks of infectious diseases, proliferation of firearms, weak law enforcement, poor governance, competition with livestock for space, water and pasture, poverty and inequality (Ogutu et al., 2016).

In such for food, animals like dikdiks have been severely hunted down for food endangering their future existence. Forests are also shrinking at a very high rate because of unsustainable cutting of trees, overgrazing and charcoal burning. Due to prolonged droughts as a result of global warming, vegetation cover is drastically reducing affecting the habitats of various wildlife. For instance, birds' population has reduced in the last 30 years due to degradation of their habitats (UNEP-WCMC, 2012).

Over time, global warming effects has resulted in the shrinking of lakes and rivers leading to extinction of some aquatic species and reduced populations of others. For example, 11 species of fish in lake Turkana are reported to be endemic due to the effects of climate change for the last 30 years.

According to historic data the lake supported the world's largest colony of Nile crocodiles but recent observations suggest the crocodile population is a fraction of previous size due to increasing anthropogenic activities and effects of climate change (EAWLS, 2014). There has been a drastic decrease and even extinction of some rare animals like hippopotamus, wild dogs, lion, cheetah, reticulated giraffe, grevy's zebra and Lewel hartebeest (UNEPWCMC, 2012).

4.5 Challenges facing Biodiversity

The recorded challenges affecting the County's biodiversity are a result of both anthropogenic activities and climate change. These challenges include:

- ✓ Climate change has led to prolonged droughts that have affected vegetation growth and water availability in the area and indirectly affecting the lifeforms depending on the vegetation for food and shelter.
- ✓ High population increase in the region has led to destruction of vegetation as they create space for settlement as well land for cultivation.
- ✓ Overgrazing- Due to prolonged droughts the scarce vegetation is overstrained by the high animal population in the region.
- ✓ Deforestation and charcoal burning- There are high cases of illegal charcoal burning in the region endangering the indigenous forests in the area.
- ✓ Reduced inflows in the lakes and rivers- Due to the erection of Dams along the rivers e.g. the Omo River which accounts for about 90% of the lakes inflow has led to the shrinking of Lake Turkana affecting the fish and other aquatic biodiversity.
- ✓ Information from 2012 suggests that crocodiles are heavily persecuted by fishermen who destroy nesting sites, including those on South and Central Islands.

- ✓ Poaching- Although the wildlife resources in national parks are protected by law, the protection means are ineffective with little control over poaching and livestock and fishing encroachments into the parks.
- ✓ Infrastructural development- Oil exploration across the Lake Turkana basin and Infrastructural development across the County poses a great threat to the local biodiversity.
- ✓ Emergence of invasive plants- *Prosopis juliflora* in the County has massively spread along the riverine areas smothering the local indigenous tree species.

4.6 Need for Conservation/Protection

There is great need to conserve the County's environment for the future sustainability of its biodiversity. Due to the climatic conditions of the area, there are scarce and rare vegetation which support a wide array of the regions life forms. The existing environmental protection acts and legislation should be strengthened and well implemented to save the regions biodiversity from extinction. There is need to protected the fishing areas and conserve the fish stocks from overexploitation and encroachment by invasive species. Conservation of Water resources; with oil exploration and infrastructural development in the region the few water sources might be overstrained due the increased demand.

4.7 Areas of Research

- ✓ There is need to carry out census research for the exact value trend of the County's biodiversity (Fauna and Flora). This will help in quantifying the environmental effect on local biodiversity and to enable for coming up with the best management mechanism.
- ✓ Control of *Prosopis juliflora*. There is need for research to come up with the best control strategy to manage Prosopis spread as it is reducing the indigenous plant diversity and even encroaching the water bodies affecting the aquatic diversity.

4.8 Biodiversity Conservation Hotspots in Turkana

Some of the biodiversity conservation hotspots in Turkana include; Lake Turkana, Loima Forest Reserve, Lotikipi National Reserve, River Turkwel, River Kerio, River Tarach, Lorionotom and

Lokwanamor ranges, Mogila hills, Lake Lokipi, Kapedo waterfall, Kailongkol and Songot ranges, and various springs such as Eliye and others.

4.8.1 Threats to Biodiversity

Land degradation due to drought, floods, invasive/alien species, population growth, habitat fragmentation, over exploitation, climate change, River Omo damming etc. Plants and animals which are under threat in Turkana include sandalwood (*Osyris lanceolata*), Acacia spp, Aloe spp, medicinal plants, pastures, elephants, zebra, ostrich, crocodiles and fish.

4.9 Turkana County Government Initiatives to Conserve Biodiversity

Turkana County Government contribution towards protection and conservation of biodiversity are notable.

- The County Government of Turkana has a gazzetted Turkana County Environment Committee whose mandate is ensure that there is proper management of the Environment.
- Turkana County Government has established 30 tree nurseries for seedlings production
- Turkana County Government has gazzetted Loima forest as a community forest
- Turkana County Government is in the process of Gazzetting Songot as a Community Forest.
- Turkana County Government together with Kenya Wildlife Service is in the process of Gazzetting Lotikipi as a National Reserve.
- Distributed and planted over 2,517,070 tree seedlings since 2013
- Turkana County Government has developed a climate change action plan.
- County Environment Bill, Natural Resources management bill and Climate change legal framework will soon be subjected to public participation and be enacted.
- All County Projects are subjected to Environmental Impact Assessments
- Turkana County Government has recruited 63 wildlife and forest rangers to support conservation initiatives
- Turkana County Government through Director General NEMA, Gazzetted 12 Environment Inspectors who are enforcing environmental laws in Turkana County.

4.9.1 Mitigation Actions

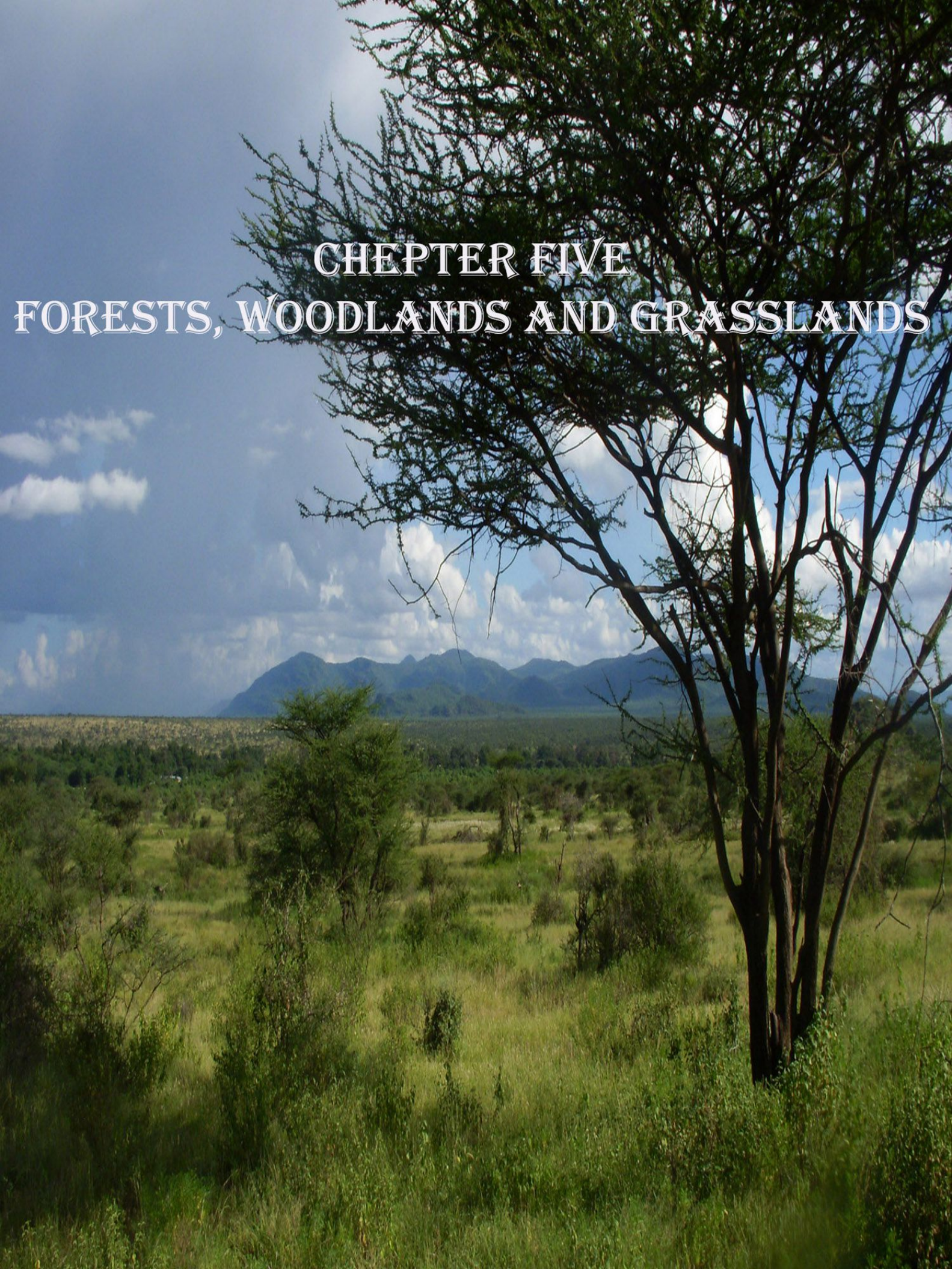
They are shown in Table 9 below.

Table 9: Mitigation Measures to control the challenges on Biodiversity

Biodiversity issue	Contribution to economy	Impact on the environment	Mitigation measures	Responsible agency	Cost in Ksh Million/5yrs
1. Continued illegal harvesting of indigenous plant species and products. ***-Aloe turkanensis*** an aloe species most sought by bio-prospectors. It is listed as endangered by CITEs under Appendix 11(This entails for one to be licensed by KWS/CITEs to trade with aloe products, there must be prove of established plantations or got from sustainably managed plantations(registered AMU)	-A positive contribution on per capita income to that area but the current contribution is statistically insignificant but has a big potential when the sub-sector is regulated by the county and to empower the locals take over the aloe business value chain and export trade. -If only the county collaborate with KEFRI to undertake aloe resource mapping to be able to zero in on the species quantities and where is found to plan splitting of its suckers and start of individual private plantations. -The current quantities of aloe turkanensis in the wild are a very important resource planting material for the county to take off in 2-3yrs as a major exporter of aloe-gum, a product with an exceptionally huge market in China, Pakistan and USA. - If well tapped put together with gum-Arabica can turn around lives and economy of many pastoralist turkana.	-They occupy a very delicate niche on the hills and as understory in acacia species zone -Its continued exploitation accelerates soil erosion and fast siltation of dams. .Loss of medicinal benefit drawn from the aloe plant. -Loss of other important bio-diversity associated with the species and niche.	- Promote aggressive community domestication campaigns through provision of incentives and formation and training of LEC/VIE to be empowered to co-ordinate work on the ground. -Create awareness on conservation and sustainable harvesting techniques -Establishment of Aloe Management Units(AMU) guidelines and bye laws in all areas where aloes are found in community land. -Stakeholders to initiate strategies to support individual initiative conservation and propagation.	KWS, KEFRI, KFS, CBOs, NGOs, County Department of Environment, Natural Resources, TCEC, NEMA, PARTNERS	75M
2.*Prosopis juliflora*(*Mathenge or etirai* It has invaded riverine, grazing lands and dry lands	-Mitigates effect of climate change (acts as carbon sink) and the local community benefit from carbon trading compensation co-ordinated by FAO. -Since they grow on very dry and harsh environments where other species can't grow, it has ensured	-There are both positive and negative effects on environment but KEFRI and other partners have initiated several pilot studies since 2002 to minimize the	-Enhance community trainings and awareness on maximum utilization (certify use of prosopis charcoal, formulation livestock feed by use of prosopis pods(flour) as a main component)	KWS, KEFRI, KFS, CBOs, NGOs, County Department of Environment, Natural Resources, TCEC, NEMA, PARTNERS	30 million Per /yr for all the 7 Sub-Counties. -To allocate more funds

	sufficiency in fodder for livestock and food for humans,fuelwood and timber. -A big contribution to the county and national economy through sale of charcoal,firewood, posts,fodder from pods. -Minimal tax on these products will be a driving force in other sectors. -KEFRI has projected that Turkana alone has a pod production potential of 100,000 tons/per month if collection is well organized and co-rdinated and that in itself accrues about 400million/month paid to collectors assuming a 25kg bag costs a conservative Ksh 100	negative effects through development of elaborate product value chain as a resource and have proved that the negative effects can be reduced substantially. -It has made the once fragile and semi-arid area habitable (new livelihood villages cropping up deep inside in prosopis thickets in -Lokangae location) -- Prosopis species contributes to enrichment of soils through nitrogen fixation	-Enforce use of prosopis firewood in all the refugee camps -KEFRI to enhance research in development of new products from prosopis that increases the benefits to a pastoralist. -The county government to initiate a rewarding system for those who start field schools.		to Turkana West (Lokangae, Morungole and Letea),Turkana South(Katilu and surrounding) and Central(Nadapal, Kalokol and Lodwar Town),these are the areas with highest *Prosopis* populations.
3. Encroachment on National parks(Turkana South National Reserve, Sibiloi South and Central)	Tourism is one of the 3 sectors mainly depended by the County's Economy	Overgrazing, poaching, reduction of water resources	Strengthening policies to control poaching of the animals, daming of lake inflows. maintaining carrying capacity.	KWS, KFS, KEFRI, TCG, NEMA, Partners, TCEC	58M
4.Lake Turkana biodiversity (fishes, frogs and turtles)-Reduction in fish population and fishing grounds	Fishing contributes to 5% of Turkana County's GDP and supports over 500000 people	Overharvesting of fish especially the endemic species Reduction of water volumes and increasing salinity. Encroachment by invasive species e.g.	Strengthening the policy's formulated to control from overfishing. The government with the Ethiopian Government should fasten the process on the agreement to equally share the water of	KWS Ministry of fisheries (National Level) County Department of Fisheries, County	100M

		Prosopis.	Omo river. Control of *Prosopis* invasion	Department of Environment	
5. Unsustainable charcoal burning (threatens indigenous species)	-80% of urban Households uses charcoal for cooking. This is an indicator on the importance of charcoal in the day to day life of many Kenyans hence a driving force in the economy.	Over-exploitation of indigenous spp,(*Acacia tortilis, Salvadora persica, Acacia oleifera*) desertification, soil erosion, loss of biodiversity.	-Initiate consultation on development of guidelines on sustainable harvesting of fuelwood from acacia tortilis and other acacias in charcoal production. Proper legal framework, formation of charcoal associations. Advocate for alternative sources of livelihood. Use of only *Prosopis* to produce charcoal	KFS, KEFRI, NEMA County Government, County Environment Committee	115M
6. Infrastructural Development and Oil exploration	Employment creation, income from exports, development of other industries.	Clearing of land for exploration, interfere with biodiversity in the lake and at the national parks.	Strengthen legal policy on the mining act CAP 306	Oil Company, NEMA, Turkana County Government, TCEC	10M
7. Habitat destruction		Loss of Biodiversity • Siltation • Erosion	Proper policy and enforcement • Habitat restoration • Education and awareness • Creation of sanctuaries, wildlife corridors etc.	KFS, KEFRI, NEMA County Government, County Environment Committee	50M



CHEPTER FIVE
FORESTS, WOODLANDS AND GRASSLANDS

CHAPTER 5
FORESTS, WOODLANDS AND GRASSLANDS

5.1 Status, Trends of Forests, Woodlands and Grasslands

Forests which are an integral part of biodiversity rank high as some of the most important national assets in terms of economic, cultural and social values. It is estimated that the forest sector contributes about KES 10 Billion to the economy and employs over 50,000 people directly and about 300,000 indirectly. More than 530,000 households living within a radius of 5 km from the forest reserves depend on forests for cultivating, grazing, fishing, fuel wood, honey, herbal medicines, water and other benefits. Sustainable supply of raw materials to the wood industry has been found crucial to protection and conservation of natural forests. The natural forests also act as carbon sinks as well as offering water catchment and biodiversity conservation functions.

Forest types in Turkana can be categorized as:

- Montane forest as in Loima and Lokwamoor in Kibish.
- Dry land forest comprising acacia woodland.
- Riverine forest along the rivers.
- Prosopis Woodlands mainly dominant in Turkana West and Lotikipi.

Forest cover in the Turkana County stood at 4.06 % in 2015. This may be attributed to the invasive nature of *Prosopis Juliflora*. The cover is less than the recommended threshold of 10%. Status and trend for the past 30 years can be obtained from satellite images available at the Regional Centre for Resource Surveys and Mapping for Development at Kasarani, Nairobi. There exist forests in high altitude ranges or mountain (montane forests) and along river courses (riverine forests). Forests known to exist can be found on Loima hills, Mogila hills, Songot hills, Pelekech Hills, Lorionotum, and Lokanamur (Turkana County Resource Mapping, 2015).

The dominant tree species in the area are; *Aristida mutabilis*, *Acacia mellifera, Acacia tortilis*, *Acacia reficienns, Ziziphus mucronata, Juniperas procera* (Aminit), *Olea europea*, *Olea capeusi, Teclea nobilis, and Podocapus falcatus*.

The woodlands are dominated by by *Aristida mutabilis, Mallugo cerviana and Jatropha villosa* while the grasslands are mainly dominated by *Digitaria milanjiana, Panicum maximum, Sporobolus conjinis* and *Echinochloa haploclada.*

The forests, woodland and grassland sizes have been reducing over time due to the effects of climate change which has resulted to prolonged droughts in the region.

The forests are also under threat because of illegal deforestation for charcoal burning and timber harvesting. Infrastructural development and oil exploration in the region is also threatening the existence of some forests in the region.

Currently there is a fast spread on invasive *Prosopis juliflora* colonizing mainly the riverine regions.

5.2 Challenges facing forestry in Turkana County

i. *Hyphaene coriacea (*Doum palm) at Kalokol is the main source of fuel for smoking fish. The existence of species is threatened because of indiscriminate use of its seed from trees leaving none for succession.

ii. Invasive nature of Prosopis and its threat to existence of other indigenous species.

iii. No zonation for charcoal burning areas though an important source of livelihood.

iv. Non gazzetement of forests on hill tops.

v. No ecosystem management plans.

5.3 Need for Conservation and Protection.

- Population growth and upcoming urbanization.
- Global warming and loss of carbon sinks.
- Posterity and intergenerational equity.
- Food security and survival of species including mankind – the food chain phenomenon.
- Plant biodiversity is the source of traditional and classic medicine.

- Land degradation and soil erosion.

5.5 Areas of research

a) Agro forestry with emphasis on Silvipastoral systems (fodder trees integrated with livestock), Arboriculture (indigenous food and fruit trees) and Agro Silvipastoral systems (integration of food crops, livestock and trees on farms).

b) Establishment of date palm plantations

c) Farm forestry.

d) Plantation forestry in the dry lands.

e) Systematics - (identification and documentation of tree species and their uses).

f) Documentation of indigenous trees knowledge.

g) Management of *Prosopis Juliflora.*

h) Market research for charcoal and Non Wood Forest Products.

i) Propagation of dry land bamboo species.

j) Aqua Forestry (integration of fodder trees and fish ponds)

k) Apiculture (bee keeping).

5.6 Uses of Forest Produce in Turkana

- ❖ Source of wood fuel- According to D'Aietti et al. (2019) Over 96% of the households in Turkana county get collect firewood from the forests and shrublands. Refugee camps like Kakuma hugely depend on firewood as fuel.
- ❖ Pasture for livestock- Over 85% of Turkana residents are pastoralist and they depend on the forests, woodlands and grasslands for pasture for their animals.
- ❖ Raw materials for construction- Most of the locals are pastoralist who don't have permanent houses and the depend on wood from the forests to prepare makeshift structures.

- ❖ Charcoal burning- Most of the charcoal produced in Turkana County are mainly sourced from the forests and woodlands.
- ❖ Habitats for wildlife- Most of the game reserves in Turkana County are located in the forested areas and the grasslands.
- ❖ Weaving and Basketry- Individuals producing mats, baskets and even chairs depend on the raw materials from the forest and the grasslands.
- ❖ Apiculture- Most bee farmers in the region do it in the forested areas.

5.7 Indigenous Knowledge in Forest and woodlands conservation

According to Stave et al. (2007) community-based conservation is key in managing and restoration of the forest vegetation in the region.

Generally, this people-centred approach holds that local participation is a prerequisite for sustainable conservation and management of natural resources. The promotion of community-based conservation has been accompanied by, and largely based upon, a raised awareness and

appreciation of traditional ecological knowledge (TEK).

Turkana locals have indigenous knowledge on forest conservation. For centuries they have been protecting the forests and grasslands for as it serves as the main source of pasture for their animals as well as other economic livelihoods.

The observed forest degradation in the near future is due to the impacts of climate change that has reduced the potential of pastoralism pushing others to look for alternative means of survival unfortunately charcoal burning is one opted for by many (Turkana County CIDP II, 2018-2022).

5.8 Other livelihood options

The main economic livelihood in Turkana County are pastoralism, fishing and agriculture.

The county also has a potential of other economic livelihoods like

1. Poultry farming- Due to recurrent droughts and consequential malnutrition in the region, FAO and National government introduced poultry farming programme. Twenty thousand chicks with improved genetics were introduced to the area (FAO 2015). The chickens

now form an important part of people's diets and they are becoming an essential component of local livelihoods. Women are empowered as they are provided with an additional source of income and therefore social and economic independence (FAO 2015).

2. Apiculture- Bee keeping has a high economic potential in Turkana County, however it remains underexploited. There are an estimated 6,921 beehives in the county producing an average of eight litres of honey each that translates to approximately KSh14 million. Honey production is predominantly for subsistence use. Other side products like pollen, beeswax propolis, royal jelly and bee venom production are currently not fully exploited.
3. Butterfly farming- Butterfly farming has improved the local eco-tourism and conservation education, and has led to better involvement of the local community in managing and conserving forest resources.

5.9 Threatened Species

Due the effect of climate change and human activities some plant species in Turkana County are endangered are at the verge extinction.

Some of the species that have been classified as threatened in the area include:

1. **Doum Palm -** Found mainly around lakeshores and riparian areas. These areas are hugely populated settlements leading to degradation mainly through;
   - ❖ Building materials for housing and rafter construction for fishing.
   - ❖ Fish smoking by use of both wood and seeds of doum palm that is supposed to regenerate.
2. ***Aloe turkanensis*-** Illegal and uncontrolled harvesting of Aloe. After harvesting, the Aloe species are then extracted for its juice which is then sold in the `black market´.
3. ***Acacia Senegal:*** The species is highly valued by some of the community living around Loiyangalani forproduction of gum Arabica.
4. **Bosilia Species:** The Bosilia species and in particular the Malala-doomberger is of economic importance in the making of traditional baskets.

5. ***Acacia Totillis:*** The tree is highly regarded by members of the local community as an indicator of presence of ground water (deduced from the lining pattern).
6. ***Ficus* Species**: These trees produce fruits that eaten by wild animals and provide a perpetual habitat for some animals.
7. **Sandal wood:** The tree is of high economic value, although mainly for illegal trade.

5.10 Environmental challenges facing forests, woodlands and grasslands

The major threats and challenges forest conservation in Turkana County include

- Prolonged droughts- which render some species extinct due to lack of water.
- Unsustainable cutting of trees for charcoal burning as there are no sufficient economic livelihoods to pastoralism which is greatly affected by prolonged droughts in the region.
- Overgrazing- Due to the impacts of climate change, the scarce vegetation cannot sustain the huge animal population.
- Industrialization and infrastructural development in the area has led to clearing of the forests to pave way for construction.
- Emergence of invasive species e.g. *Prosopis juliflora* which is displacing the indigenous species because of its allelophatic effects.
- Forest encroachment
- Weak institutional linkages
- CFA's capacity and institutional strengthening in conservation and management issues.
- Forest fires- infrastructure/ equipment and capacity to suppress fires.
- Control, regulatory frame work and exploitation of forest resources within non-gazzetted forest areas
- Rehabilitation of degraded areas against a skeptical regeneration
- Politics of conservation on issues of ownership, utilization and access of forest resources
- CFA internal conflicts and lack of commitment towards fulfilling their mandates
- Low funding levels among others
- Shifting cultivation is still being practiced in county thus opening up closed vegetation in sloppy and hilly areas- erosions becomes eminent

- ❖ Habitat Loss
- ❖ Invasive species
- ❖ Population increase
- ❖ Pollution
- ❖ Over-consumption or unsustainable use

5.11 Actions to increase forest cover.

a. Promotion of agro-forestry

b. Rehabilitation of degraded areas (outside state forests)-mostly on public land.

c. Establishment of farm forest field schools to educate farmers on best practices. Setting up farm demo plots, tree planting in schools as a way of boosting sufficiency.

d. Enhancing afforestation in other parts of the county and also reafforestation to areas that has experience deforestation.

e. Increase industrial forest cover

5.12 Mitigation Actions

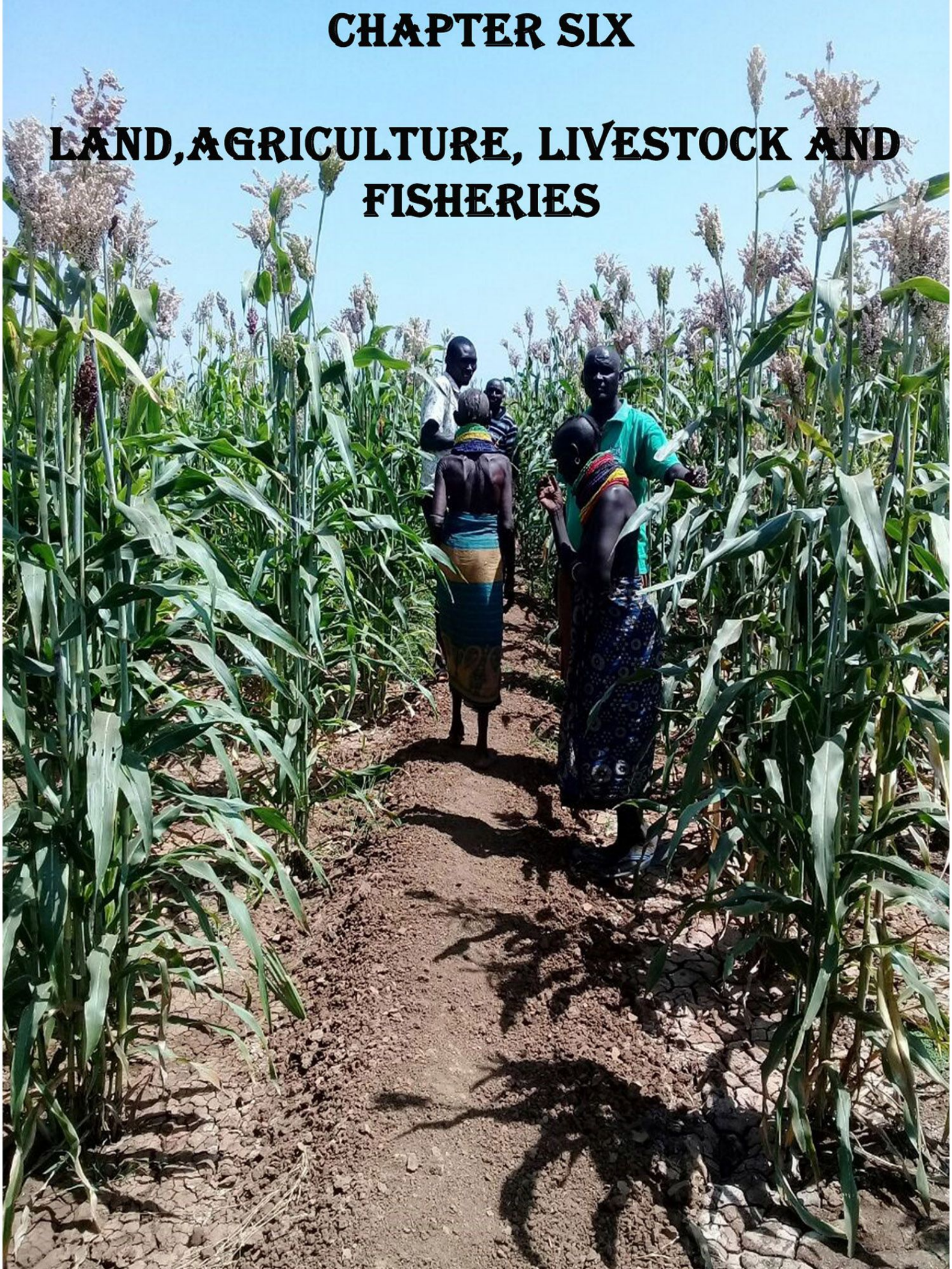
Some of the proposed mitigation measures to the challenges of forest and woodlands conservation are as shown in table 10 below.

Table 10: illustration of forest, woodland &grass land issues and proposed mitigation measures

Biodiversity Issue	Contribution to the economy KES Per Annum	Impact on the environment	Mitigation Issues	Responsible agency	Cost KES (Million)
Invasive nature of *Prosopis Juliflora*	No data	Displacement of other indigenous species	Implementation of documented research interventions and capacity building	TCG KEFRI, TCEC, KFS,NEMA, Partners	150M
Unsustainable charcoal burning	1.5	Drought, desertification and extinction of species	Area zonation, formation of charcoal user groups, CFAs and capacity building	TCG, KFS, KEFRI, NEMA, Partners	50M
Logging	6 million	-Reduced vegetation cover.	Licensing,	KFS, KWS, County, Partners, NGOs	15M
Opening up of woodlands for agricultural use	No data	Degradation and soil erosion	Encourage agroforestry	KFS, KWS, County, Partners, NGOs	20M
Depletion *Hyphaene coriacea* (Doum palm) trees	No data	Degradation of riverine and lake shore ecosystem	Restoration by planting and capacity building of the fishing community	TCG, KFS, KEFRI, NEMA, TCEC, Partners	20M
Indiscriminate tree felling and harvesting	No data	Environmental degradation and biodiversity loss	Reforestation, formation of CFAs and community scouts, capacity building and policing	TCG, KFS, KEFRI, NEMA, TCEC, Partners	50M
Lack of dry land plantations	No data	Pressure on indigenous trees and depletion of the same	Research, site Identification, community sensitization and reforestation	TCG, KFS, KEFRI, , TCEC, Partners	70M
Shortage of indigenous tree seed due to poor seeding	No data	Limited recruitment and succession of trees leading to loss of species and desertification	Establish indigenous seed stands and seed orchards	TCG, KFS. KEFRI, TCEC, Partners	10M
Unsustainable harvesting of *Aloe turkanensis*	No data	Environmental pollution and depletion of the species	Licensing, regulation of the trade, Aloe restoration mechanisms, and capacity building	TCG,NEMA, KFS, KEFRI, , TCEC, Partners	25M
Forest encroachment	No data	Degradation and reduced forest cover	Demarcation and gazettement	TCG,NEMA, KFS, TCEC, Partners	20M
Overgrazing	No data	Degradation of the vegetation cover in the forests and woodlands	Advising the pastoral communities on the importance to reduce their herd size. Training the locals on the need to diversify to other potential economic livelihoods e.g. Apiculture. -20 baraza for Awareness creation per yr. Enforcement of by-laws	KEFRI, KFS County departments of Forestry and Environment, TCEC, Partners	70M
Infrastructural development	No data	Destruction of forests to create room for development	Stringent measures should be put in place to take care of the forest resource despite the need of infrastructural development.	KEFRI, KFS County departments of Forestry and Environment	150M

CHAPTER SIX

LAND,AGRICULTURE, LIVESTOCK AND FISHERIES



CHAPTER 6
LAND, AGRICULTURE, LIVESTOCK AND FISHERIES

6.1 Land

Turkana County is the second largest of 47 counties in the Republic of Kenya, covering 71,597.6 km^2 and accounting for 13.5% of the total land area in the country. The county is purely classified as arid and semi-arid with few rivers e.g. River Turkwel and Kerio flowing through its soils. The county also has lake Turkana on its land.

6.1.1 Land Use and Types

Because the vast land is arid, the main economic activities that it can support are pastoralism and fishing in lake Turkana. Food production is also taking stage under irrigation along the riverine areas.

Parts of the lands have been protected to for as forested areas to conserve the indigenous vegetation and to also serve as game reserves to attract tourist in the region. For instance, Sibiloi National Park and Lotiki National Game Reserve have been gazetted as protected areas.

This vast land in the northwest of Kenya is an awakening economic giant, for beneath its surface lie huge oil deposits that are currently being explored and will see extraction in an industrial scale during the years to come.

On its land, the County also boast of plenty of wind, sun, flowing water and underground steam for geothermal power which could make it literally a powerhouse in sustainable energies.

6.1.2 Land ownership and Tenure systems

In Turkana County, like in most pastoralist areas in the country, land is owned communally. In this set up, communal land ownership is bestowed upon county councils under the Trust Land Act (Cap 288). This form of ownership ensures equitable distribution of resources for the community members who principally need the land for grazing their animals. The members of the community don't have documents for individual parcels of land except in urban areas where they are given allotment letters as proof that they are occupying the land legitimately.

6.1.3 Land conservation and protection

Turkana County has vast and beautiful land that would be very useful for community owned and managed conservancies, with the attendant benefits of conserving environment, wildlife and indeed supporting tourism. Like Sibiloi National Park and Lotikipi National game reserve which have been gazetted under protected lands, other areas like Loima forests, Mogila forest, Songot forest, Pelekech forest, Lorionotom forest, Lokwanamor forest and other forested areas in the County should be gazetted for protection as they are under threat due to illegal charcoal burning.

6.1.4 Land Use and Impacts on environment

- Soil erosion- Majority of the Turkana residents practice nomadic pastoralism where they keep huge herds of animals which affect vegetation cover exposing the lands to agents of erosion.
- Deforestation- The locals use trees to prepare makeshift houses and cattle structures as they move around with their animals.
- Water pollution- Those who are doing agricultural food production along the rivers release toxic agrochemical effluents into the waters affecting the water quality for aquatic animals and domestic use downstream. Those who do fishing using motor boats sometimes cause oil spillage in the waters.
- Soil and Air pollution- With the exploration of oil in the region, there is a lot of environmental pollution taking place as fumes from the oil mining industries are released to the atmosphere while oil spillage also pollute the soils.
- Degradation of land- After the mining activities most of the land are left derelict bringing more environmental effects

6.2 Agriculture

Agricultural production is dominated by cereals. Households generally consume crops produced and sell the surplus for cash. Subsistence farmers grow sorghum, maize, cowpeas and green grams. Other crops include date palm, mangoes, local vegetables, kales, spinach, bananas and tomatoes. Crop production is restricted by the availability of water, soil nutrients, skilled labour,

pests and diseases. The agricultural sector is often limited by poor transport, communication, storage and processing infrastructure (Turkana County Government 2015). Food is imported from Kitale and Uasin Gishu counties, since most pastoralists do not practice crop farming. Turkana has around 2.5 million hectares of arable land. Turkana's soil is poorly developed due to its aridity and constant erosion by flood, water and wind. A stony layer often caps the soil, making agriculture difficult. Only about 30% of the County's soil can be rated as moderately suitable for agricultural production. In 2017, the County Agriculture Directorate reported a total of almost 7,245 ha under food crops, with 5,788 ha during the long rains and 1,457 ha under crops during the short rains. This produces almost 4,000 metric tons of food, with an estimated value of just under KSh400 million. Most of the County's irrigation schemes — and consequently its most productive farm lands — are established along the banks of the Tarach, Kerio, Malimalite and Turkwel rivers. Moderately fertile soils are found in the central plains of Lorengippi, upper Loima and the lowlands of Turkwel, Nakaton and Kawalathe drainage, along the lake at Todonyang plains, the lower Kalokol and Turkwel-Kerio River, and a portion of Loriu plateaus.

The County has over 51 irrigation schemes utilizing surface, spate and drip irrigation technologies, most of which are river-based. The schemes are not operating at optimum levels because of security, technical, infrastructural, and financial resource challenges. The largest irrigation scheme is Katilu irrigation scheme covering an estimate of 1,215 ha (GIZ, 2014). The schemes were developed in partnership with the national government through the National Irrigation Board and development partners such as World Vision Kenya, Catholic Diocese of Lodwar, WFP, NDMA/UNDP, FAO, Kenya Red Cross Society, FID, and Child Fund Kenya. A small number of irrigation schemes have been started by farmers on their own, either individually or in small groups. These small-scale irrigation schemes have significantly alleviated poverty and increased food security in the region, whilst also improving environmental conservation (FAO 2015). Just over a quarter of the conventional schemes are found in Loima but the majority of non-conventional schemes are in Turkana Central (GIZ, 2014). The total land under irrigation is approximately 7,087 ha directly benefiting over 32,000 households. This is against a potential of 37,500 ha for the county (Oduor et al 2012).

6.2.1 Land Productivity in relation to crops grown

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The main crops grown in the irrigation schemes in Turkana are maize and sorghum. Most are grown on subsistence farms measuring on average 0.2 ha. Turkana farmers grow maize, sorghum, millet, cow peas, and green grams. The main horticultural crops are vegetables, paw paws, watermelon and mangoes. Dates, guavas, grapes, lemons, oranges and bananas have also been tried in the County with some success.

6.2.2 Agricultural practices and impacts on environment

Most of the agricultural practices taking place in Turkana county occur under irrigation with very few depending on rain fed agriculture. These agricultural practices have been associated with various environment impacts e.g:

Mono-cropping

- ✓ Leads to build up of diseases and pests
- ✓ Buildup of such diseases and pests encourages use of chemicals to combat them hence environmental pollution

- ✓ Mono-cropping also encourages excessive uptake of macro-nutrients and thus encourages invasive plants like striga weed

Irrigated agriculture

- ✓ Over-irrigation or over-flooding of irrigation fields without proper drainage system in place leads to salinity of the soils.
- ✓ Stagnant water in the irrigated field is also a breeding place for mosquitoes and if the water is not well drained it can encourage spread of bilharzia.

Shifting Cultivation

- ✓ This type of farming is done by farmers growing finger millet.
- ✓ The farmers burn the vegetation before preparing the land. This encourages clearing of vegetation and charcoal burning and destroys biodiversity.

Farming on steep slopes

- ✓ Farming on hilly land continuously every year, can inadvertently cause severe erosion.
- ✓ If farming is done on the same land using contour methods or minimum tillage methods, erosion can be reduced.
- ✓ Erosion leads to movement of sediments into waterways. Sediments are by far the largest polluter of water bodies. (SILTATION OF WATER BODIES)
- ✓ Clearing of land on steep slopes for cultivation leads also to landslides which can result into death and destruction of property.
- ✓ Land clearing (e.g., deforestation) often cut down and burn all vegetation, causing emission of large amounts of smoke, CO2, particles, and other air pollutants. Air pollution can also be caused when crop residues are burned after harvesting.
- ✓ Also exposes soil to erosion
- ✓ Destroys the carbon sink.

6.2.3 Agricultural input usage and impact to environment

- ✓ Excessive fertilizer and pesticide application are washed off into rivers, lakes, and groundwater, causing polluted and unhealthy (or toxic) water.

- ✓ Excessive N and P application can be washed off into water bodies to cause eutrophication which can lead to death of fish.
- ✓ Use of herbicides and pesticides which can again work their way into the food chain and build up, harming larger animals (DDT use and osprey in Scotland is a good example of this). This has also been blamed for the decline in bee populations, which are useful pollinators and are an ecosystem service which it is difficult to put a value on, but have been estimated at hundreds of billions of euros annually around the world.

6.2.4 Management of Agricultural Waste

- ✓ Many farmers in the county don't recycle agricultural waste-composting is minimally done by farmers
- ✓ Wastes from the farm like crop residue are mainly burnt by farmers rather than composting it.

6.2.5 Mitigation Measures to the Impacts of Agricultural Practices On Environment

- ❖ **Integrated pest management**: Integrated pest management a combination pest control technique for identifying and observing pests in the initial stages. One needs to also realize that not all pests are harmful and therefore it makes more sense to let them co-exist with the crop than spend money eliminating them. Targeted spraying works best when one need to remove specific pests only. This not only helps you to spray pest on the selected areas but will also protect wildlife from getting affected.
- ❖ **Crop Rotation**: Crop rotation is a tried and tested method used since ancient farming practices proven to keep the soil healthy and nutritious. Crop rotation has a logical explanation to it – the crops are picked in a pattern so that the crops planted this season replenish the nutrients and salts from the soil that were absorbed by the previous crop cycle. For example, row crops are planted after grains in order to balance the used nutrients.
- ❖ **Natural Pest Eliminators**: Bats, birds, insects etc work as natural pest eliminators. Farmers build shelter to keep these eliminators close. Ladybugs, beetles, green lacewing larvae and fly parasites all feed on pests, including aphids, mites and pest

flies. These pest eliminators are available in bulk from pest control stores or farming supply shops. Farmers can buy and release them on or around the crops and let them make the farm as their home.

- **Conservation Agriculture**; Minimum tillage, zero tillage, Mulching, cover crop and Mixed farming.
- **Put in placed soil and water conservation structure**; Terracing, Grass strips, Use of trash, leaving un ploughed strips, Stones, Control of gully erosion, avoiding to farm on very steep lands

6.2.6 Appropriate Production System to Increase Income Per Unit Land Area.

- ✓ Embracing value chain practices ensuring that wastes (bye-products) are recycled back to the farm
- ✓ Adding value to the produce of the farm throughout the whole value chain
- ✓ Mechanization of farm practice will enhance production
- ✓ Making use of the appropriate agronomic practice

Table 11: Illustration of Agricultural practices and their impact on environment

Agricultural Practice	Impacts on the environment	Mitigation measures (action to be taken)	Responsible agency	Cost Kshs/Yr
Mono cropping (maize)	- Soil nutrient depletion	- Intercropping - Diversification - Crop rotation	Department of Agriculture, Land Reclamation, Groups, Private Sectors	30M
Inappropriate land Preparation	- Destruction of soil Structure and beneficial Micro-organisms - Soil erosion - Destruction of natural vegetation	- Stop burning as a land preparation tool. - Training of private tractor on ploughing. - Sensitization and training of farmers on good land preparation.	Department of Agriculture, NGOs, FBOs, Partners, Farmers, NEMA, Environment, A.M.S. A.T.D.C.	15M
Inappropriate use of pesticides and fertilizers for crop production	- Land and water pollution. - Health hazard. - Destruction of beneficial insects.	- Training of farmers and input suppliers on safe use and disposal of agro- chemicals.	Department of Agriculture, NGOs, FBOs, Partners, Farmers, NEMA, Environment	20M
Irrigation Farming	- Buildup of salinity in soils - Soil erosion - Water over abstraction - Water pollution - Deforestation - Loss of biodiversity	- Addition of Gypsum to lower the soil PH. - Construction of soil conservation terraces - Trainings on proper tillage - Promotion of efficient water use - Proper and precision use of inorganic fertilizers and other agro-chemicals - Trainings on Agro-forestry - Promotion of integrated pest management, Promotion of agroforestry - Biodiversity conservation	Ministry of agriculture, Ministry of Environment, WARMA, Ministry of environment, Kefri, ministry of Environment, KWS, Natural Resources	300M
Poor post-harvest handling	- Health hazard. - Loss of income.	- Training and sensitization of farmers on appropriate post-Harvest handling practices, - Regular surveillance on all Agricultural produce.	Department of Agriculture	10M

Poor marketing structures.	- Environmental pollution by perishable Agricultural produce due to market flooding.	- Training of farmers on Value addition and processing. - Formation of produce organizations.	Department of Agriculture	15M

6.3 Livestock and Fisheries

6.3.1 Livestock

Turkana County is well known for pastoralism as majority of the population keep livestock. Livestock in Turkana include goats and sheep, cows, camels, donkeys and poultry (mainly chicken) and pigs. Most of the breeds are indigenous. Products from livestock include milk, beef, mutton, donkey meat, hides and skins, bones, hooves, eggs and poultry meat. The quantities produced annually are: milk 10 million L, beef 286 million kg, mutton 162 million kg, poultry meat 363 115.5 kg and 3 million eggs. The values of these products are estimated at: KSh165 million, KSh172 million, KSh130 million, KSh24 million and KSh45 million respectively (Turkana County CIDP II, 2018-2022). There are 21 private stakeholders participating in the livestock value chain. The main livestock facilities are: two abattoirs, size class C, 34 operational livestock marketing facilities and one tannery. There are 22 hides and skins licensed traders. (Turkana County CIDP II, 2018-2022).

Since land is communally held, there are no livestock ranches. However, there are pasture enclosures and designated wet and dry season grazing areas. The pasture enclosures are situated in Natira, Lomunyenakirionok, Kalobeyei, Nawontos, Nakabosan, Kaemuse, Kalemng'orok, Kotela, Ng'imuria and Lokipoto. The County has one holding ground at Lomidat Abattoir in Turkana West Sub-county. Napeililim holding ground in Loima Sub-county is under construction. There is a need for rangeland mapping to enable the county to establish the potential of these resources in meeting pastoralists' grazing needs and to develop strategies to fill any identified gaps. A key strategy for rangeland management is to further develop or re-invigorate rangeland management structures for ensuring livestock are managed in a way that continues to restore land and ecosystem function and grass production. It has been recommended that fast growing and hardy grass species be introduced for pasture (e.g. Cenchrus ciliaris). To effectively manage the rangelands, adequate water sources for livestock must be created. This can be done through creation of rock catchments, sand dams, water pans, or sinking of boreholes along the animals' migratory routes. The national development blueprint Vision 2030 has identified flagship projects in the arid and semi-arid lands (ASAL) that can stimulate economic

growth. To empower people socially and economically, support in the development of the livestock sector is crucial, especially by creating the right environment for economic growth to take place. To realize sustainable economic growth, enabling factors must be present including support to private businesses through the enactment of business-friendly laws and policies, the development of an enabling infrastructure, people's participation in livestock value chains, and the promotion of alternative business opportunities. In the new constitution, the responsibility of livestock development falls under the county governments. Given that the dominant livelihood option in the Turkana is livestock production, the efforts to lift people out of poverty should focus on investing in the protection and management of the most valued asset of the people, the livestock. While working with the national government on broader policy and regulatory frameworks, the County Government of Turkana will support pastoralists in developing and implementing pastoralist-friendly policies and programmes to promote economic growth, by managing and utilizing the huge livestock resources in the County. To enable communities to be food secure, the Turkana County Government will work closely with the private sector and development actors to support and promote community participation in livestock economic activities. The drought in 2016 resulted in a collapse in the price of livestock. The price of cattle declined by 50% below the normal price in Turkana (UNOCHA ROSEA 2016). The cross-border movement of people and livestock resulted in intercommunal conflict. An increase in livestock movement has been observed from Turkana (Kenya) into Karamoja (Uganda) and Nadapal (South Sudan). The movement of livestock to Uganda is on many occasions necessitated by water stress rather than pasture depletion. The livestock congregate on riverbanks to access water and grazing which fuels conflict with local pastoralists and farmers (UNOCHA ROSEA 2016). Drought incidences occur in Turkana County on a regular basis due to increasingly erratic climate conditions and ineffective water cycling. These drought episodes cause significant stress on the county, with loss of human life and increased rates of malnutrition due to inadequate food supplies and access to clean water, as well as loss of livestock. The National Drought Management Agency (NDMA) collects monthly early warning bulletins, which the county uses for planning and monitoring droughts. Information provided by the bulletins includes the following indicators: rainfall, vegetation condition index, pasture, crop production, livestock

body condition, milk production, trekking distance to water sources, terms of trade, percentage of children under five at risk of malnutrition, and coping strategy index.

6.3.1.1Challenges in livestock production

The challenges that face the livestock sector include:

- ✓ Frequent droughts caused by climate change, leading to massive losses of livestock herds.
- ✓ Violent inter-ethnic conflict
- ✓ Inadequate enabling infrastructure
- ✓ Cultural perspectives that limit the number of livestock that are released to the market.
- ✓ Shortage of skilled personnel to provide quality extension services.
- ✓ Low investment in livestock development.
- ✓ Animal pests and diseases
- ✓ Poor coordination between national and county governments, especially on policy implementation.

6.3.2 Fisheries

Fishing is one of the main economic livelihood in Turkana County after pastoralism. Lake Turkana is a main fishing ground in the region with over 50 species of fish having been reported from the lake of which 11 species are endemic.

Out of the 50 documented fish species in Lake Turkana, 12 species are exploited commercially; Tilapia (Kokine), Nile Perch (Iji), Labeo horie (Chubule), Cat fish (Kopito), Distichodus *niloticus* (Golo), *Alestes baremose* (Juse) and *Citharinus* (Gech).

Lake Turkana fishery supports 1,500 households directly and 1,100 households indirectly in the county. The Lake has a maximum sustainable yield (MSY) of 25, 000 metric tonnes annually but on average annual yield of 8 500 metric tons has been recorded.

The department of fisheries is in process of introducing aquaculture Katilu and Loima along river Turkwel, Nadoto along River Kerio and cage farming in the Lake. Introduction of aquaculture in the county aims at introducing an alternative source of food and pressure reduction on the Lake.

6.3.2.1 Challenges in the fishing industry

- ✓ Lack of storage facilities that lead to selling the produce at very low prices.
- ✓ Declining water levels of Lake Turkana due to perennial drought, evaporation, siltation and damming activities of River Omo in Ethiopia threaten to affect this source of livelihood for the local community.
- ✓ Poor infrastructure and insecurity have hampered efforts to provide market access to fishermen.
- ✓ Invasion of the fishing grounds by *Prosopis julifora.*

6.3.3 Impacts of Livestock keeping and Fishing on Environment

- ❖ Soil erosion- due to large animal herds, the scarce vegetation is destroyed exposing the land to the agents of erosion.
- ❖ Deforestation- The locals use trees to prepare makeshift houses and cattle structures as they move around with their animals as well as firewood to smoke the fish
- ❖ Contribution to the greenhouse effect- as animals produce a lot of methane gas to the environment.
- ❖ Water pollution- sometimes the fishermen using motor boats causes oil spillage which pollutes the water.
- ❖ Loss of biodiversity in the lake due to overfishing

6.3.4 Proposed mitigation Measures on environment and challenges faced by the locals

In order to protect the pastoral community, the fishermen and the environment, the County government ministry of pastoral economy, fisheries and environment will develop policies that will be invested in the following areas:

- ✓ Strengthen the initiatives to introduce solar [fish] driers, and sensitization of fishermen on how to produce sun-dried salted fish a move to conserve the doum palms which have been used for smoking the fish.
- ✓ The County Government is putting up policies that will attract private investors to put up cold facilities to help fishermen store their fish.

- ✓ Develop livestock marketing infrastructure to support economic growth and enhance livestock value chains by promoting marketing of live animals and increase value-addition to livestock products.
- ✓ Provide better livestock extensions services. The introduction of mobile extension services will be considered as a pragmatic way to reach out to geographically isolated communities. The county government will strengthen the capacity of departments of livestock through training, better logistic support and by employing more personnel.
- ✓ Work with the private sector to strengthen provision of veterinary services through regular disease surveillance, prevention and control.
- ✓ Protect pastoralist lands by working with communities to identify key pastoral areas and corridors then legally protect them. The county government will work with communities and other stakeholders to ensure the implementation of rangeland policies and practices.
- ✓ Develop enabling infrastructure to support livestock development. The Department of Agriculture, Pastoral Economy and Fisheries will mobilize support to develop dams to provide water for livestock, feeder markets and roads, energy to support livestock investments.
- ✓ Empower women and youth economically by enabling them actively to participate in livestock-related businesses. This will be done through the issuance of business grants and business skills training.
- ✓ Empower communities with information through sensitization campaigns and civic education aimed at changing attitudes and behaviours, especially those related to commercialization of livestock production.

Table 12: Illustration of livestock production systems and their impact on environment

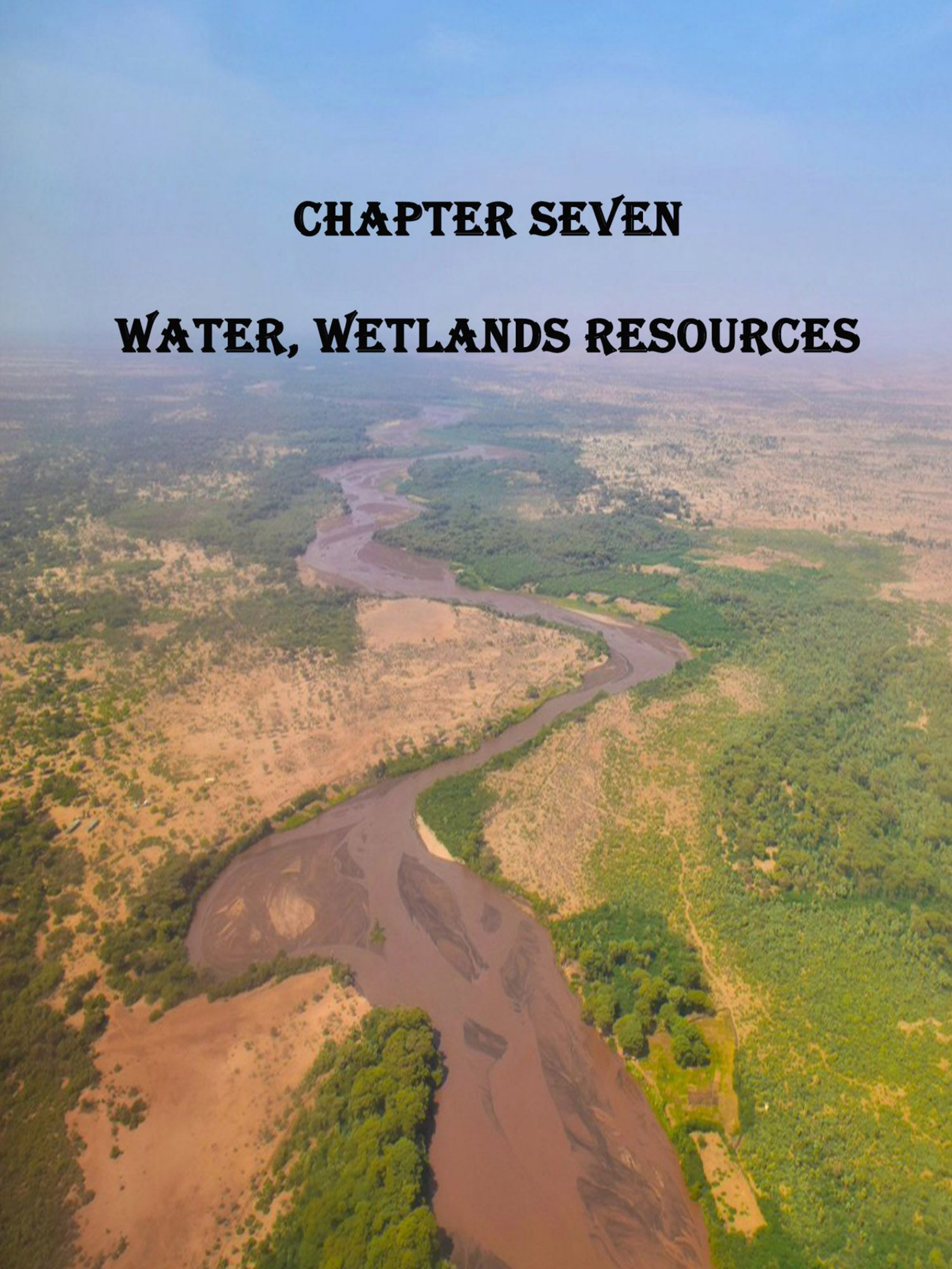
Production system	Impact on the environment	Mitigation measures (action to be taken)	Responsibility agency	Cost kshs. In million
Livestock (Nomadic pastoralism)	- Overgrazing-soil erosion - Deforestation - Air pollution - Production of greenhouse gases	- Controlled stocking	Ministry of Pastoral Economy, Ministry of Environment	370M
Fisheries	- Water pollution - Deforestation	- Introduction of fish solar driers - WASH Facilities along the beaches	Ministry of fisheries, Environment, NEMA, Public Health	150M

Table 13: Fisheries production systems and their impacts to the environment

Production system	Impacts	Mitigation measures	Responsible agency	Budget
Lake fisheries	- Introduction of biodegradable substances e.g. oils & detergents	- Enactment &enforcement of existing laws - Limiting of access to the fishery - Awareness creation to resource users	Fisheries, Environment, NEMA	10 M
Aquaculture	- Introduction of effluents from agriculture inputs into the water system - Soil erosion and silting	- Regulation of pond construction - Regulation of types of Inputs - Soil erosion control practices	Fisheries Environment, NEMA	10M

CHAPTER SEVEN

WATER, WETLANDS RESOURCES



CHAPTER 7
WATER, WETLANDS RESOURCES

7.1Water resources Availability and Potential

The main sources of water in rural parts Turkana County are unprotected dug wells, boreholes streams, rivers and Lake Turkana. More than half (61%) of rural households in Turkana County (n= 103,827) use unimproved water sources with majority relying on unprotected wells and streams. Water resources Potential for the county is not yet known for example no proper monitoring installations in permanent rivers and the presumed availability of groundwater only along riverine as attested by shallow wells and boreholes drilled in the county (Turkana County Resource Mapping, 2015).

It is reported that Lotikipi plains has 3 key water aquifers that hold up to 26 Billion cubic meters of water sufficient to serve this nation for the next 70 years. Gatome, Nakalale, Lodwar and Kachoda springs cumulatively have a potential of about 40,000 million cubic metres of water.

Access to water greatly affects food security i.e. Level of livestock production, crop production, sanitation, health and nutrition-thus consequently human productivity.

7.1.1 Groundwater Resources

Groundwater is a key source of water to be considered in the County which happens to located in the ASAL areas of Kenya. It is the only source of portable water in the county. The underground water sources in Turkana County comprises of unprotected dug wells, boreholes and springs.

Boreholes have been drilled across the county either by the national government, Diocese of Lodwar, county government or even international organizations to give the resident communities access to clean water. Currently, the drilled boreholes across the County is estimated to be over 300 in number.

Turkana County also has several springs running from cold to warm to hot springs. The warm springs include; Eliye Springs, also known as Ille Springs and Koyasa warm spring.

The hot springs include; Lomonakipi spring hot spring in Kibish, Muruatapal hot spring, Lobiritit hot spring, Kachapo hot spring in Latea and the Kapedo hot springs. Nakurio spring in Kerio Delta represent the cold springs.

7.1.2 Surface Water Resources

The surface water resources are represented by rivers and lakes. Notably, surface water from the seasonal rivers is accessed by the community during the rainy season, and also accessed by digging holes in the sandy areas of riverbed to access water during the dry season. This water is not portable and hence the communities as exposed to water borne diseases. Despite the dry nature of the county in most parts of the year, there are a few permanent rivers including the Turkwel river, Kerio river, Elelea irrigation canal, Nabwanyang river, Nawoyawoi river. Lake Turkana also serves as a major source of surface water in the County.

7.2 Water use

The water sources are utilised to fetch water for domestic consumption, livestock watering, irrigation used in industries and as fishing grounds. The representative sources and their capacities are as presented in table 14 below.

Table 14: Illustration of source of water by type and yields

Source/type	Quantity	Yield (m^3).
Boreholes	800	Approximately 14,000m^3 per day (24 hrs).
Rivers	2 permanent and 15 major seasonal rivers	Mean Annual Flow 224,656,288m^3 per year for Turkwel river and 190,162,080m^3 per year for Kerio river
Dams	80	Storage 1,813,184m^3
Springs	27	Approximately 105,580 m^3per day (24 hrs).
Lakes	1	Storage 203,600,000,000m^3
Aquifer	Lotikipi Gatome Nakalale Lodwar Kachoda	207,300 million m^3 17,250 million m^3 7,000 million m^3 7,000 million m^3 6,500 million m^3

7.3 Ecological and economic threats to the water sources in Turkana County

- ✓ Habitat degradation- especially by damming of the Omo River and irrigation in the Omo Valley, biodiversity loss.
- ✓ Climate change- Prolonged droughts has led to reduced water volumes in the water resources.
- ✓ Pollution-Heavy grazing along watering routes and settlement close to the rivers contributes to pollution by human and livestock waste.
- ✓ Siltation-150,000-200,000 hectares of woodland in southern Ethiopia are cleared annually for wood fuel, exposing soils to strong winds which causes siltation of the lake.
- ✓ Reduction in water volumes- use of water for irrigation in the Omo river valley, river Turkwel and Kerio. Construction of a hydropower dam and the large irrigation scheme in the Omo valley are expected to cause a drop in lake level.
- ✓ Invasion by *Prosopis juliflora* has created dense and impenetrable thickets making the shores inaccessible.

7.4 Mitigation Measures to water challenges

It should be understood that adhering to regulations governing water resources use alone can resolve these challenges effectively. The mitigation measures are:

- ✓ Installation of master meters and control devices at abstraction points and complying to water allocations on the water permits.
- ✓ In applicable cases the abstractor (user) to Develop Effluent Discharge Control Plans and adhering to the same.
- ✓ Innovations in dam design and constructions (deep and narrow) with possibility of covering with polythene papers to reduce evaporation.
- ✓ Being in innovative in encouraging communities to construct and use latrines expeditiously.

Table 15: Illustration of water resource issues

Water resource	Contribution to economy(estimate) Kshs.	Threat to the resource	Mitigation measures (action to be taken)	Responsibility agency	Cost Kshs. In million
Rivers (Kerio, Turkwel, Nabwanyang, Nawoyawoi)	- Through irrigation they contribute to about 1.6 billion shillings annually	- Water pollution - Over abstraction - Colonization by Prosopis	Enforce water quality regulation Controlled water channeling to irrigation farms	WRA NEMA Ministry of Agriculture. County Department of Environment, TCEC, Partners	115M
Lake Turkana	- Contributes to about 4000 Tons of fish per year.	- Water Pollution - Over Abstraction - Colonization by Prosopis, reeds	Control overgrazing along the water shores Stop the release of waste materials to the water bodies Control the fishing activities Control the spread of P. juliflora	WARM NEMA Ministry of water (National government) County department of Water &Environment.	50M
Dug wells and Aquifers	- Contributes to over 300,000 million cubic meters of water	- Salinization - Pollution	De-salinization Controlled pollution	County departments of Water & Environment	300M
Catchment degradation		- Increased runoffs - Soil erosion - Pollution - Wastages	Soil and water conservation -protection of springs -no grazing -Brick making/pots	- KFS -community through WRUAS -WARMA -NEMA -Water services -County Government	20M

Regulation and enforcement of the water rules		- Lack of defined boundaries - -Conflicting laws - -Land use	-define based practise - Harmonize and have synergy of the laws -develop technical land use guide lines Delineation and zoning.	Agriculture -WRA -Public health -NEMA CG	50M
Water pollution (quality)	100,000m	-farming practises -human &municipal Waste -Institutional waste -Incidental waste -Car Wash/well drilling -quarrying and gold mining. -Affluent discharges from miners	-Enforcement and compliant -Zoning and delineation. -There should be investment such as laboratories.	-NEMA -Water -County Government -WARMA	20M

7.5 Wetlands

The county has 2 major wetlands namely Lake Turkana and Lotikipi swamp in the north. Lake Turkana wetlands has a water surface of 6,405 km^2 and is mainly used for fishing, tourism and sources of water for domestic use. Lotikipi wetlands has 3 key water aquifers that hold up to 26 Billion cubic meters of water sufficient to serve this nation for the next 70 years. The Lotikipi Plain, receives water from several seasonal rivers, notably the Gatome, Narengor, Tarach, Napass, Natira and Nanam rivers. The actual present area is not yet established but may be estimated at 4146km^2 in Kenya.

River Turkwel and Kerio which are the only permanent rivers in Turkana County also form part of the wetlands.

Table 16: Illustration of Wetland resource issues

Name of wetland	Area	Threat	Mitigation measures	Responsible agency	Cost (million kshs)/5 yrs
Lotikipi aquifer	4,146km^2	• Salinity, • Contamination, • Prosopis invasion	• Controlled farming • Desalination • Prosopis clearance	NEMA/WRMA County departments of Water, environment & Agriculture	115M
Lake Turkana	6,405 km^2	• Invasion by Prosopis in some parts of the wetland. • Fishmonger's activities that has potential for pollution of the water resource. • Over abstraction along the Omo river and other tributariers, • Pollution • Flooding, siltation • Receding of the Lake	• Mechanical Control of Prosopis • Promote soil conservation measures along the lake shores e.g tree planting, grassing. • Regulate the use of water resource through issuance of permits • Enforce water quality regulations • -Enforce Agriculture Act	NEMA/WRMA County departments of water and Environment, Natural Resources, KEFRI, KFS, Fisheries, KMA	200M
River Turkwel	~76km in Length	• Over abstraction for irrigation • Pollution • Invasion by Prosopis juliflora • Siltation • Encroachment and conversion to agricultural land	• Mechanical Control of *Prosopis* • Controlled channeling of water for irrigation • Conservation of Vegetation cover • Community to sensitized on the importance protecting the wetlands • Marking and pegging the riparian land / reserves • Fencing all-round the wetland areas • Enforce the law on integrated water resource management	NEMA, TCG, TCEC County departments of water and Environment, WRMA WRUAS, Natural resources Other Stake holders	125M

Kerio River	~350km long	• Over abstraction for irrigation • Pollution • Invasion by Prosopis juliflora • Siltation • Drying of the river downstream • Catchment degradation	• Mechanical Control of Prosopis • Intercounty cooperation agreement • Controlled channeling of water for irrigation • Conservation of Vegetation cover • Catchment restorations • Riverbanks protections	NEMA/WRMA, TCEC, County departments of water and Environment, NOREB, NCCK, Partners	130M
Eliye springs		• Water pollution • Over abstraction	• Enforce water quality regulations • Enforce Agriculture Act • Protection of wetland.	NEMA, TCEC WRMA Agriculture Public Health, CGT	70M

CHPATER EIGHT

HEALTH AND ENVIRONMNET

CHAPTER 8
HEALTH AND ENVIRONMENT

8.0. Introduction

By the year 2030, as a contribution to attaining the Sustainable Development Goals, Kenya aims to ensure that all households will be made aware of the importance of improved environmental sanitation and hygiene (ESH) practices for improved health; and that 90 percent of households will have access to a hygienic, affordable, and sustainable toilet facilities, improved housing, usage of safe drinking water and the means to safely dispose of waste products. Attainment of these goals is expected to drastically reduce the incidence of environment sanitation-related diseases. The health status of Turkana County is characterized by low access to health care despite a substantial number of health facilities. This has largely been attributed to a large proportion of population living about 5 km's from health facilities, impassable roads and also poverty.

Access to health services in the County has improved in the last four years. The doctor population ratio stands at 1:20 000 compared to 1:70 000 in 2013, while the nurse-population ratio is 1:2310 compared to 1:5200 in 2013. The average distance a person needs to travel to the nearest health facility dropped from 50 km in 2013 to 35 km in 2017. A majority (81.7%) of the population seek care from public clinics. In Turkana North, nearly 10% seek assistance from mobile clinics, the highest proportion in the County. Lodwar County Referral Hospital has a new intensive care unit, among other upgrades (Turkana County CIDP II, 2018-2022).

There are 13 hospitals, 19 health centres, 177 dispensaries and 168 community health units of these, there are 1 hospital, 2 health centres with maternity wards, and 5 health clinics serving refugees and host communities in Kakuma. Despite the milestone in the health sector, there are still many challenges inclining towards environmental pollution greatly affecting the sanitation status in the County as a result of population pressure especially in the urban setups, infrastructural developments as well as the impacts of climate change.

8.1. Linkages between health and environment

There are several health issues associated with environmental health conditions in the county. These include water pollution, water borne diseases, eutrophication of water bodies and pollution of the underground water reservoirs. Several environmental factors are threat to health, they include:

- Environmental conditions favoring disease vectors e. g viruses, bacteria, e.t.c
- Environmental disruptions: floods, droughts,
- Air quality: pollen and pollution leading to respiratory diseases or cancers;
- Water quality: leading water related diseases

8.2 Sources of pollution

A number of sources have been identified as the major sources of pollution in the county. Some of these sources include;

- Population growth – There has been high population surge especially in the urban and peri-urban areas. These populations generate a lot of wastes which are not well handled in some cases resulting on health implications experienced in the County.
- Infrastructural development- The County is in a transitional economic growth seeing a lot of infrastructural developments and in the process leading to both air and water pollutions which may directly or indirectly linked to some health implications in the County.
- Agricultural production- With irrigation schemes along the riverine areas, a lot of soil, water and air pollution are happening especially from the agrochemicals used in the management of pest and diseases.
- Oil exploration and drilling- Since the discovery of oil in the County, there has been a lot of soil water and air pollution emanating from the industry which have and are speculated to have more health implication in future if not well managed.

- Mining- The county is endowed with a lot of minerals. The groups that perform the mining activities most of the time leave this lands derelict posing a lot of health implications.
- Fishing activities- Fishing activities both in the lake and rivers in Turkana county have been linked with water pollution which not only affect the aquatic biodiversity but also the human health as they depend on these sources for their water for domestic use.
- Overgrazing unmanaged grazing in the area has led to degradation of vegetation and exposing the land to the to the agents of erosion and environmental pollution.
- Illegal charcoal burning not only cause degradation of vegetation but also emit a lot of greenhouse gases to the atmosphere.

8.3 Types of waste (Pollutants)

Wastes generated in the County have been classified as either solid wastes, liquid wastes or gaseous wastes.

Solid wastes comprise of food wastes from homes and industries, poorly disposed human and animal faecal wastes, plastics and soil heaps in the landfills.

Liquid wastes are mainly comprised of the sewage waste from home and industries. Gases wastes on the other hand comprises of emission from industries, charcoal burning and especially fumes from oil mining industry, motor vehicles fumes and burning of plastic wastes in the county.

8.3 major pollution sources

Major pollution sources in Turkana County include solid waste from markets, households, institutions, premises and road construction waste materials, liquid waste from products manufacturing and processing plants. The emerging one is Extractives waste which are harmful and hazardous (Table 17)

Table 17: Major source of Pollution

Types of waste generated	Where generated	Disposal Method
Solid waste • Non-Biodegradable waste like Plastic paperbags,	• Households • Manufacturing plants • Premises	• Recycling

bottles, pens, pails and buckets; metallic containers • Biodegradable waste like vegetable waste and fruit peelings from farm produce	• Institutions • Municipality • Markets	• Decomposing
Liquid waste • Sewage • Wastewater	• Water closets in Households Institutions • Premises • Manufacturing Industries	• Sewage treatment and Water treatment
Infectious waste • Non-biodegradable-Used syringes, cotton wool, test kits, gauze • Biodegradable-placentas, amputated body parts	• Hospitals	• Burning/Incineration • Burying/Incineration
Synthetic Oil Based Mud Cuttings waste and Drilling Water from Oil and Gas	• Oil and Gas Companies	• Biological, Chemical and Land filling

8.4 **Challenges facing disposal of waste types**

- Lack of a clear waste management policy in the sub counties
- Lack of high temperature incinerators
- Lack of waste segregation
- Cost of disposal of most hazardous waste very high
- Lack of designated disposal sites for hazardous waste
- Private clinics contracting non – professional medical waste handlers which later end up disposed of haphazardly
- Scavengers
- Inadequate waste collection containers
- Vandalisms of waste management infrastructures
- The two sub counties currently do not have a well-designed disposal mechanisms for both solid and liquid wastes.
- Uncoordinated waste collection and disposal
- Inadequate resources to handle the collection and disposal of wastes
- Land Topography
- Grabbing of land identified for waste management service
- Collection of soil matter into storm water drains
- Emptying of pit latrine on open ground
- Unplanned housing in slum
- Discharge of raw sewage into the environment

- Lack of Space for waste disposal
- Lack of technical capacity to handle waste management
- Lack of Oil and Gas disposal and treatment facilities
- No method on disposal of E-Waste

8.4.1 Solid Wastes

- ✓ Both the urban and rural areas of Turkana County do not have licensed solid waste disposal sites. It is therefore common to find solid waste on the streets and around homes and establishments. There have been efforts to provide make shift dumpsites in some towns which serve as disposal sites for solid wastes. These sites are however not licensed by the National Environment Management Authority (NEMA).
- ✓ The county has tried to managed solid waste disposal by providing waste disposal bins unfortunately the bins have not been adequate to meet the population needs.
- ✓ There are very few private enterprises that have ventured into collection and disposal of solid wastes particularly within the major towns and marketplaces such as Lodwar, Kakuma and Kalokol.
- ✓ Efforts by NGOs have been unsuccessful due to the unwillingness of community members to pay a minimal amount for the services rendered.
- ✓ In fishing town centers and marketplaces, fishmongers often carelessly dispose of unsold and undersize fish together with the fish entrails in the market areas and along the lake shore.

8.4.2 Liquid waste

- ✓ There is no liquid waste management treatment area in the entire Turkana County. In more ideal situations, individual homes, offices and hotels have their own septic tanks and when these fill up, the liquid waste is transported by trucks to the Kitale liquid waste management facility, more than 300 km away from Lodwar town.
- ✓ Some homes and establishments especially in the urban areas have not installed septic tanks and therefore their raw liquid waste is released into the open channels and later drain into water bodies.

- ✓ Most urban areas and market centers do not have public restrooms and where they exist they are not properly maintained and thus pose public health risks.
- ✓ Majority of the household in the rural areas do not have proper pit latrines hence most of the liquid and solid wastes find their way to the open environment.
- ✓ Poor use of the main water sources for watering the animals, irrigation, washing and bathing and car washing cause a lot of pollution leading to a lot of health implications downstream.

8.4.3 Gaseous wastes

- ✓ With low infrastructural development especially on roads it is difficult to control air pollution due to dust emanating from vehicles or trucks transporting materials in and out of the county.
- ✓ The location of airstrips particularly the one in Kakuma sub-county is of great concern as it is very close to the town and whenever a plane takes off or lands, it generates a lot of dust thus polluting the air.
- ✓ Since there is no proper waste disposal method in the county burning of waste especially plastics is the only alternative way which comes with air pollution.
- ✓ Most of the slaughter houses in the county are open therefore there is a lot of methane gas release from the animals into the air causing pollution.
- ✓ The is release of burnt and unburnt gases from the oil mining sites because combustion has been found to be more economical that converting them to beneficial use.

8.5 Trends of incidences &Severity of Environment and Related diseases

- ❖ According to devolution hub (2014) on state of sanitation in Turkana County, the County loses 1.1 Billion KES each year due to poor sanitation. This includes losses due to access time, premature death, health care costs and productivity. This estimate does not include some costs that could be significant (such as water pollution and tourism) and is therefore likely to under-estimate the true cost of poor sanitation.
- ❖ There has been a continuous increase in the outbreaks of Cholera due to lack of proper toilets and water pollution in the region.

- ❖ The gas flaring from the oil mining industry is feared to result in emission that shall have great environmental and health risks in the near future.

8.6 Mitigation measures

Due to the existence of various sources of environmental pollution with possible health implications, the County government of Turkana through the various department have implemented and also proposed other mitigation measure to curb the further effects. The mitigation measures are as shown in table below.

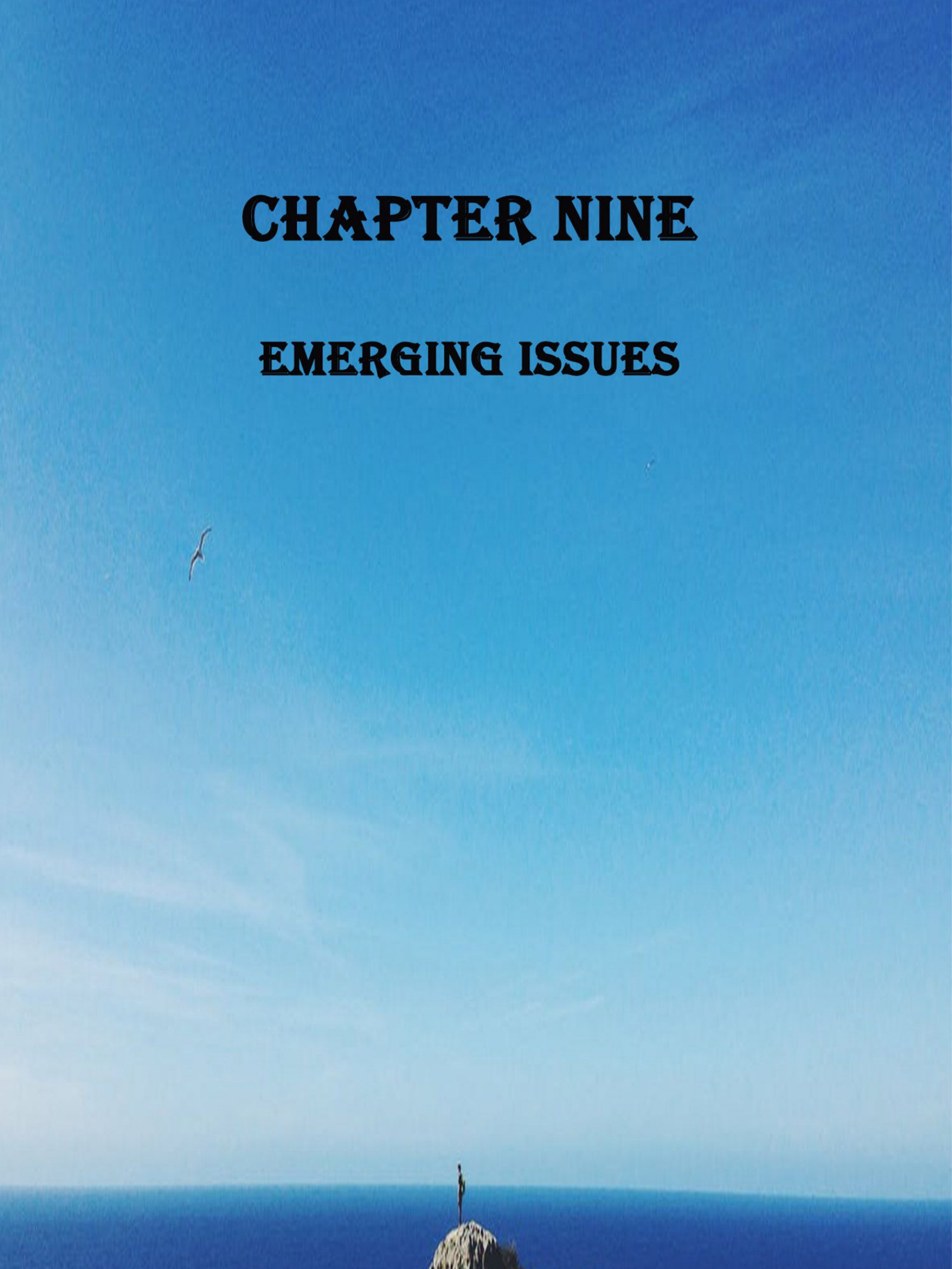
Table 18: An Illustration of Health and Environment issue and mitigations measures

Issue	**Impacts on the environment**	**Mitigation measures**	**Responsibility**	**Cost Kshs. In Millions**
Inadequate waste management facilities such as solid waste disposal sites	- Pollution - Diseases - Loss of aesthetic conditions - Eutrophication of aquatic ecosystems	- Enhance solid waste management - Establishment of sewerage system - Education and awareness - Policy implementation - Provide adequate funding	- Ministry of Health - County government - NEMA - Ministry of Lands and Settlement	120
Inadequate enforcement of the rule of law	- Poor management of waste (solid and liquid) leading to pollution - Outbreak of water borne diseases	- Education and awareness - Policy implementation - Recruitment of more health personnel	- Ministry of Health - County government - NEMA - Ministry of Lands and Settlement	55
Lenient fines and penalties	- Poor management of waste (solid and liquid) leading to pollution - Outbreak of diseases	- Education and awareness - Policy enhancement	- Ministry of Health - County government - NEMA - Ministry of Lands and Settlement	67
Low compliance	- Poor management of waste (solid and liquid) leading to pollution - Outbreak of diseases	- Education and awareness - Policy implementation	- Ministry of Health - County government - NEMA - Ministry of Lands and Settlement	45
Inadequate waste management infrastructure	- Accumulation of garbage leading to pollution - Loss of aesthetic	- Plan for waste disposal sites - Education and awareness - Policy implementation	- Ministry of Health - County government - NEMA - Ministry of Lands and	89

	conditions - Uncontrolled dumping		Settlement	
Low awareness	- Environmental degradation	- Education and awareness - Policy implementation	- Ministry of Health - County government - NEMA - Ministry of Lands and Settlement	12
Pollution of water resources	- Degraded water resource	- Awareness creation on	MOH, NEMA, Environment, Public Health, Water	20M
Crude dumping	- Breeding of disease vectors	- Health education	MOH, NEMA, Environment, Public Health, Water	30M
Poor disposal of fecal matter	- Breeding of disease vectors	- CTLS	MOH, NEMA, Environment, Public Health, Water	25M
Haphazard disposal of medical waste	- Cross infection	- Awareness creation on medical waste disposal, - Prosecution of offenders	MOH, NEMA, Environment, Public Health, Water	1.8 M
Emptying of pit latrines contents onto the open ground	- Outbreak of water borne infections	- Awareness creation on proper disposal of latrine contents, - Prosecution of offenders	MOH, NEMA, Environment, Public Health, Water	1.5 M
Connection of sewage water into storm water drains	- Degradation of receiving water bodies	- Awareness creation on medical waste disposal, - Prosecution of offenders	MOH, NEMA, Environment, Public Health, Water	3 M

CHAPTER NINE

EMERGING ISSUES



PART 3: EMERGING CHALLENGES

CHAPTER 9

EMERGING ISSUE

9.1 Introduction

An emerging issue is an occurrence that is exerting an increased impact on the environment and people. These issues can either be old but looked at in new ways or may be completely new posing potential risks in the future.

9.2 Oil Exploration and Production

In 2012, Kenya announced the discovery of commercially viable quantities of oil in the Turkana Basin. Eight years on, Kenya is now preparing to start exporting some of the early oil, with a view to full commercial production in 2022. With the exploration of the resource, the area is turning into an economic giant. In 2018 alone the country earned more than 1.83 billion KShs (US$18.3 million) in taxes and fees from the main players Tullow/Africa. Apart from the economic benefits, Oil and gas exploration and production operations have the potential for a variety of impacts on the environment. These 'impacts' depend upon the stage of the process, the size and complexity of the project, the nature and sensitivity of the surrounding environment and the effectiveness of planning, pollution prevention, mitigation and control techniques.

The impacts can be classified as human, socio-economic and cultural impacts; atmospheric, aquatic, terrestrial and biosphere impacts.

9.3 Human, socio-economic and cultural impacts

Exploration and production operations are likely to induce economic, social and cultural changes. The extent of these changes is especially important to local groups, particularly indigenous people who may have their traditional lifestyle affected. The key impacts may include changes in:

- Land-use patterns, such as agriculture, fishing, logging, hunting, as a direct consequence (for example land-take and exclusion) or as a secondary consequence by providing new access routes, leading to unplanned settlement and exploitation of natural resources;

- Local population levels, as a result of immigration (labour force) and in-migration of a remote population due to increased access and opportunities.
- Socio-cultural systems such as social structure, organization and cultural heritage, practices and beliefs, and secondary impacts such as effects on natural resources, rights of access, and change in value systems influenced by foreigners.
- Availability of, and access to, goods and services such as housing, education, healthcare, water, fuel, electricity, sewage and waste disposal, and consumer goods brought into the region.
- Planning strategies, where conflicts arise between development and protection, natural resource use, recreational use, tourism, and historical or cultural resources.

9.4 Atmospheric impacts

The primary sources of atmospheric emissions from oil and gas operations arise from:

- Flaring, venting and purging gases;
- Combustion processes such as diesel engines and gas turbines;
- Fugitive gases from loading operations and tankage and losses from process equipment
- Airborne particulates from soil disturbance during construction and from vehicle traffic; and Particulates from other burning sources, such as well testing.

The principal emission gases include carbon dioxide, carbon monoxide, methane, volatile organic carbons and nitrogen oxides. Emissions of sulphur dioxides and hydrogen sulphide can occur and depend upon the sulphur content of the hydrocarbon and diesel fuel, particularly when used as a power source.

9.5Terrestrial impacts

Potential impacts to soil arise from three basic sources:

- Physical disturbance as a result of construction;
- Contamination resulting from spillage and leakage or solid waste disposal

- Indirect impact arising from opening access and social change.

9.6 Influx of Refugees

The county host the largest refugee camp in East and Central Africa in Kakuma. The camp was meant to have a maximum capacity of 70,000 residents, but by 2015, the population had risen to 183,000. This led to the Turkana County government allocating land for a new settlement at Kalobeyei, which now hosts about 40,000 refugees.

- ✓ Kakuma and Kalobeyei also suffer immense pressure from the demand for firewood, which is the primary source of cooking fuel. This has led to the rapid exploitation of the existing woodlots and creating tension with the host community.
- ✓ The camps have brought about sanitation issues as due to inadequate proper latrines.
- ✓ Waste disposal is a problem as there are no well maintain treatment sites for the wastes in the area.

9.7 Large Irrigation Schemes

The County has over 51 irrigation schemes utilizing surface, spate and drip irrigation technologies, most of which are river-based. The schemes are not operating at optimum levels because of security, technical, infrastructural, and financial resource challenges. The largest irrigation scheme is Katilu irrigation scheme covering an estimate of 1,215 ha. The schemes were developed in partnership with the national government through the National Irrigation Board and development partners such as World Vision Kenya, Catholic Diocese of Lodwar, WFP, NDMA/UNDP, FAO, Kenya Red Cross Society, FID, and Child Fund Kenya.

- ✓ These large irrigation schemes have led to over abstraction of water for irrigation farming reducing the river flow and hence affecting the riparian ecosystems.
- ✓ The irrigation schemes have led to destruction of vegetation due to land expansion for cultivation.
- ✓ The have been cases of increase soil, water and air pollution due to the overuse of agrochemicals in the irrigation lands.

- ✓ Poor cultivation has led to soil erosion which brings about siltation of the rivers.

9.8 Invasive species (*Prosopis juliflora*)

Prosopis juliflora is an invasive tree species which was introduced in Turkana County in 1979 by GOK in collaboration with NORAD. The plant was intended to reduce the effects of desertification. Unfortunately, the plant has turned invasive and has since colonized vast areas of the pastoral rangeland invading along the water courses heavily e.g. along Rivers Turkwell and Kerio and on the western shores of Lake Turkana. Prosopis has invaded many areas in Lokichogio, Letea and Kakuma.

This has affected plant biodiversity in the ASALS which changes the ecology of these rangelands. This will eventually affect pastoralism.

Prosopis has reduced the pasture and forage in this rangelands hence animals need to move longer distances in such of pasture.

Prosopis has now invaded wetlands like River Turkwell and Kerio and around Lake Turkana. It is also colonizing Lotikipi nature reserve where a water aquifer has been identified with sufficient water for the whole nation.

Prosopis has been known to host pests like aphids which affect crop production and tsetse flies which affect livestock keeping.

9.8.1 Constraints in Managing *Prosopis*

- ✓ Land tenure system: In communal land ownership the environment suffers the tragedy of the commons. No one takes the responsibility to clear the invasive weed
- ✓ Pastoral way of life. They are always moving in search of pasture and water
- ✓ Mechanical control not viable since they regenerate (coppice) from cut stems and roots disturbance of the soil makes the many seeds underground to sprout.
- ✓ *Prosopis juliflora* is a profuse seeder producing 60000 seeds per ha per annum
- ✓ The weed is very thorny and stems are very hard to cut hence requires specialized equipment like power saws

- ✓ Lack of Machinery to clear large areas mechanically with chain bulldozers while chemical control is not environmentally sound
- ✓ The Turkana people keep a lot of livestock (overstocking is common) which feed on the *Prosopis* pods hence spread the seeds in their dung all over the grazing field helping in seed dispersal and germination as the seeds are not destroyed but are scarified through the natural digestion process and deposited in nutrient rich dung.
- ✓ Seeds are washed down in flash floods helping in dispersal
- ✓ Has deep rooting system up to 20M deep hence outcompetes others for water and nutrients and can regenerate from cut stems and roots (coppicing with over six stems per stool)

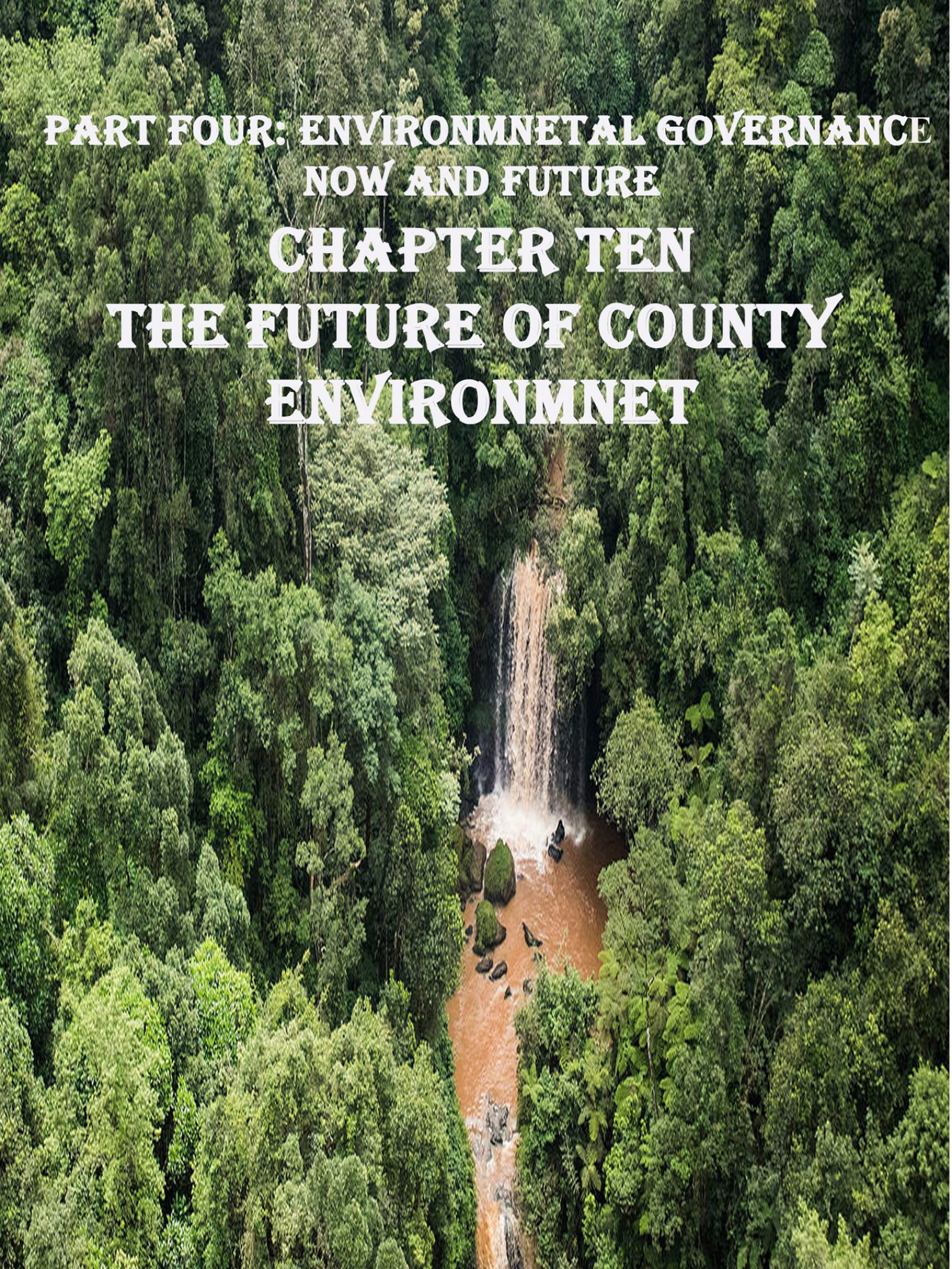
9.9 Mitigation Measures

The county in collaboration with different agencies have tried to control some of the effects while proposing new strategies to manage the emerging environmental issues from these new aspects in the county. Some of the implemented and proposed measures are as indicated in the table below

Table 19: : Illustration of Emerging Environmental Issues and Mitigation Measures

Emerging issues	Contribution to economy(estimates) kshs	Impact on the environment	Mitigation measures (action to be taken)	Responsibility agency	Cost kshs. In million (estimate)
Refugee influx from S. Sudan	- Market for goods and services 400M	- Land degradation - deforestation - over use of water - insecurity	- Control the influx, Provision of adequate social amenities for proper waste disposal. - Increasing the use of solar energy and other renewable forms to conserve the scarce vegetation. - Encouraging the locals to use prosopis for fuel and preserve the indigenous species	- Department of Refugee Affairs/UNHCR - County departments of Environment & Health - NEMA - County Government	15B
Oil exploration and Production mainly by Tullow Oil	- Revenue Generation Over 1.83 billion per year	- Air pollution - Soil pollution - Water pollution - Deforestation	- Converting of the natural gas to useful product rather than flaring. - Proper handling of wastes from drilling either by treating before release or recycling. - Hazardous waste management facility to treat oil and gas waste	Oil Company, County departments of Environment & Health, NEMA, KFS, Natural Resources, County Environment Committee	900 M
Prosopis juliflora		- Reducing plant biodiversity in the region. - Encroachment of wetlands - Lowers water table	- Encouraging charcoal processing through training installing modern charcoal kilns - Stop burning *P. juliflora* as it encourages re- sprouting from damaged stems, scarifies the dormant seeds and removes all valuable native plants from the ground. Moreover, it also releases carbon dioxide which	County department of Environment KFS, NEMA, Natural Resources, KEFRI	300M

			contributes to global warming. - Establish Prosopis Energy plant - Collect and grind pods and produce fodder		
Irrigation schemes	- Contributes about 1.6 billion shillings annually	- Water, soil and air pollution - Land degradation leading to soil erosion - River siltation - Over abstraction - Destruction of vegetation.	- Controlled water abstraction. - Ensuring proper tillage method to stop erosion and siltation	WRA County departments of Water, environment & Agriculture	
Flash floods		- Land/soil degradation, - Forests/habitat destruction and - Loss of biodiversity water pollution	- Develop an emergency response plan to address flash floods incidences, re-afforestation programs, upgrading surface run-off harnessing infrastructure	WRA County departments of Water, environment & Agriculture, Disaster Department, NDMA	30M



PART FOUR: ENVIRONMNETAL GOVERNANCE NOW AND FUTURE

CHAPTER TEN
THE FUTURE OF COUNTY ENVIRONMNET

PART 4: ENVIRONMENTAL GOVERNANCE NOW AND FUTURE

CHAPTER 10

THE FUTURE OF COUNTY ENVIRONMENT

10.1 Introduction

Environmental Governance entails the formulation of comprehensive environmental policies, and the enactment of supportive legislative regimes. These should be complemented by strong and well –coordinated environmental institutions. The institutions would then draw up and enforce environmental regulations and standards, to ensure sound environmental management. The public and civil society organizations should be facilitated to access and use information on environmental policies and legislations. An informed society will have an enhanced ability to make decisions and fully participate in sustainable development issues. The achievements of sustainable development in semi-arid areas will mainly depend on the empowerment and capacity of the public and civil society to complement the government efforts in environmental management and this can only be achieved, if everyone will have capacity to localize/ domesticate and take advantage of the technical facilities provided for in various MEA'S

The increasing human population and associated consumption patterns have threatened the environment and natural resources. Population has also impacted on the quality of environment especially in aspects related to settlement and urbanization. The environmental governance consists of the legislation, standards regulation and institutions to control activities damaging the environment. The enactment of EMCA (1999) and the current national policies on the environment have been influenced by a series of development both at the national and international level.

Environmental management in the county should have a bottom up approach if it is to be realized. The trend in the past has been that NGOs and other bilateral and multilateral organizations come with the projects and try to impose them to the group/ people. This approach has failed because the people needs are different while the Private Sector provides services at a fee.

The Constitution of Kenya 2010, Chapter 42 deals with environmental governance which states that: Every person has the right to a clean and healthy environment which includes the right –

a) to have the environment protected for the benefit of present and future generations through legislative and other measures, particularly those completed in Article 69; and
b) to have obligations relating to the environment fulfilled under Article 70.

The future of Turkana County environmental issues lies in pastoralism, Extractives, infrastructural development, Refugee influx, irrigation and the emergence of invasive plant species. The potential for further environmental degradation in already fragile ecological conditions is a key concern for those living in the region.

An estimated 60% of the region's inhabitants are pastoralists who have long struggled with seasonal droughts, which have led to the deaths of thousands of livestock. The situation has deteriorated significantly over the last decade and it is estimated that 75% of the population now are reliant on food aid. Projects are ongoing in the region to promote the diversification of economic activities, thus limiting dependency on the livestock trade; however, lack of infrastructural development continues to serve as a significant impediment to such initiatives.

While the oil exploration and mining industry undoubtedly will produce marked improvements in infrastructure, this is likely to be counterbalanced by the unavoidable ecological impact resulting to air, soil and water pollution.

It is not just oil which lies beneath Turkana County. Recently, massive water reserves have been discovered in the region, and many believe that this water wealth could provide the solution to water insecurity not just in the drought-blighted regions in the north, but for the entire country. With both water and oil drawing all eyes to Turkana County, government and commercial stakeholders must act now to ensure that these recent discoveries are to the benefit of local populations and to prevent the region becoming a focal point for a resource-driven conflict.

10.2 Policy and Legislative approaches including relevant MEAs for preventing, controlling and mitigating specific impacts on the environment

Environmental Management and Co-ordination Act (EMCA) 1999

To ensure implementation of NEAP, the environmental policy of 1999 was formulated. This was followed by enactment of environmental management and co-ordination Act (EMCA) of 1999 which was again amended in 2015. EMCA provides an appropriate legal institution framework for the management of the environment. It is also an umbrella legislation that provides the guidance co-ordination and harmonization of all environmental laws in the country.

10.3 Key issues in compliance and enforcement.

Policy responses relating to environmental governance include the decentralization of management responsibilities from central to lower levels of government such as the counties. There is also community involvement in planning and management of environmental resources. EMCA provides for decentralized environmental management and planning through CECs.

The awareness and capacity is low and weak in both government and community organization. They should work in partnership with the private sector to promote a clean and healthy environment. These arises out of the characteristics of the ASAL and the anticipated focus on decentralized management, private sector and commercialization of natural resource exploitation and the development of rural infrastructure at the county level.

Table 20: The opportunities and threats to the environmental resources (SWOT Analysis)

Stakeholder	Role
Water Services, Agriculture and Irrigation Departments	Explore and exploit underground water; Enhance conservation of catchment areas; capacity build farmers on adoption of irrigation farming methods
Lower Turkwel WRA,	Regional body responsible for regulation and planning of water services
Water Resource Users Associations, WRUAs	enable communities and water users to participate in water resource management; provision of water in the County
NEMA , KFS , KWS, Directorate of Environment, Directorate of Natural Resources	Safeguarding the wetlands, forests; Sensitizing the public on catchment management and conservation; Evaluation of EIAs; Regular monitoring.
Farmers	Participate and get involve in conservation of environment and water.

Donors, NGOs, CBOs, FBOs	Capacity building of farmers in project planning and management and technical training; Assist in provision of tree seedlings to farmers; Assist in environmental conservation.

To ensure the sustainable management, protection and conservation of the environment the county of Turkana in line with Multilateral Environmental Agreements (MEA) has developed and intends to develop other polies that will help curb the experienced and future environmental uncertainties. These policies and legal frameworks are meant to ensure there is proper management of environment within Turkana County:

10.3.1 Solid Waste Management

The County of Turkana shall:

- Enforce the relevant provisions of the Environmental Management and Coordination Act (EMCA), 1999, Chapter 387 and the Integrated National Waste Management Strategy relating to the disposal of solid wastes.
- Designate proper dumping sites for the safe disposal of solid wastes in all major towns and market centers within the county.
- Designate appropriate areas for the safe disposal of fish entrails in towns and market centers where the sale of fish is a major economic activity.
- Establish mechanisms that facilitate the recycling and up-cycling of solid waste materials.
- Put in place transparent mechanisms that allow for the participation of private firms in the collection and disposal of solid wastes with preference being given to local community groups already providing these services.

10.3.2 Liquid Waste Management

The County of Turkana shall:

- ❖ Enforce the relevant provisions of the Environment Management and Coordination Act (EMCA), 1999, Chapter 387 and the Integrated National Waste Management Strategy relating to the disposal of liquid wastes.
- ❖ Put into place mechanisms that ensure the operationalization of a centralized sewer system that ends up in a licensed liquid waste management facility particularly in the urban areas and major market centers.
- ❖ Designate areas for licensed liquid waste management facilities in all major towns and market centers within the county.
- ❖ Establish mechanisms facilitating the recycling of liquid wastes particularly in the urban areas and major towns.
- ❖ Assist rural communities construct pit latrines within homesteads.
- ❖ Rehabilitate and/or renovate existing public toilets and construct new ones where none exist in town and market centers.
- ❖ Oversee the management of public restroom facilities to ensure that they continue operating under the required public health standards.

10.3. 3 Water Quality

The County of Turkana shall:

- ✓ Enforce the relevant provisions of the Environment Management and Coordination Act (EMCA), 1999, Chapter 387 relating to the prevention and prohibition of water pollution.
- ✓ Construct appropriate water troughs for watering livestock away from water bodies.
- ✓ Support efforts aimed at protecting and conserving water catchment areas.
- ✓ Embark on licensing car wash facilities to ensure that the required water disposal standards are met and penalties imposed where these are not adhered to.
- ✓ Enforce license requirements for the operation of slaughterhouses to ensure that disposal of wastes is done according to the law and license conditions.

- ✓ Identify and designate official cemetery sites in all major towns and market centers.
- ✓ Establish mechanisms for instance through issuing burial permits to ensure that burials are conducted appropriately.
- ✓ Support the capacity building of water resources users' associations (WRUAs) and involve them in the process of designing and managing water projects.
- ✓ Establish mechanisms that allow for the enforcement of communities' Constitutional right to clean and safe water.

10.3.4 Air Quality

The County of Turkana shall:

Enforce the relevant provisions of the Environment Management and Coordination Act (EMCA), 1999, Chapter 387 relating to the prevention and prohibition of air pollution.

Enforce the legal stipulations pertaining the sustainable exploration and extraction of oil and gas as provided for in the national legislation regulating the exploration and extraction of oil and gas and in the Environment Management and Coordination Act, 1999 as amended in 2015.

Enforce the anti-air-pollution standards set out for the release of methane gas by slaughter houses.

Establish mechanisms in collaboration with the Kenya Forest Service (KFS) and in accordance with the relevant provisions of the Forest Conservation and Management Act, 2016 to ensure that a certain level and variety of indigenous tree species are maintained to ensure that these do not go into extinction as they play a vital role in regulating air quality.

Establish mechanisms in collaboration with the National Government that ensure that airstrips are situated at least ten km from towns.

Where garbage has to be burnt, designate areas away from residences and establishments for the same.

Make provision for environmentally friendly technologies to be used for burning wastes; and providing environmentally friendly technologies to be used for smoking and drying fish.

10.3.5 Reduction of the Prevalence of Plastics

The County of Turkana shall:

- ✓ Establish mechanisms to encourage the use of bags from biodegradable materials such as from the leaves of the doum palm and leather by placing a tax on plastic bags.
- ✓ Encourage the use of water bottles that can be recycled by placing a tax on plastic bottles.
- ✓ Put in place mechanisms to encourage the recycling of plastics particularly through Public Private Partnerships (PPPs).

10.3 6 Soil Quality

The County of Turkana shall:

- Enforce in collaboration with the national the requirements pertaining to public participation before EIA licenses are given to mining and oil drilling companies.
- Enforce the condition of site rehabilitation as set out in EIA licenses.
- Establish mechanisms that facilitate the construction and use of incinerators to disintegrate unrecyclable, hazardous and toxic wastes.
- Set up mechanisms that permit motor bike and motor vehicle garages to operate only upon being issued with licenses.
- Enforce the conditions set out in the licenses issued to motor bike and motor vehicle garages regarding the disposal of oil and any other items that pose environmental threats.
- Put in place a disposal facility for waste oil in urban areas.
- Establish mechanisms to facilitate the exploration and implementation of alternative beneficial uses of tree and plant species that are considered invasive.

- Establish mechanisms that encourage and empower community members to engage in tree planting and maintenance initiatives to prevent flash floods.
- Establish mechanisms in collaboration with (KFS) and in accordance with the relevant provisions of the Forests Conservation and Management Act, 2016 to ensure that a certain level and variety of indigenous tree species are maintained to ensure that these do not go into extinction as they play a vital role in maintaining good soil quality.

10.3.7 Regulating Charcoal Production

The County of Turkana shall:

- ✓ Enforce the provisions of the Forests (Charcoal) Regulations, 2009 as read together with the relevant sections of the Forest Conservation and Management Act, 2016.
- ✓ Set up mechanisms for facilitating improved coordination between the relevant County Government Departments, the Kenya Forest Service and the affected communities.
- ✓ Establish mechanisms to enforce the use of modern technology in charcoal production to reduce pressure on trees; particularly indigenous species as a source of raw material in charcoal production.
- ✓ Establish mechanisms to encourage the use of tree species that are considered invasive such as *Prosopis juliflora* as a charcoal production raw material.

10.3 8 Noise Pollution Control

The County of Turkana shall:

- ❖ Enforce the relevant sections of the Environment Management and Coordination Act, 1999 as amended in 2015; as regards permitted noise levels.
- ❖ Set up mechanisms detailing the process of obtaining a license to exceed the recommended noise levels.

10.3.9 Vibrations from Mining Activities and Oil and Gas Exploration and Exploitation

The County of Turkana shall:

- Enforce the relevant sections of the Environment Management and Coordination Act, 1999, Chapter 387 regulating vibration levels.

10.4 Climate Change Mitigation and Disaster Management

The County of Turkana shall:

- ✓ Develop and implement a robust Climate Change Adaptation Programme in line with the National Climate Change Strategy (NCCS).
- ✓ Identify and raise awareness amongst the people of Turkana County on the opportunities for adaptation measures through promotion of appropriate technology transfer and capacity building.
- ✓ Develop an integrated and improved County early warning and response system for climate and disaster risks with a clear strategy for dissemination of information at the grassroots.
- ✓ Integrate traditional adaptation and early warning mechanisms into the County climate change programmes.

10.5 SWOT Analysis of Environmental Resources

(A)Land Resource

Strength ✓ Have some parts of land that are productive under irrigation scheme. ✓ Have wildlife protection areas.e.g Loima Hills,south turkana national and central island national reserve where wild life are mainly found.	**Opportunities** ✓ There is potential to better manage urban interface with rural-resource lands. ✓ Increased food production through improved irrigation farming enhancing food security. ✓ Numerous undeveloped road right of ways provide opportunities for access to facilities such as those found by the Lakeshores e.g Eliye Springs. ✓ Potential flexibility of housing types and styles especially due to projected population increase due to improved economic activities in major towns such as Lodwar,Kakuma,Lokichogio.
Weakness ✓ The land is majorly unproductive for agriculture. ✓ Poor land policy derail sustainable exploitation of land e.g. Land in Turkana is communally owned under the trust of County Government.	**Threats** Mining / resource extraction threaten community use, enjoyment i.e. recreation, grazing lands.

(B) Wildlife

Strength Abundant wildlife enhances quality of life	**Opportunities** Park development will enhance ecosystem protection and thereby promote ecotourism.
Weakness Most residents are not aware of wildlife benefits which leads to human-wildlife conflict	**Threats** Long periods of dry spell are a threat to the forest ecology which is the main habitat for wildlife.

(c) Forests/Vegetation

Strength ✓ The types of forests found in the district are Lake shore forests,Riverine forests,Wood shrub land and Hill top forests. ✓ Vegetation found also includes; dense bushland, bushland, wooded annual grassland, woodland, wooded dwarf shrub land, and dwarf shrub land.	**Opportunities** ✓ The forest products are charcoal, wood carvings, fencing posts, firewood, aloe vera and herbal medicine. ✓ The resource is also used to produce timber for construction and other related use.
Weakness There is no gazetted forest in the county.	**Threats** ✓ Problem of deforestation e.g. deterioration of vegetation around the refugee camp and harvesting zones, firewood harvesting for refugees. ✓ Problem of conversion of forest areas and expansion of land for irrigation which are common in the county.

	✓ Lack of adequate facilitation for conservation and management. ✓ Encroachment of invasive plant species that are a threat to the existing forest biodiversity.e.g *Prosopis juliflora*(Mathenge)

D)Lake Turkana

Strength It is home ground for a good number of fisheries resources.	**Opportunities** The lake is a tourist attraction
Weakness It is salty water lake due its nature of lack of outlet. The lake water also has high amounts of silt and organisms.	**Threats** The lake is said to be receding at an alarming rate. It also faces challenge of siltation and contamination especially with the recent discovery of oil and gas resource in the county.

CHAPTER 11
POLICY ANALYSIS AND OPTIONS FOR ACTION

11.1 Introduction

Kenya has ratified a number of UN Conventions also known as Multilateral Environmental Agreements (MEA) which were proposed at the United Nations Conference on Environment and Development (UNICED) in Rio de Janeiro, Brazil, in 1992.These agreements were built around a set of principles and obligations related to the protection of the Earth and to the improvement of the quality of life of its inhabitants through sustainable development**.** Turkana County has developed the following frameworks to encourage proper management of the environment;

a) Gazzetted Turkana County Environment Committee

b) Developed Turkana County Climate Change Adaptation Plan

c) Mainstreamed Climate Action into the CIDP

d) Developed Turkana County Environment Policy

e) Developed Turkana County Climate Change Policy

f) Developed Turkana County Environment Management Bill, 2020; Turkana County Climate Change Bill which are currently in the process of enactment by the Turkana County Assembly.

Some of the conventions ratified by Kenya include:

11.2 United Nations Convention on Biological Diversity (CBD)

Kenya ratified the CBD in 1994.NEMA is the institutional Focal Point of the Convention

It aims to;

- ✓ Conserve biological diversity for its intrinsic value.
- ✓ Provide for sustainable use of its components.
- ✓ Provide for fair and equitable sharing of the benefits arising from the utilization of genetic resources.

For Example:

Locally, the policy has been used to protect the major biodiversity's under threat include; *Aloe turkanensis, Salvadora persica,* fish species in Lake Turkana e.g Nile perch, Turkana mud tuttle (*Pelusios broadleyi)* and Turkana Toad *(Bufo turkanae)*

11.3 United Nations Framework Convention on Climate Change (UNFCCC)

Kenya ratified the UNFCCC on 30th August; 1994.NEMA is the institutional Focal Point of the Convention

It aims to;

- ✓ Gather and share information on greenhouse emissions, national policies and best practices.
- ✓ Launch national strategies for addressing greenhouse emissions and adapting to expected impacts, including the provision and technological support to developing countries.

The policy has been used in the oil industry to try and manage the gaseous effluents though there is still a lot to be done to stop the flaring.

11.4 United Nations Convention to Combat Desertification (UNCCD)

The international community has long recognized desertification as a major economic, social and environmental problem of concern to many countries in the world. In 1997, the UNCCD adopted a Plan of Action to Combat Desertification (PACD).

As result, the question of how to tackle desertification became a major concern for UNCED in1992.

There is no specific law in Kenya on desertification, but the issues addressed under sectoral legislation including; Water Act 2002(Cap 372), Forest Act 2005 (Cap 385), Wildlife Conservation and Management Act (Cap 376).

11.5 The Environment Management and Coordination Act (EMCA)1999

Has harmonized the sectoral laws and has addressed to a great extent, the required policy, legal and institutional framework to facilitate actions to mitigate against specific negative impacts on the environment

EMCA 1999 was enacted against a backdrop of 78 sectoral laws dealing with various components of the environment, the deteriorating state of Kenya's environment, as well as increasing social and economic inequalities, the combined effect of which negatively impacted on the environment. The supreme objective underlying the enactment of EMCA 1999 was to bring harmony in the management of the country's environment.

11.5.1 Regulation under EMCA 1999

a) **EIA & Audit regulation 2003**-EIA ensures that decision on proposed projects and activities are environmentally sustainable.

   It generates baseline data for monitoring &evaluation of impacts during project cycle.

   The Turkana environment office monitors and evaluates EIA/EA project reports submitted for medium and low risk projects especially; Irrigation Schemes, Boreholes.

b) **Water quality regulation 2006-**

   The objective of the regulations is to protect human health and the environment. In Turkana County, the regulation has been applied in controlling disposal of effluent wastes especially wastes from exploration Camps-Tullow and CEPSA Camps, hotels and lodges.

c) **Waste management regulations, 2006**-

   Waste minimization, cleaner production & segregation of waste at source

   The Turkana county government is in the process of designating a dumpsite to enable effective implementation of this regulation and promote a cleaner Turkana county.

   Wetlands, River Banks, Lake Shores and Sea Shore Management Regulations,2009-

   This particular regulation has been very instrumental in protecting riparian reserves given that agricultural activities are mainly concentrated around irrigation schemes e.g River Turkwell,Kerio River. The activities around this riparian area are regulated through issuance of Water Resource Use Permits and EIA licenses for the projects in question.

d) **Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing, 2006.**

This regulation aims to identify and prepare an inventory of biological diversity including threatened, endangered and rare species;

This is to aid in monitoring the status and components of biological diversity and take necessary measures to prevent and control their depletion.

For Example, in Turkana County species under threat include*; Aloe turkanensis*

11.6 Policy Analysis and Adoption

Table 21: Illustration of Policy Analysis and options

Legislation	Description	Current status of implementation	Implementation/ issues arising	Action	Responsible entity
Environment Management and Coordination Act,1999	- EMCA,1999 provides for the establishment of an appropriate legal and institutional framework for the management of the environment and related	- NEMA established. - Established County Environment Committee - EIA adopted - County Environment offices operationalized. - 8 environmental Regulations gazette	-Low awareness level. -Inadequate legal and administrative co-ordination of the diverse sectoral initiatives. -Conflicting with existing law. -Non-compliance laxity. -Non-deterrent punishment.	Enforcement, Amendment, Awareness creation, M & E.	NEMA, County Government, County Environment Committee
Turkana County Environment Policy	- Has Policy statement on County Environmental management	- Operational	Low awareness level, Lack of funds to operationalised	Awareness creation, Improve budgetary allocation for Environment	Turkana County Government, MWEMR, County Environment Committtee
Turkana County Environment Bill, 2020 (Yet to be enacted)	- Contains provisions on proper management of the environment in Turkana. Customized from EMCA 1999 to appreciate devolution	**Enactment process ongoing**	**Not yet**	County Assembly to enact	TCG and Turkana County Assembly
Turkana County Climate Change Policy	- Has Policy statement on County climate change mainstreaming to sectors	- Operational	Low awareness level,	Awareness creation, Improve budgetary allocation for climate change	Turkana County Government, MWEMR, County Environment Committtee

Turkana County Climate change Bill, 2020 (yet to be enacted)	- Contains provisions on climate change mainstreaming, greenhouse gases reduction, establishment of climate change committees and establishment of climate financing structures	- Enactment process ongoing	Not yet	County Assembly to enact	TCG and County Assembly
Turkana County Climate change fund regulation (yet to be published0	- Establishes Climate change fund and sets a side 2% of Turkana County Development budget towards climate actions	- Publication process ongoing	Not yet	County Executive finance and Environment to publish	County Executive finance and Environment to publish
EIA & Audit regulation 2003	- EIA ensures that decision on proposed projects and activities are environmentally sustainable - It generate baseline data for monitoring &evaluation impacts during project cycle	- Good	Low level of awareness	Sensitization	NEMA, TCG
Water quality regulation 2006	- Water quality recreational purposes, water used for fisheries and wildlife purposes & water used for any other purposes. - Different standards apply different modes of usage - The regulation provide for protection of water bodies	- The objectives of the regulations are to protect human health and the environment. - The effective enforcement of water quality regulations will reduce water-borne diseases	Low level of awareness	Sensitization	NEMA, TCG
Waste management regulations, 2006	- Section 92 &147 of the EMCA Act no.8 1999 - Waste management regulations are meant to streamline handling,	- Waste minimization, cleaner production & segregation of waste at source	Low level of awareness	Sensitization	NEMA, TCG

	transportation & disposal of wastes				
Water Policy (Sessional paper No. 1 of 1999)	- Separation of functions (water resources management, water service, policy, regulation and financing) - Decentralisation (devolving to regional and local levels) - Commercialisation (water treated as an economic and social good) - Stakeholder participation (through community and private sector participation)	- There is improvement water resources management, water service provision and financing of water sector.	No major issues	Create awareness	WRMA,
Turkana County Water Act 2019	- New institutions with separate functions, decentralized decision making.	- Various institutions have been created with distinct mandates.	Regulations and structures not formed	Form structures and publish regulations	Directorate of Water Services, TCG
Water Resources Management Rules 2007	- Set of regulations in line with Water Act 2002.	- Non-compliance to the Rules despite wide stakeholder consultation during the rules preparation	Compliance to regulation of water use not given priority except when there is serious problem	Sensitization of the leaders on the importance of regulation.	WRMA
Agricultural act	Agricultural Act Cap 318 provide for prohibition of land use where o land is protected against gulleys, floods, soil on ridges and in valleys. It provides for protection of the riverine and maintenance of water bodies, for preservation of soil fertility for reforestation and afforestation and application of land use methods compatible with biological diversity, prohibition of	- MOA established. - Environment and land development division in all extension units.	Non-compliance. Non- deterrent punishment.	Enforcement. Follow-ups. Domestication by communities.	NEMA/MOA Lead agencies

	introduction of alien species in farmlands and natural habitats,				

APPENDICES

Appendix I. Resources

Resource	Distribution	Description/status	Use	Quantity	challenges
Land and land use	The entire county	The land is communally owned and is under the trust of the county government. The average mean holding size stand at two acres/household The land doesn't have title deed except three people in the entire county.	Used for human settlement Also used for agricultural activities e.g. livestock keeping, crop farming, bee keeping etc.	The total land mass in turkana after excluding water mass is 61,120.3 km^2	The land is majorly unproductive for agriculture. Poor land policy derail sustainable exploitation of the land.
Crop	Farming is concentrated along river turkwel and kerio	Main crop produced are sorghum, millet, maize and vegetable i.e. kales. farming is mainly irrigation. Initially there was cotton production in katilu but currently there isn't any cash crop farming being practiced in the county. Main storage facilities for farm produce are traditional granaries however the county has an NCPB store located in Lodwar.	Provide food to human being for consumption. Provide fodder for livestock.	Acreage of land suitable for arable farming is 25,000 km^2. The average farm size is at least 2 acres/farmer	Unreliable rainfall pattern in the county. Poor soil for agriculture The problem of climate change that is worsening the situation.
Fisheries resources	Mainly found in lake turkana	The main types of fish found in the counties water bodies are tilapia, mudfish, nilepearch, king fish and catfish. There are many other species of fish that are harvested in the lake. The county has 23 registered landing beaches and some of them are longech, eliye springs, kalimapus/namadak,merrier, lowareng'ak, lomekwi and kalokol.	The resources are consumed locally as white meat reach in protein. The resource is also exported to other market outside the county.	The resource is found in water bodies that covers 7,560 Km^2	Lack of modern fishing gears making the resource under exploited. Over exploitation especially near the shore due to lack of sophisticated fishing equipment that can handle deep fishing.
Biodiversity	Major Eco systems include Loima hills forests, Dry land flat plains, Mountain ranges, Riverine vegetation, springs and other watering points	The types of ecosystem biodiversity include mountain range eco system, perennial grasses, riverine vegetation eco system, riverine vegetation eco system, trees and shrubs, marine and inland water ecosystem	They are important sources of food, beverages, medicine, forage, vegetable oil, fibre and hides and skins	vegetation in the county is about 12,500 km^2 the wildlife occupy 2km^2.	Deforestation Lack of soil and water conservation measures. Invasive species Drought Overgrazing Forest encroachment

		Many species still remain unknown because they have not been documented or not yet even discovered			for settlement and farming Poaching of wildlife Destruction of wildlife migratory corridors and dispersal areas Wildlife diseases. Wild fires caused mainly by poor honey harvesting activities Livestock restocking after droughts Insecurity Inadequate watering points and or distribution Frequent droughts
Wildlife	There are two national reserves i.e south turkana national and central island national reserve where wild life are mainly found.	Wildlife found in the county include crocodiles, monitor lizards, flamingoes, fish snakes, elephants, dikdik, zebra, hyena, pythons, baboons and monkeys.	Used for tourism that fetches the county revenue foreign exchange.	2 km^2 The number of wildlife existing are: crocodiles; 1700, elephants 280, jackals 150, hyenas 250, buffaloes 200 and 2000 flamingoes.	Frequent drought and famine. Environmental degradation. Deforestation. Climate change. Poaching.
Forest/vegetation	There is no gazetted forest in the county. The types of forests found in the district are Lake shore forests,Riverineforests,Wood shrub land and Hill top forests.	The type of vegetation found are forest, dense bushland, bushland, wooded annual grassland, woodland wooded dwarf shrub land, dwarf shrub land, shrub land, riparian forest, woodland, The species found are *juniper procera,losoniainamis, euphobianyikaye, papaecapensis, acacia Senegal,acaciatortils, anstidamotabilis, indigofersspinosa, heliatrophiumstaeudleri, acacia refeciens, sederabirsuta, indigoferacliffordiana, sericocomopsishilderbrandtii, sedderahiruda, balanitesaegypitica, salvadora Persia, hypbaenevetirosa,*	The forest products are charcoal, wood carvings, fencing posts, firewood, aloe vera and herbal medicine. The resource is also used to also used to produce timber for construction and other related use.	The forest cover in the county is approximately 20,000 km^2	Problem of deforestation e.g. deterioration of vegetation around the refugee camp and harvesting zones, firewood harvesting for refugees, . Occassionaly forest fire. Problem of conversion forest areas and expansion of land for irrigation wich are common in the county Climate change is

		slanamcoagulanus			posing a challenge to its survival. Lack of political good will in the conservation effort. Lack of adequate facilitation for conservation and management.
Water resources	The county is divided into four major Catchment areas namely: - Suguta,Lake - Turkana,Lotikipi plains - Sanderson Gulf. The Major rivers in the district are; - Kerio, - Turkwel, - Tarach - Suguta River. The water resources are mainly concentrated in - Loima, - Kibish - Lomelo.	Most of the rivers and their respective lagga system in Turkana tend towards east to the Lake Turkana. As they move they collect a lot of dissolved substances and that's why the water in these rivers are very turbid. Fresh water boreholes are contained along major rivers/laggas and on tertiary volacanic.	The water resources are used for domestic use i.e. drinking washing. They are used agricultural activities e.g. irrigation farming. Livestock use them for drinking.	The total water mass in the county is 7,560 Km^2 of which there are 101 boreholes, 3 protected springs, 10 unprotected spring, 44 waterpans, 231 shallow wells and 35 dams	There is a reduced river flow due to climatic Changes. Harsh climate that challenge their sustainability. Contamination of the resources. Climate change.
Lake	It stretches from the ethipian boundary passing through some part of turkana north, turkana west and turkana central	Lake Turkana is mainly fed by Omo River (Contributes about 95% of the waters) which Originates from Ethiopia. It is salty water lake due its nature of lack of outlet. Turkwel and Kerio rivers also drain into the Lake. The lake has a pH of (8.6-10.6) It has high content of sodium and potassium and high content of total dissolved solids. The lake water also has high amounts of silt and organisms. The water quality is not homogeneous.	Lake is used for navigation purposes. It is home ground for a good number of fisheries resources. The lake is also a tourist attraction.	The lake is one	The lake is said to be receding at an alarming rate. It also faces challenge of siltation and contamination especially with the recent discovery of oil and gas resource in the county.

		The water is of 'better' quality near the Omo Delta and has low salinity.			
Livestock	Distributed in the entire county but mainly concentrated in the southern part of Turkana county	The main types of livestock being bred are cows, shoats-goats and sheep, camel. Donkeys and poultry mainly chicken. Most of the breed are local breeds.	Use for production of milk, meat, and hides. Used for cultural values i.e. prestige(the quantity symbolize the extend of wealth and thus respect).	The number of livestock in the county are as follows: Cattle 356,100 Sheep 1,623,190 Goats 433,990 Bee hives 19,205	The county has no ranches. Livestock diseases that are prevalent in the area. Poor yielding breed that don't meet the local demand adequately. Hostile climatic condition hampers the livestock farming. Inadequate rainfall

Appendix II: List of participants

S/NO.	NAME	DESIGNATION	ORGANIZATION	TEL NO.
1.	CHRISTOPHER ALETEA IMANA	CEC MWEMR and Chair Environment Committee	TCG- MWEMR	0715786938
2.	MOSES NATOME	Chief Officer Water Environment and Mineral Resources	TCG-MWEMR	0728660932
3.	CLEMENT ETABO NADIO	Director Environment	Turkana County Govt	0724088911
4.	STELLA TOTO OPAKAS	Director Mineral Resources	Turkana County Govt	0725890955
5.	JOSEPHAT LOTOME CHAMA	CTEC Member/Director Land Reclamation	Turkana County Govt	0711666160
6.	DUNCAN MUMO KIMWELE	Deputy Director Mineral Resources	Turkana County Govt	0722905216
7.	JACOB ASEMBO	CDE NEMA, Turkana County	NEMA	0723940444
8.	CHRISTINE NALEMSEKON	Sub county Administrator/CTEC Member	Turkana County Govt	0725070942
9.	PAULINE NGOLI PUSIYE	Director Mineral Resources/CTEC Member	Turkana County Govt	0729917542
10.	MOLLEN KWAMBOKA ONDERI	Director Trade/ CTEC Member	Turkana County Govt	0723149424
11.	VICTOR LEKARAM	Director Economic Planning/CTEC Member	Turkana County Govt	0721862864
12.	SARAH AKIRU ESINYEN	Deputy Director Policy/CTEC Member	Turkana County Govt	0724209070
13.	SAMUEL KUWOM EREGAE	Director Education/CTEC Member	Turkana County Govt	0718737987
14.	KENNEDY OMONDI OBONGO	Director Public Works/CTEC Member	Turkana County Govt	0722857807
15.	STEPHEN KARUE NJOROGE	CTEC Member	Turkana County Govt	0720679215
16.	SAMUEL NJIHIA	WRA Sub-regional Manager /CTEC Member	WRA	0757886398
17.	CONSOLATA KIYONGA	CTEC Member	Community Rep	0713767847
18.	VINCENT EKIPOR LOBWIN	CTEC Member	Community Rep	0720028155
19.	PENINA LOTARUK	CTEC Member	Community Rep	0702980713
20.	MICHAEL NANGODIA SIANGALE	CTEC Member	Community Rep	0714376612
21.	FRANCIS ESIBITAR LOPOTEA	CTEC Member	Community Rep	0711879610
22.	JACOB MUTUA	Turkana West Sub-County Environment Officer	Turkana County Govt	0729451681
23.	WILLIAM MBOTELA	Turkana East Sub-County Environment Officer	Turkana County Govt	0727848942
24.	EKARAN SAMUEL	Loima Sub-County Environment Officer	Turkana County Govt	0774360045
25.	MARK ARUS	Turkana North Sub-County Environment Officer	Turkana County Govt	0702863518
26.	FRANCIS EKAALE	Turkana Central Sub-County	Turkana County Govt	0740876899

		Environment Officer		
27.	JOHN LONGORI	Kibich Sub-County Environment Officer	Turkana County Govt	0717663675
28.	LYDIAH EJORE	Turkana South Sub-County Environment Officer	Turkana County Govt	0712850709
29.	RAPHAEL KHAEMBA	CLO	MOA	0712846203
30.	SAMUEL MUTAI	CDMS	MEMNR	0727791866
31.	DAVIES MUNIALO	DIRECTOR PHYSICAL PLANNING	MIN. OF LANDS	0723518554
32.	AUGUSTINE LAMBERT		IOM	0713811920
33.	KIPROTICH KIPTUI	CDLP	Livestock Production Dept.	0713828692
34.	LOPONGO SOSPETER AKIPOR	YOUTH COUNCIL SEC.	NATIONAL YOUTH COUNCIL, TURKANA	0718087935
35.	LAWRENCE LOLII		KERRA	0722447386
36.	JOSEPH NGASIKE	MIN. INFTRASTRUCTURE AND HOUDING	MIN. INFTRASTRUCTURE AND HOUDING	0729005173
37.	EYOMO E.SIMON	MEMBER	YOUTH COUNCIL	0706572053
38.	EKIDOR LINUS	CO-ORDINATOR	DOL	0713217810
39.	SAMUEL NJIHIA	SUB REGIONAL MANAGER	WRMA	07344254585
40.	WMK TAIY	CC	ASDSP	0722434021
41.	KORIR K.HILLARY	LRO	TRP	0725895585
42.	DIANA A.MANYALA	SECRETARY	SOCIAL SERVICES	0700400735
43.	EPHRAIM LOJUU	GS	LAW COURTS LODWAR	0705661755
44.	SUSAN NGETICH	SA	LAW COURTS LODWAR	0711341419
45.	PATRICK MWENJA	RESEARCH ASST.	KEFRI	0716352635
46.	VICKLINE MUGA	COMMUNITY DEVT TECH, ASST.	JICA-ECORAD	0729778893
47.	SAFARI (KFS)	KFS	Ecosystem Conservator	0721246864
48.	JOSPHAT ERUPE	KWS	Senior Warden	0724954745
49.	TIMOTHY KITONYI	COUNTY WARDEN	KWS	0724887567
50.	ESTHER L EMURON	PROJECT OFFICER	APaD	0710357853
51.	PAUL EKUCHEI	BM	CO-OP BANK	072184198
52.	STELLA OPAKAS	DIRECTOR MINERAL RESOURCES	TCG-MWEMR	0725890955
53.	DANCAN KIMWELE MUMO	DEPUTY DIRECTOR MINERALS	TCG-MWEMR	0722905216
54.	JAMES LOKWALE	DIRECTOR TRADE	TCG-TRADE	
55.	CHARLES EKAI	DIRECTOR RESOURCES MOBILIZE	TCG-FINANCE	
56.	NICHOLAS MAIYO	DIRECTOR FINANCE	TCG FINANCE	

ANNEXES

Annex I: Implementation Matrix

	Priority Issues	Objectives	Output	Activities	Target Area	Lead Institution(s)	Time Frame	Budget
Settlements & infrastructure	- Unplanned human settlement, slums, - solid waste management, - sewer system	To reduce unplanned settlement, slums, To manage poor sanitation	- Planned human settlement, - upgraded slums, - appropriate waste disposal systems	- Preparation of development plans - Upgrading of slum, - Apply and enforce water quality and waste management regulation - Promote land use planning - Designate waste disposal site	Planned towns	County Govt, Municipality, NEMA	5 years	100M
Environmental research	- Unsustainable production, utilization and marketing of wood and non-wood forest products, - Importance of forests Estimation of carbon sink, deforestation and forest degradation	To promote research in dry land forestry	Research reports, research demonstration plots, workshops	- Carry out research on dry land forestry, - enhance technology transfer through demonstration,	Biodiversity hotspots like the Mau.	KEFRI, KFS, NEMA, Turkana University College, TCG, TCEC, Partners	5 years	700M
Gender and Environment	- Impact on water, energy and climate change related challenges on women in urban and rural areas.	To reduce challenges of water, climate change and energy on women.	Water and energy accessibility, climate change adaptation strategies	- Promote water harvesting and storage technologies, - promote efficient energy sources, - develop climate change adaptation mechanisms.	Turkana County	Min. of Gender ,youth, water, energy, NGOs, TCG	5 years	150M
Socio-economic	Poverty HIV/AIDS	To improve living standard	- Reduced rate of HIV/AIDS	- Promote credit accessibility	Whole county	Kenya National Bureau of	5 yrs	410M

	Cultural changes Unemployment Unsustainable charcoal production	and human health To promote sustainable Charcoal	prevalence - Increased opportunity and enhanced livelihoods options - EIA licenses and permits and routine inspections on charcoal making	- Promotion of youth enterprise programmes - Awareness Creation - Law enforcement charcoal making		Statistics, Ministry of Devolution and planning, County Government, NEMA, KFS, Natural Resources, Environment Directorate, MOH		
	Priority Issues	**Objectives**	**Output**	**Activities**	**Target Area**	**Lead Institution(s)**	**Time Frame**	**Budget/5yrs**
Climatic Change/ Variability	- Frequent drought - Flooding, - Rise in Lake Turkana level, - Rise in temperature, Salinity, - Change in water density. - Impact of climate change on agriculture, livestock, water, gender and biodiversity	To mitigate climate change impact on agriculture, livestock, water, gender and biodiversity	Mitigation strategies/mechanisms such as sustainable agriculture, livestock, eco-development, clean development projects etc	- Training Fishermen, pastoralists on alternative means of livelihoods - Establish drought tolerant crop and range seeding, - Plant early maturing crops. - Construction of storm water system - Establishing early warning system for monitoring climate change, - Develop sustainable agricultural systems, - Conserve biodiversity hotspots, - ensure development projects are ecosystem friendly - Afforestation & re-	Whole county, Lake Turkana, Agricultural land, water catchments and biodiversity hotspots.	Metrology Department, NEMA, KFS, Natural Resources, Directorate of Environment, Ministry of Agriculture, Livestock and fisheries, WRMA, Department of Environment, TCEC	5 Yrs	170M

				afforestation - eg river banks				
Biodiversity	- vegetation degradation - Encroachment of development activities on riparian reserves - Overexploitation of natural resources - Loss, degradation and fragmentation of ecosystems - Threatened biodiversity hotspots, - Impacts of invasive species - To utilize untapped eco-tourism potential	To protect and conserve biodiversity	Catalogue of threatened biodiversity, invasive species maps of biodiversity hotspots, conservation strategies	- Research on threatened biodiversity, - surveying and mapping of biodiversity hotspots, - development of conservation strategies - Preserve the biological diversity in the county - Involve the community in wildlife management - Regulate activities of herbal doctors with regards to access to genetic resources - Plant indigenous trees - Protect natural ecosystems - Stop illegal logging	Turkana South National Reserve, Lotikipi National Reserve, Loima Forest, Riverine Forest, prosopis juliflor, Central Island and other Biodiversity hotspots	KWS, Fisheries department, KFS, NEMA, Environment Directorate, Natural Resources, KEFRI	5 Yrs	28M
	Priority Issues	**Objectives**	**Output**	**Activities**	**Target Area**	**Lead Institution(s)**	**Time Frame**	**Budget/5yrs**
Forests, Woodland and Grasslands	- Illegal cutting of Trees, Wildfires, Encroachment, - Prosopis colonization, - Inadequate capacity within communities to understand the importance of	To promote sustainable forest management; To conserve and protect the existing vegetation in gazette areas; To	Forest management plans, permits on forest use and products Increased forest cover Sustainable use of forest resources	- Tree planting, - Survey and mapping of boundary - Preparation of settlement action plan, - Resettlement exercise, - Surveying and	Turkana County	KFS, KEFRI, County Government, Partners	5 yrs	5.5M

	conserving biodiversity, - overgrazing, - overexploitation of some tree species for timber, medicine, - invasive species, - climate change among others.	build capacity of communities on conservation forestry; To regulate use of forest resources.		mapping of forest areas. - enforcement of laws on licensing and permitting of forest use and forest products tree nursery establishments. - Tree planting in degraded sites. - Promotion of farm forestry/ agro forestry. - Regulation on herbalists				
Land	- Unsustainable land uses - Poor land adjudication - Land tenure - Land use - Zonation - Restoration of degraded lands	To promote sustainable land uses, To put in place planned human settlement and develop land use plan	Developed land use plan and planned human settlement	- Preparation of land use plan, - Land registration, - surveying and mapping of land	Whole County	Ministry of lands, Urban and housing	5 yrs	150M
Agriculture	- Soil erosion, - Poor post-harvest handling, Poor marketing structure, - Inappropriate use of pesticides and fertilizers, - Unsustainable land clearing & preparation, - Mono-cropping, - unsustainable use of chemicals, fertilizer - Impacts of climate change	To enhance food security To promote sustainable soil conservation, To reduce high rate of soil erosion and low crop yields	Food security enhanced Soil erosion Arrested, Reduced soil erosion/ land degradation Increased crop productivity/ food security	- Soil conservation, - Training farmers on appropriate agricultural practices, - Provision of extension services, - Training farmers on value addition and processing, - promote water harvesting and storage technologies, - Control of	Turkana South, Turkana East, Loima, Along the Rivers, Water catchment areas in the county	Ministry of Agriculture, Livestock and Fisheries, NEMA, County government	5 yrs	132M

				agrochemicals based pollution - intensifying river bank protection - Initiate appropriate soil conservation measures - Afforestation & re-afforestation programmes - Promote roof water catchments - Promote agro-forestry - Crop diversification				
Livestock and Fisheries	- Overgrazing, - overstocking, - livestock diseases, - Untreated effluent discharge by slaughter house and hatcheries, - Inadequate pasture and forage due to overstocking	To promote sustainable livestock and fisheries production, processing and marketing, To reduce land degradation, To increase livestock productivity	- Setting up waste treatment facility for slaughter Slabs - Pasture and forage growing conserved and enhanced, - Appropriate livestock and fisheries production, processing and marketing technologies developed - grazing plans	- Identify slaughter houses without effluent treatment facility and advice on installation. - Appropriate livestock and fisheries production, processing and marketing technologies - Improved pasture/ seed stock - Controlled grazing especially in the forest - Control animal diseases - Plant fodder trees/ crops	Whole County	Ministry of Agriculture, Livestock and Fisheries, KWS, KMA, NEMA, KEFRI, KFS, County Government	5 yrs	348M
Fisheries	- Soil erosion and siltation - Pollution of water bodies - overfishing	To promote utilization of fisheries resources, improve market and quality control	Improved Livelihood	- Research to determine unstainable harvesting license. - Regulation of fishing seasons. - Regulated use of fishing ear. - Enforce legislation on proper fishing Practices.	Lake Turkana	Ministry of Agriculture, Livestock and Fisheries, NEMA, County government	5 yrs	45M

				- Develop fishpond at household level/ institution level				
Water, wetland and marine	- Shortage of clean drinking water. - Contamination of underwater. - Salt water intrusion. - Over abstraction of ground water.	To manage and conserve water resources	Water resources conserved and managed	- Riverbank and shoreline protection. - Pollution control - Preparation of sub catchment management plan. - Enforcement of regulation.	Whole county	WRMA, NEMA, LOWASCO, KFS, KEFRI, KMA, County Government	5 Yrs.	350M
	Priority Issues	**Objectives**	**Output**	**Activities**	**Target Area**	**Lead Institution(s)**	**Time Frame**	**Budget/5yrs**
Health and Environment	- Sewerage system in urban areas, - inadequate incinerators, dust bins, transfer stations, informal and unplanned developments - Pollution. - Climate change. - Environmental disease. - Inadequate provision of sanitation and health services.	To promote sustainable waste disposal systems and planned development,To reduce ill health of the people.	Development plans, dump sites, waste bins, sewer systems, incinerators, Reduced environmental diseases, Provision of sanitation and health services, Reduced incidences of pollution and better management of biomedical waste.	- Enforcement of laws on development plans and waste disposal, - putting up a dump site, - upgrading of sewer systems, - installation of incinerators, waste bins - Apply and enforce waste management and water quality regulations - Providing vector control services. - Awareness creation on medical waste disposal. - Capacity building of service providers and the public. - Promote provision of sewage management system by household.	Private hospitals. Ministry of health, dispensaries and health centers. Private facilities. Urban centres	Ministry of Health, NEMA, TCG, Partners,	5 Yrs	56M

Water Resources	- To reduce degradation of water resources - To reduce/ avert water pollution - To increase community participation in water resource management	To promote improved water resource management Increased community participation in water resource mgt Decreased degradation of water resources	improved water resource management Increased community participation in water resource mgt Decreased degradation of water resources	- Protect and conserve water resources - Protection of springs, streams river banks and the riparian reserves - Undertake the appropriate soil conservation measures - Afforestation &re-afforestation of water catchments - Promote roof water catchments	The whole county	WRMA, County Govt, Public health, NEMA, MOA, Water CEC		
Emerging Issues	- *Prospis juliflora* spread, - Oil and gas exploration waste and gases - Extractives impacts - Noise pollution. - Vandalism of scrap metal. - Cultural change. - Flash floods.	To develop effective measures to handle emerging issues.	Effective measures Developed.	- Enforcement of relevant regulations. - Infrastructural provision. - Awareness creation on emerging issues.	Whole county.	County government, NEMA, National Security, KFS	5 Yrs	122 M
Environmental Governance	- Inadequate environmental standards and regulation - Low enforcement of Environmental laws. - Low public awareness and public participation.	To enhance implementation and further development of environmental laws and regulations.	Environmental laws and regulation implementation; Enhanced and developed.	Inspection, Awareness creation on laws and regulation	Whole County	NEMA , County Environment Committtee, County Government, National Security,	5 Yrs	10M

Annex II: Monitoring matrix

Sector	Activity	OVIS (Objectively verifiable indicators	MOVS (Means of Verification	Reporting schedule	Lead institutions for M & E.	Timeframe
Settlements and Infrastructure	- Preparation of land use plans, slum upgrading, and establishment of waste disposal systems	- No. of plans prepared, - No. of slums upgraded, - No. of waste disposal systems developed or upgraded	Master plans, maps Reports	Annual	Turkana County	5 years
Environmental research	- Carry out research on dry land forestry, establish demo plots and workshops	- No. of research projects undertaken, - No. of demonstration plots established	Reports Workshops Maps	Biannual	County Government, KEFRI, KFS, NEMA	5 years
Gender and environment	- Promote water harvesting and storage technologies, - promote efficient energy sources - develop climate change adaptation mechanisms.	- No. of new technologies and innovations developed	Reports Awareness workshops	Annual	Min. of Gender, Sociology and Youth, Water and Energy, NGOs, Partners, TCEC	5year
Climate change	- Develop sustainable agricultural systems, - conserve biodiversity hotspots, - ensure development projects are ecosystem friendly	- No. of adaptation technologies and innovations developed and adopted	Reports Technology dissemination workshops	Annual	County Government, Min. of Agric, Met, Energy, Universities, Research Institutions, , NEMA, Physical planning, WRMA	5 years
Socio-economic	- Promote credit Accessibility, - Promotion of youth enterprise funds, - Awareness creation, - Law enforcement on charcoal making, firewood collection and medicine harvesting	- No. of groups that have accessed credit. - No. of enterprise established by youth. - No. of awareness programmes/ training initiated. - No. of licenses given, No. of fines/penalties imposed	Reports	Annually	Ministry of Devolution and Planning, County Government, KFS, NEMA, Partners, TCEC	
Biodiversity	- Research on threatened biodiversity and invasive species, - eradication surveying and mapping of biodiversity hotspots, - Wildlife corridors development of conservation strategies. - Species and habitat conservation and management strategies.	- No. of biodiversity hotspots identified, - acreage of invasive species, - No.of corridors secured maps developed, - No. of management plans developed. , - Acreage of forest established - Status of inventory/ research on biodiversity.	Reports, Maps Management plans	annually	KWS, Fisheries Department, County Government, KFS, KEFRI, Partners, TCEC	5 years
Forest, woodland and grasslands.	- Surveying and mapping of forest areas, - forestations, - enforcement of laws on licensing and permitting of forest use and forest products.	- No. of maps produced, - acreage reclaimed, - no. of permits issued, - no. of penalties imposed	Reports Maps Reports, Management plans	Annually	KFS, Ministry of lands, urban Areas , KWS, NEMA, County Government commission, County Government, NEMA, KEFRI, KFS	5years

	- Resettlement exercise.					
Land	- Preparation of land use Plan, - Land registration, surveying and mapping of land	- No. of land use plan, - Acreage of new areas surveyed and mapped, - No. of land parcels registered.	Plans	Two years	County Government, Min. of lands, NEMA, KMD, Min of water & irrigation, NGO's Ministry of Devolution and planning.	5 years
Agriculture	- Soil conservation - Training farmers on appropriate agricultural practices - Provision of extension services	- No. of soil conservation structures made - No. of farmers trained, - No. of water harvesting technologies , - Soil conservation structures and innovations developed,area under extension services	Reports Technology dissemination workshops	Bi-annually	County Government, Min. of Agric, NEMA, KMD, Min. of water & irrigation, NGO's, Partners, TCEC	10 Years
	- Training of farmers on value addition and processing, - Promote water harvesting and storage technologies, - Soil and water conservation, - Extension services, - Control of agrochemicals based pollution, - intensifying river bank protection	- No. of extension visit made by officers.			County Government, Min. of Agric, NEMA, KMD, Min. of water & irrigation, NGO's, Partners, TCEC	
Livestock	- Promote appropriate livestock and fisheries production, - Develop Grazing Management Plans - processing and marketing technologies, - Identify slaughter house lacking effluent treatment facility and advice on installation.	- No. of livestock and fisheries production, processing and marketing technologies and innovations Plans developed. - No. of effluent treatment facility established by slaughter house	Reports, Technology dissemination workshop, Grazing Plans	Three years	County Government, Min. of Agric, NEMA, County Government, Min of water & Irrigation, NGO's	7 Years
Fisheries	- Research to determine sustainable harvesting - Licensing regulation of fishing seasons - Regulating use of fishing gears. - Enforcement of legislation on proper fishing practices. - Development of fishponds at household level/institution level	- No. of research done. - No. of license issued. - No. of training - No. of prosecution - No. of fish pond developed at household and institution level	Reports	Annually	MoALF, KEMFRI, County Government, NEMA, County Environment Committee	
Water resources and wetlands	- Awareness creation, - mapping of pollution sources, - law enforcement	- No.of awareness programmes, - point and non-point sources identified, - No.rehabilitated , Riverbank/shoreline	Reports	Annually	Min of water & irrigation, KFS, KWS NEMA, WRMA, NGO's, County Government,	5 Years

	- ,rehabilitation of water sources , Riverbank and shoreline protection - Pollution control - Preparation of sub catchment management plan - Enforcement of - Regulation, Surveying and mapping of wetlands, - development of management plans	distance protected, - Magnitude of pollution control measure implementation., - Production of sub catchment plan, - No. of prosecution, - Acreage surveyed, - No. of maps produced, - no. of management plans developed			KMFRI, KWTA, KMA	
Health and Environment	- Enforcement of laws on development plans and waste disposal, - putting up a dump site, - upgrading of sewer systems, - installation of incinerators, - waste bins - Promote of provision of sewage management by households. - Providing vector control services - Capacity building of service providers and public - Awareness creation on medical waste disposal.	- No. of enforcement exercise carried out - No. of training/sensitization forum - No. of reduced related incidences - No. of training carried out. - No. of licenses issues, - no. of penalties imposed, - no. dump sites, - incinerators, - bins installed, - No. of Decentralized Waste water treatment established	Reports	Annually	County, Government, NEMA, Public health, Physical Planning, Municipality, MOH	5 years
Emerging issues	- Oil and Gas waste - Enforcement of relevant regulation - Awareness creation - Infrastructural provision	- Quantity of waste treated and disposed - NO. of prosecution, - No. of hazardous waste disposal and treatment facility established, - No. of training & sensitization forum conducted - No. of new infrastructural/development activities initiated. - No. of samples collections (Air, soil and water) for quality test	Reports	Biannual Annually Two Years	NEMA, Ministry of Infrastructure, County Government, National, Oil Company security.	
Environmental Governance	Inspection Awareness	- No. of inspection done. - No. of training/ sensitization forum done	Reports Reports	Annually Annually	NEMA, County government.	

Annex III: Dumpsites status in Turkana County

No.	Town/centre	Area/Sq km	Existence of a dumpsite	Amount of solid waste generated-tons/month	Dumpsite required?
1	Lodwar town	5	1	110	Required
2	Kanamkemer	4	0	80	Required
3	Lokichar	2	0	15	Required
4	Kainuk	1	0	10	Required
5	Katilu	0.5	0	5	Required
6	Lokori	0.5	0	5	Required
7	Kapedo	1	0	5	Required
8	Lorugum	2	0	7	Required
9	Turkwel	2	0	9	Required
10	Kakuma	3	1	90	Available
11	Lokichogio	2	1	20	Required
12	Lokitaung	1	0	5	Required
13	Kalokol	1	0	30	Required
14	Songot	1	0	4	Required
15	Lowarengak	1	0	4	required
16	Kibish	1	0	3	required
17	Eliye springs	1	0	15	required

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TURKANA COUNTY STRATEGIC ENVIRONMENT

ACTION PLAN

JULY, 2020-JULY, 2024

THEME:

SUSTAINABLE DEVELOPMENT TOWARDS ACHIEVEMENT OF VISION 2030