

State of Coast Report for Kenya (Second Edition)

Enhancing Integrated Management of Coastal and Marine Resources in Kenya



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Published in 2017 by the National Environment Management Authority (NEMA), Kenya.

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For bibliographic purpose, this document should be cited as follows: Government of Kenya (2017) State of the Coast Report II: Enhancing Integrated Management of Coastal and Marine Resources in Kenya. National Environment Management Authority (NEMA), Nairobi.

Participating institutions

Lead institution: National Environment Management Authority

Consultant: Kenya Marine and Fisheries Research Institute

Main Sponsor: Indian Ocean Commission

Co-sponsors:

- National Environment Management Authority (NEMA)
- Kenya Marine and Fisheries Research Institute (KMFRI)
- Danish International Development Agency (DANIDA)

Institutions and Sources of Information:

- National Environment Management Authority
- Ministry of Environment and Natural Resources
- Kenya Marine and Fisheries Research Institute (KMFRI)
- Kenya Forest Service
- Kenya Wildlife Service
- Kenya Fisheries Service
- Kenya Maritime Authority
- Coast Development Authority
- County Governments (Mombasa; Kwale; Kilifi; Taita Taveta; Tana River and Lamu)
- Water Resources Authority
- Ministry of Mining
- Universities (Pwani University; Technical University of Mombasa and Nairobi University)
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Preface

I am delighted to present this second edition of the State of the Coast report for Kenya. The pioneer first report was published 8 years ago in 2009. Many developments that impact the coastal region in diverse ways have taken place since the first edition was prepared. This report has reviewed the current status of the coastal environment and its natural resources, the demography and rich culture of Kenya's coastal communities, as well as the pressures and threats to environmental health being experienced in the coastal zone. The report has identified the drivers and pressures on resource use, the observed impacts on the environment, and the advances made to safeguard the environment. The report further proposes measures to mitigate or reverse environmental degradation in order to safeguard the environment and the ecosystem goods and services it provides to the coastal communities and the economy.

Kenya's coastline, extending from the border with Somalia in the north to the border with Tanzania in the south, is about 600 km long. The coastal zone is endowed with rich natural resources, which are of immense economic and cultural value to the coastal region inhabitants and the nation at large. These resources, in addition, provide critical ecological services, whose real value has tended to be underestimated. The coastal region supports many economic activities that contribute significantly to the country's gross domestic product.

This report shows that during the last 8 years the coastal urban population has increased steadily mainly due to immigration, leading to increase in demographic pressure on the natural resource base. Shipping and tourism remain the two main industries that attract immigrants due to the real and potential employment opportunities. Other key economic activities include agriculture, fisheries, mining, and manufacturing. While the shipping industry continues to grow and offer livelihood opportunities, tourism has significantly contracted due to insecurity and other external factors. Apart from changes in demography, new developments in the agriculture, water management, infrastructure and industry have continued to impact the environment.

To counter the impacts, the report shows that considerable efforts and gains have been made at policy and management level during the period to address the issues facing the coastal and marine environment. Such efforts include implementation of the first Integrated Coastal Zone Management (ICZM) action plan between 2011- 2015; review and development of laws and policies relevant for coastal zone management such as ICZM Policy 2014; implementation of various sectoral programmes and improvement in public participation among other efforts. While the outcomes of such efforts are already visible as documented in this report, it is undoubtedly clear that much still needs to be done in order to promote sustainable development in the coastal zone. This report will inform the formulation of the ICZM Action Plan for the next 5 years besides other programmes and strategies by stakeholders to enhance conservation of the coastal and marine environment. Furthermore, the production of this report serves to deliver part of Kenya's obligations to the

Nairobi Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region.

I would like to thank our Government, Indian Ocean Commission and DANIDA for supporting preparation of this report. The leadership and coordination role played by NEMA in preparation of the report is commended. The participation by various stakeholders in the preparation of the report led by NEMA and Kenya Marine and Fisheries Research Institute is highly appreciated. I encourage all stakeholders to make use of the information provided in this report to plan and implement programmes and projects that will go a long way in enhancing sustainable development of Kenya's coastal zone.

Prof. Judi Wakhungu
Cabinet Secretary, Ministry of Environment and Natural Resources

Foreword

This report has reviewed the first edition of the State of the Coast (SOC) Report for Kenya prepared in 2009 by updating and adding new data and information on the status of the coastal and marine environment. The findings of the report provide evidence on the need to foster integrated approach to management of the coastal zone.

Since early 1990s concern about the issues affecting the coastal and marine environment has led to a number of initiatives based on the concept of integrated coastal zone management (ICZM). ICZM seeks to create a balance between development needs with the need to protect the very resource base that sustains the coastal economic and livelihood activities. It brings together all stakeholders involved in development, management and use of coastal zone resources within a framework that facilitates integration and coordination of their efforts with a view to promoting sustainable coastal development. ICZM was institutionalized in the country in 1999 following the enactment of the Environment Management and Coordination Act (EMCA) 1999 which today is EMCA CAP 387 following a review done in 2015 to align it with the new constitution.

The Kenya Coast is endowed with some of the world's most valuable coastal and marine resources that not only support economic activities but also the livelihoods of the people. The resources include mangrove forests, estuaries and deltas, sand dunes, beaches, coral reefs, seagrass beds as well as pelagic habitats among others. These resources are environmentally sensitive and easily degrade if poorly managed and used. This report has clearly shown that there are numerous issues and challenges facing the coastal and marine environment. Notable drivers of environmental degradation in coast region are: high rates of population growth, urbanization, expansion of industrial developments, overexploitation of natural resources and climate change among others.

The fast growth of coastal urban settlements without the necessary support services has led to the degradation of the built/urban environment through pollution; clearing of urban forests; and reclamation of urban wetlands among other impacts. The report also shows that emerging issues brought about by large-scale socio-economic developments and climate change are also putting a lot of pressure on the coastal and marine environment. These issues, unless addresses, will continue reducing the resilience of the coastal environment and its capacity to sustainably provide ecosystem good and services.

This second edition of SOC report has recommended a broad range of measures and actions to address the issues and challenges facing the coastal and marine environment. Pursuant to EMCA Cap 387 sec 55, an ICZM plan will be prepared based on the findings of this report to guide the management of the coastal and marine resources in the next five years. The Ministry of Environment and Natural Resources is committed to working with NEMA and all other

stakeholders to develop and implement plans and programmes to address the issues facing the coastal and marine environment as reported in this report.

Mr. Charles T. Sunkuli,
Principal Secretary, State Department of Environment

Acknowledgements

This reviewed State of the Coast report was prepared with contributions from many institutions and individuals. Stakeholders including National Government institutions, Coastal County Governments (Mombasa, Kwale, Kilifi, Taita Taveta, Tana River and Lamu); NGOs; private sector players, experts and local communities played a significant role in preparation of the report by providing invaluable information and participating in forums. Their contribution is highly appreciated.

Special thanks are accorded to Kenya Marine and Fisheries Research Institute (KMFRI) for the role it played as the lead consultant in preparation of the report. The work was implemented with support of the KMFRI Director, Prof James Njiru and Deputy Director Dr. Renison Ruwa. Many KMFRI scientists led by Dr. Edward Kimani provided the drafts of the chapters and parts of the report. Experts including Prof. Saeed Mwanguni; Dr. David Obura; Dr. Mohamed Omar; Dr. Judith Nyunja; Ms. Elizabeth Mueni; Mr. Paul Munyao; Dr. Benard Fulanda and Dr. Joseph Tunje contributed to various sections of the report.

NEMA, in particular, Mr. Stephen Katua and Mr. James Kamula provided the overall coordination of the report preparation process. The effective coordination, hardwork and dedication they demonstrated throughout the process is highly commendable.

The NEMA Board of Management is appreciated for the unwavering support throughout the report preparation period. Last but not the least, the financial support provided by the government of Kenya; IOC through its Regional Biodiversity Programme and the Danish International Development Agency (DANIDA) for the preparation of this report is greatly acknowledged. The Authority is committed to monitoring the state of the coastal environment and coordinating implementation of appropriate measures to foster sustainable development in the coastal zone.

Prof. Geoffrey Wahungu

Director General, National Environment Management Authority

Executive Summary

This report reviews the first State of Coast Report, published in 2009. The review used the current data and information on the status of Kenya's coastal and marine resources and the environment, demographic and resource-use trends, current impacts and threats to sustainability, and management measures to mitigate and prevent continued resource overexploitation and environmental degradation. The report recognises the changes in the management structures and instruments, changes in economic fortunes of the region, accelerated economic development and other issues emerging during the intervening period. The information will serve as the foundation for the development of the Integrated Coastal Zone Management (ICZM) Action Plan for the next few years in addition to informing other programmes and strategies by stakeholders to enhance conservation of the coastal and marine environment.

The preparation of this document was led by KMFRI in collaboration and consultation with experts and managers in each sector from the coast region as well as resource users. The DPSIR (Drivers, Pressures, Status, Impacts and Responses) framework was used to prepare the document, in which the drivers and pressures of the changes are identified clearly, the status and impacts of pressures on the resources is evaluated, and the management response strategies and their effectiveness are discussed. The document contains 9 technical chapters which give an overview of the coastal environment of Kenya, coastal ecosystems and biodiversity, species of conservation concern, coastal communities, land and water resources, economic activities, major threats and impacts on coastal and marine biodiversity, governance of the coast and marine environment and emerging issues.

Chapter one provides a detailed description of the methodology used to prepare the report while Chapter Two provides the geographical, physical and geological setting, climate as well as the factors that drive the state of the environment at the coast. Climatic, oceanographic and weather patterns are driven by the Intertropical Convergence Zone (ITCZ) which influence seasonal monsoons and associated human activities. The factors drive changes in the environment through economic and demographic developments, urbanisation, tourism, agriculture, mining and shipping. The changes observed in the coast environment since the previous report include sea level rise and associated impacts of coastal erosion, reduction and higher variability of precipitation and river discharge. The changes are further exacerbated by local changes in water and land resource uses driven by population growth and the demand for food other natural resources.

Chapter Three presents in detail the various ecosystems and biodiversity supported by the coastal and marine environment. The ecosystems include the estuaries and deltas, coastal sand dunes and beaches, terrestrial and coastal forests, mangroves, seagrass beds, rocky habitats and coral reefs, as

well as pelagic and deep water ecosystems. The review established that these ecosystems have diminished in size and species diversity due to the impacts of human settlements and developments, which in turn has reduced their ability to provide ecosystem services required for sustainability. The most impacted ecosystems include coastal terrestrial forests, coastal forests and wet lands, coastal beaches, seagrass beds as well as coral reefs.

The main drivers of change in these ecosystems are over-use by an increasing human population, economic development and climate change. Populations of key species within these ecosystems have been impacted to critical levels threatening their continued existence. The most affected species within the terrestrial environment include the primates and, reptiles; while in the marine environment sea mammals, turtles, and elasmobranchs are highly threatened by over-exploitation and the impacts of marine resources use. Mitigation measures to the threats are based on global conservation approaches, national environment preservation measures such as protected and conservation areas and local community based conservation areas and rehabilitation measures as well as the establishment of a seed bank store to preserve the genetic diversity of indigenous threatened plant species.

Chapter Four describes the status of species of conservation concern. Species of conservation concern include those that are rare, endemic or show evidence of local population declines, and are classified by IUCN as critically endangered, endangered, vulnerable, or near threatened. They include marine mammals (Cetaceans and Sirenians), sea turtles, bony fishes and elasmobranchs (sharks and rays), and terrestrial species (mammals, reptiles, birds, amphibians, and plants). Human induced pressures continue to impact on species of conservation concern driven by increasing coastal populations, poverty, shrinking habitats, overexploitation of resources, coastal development and urbanization, and tourism. There are general uncertainties on their status; however, anecdotal evidence continues to indicate declining populations. Nonetheless, there have been concerted efforts since 2009 to document sightings of these species through collaborative monitoring efforts, which has enhanced knowledge on their distribution and enabled the identification of important areas of biodiversity.

Chapter Five provides details of coastal communities in relation to the environment. Population growth is one of the key drivers of changes in the coastal environment. The national population census of 2009 estimated the coastal population at 3.3 million people with an annual growth rate of 2.9% compared to the national growth rate of 3.2%. The region has a population density of 40 persons/km², which is lower than the national average of 66 persons/km² with a high concentration in urban centres. Population size and distribution in the coastal region is driven by immigration and settlement of landless people. Settlements and land use patterns have not been well coordinated nor informed by the considerations of ecological sustainability. Densely populated areas have arisen without the necessary services including clean water supply, sanitation, education and health facilities, leading to decline in environment and human health. The rapid human

population growth, combined with poor resource management has led to unsustainable extraction of natural resources, including water, forests, and fisheries.

Chapter Six describes the land and water resources which are key factors to economic developments. These resources are also the part of the environment that is directly impacted by economic activities. The review shows an increase in protected and conservation areas, which serve as reserves of biological diversity and ecological functions. Large-scale agriculture and ranching also occupy a significant part of the land at the coast region. However, issues related to land tenure hinder investment and food production. Moreover, most of the land at the coast is not adjudicated and a large part of the population does not have the rights to the land they occupy, whereas a significant part of the land is owned by absentee landlords. Remarkable changes in land use patterns are taking place due to a huge demand for land for housing and settlement particularly near urban areas.

Like most of Kenya, the coast region is water deficient. The coastline receives significant convectional rain that supports natural vegetation and agriculture. The main sources of domestic water are surface water, ground water, and rainwater. The densely populated coastline gets most of the water from the springs in Taita-Taveta, the River Athi and ground water from the shallow Msambweni aquifers. While piped water is the main source of water in the urban areas, few households have piped water in their houses, and the rest obtain water from vendors. In some areas of the coast such as Lamu, households mainly depend on harvested rainwater for domestic use. Interventions to improve the supply of domestic water include servicing of aged water supply systems, building of new dams; while desalination of seawater is proposed to increase freshwater supply to urban areas.

Chapter Seven describes the key economic activities and the impacts on the coastal environment. The key sectors contributing to the coastal economy are tourism, ports and shipping, agricultural industry, fisheries, agriculture, forestry, and mining. The coast has diverse tourist attractions that support the national economy. These attractions include some of the best beaches in the world, wildlife conservation areas, and historical and cultural attractions. The review has established that the performance of the tourism sector has markedly declined mainly due to insecurity. However, tourism remains one of the most important economic activities in the region and the leading source revenue and of job opportunities. The impacts of the various economic activities on the environment include physical alteration and destruction of habitats; pollution; salination of ground water; and overextraction of resources among others. Recommendations have been made to address these impacts.

Chapter Eight evaluates the major threats on coastal and marine biodiversity including pollution by effluent and solid waste, eutrophication, permanent alteration and destruction of habitats, invasive species as well as climate variability and adverse weather patterns. The key sources of pollution

affecting coastal and marine environments are industrial discharge and oil spills, while sewage discharge and agricultural activities lead to nutrient enrichment of water bodies resulting in loss of biodiversity. In most of the larger coastal urban centers and their suburbs, the use of septic tanks, soak pits, pit latrines and open drains is prevalent due to lack of sufficient sewerage disposal systems resulting in the contamination of surface as well as ground water. Solid waste management systems are inadequate. The situation is made worse by the increasing use of non-biodegradable plastics that end up in the environment as microplastics threatening the health of wildlife and human beings. Large areas of land have been permanently altered by clearing of natural vegetation for agriculture, salt manufacture, mining, and extraction of construction materials without any plans for rehabilitation. The loss of natural vegetation and useful land to invasive plants pose significant risks on livelihoods and the environment, while variations in weather patterns constitute a serious threat to the region's natural environment and the economic and physical systems in which sustainable development and prosperity depends.

The status of governance of the coastal and marine environment has been reported in Chapter Nine 9. The review established that the national government has enacted several legislations that effect natural resource management within the coast region based on the new National Constitution (2010). The new constitution devolved many functions on the management of natural resources and the environment from the National Government to County Governments. The provisions of the constitution have been operationalised through sector specific legislations. The EMCA CAP 387 is the key national framework law for managing the environment. Other relevant laws include the Forest Conservation and Management Act 2016, the Fisheries Management and Development Act 2016, Wildlife Conservation and Management Act 2013, County Governments Act 2012 and the Land Act 2012 among others.

Some new structures have also been established through the new legislations. They include, County Environment Committees, the Kenya Fisheries Service and Kenya Fish Marketing Authority. Through the new Constitution more responsibilities on management of natural resources have been vested on the Counties Governments. Public awareness on the importance of the coastal and marine environment has also improved. This is evidenced by large number of CBOs formed and actively participating in environmental conservation in the period. The review and improvement of legal frameworks providing for community participation in environmental management has also enhanced community participation in coastal resource management. As a result there are more BMUs; CFAs; and WRUAs formed and actively conserving the coastal environment than it was during the first state of coast reporting. However, environmental governance issues still exist. Recommendations have been made to address them.

A number of emerging issues associated with new developments since the previous report are discussed in Chapter 10. These include the mega infrastructure projects, LAPSSET and the SGR and large scale farming initiatives aimed at improving food security. Other emerging issues, which may

also have an impact on the coastal economy and the environment, include security, climate change, oil and gas exploration and development of offshore shipping infrastructure.

Finally, Chapter Eleven of the report has made recommendations on the proposed interventions to address the issues affecting coastal and marine resources. Although many of the interventions proposed fall under specific sectors, it is important to note that embracing integrated and ecosystem-based approaches would be more beneficial as it will create synergy, avoid duplication, and result in outcomes that are more effective. A key starting point towards implementation will be to capture the recommended actions in the ICZM Action Plan for the next five years and in sectoral strategies, programmes and plans.

Acronyms and Abbreviations

AFFA	Agriculture Fisheries and Food Authority
ALRMP	Arid Lands Resource Management Project.
ASCLME	Agulhas Somali Current Large Marine Ecosystems
BMU	Beach Management Unit
CANCO	Community Action for Nature Conservation
CBD	Convention on Biological Diversity
CBO	Community Based Organization
CCA	Community Conserved Area
CDA	Coast Development Authority
CEPF	Critical Ecosystem Partnership Fund
CFA	Community Forest Association
CIDP	County Integrated Development Plan
CITES	Convention on International Trade in Endangered Species
CMS	Convention on the Conservation of Migratory Species of wild animals
CORDIO	Coral Reef Degradation in the Indian Ocean programme
CPA	Charcoal Producers Association
DPSIR	Drivers, Pressures, Impacts and Responses
EACC	East African Coastal Current Current
EAME	East Africa Marine Ecoregion
EAWLS	East African Wildlife Society
ECC	Equatorial Counter Current
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMCA	Environmental Management and Coordination Act
EPZ	Export Processing Zone
FAO	United Nations Food and Agriculture Organization
GCRMN	Global Coral Reef Monitoring Network
GDP	Gross Domestic Product
GEBCO	General Bathymetry Chart of the Ocean
GEF	Global Environment Facilit
GHG	Green House Gas
GOK	Government of Kenya

GOOS	Global Ocean Observing System
IBA	Important Bird Area
ICZM	Integrated Coastal Zone Management
IOC	Indian Ocean Commission
IPCC	International Panel on Climate Change
ITCZ	Intertropical Convergence Zone
IUCN	International Union for Conservation of Nature
IUU	Illegal, Unlicensed and Unregulated.
KACCAL	Kenya Adaptation to Climate Change in the Arid Lands
KALRO	Kenya Agriculture and Livestock Research Organisation
KAHC	Kenya Association of Hoteliers and Caterers
KAM	Kenya Association of Manufacturers
KCDP	Kenya Coastal Development Project
KES	Kenya Shillings
KESCOM	Kenya Sea Turtle Conservation Committee
KFMA	Kenya Fisheries Marketing Authority
KeFS	Kenya Fisheries Service
KIPPRA	The Kenya Institute for Public Policy Research and Analysis
KeNODC	Kenya National Ocean Data Centre
KFS	Kenya Forests Service
KMA	Kenya Maritime Authority
KMFRI	Kenya Marine and Fisheries Research Institute
KNBS	Kenya National Bureau of Statistics
KPA	Kenya Ports Authority
KWS	Kenya Wildlife Service
LAPSSET	Lamu Port Southern Sudan Ethiopia Transport corridor project
MARPOL	Marine Pollution (International Convention for the prevention of pollution from ships.)
MPA	Marine Protected Area
MT	Metric Tonne
NCCAP	National Climate Change Action Plan
NEM	North East Monsoon
NEMA	National Environment Management Authority

NEPAD-COSMAR	New Partnership for Africa's Development- Coastal Marine Division
NGO	Non Governmental Organization
NMK	National Museums of Kenya
OECD	Organization of Economic Co-operation and Development
PADHs	Physical Alteration and Degradation of Habitats
PCB	Polychlorinated biphenyl
ROSCA	Rotating Savings and Credit Association
SC	Somali Current
SDFBE	State Department for Fisheries and the Blue Economy
SDG	Sustainable Development Goals
SEM	Southeast Monsoon
SGR	Standard Gauge Railway
SIDA	Swedish International Development Agency
SST	Sea Surface Temperature
SWIO	South West Indian Ocean
SWIOFP	South West Indian Ocean Fisheries Project
TEU	Twenty-foot Equivalent Units
UK	United Kingdom
UNCLOS	United Nations Convention on the Law Of the Sea
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
USAID	United States Agency for International Development
VMGs	Vulnerable and Marginalized Groups
VMS	Vessel Monitoring System
WCMA	Wildlife Conservation and Management Act
WCS	Wildlife Conservation Society
WHO	World Health Organization
WIO	Western Indian Ocean
WIOMSA	Western Indian Ocean Marine Science Association
WRMA	Water Resource Management Authority
WRUAs	Water Resource User Associations
WWF	World Wildlife Fund for Nature

Chapter 1 : Introduction and Methodology

There has been increasing awareness and consensus amongst stakeholders in the country that the use of integrated approach to management of the coastal zone provides for better coordination compared to the sectoral management approach. The Integrated Coastal Zone Management (ICZM) approach brings all the sectors involved in the development, management, and use of the coastal zone within a framework that facilitates integration of their interests and responsibilities. ICZM attempts to balance the needs of development with protection of the very resources that sustain coastal economies, while taking into account the public's concern about the deteriorating environmental, socio-economic and cultural state of the coastal zone. The ICZM approach requires a synthesis of the status of the resources, their exploitation, and the current and potential impacts on the environment to facilitate systematic management.

The first State of the Coast Report (Government of Kenya, 2009) was developed by a National Task Force constituted by the National Environment Management Authority (NEMA) in 2008 when the Authority initiated steps towards the development of an ICZM framework for Kenya. The report was the first one-stop document to provide the status of the resources in the coast of Kenya, in relation to livelihoods and human welfare. The ICZM action plan was developed to guide the implementation of the recommendations of the report. To move forward, a review of the report was found necessary in order the ICZM action plan.

The initial step in the preparation of this report involved an in depth review of the content of the State of Coast report (2009) to define the scope and depth and to identify data and information gaps. The review resulted in the expansion of the land use and water resources section to a new chapter, recognising the central role of the resources in the human well-being and environmental sustainability. This report takes cognisance of the new dispensation provided in the new constitution and the devolved administrative structures and institutions. In addition, it was realised that there were emerging issues that could not be accommodated within the thematic chapters and therefore a new chapter on emerging issues was added. This report also includes a new chapter, which provide directions and future activities that will need particular attention in the ICZM Action plan for the next five years.

The review was followed by identification and collection of new data and information that has been generated through various research, surveys and documentations since the last report. The evaluation of changes in the status of resources and environmental impacts associated with their exploitation followed the DPSIR (Drivers, Pressures, Status, Impacts and Responses) framework (Figure 1.1). The framework identifies a chain of causal links starting with 'driving forces' (economic sectors, human activities) through 'pressures' (emissions, waste) to 'states' (physical,

chemical and biological) and ‘impacts’ on ecosystems, human health and functions, eventually leading to management ‘responses’ (Kristensen, 2004).

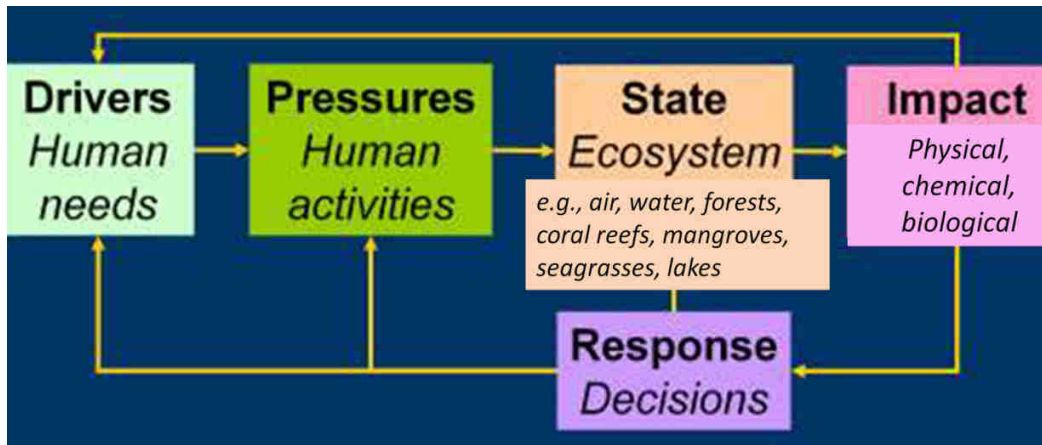


Figure 1.1 The causal links of the DPSIR framework

The main drivers of change are population growth, economic development, poverty, and low level of education. Historic, current, and emerging pressures on the coastal environment include over-exploitation of resources, land use change, shoreline change, and pollution, all of which are associated with natural and anthropogenic factors. The emerging pressures include oil and gas explorations, ocean acidification, rise in sea surface temperature, sea level rise, eutrophication and others. The environmental impacts identified include loss of biodiversity, loss and modification of habitats, declining catches in fisheries, while the responses include management interventions, changes in policy, increased enforcement of existing laws and regulations among others.

A consultative approach was undertaken in the development of the report. An inception report which described the scope of work and allocation of responsibilities as well as a work plan was developed and agreed upon between KMFRI and the NEMA. The work plan included the steps and identifiable goals of each step to ensure wide consultation of experts, stakeholders, resource persons, and target resource users, managers and decision makers. The drafting of each chapter was guided by lead experts in the thematic areas, with inputs from other external experts, resource persons and managers. The team leader oversaw the consistency and coherence of the entire report. Two expert consultative meetings were conducted to collect data and information from experts and managers responsible for various coast and marine resources. The draft report was also presented to the ICZM committee for inputs and validation. The draft was further subjected to a stakeholders review process in two other workshops. The updated data and information and the additional sections in this report will provide clear evaluation of the state of the environment and a firmer base for the preparation of the ICZM Action plan and other initiatives to support the integrated coastal zone management process.

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Chapter 2 : The Coastal Environment

2.1 Geographical setup

Kenya has a coastline of over 600 km which stretches along the seafloor, from Kenya-Somalia border at Ishakani in the north (1.7°S; 41.5°E) to Kenya-Tanzanian border at Vanga in the south (4.7°S; 39.2°E). Upon promulgation of the new constitution in Kenya in the year 2010, forty-seven (47) counties were delineated, of which Kwale, Mombasa, Kilifi, Tana River, Lamu and Taita-Taveta are within the coast (Figure 2.1). The Kenyan Exclusive Economic Zone covers an approximate area of 142,000 km² with potential extension of its continental shelf beyond the 200 nm by approximately 103,302 km² pending Kenya's submission to UNCLOS. For the purposes of this report, the coastal zone means the geomorphologic area where the land interacts with the sea and comprises of both terrestrial and marine area with coexisting biota and abiotic components (EMCA, 2015).

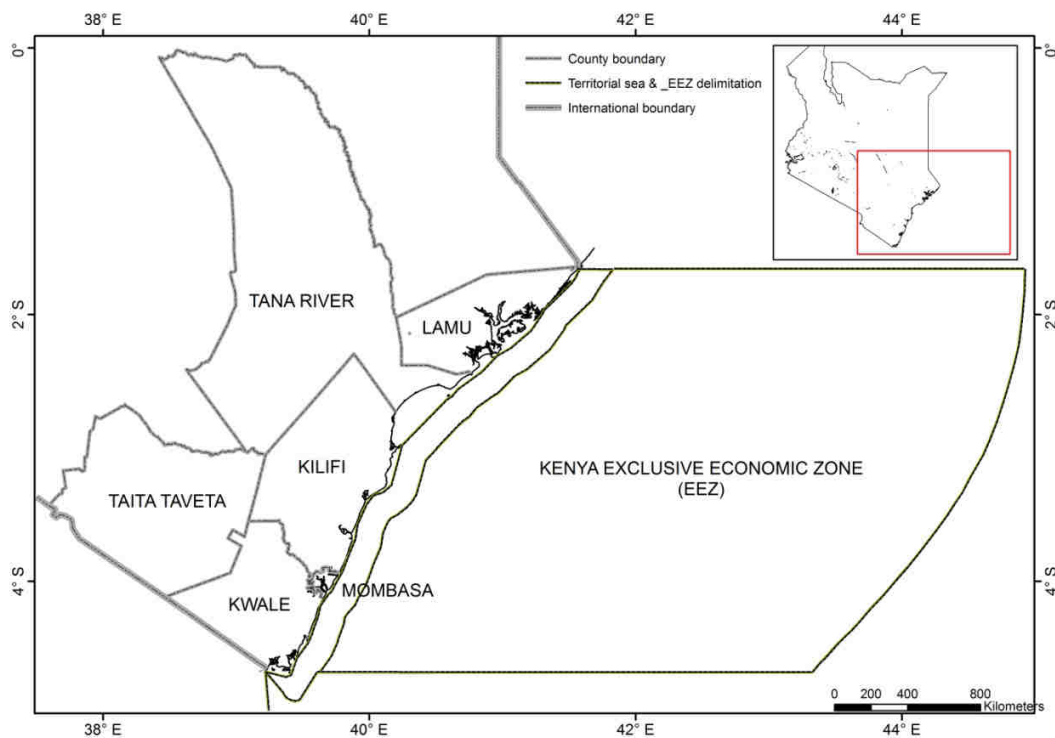


Figure 2.1 Map of the Kenya coast showing the coastal counties and the Kenyan EEZ boundary.

2.2 Climate

The Kenya coast lies in the hot tropical region where the weather is influenced by the great monsoon winds of the Indian Ocean. Climate and weather systems are dominated by large-scale pressure systems of the Western Indian Ocean (WIO) with two distinct monsoon periods. The weather is dominated by the Northeast Monsoon (*Kaskazi*) which is comparatively dry from November to early March (Figure 2.2).

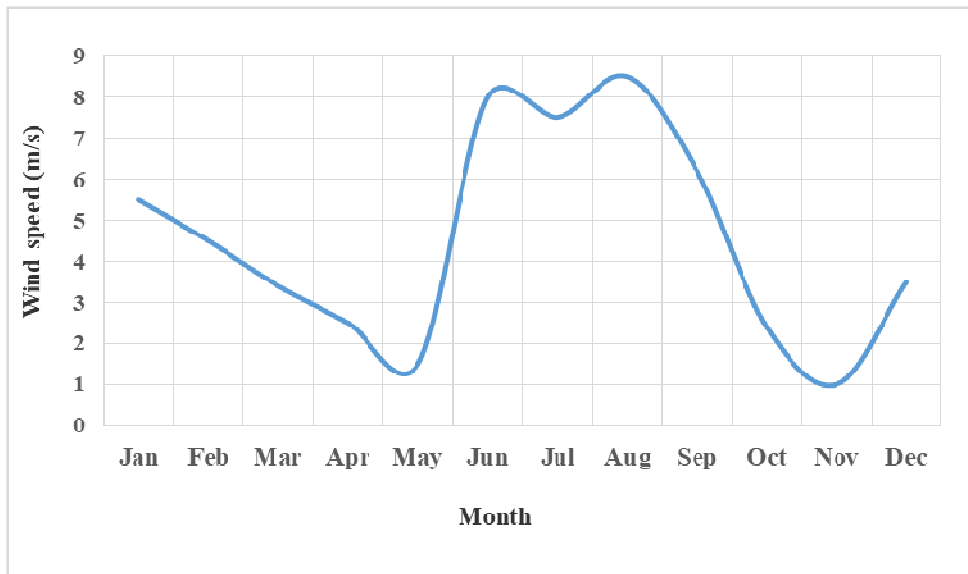


Figure 2.2 Seasonal variations of the average wind speed

During March and April, the monsoon winds blow in an east to south-easterly direction (*Kusi*) with strong incursions of air from the Indian Ocean bringing heavy rains. Between May and August, the South-easterly monsoon gradually sets in and the weather becomes more stable comparatively cooler temperatures. There is a 1 – 2 months transition period between the two seasons characterized by variable and weaker winds.

Annual rainfall follows a strong seasonal pattern peaking between late March and early June. (Figure 2.3). Another smaller peak of rain occurs between October and November but decreases rapidly from December to a minimum during January and February. Mean annual total rainfall ranges from 508 mm in the drier, northern hinterland to over 1,016 mm in the wetter areas south of Malindi. Relative humidity is comparatively high all year round, reaching its peak during the wet months of April to July.

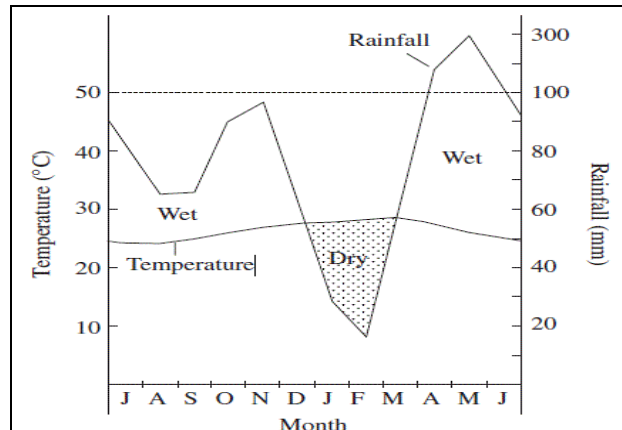


Figure 2.3 A general climate diagram of Mombasa-Kenya showing rainfall and temperature variations (Source: Lietch et al., 1999)

2.3 Oceanography

2.3.1 Tidal regime and waves

The inshore waters of Kenya experiences semi-diurnal tides with a spring tidal range of about not exceeding 4 m (Brakel 1982; Tychsen 2006). The coastal offshore waters experiences swell whose magnitude varies in different periods of the year. During the northeast monsoon season, 80% of the swells originate from the north-east with a maximum significant height of 6m. The sea is usually calm during the inter-monsoon period (March-April) and wave height drops significantly to 2.5m shifting clockwise to a southerly approach with large fluctuations. The waves are usually very large with a maximum significant height of 8m during the southeast monsoon (May-October) approaching the coast predominantly from south-east and southwest direction. Calm conditions follow during the inter-monsoon period and waves tend to approach the coast from a north-east direction.

2.3.2 Ocean currents

The offshore current system off the Kenyan coast is part of the alternating cycle of the southeast monsoon and the northeast monsoon (Knox and Anderson 1985, Schott and McCreary 2001). The cycle is caused by alternating high and low pressure systems over central Asia and south of 20° S latitude (Okoola, 1999). The predominant monsoon-driven surface currents off the Kenyan coast are the East Africa Coastal Current (EACC), the Somali Current (SC) and the Equatorial Counter Current (ECC) (Figure 2.4). The EACC flows northward throughout the year. On the other hand, the Somali current is a typical seasonally reversing current with the current flowing northward during the south east monsoon at a maximum speed of about 2 ms⁻¹(Swallow et al. 1991). During the northeast monsoon, the Somali current flows southward at a speed of 1.5-2 ms⁻¹. The reversed

Somali Current meets the EACC at latitude 2.25° S to form the eastward flowing ECC which flows as an undercurrent. The width of EACC is 160-200 km with its maximum depth at about 400 m.

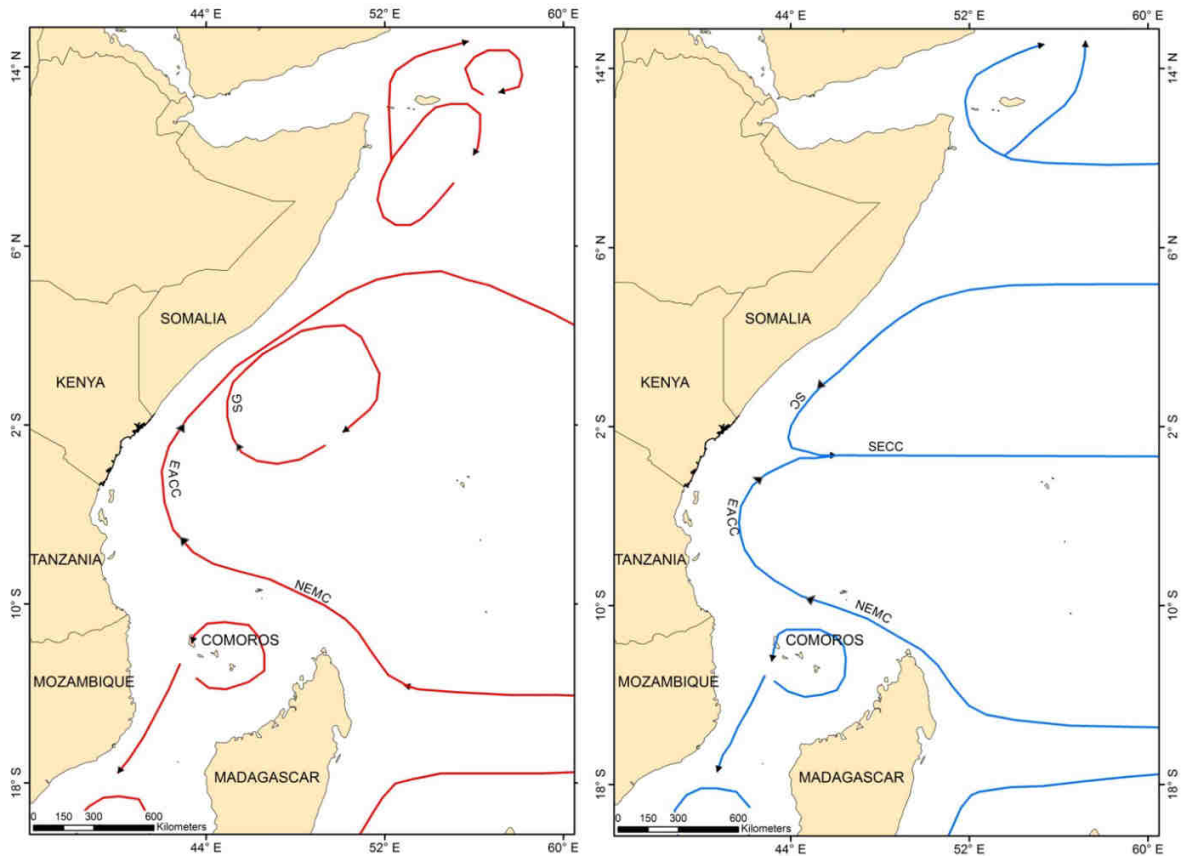


Figure 2.4 Schematic representation of ocean currents in the Indian Ocean during the South East Monsoon (red) and Northeast Monsoon (blue) including choke point transport numbers (Source: KeNODC).

2.3.3 Sea level change

Over 30 years' of sea level data derived using the Mombasa tide gauge shows a gradual increase in mean sea level over the period 1986 – 2012 of about 3 mm per year (Figure 2.5), which is consistent with projections by the Intergovernmental Panel on Climate Change (IPCC, 2013). Seasonal variations in sea levels occur with maximum values usually observed in the period April-May and October.

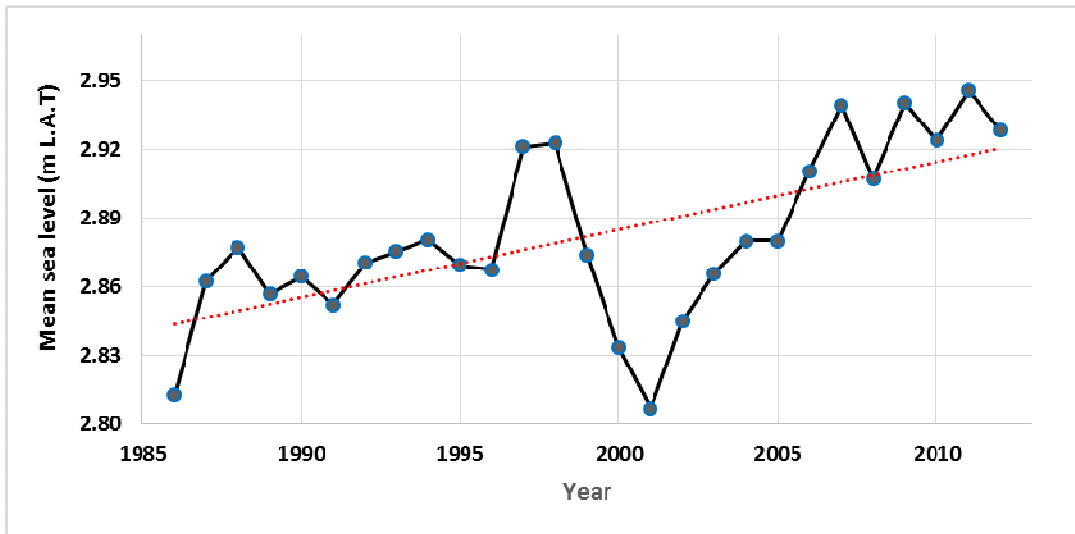


Figure 2.5 The monthly mean sea level variation at the KMFRI GLOSS Mombasa tide gauge station between 1986 and 2012. (Source: Kimeli et al., 2013 Unpublished Report)

The lowest sea level occurs in February and in the period July-August. These variations are attributable to inverse barometric effect as well as the monsoon regime. The interannual variation in sea level is attributed to thermal expansion of the ocean due to global warming and steric effects that are attributed to salinity variations.

2.4 Geology and geomorphology

2.4.1 The geological timescale

The geology of the Kenyan coast is composed of sediments from the Tertiary, Cretaceous, Jurassic, Triassic to the Precambrian ages (Figure 2.6). The tertiary being the youngest (0-50 Ma), Jurassic (150-200 Ma) and the oldest being the Triassic (200-250 Ma). Much of Kenya is covered by Precambrian Basement (Mozambique system), Tertiary volcanics and Quaternary sediments. It also comprises of coastal terrigenous clastic sediments of the Karroo system belonging to the Jurassic (144 – 206 Ma) and Tertiary (1.8 – 6 Ma) periods. The northern part around Lamu region is predominantly Pleistocene sediments which are mainly non-marine; however, a more mixed geology is discernible from Malindi down to the south. The mixed geology can be attributed to East African Rift System (EARS) that is characterised by intense geological processes.

The Kenya coastal region is generally low-lying and characterized by an extensive fossil reef, which lies a few meters above present sea level. The coastal environment is set in a passive continental margin (i.e. tectonically inactive), the evolution of which was initiated by the break-up of the mega continent Gondwanaland in the Lower Mesozoic (200 Ma). The Kenyan coast can be described in three geological physiographic zones. The Nyika lies at 600 m above the present sea

level and represents the higher ground covered by the Duruma sandstone series and older rocks to the west. The Foot Plateau occurs at an elevation between 140 m and 600 m above the present sea level. This coincides well with the relatively younger Jurassic rocks. The Coastal Plain, the lowest step, rises from sea level to 140 m. On average, this belt increases from a few kilometres wide in the southern sector, to over 40 km in the north. The geomorphology of the Coastal Plain is dominated by a series of raised old sea level terraces. Most of the coastal environment and the modern shore configuration follow the 0-5 m and the 5-15 m sea level terrace complexes.

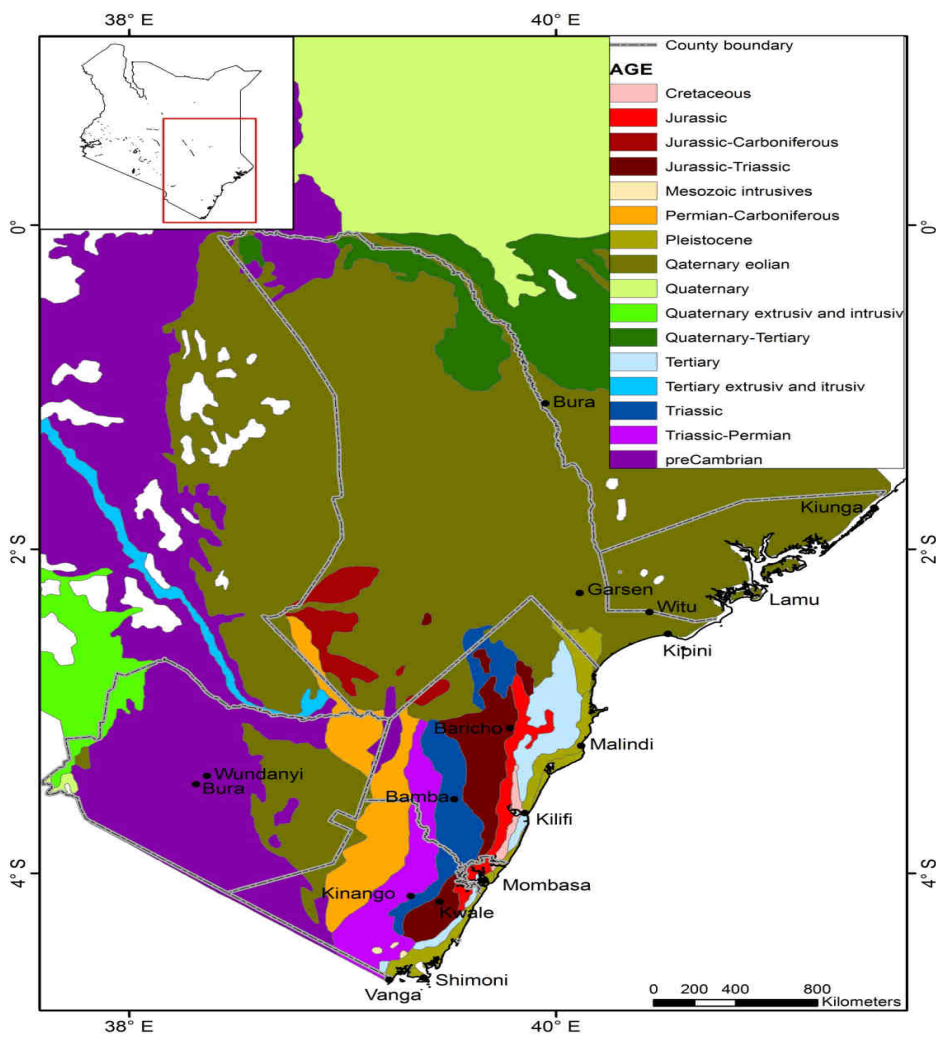


Figure 2.6 The geological ages of rocks of the Kenyan coast (Source: KeNoDC)

The Cretaceous and volcanic sediments allow for enhanced percolation and recharge of coastal aquifers, which supports immense potential for groundwater resources. Cretaceous sediments are characterised by among others mudstones, shale and sandstones. Volcanic rocks including pyroclastics, for example, have porosity and permeability similar to poorly sorted sediments that

allows for percolation and subsequent recharge of aquifers. Most of the rock formations have a shallow water table (between 20 and 30 m), with erratic yields of varying salinity. The highest water quality is found in areas covered with Kibiongoni beds and Magarini and Kilindini sands, e.g. the Tiwi area of the South Coast. Areas covered with Jurassic shales and Pleistocene limestone tends to have low volumes of poor-quality water (Munga et al., 2006).

2.4.2 Sediment lithology

Sediment lithology of the Kenyan coast shows a combination of alluvium, terrigenous to aeolian (windblown) sediments (Figure 2.7). The coastline is dominated by coral reef with instances of pronounced presence of aeolian sediments especially to the north around Malindi and Ungwana. This can be explained by the pronounced occurrence of sand dunes in this region. However, farther away from the coastline, alluvium and sandy sedimentology dominates the lithology. Alluvium are loose, unconsolidated sediments, composed of silt, sand and clay transported by water and deposited in non-marine environments.

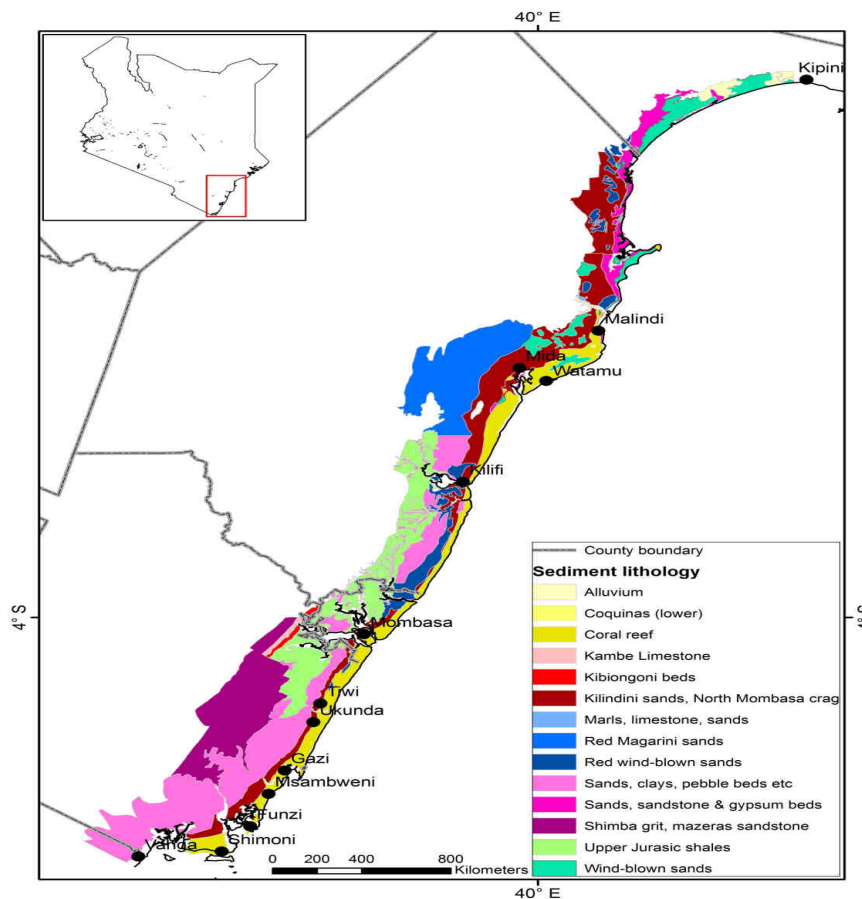


Figure 2.7 The sediment lithology of Kenya's coastal zone (Source: KeNoDC)

2.4.3 Bathymetric features

Additionally, multibeam (MBES) bathymetry and 2-D seismic reflection surveys were carried out between 2007 and 2008 by the Government of Kenya for the purpose of delineating Kenya's extended continental shelf beyond the 200 nm boundary as required under Article 76 of the United Nations Convention on the Law of the Sea (UNCLOS). The data provides new information on the geomorphology of the continental shelf, slope and abyssal plain along the Kenyan passive margin. The data showed a gently sloping continental shelf depicted with deep sea channels/canyons.

Three large seamounts ranging between 800 – 2000 m in height were also observed at the southern most part (42° 7' 52.914" E, 4° 38' 42.635" S), the other at the centre (41° 54' 32.82" E, 3° 4' 52.346" S) and the last one at the northern boundary (42° 17' 15.943" E, 2° 8' 34.173" S). The three seamounts are yet to be named and included in the digital gazetteer of undersea names maintained by the General Bathymetry Chart of the Ocean (GEBCO) Sub-Committee on Undersea Feature Names (SCUFN). The Kenyan EEZ (shallow to mid-depth) is not adequately mapped to high resolution presenting a gap that needs to be filled as part of the blue economy initiative. However, there is an opportunity for Kenya to fill this gap using a recently acquired research vessel (RV Mtafiti) equipped with state of the art echo-sounding equipment.

2.5 Drainage and hydrology

2.5.1 Rivers, catchments and sediment loads

The hydrology of the coastal region of Kenya is based on the drainage patterns of perennial and seasonal rivers into the Indian Ocean basin. The riverine parameters in the perennial and seasonal rivers that drain into the Indian Ocean along the Kenyan Coast are shown in Table 2.1.

The two main rivers, Tana and the Sabaki both originate from the highlands of Kenya around Mount Kenya and Nairobi, and the Nyambene Hills in eastern Kenya. Discharge from the two main rivers is highly seasonal, characteristic of dry land rivers, which can deliver over 80 % of their annual sediment loads within a period of a few days at the onset of heavy rains (Table 2.1). Tana River, which is the longest river in Kenya (~1,100 km), has a total catchment area of ~96,000 km² (~17% of the country), and drains into Indian Ocean near Kipini in north coast of Kenya. Sabaki River, which empties into the Indian Ocean 5 km north of Malindi town, is the second-largest river network in Kenya, with an approximate length of 650km and a total catchment area of 46,600 km² (Marwick et. al., 2014). The major perennial and semi-perennial rivers and less studied include Mwache in Mombasa County, Ramisi, Uмба and Mwena all in Kwale County.

Table 2.1 Riverine parameters of perennial and seasonal rivers draining into the Indian Ocean along the Kenyan coast (Sources: Tychsens, 2006; McClanahan and Obura, 1997; Kitheka et. al., 2003a, 2003b; and UNEP, 1998)

River		Approximate Length (km)	Catchment (km ²)	Freshwater Discharge (million m ³)	Annual Sediment Loads (tonnes)
Perennial	Tana	1100	96,000	4,000	3 million
	Sabaki	650	46,600	2,000	2 million
	Ramisi	*	*	6.3	1,500
Semi-perennial	Mwache	110	2,250	215	*
	Mwena	180	*	34	*
	Umba	300	*	16	*

*Information lacking

Tana and Sabaki rivers experience a bimodal hydrological cycle with peaks in May and November corresponding with the long and short rainy seasons, respectively. A mean annual river discharge of 156 m³ s⁻¹ has been estimated for Tana River (Figure 2.8).

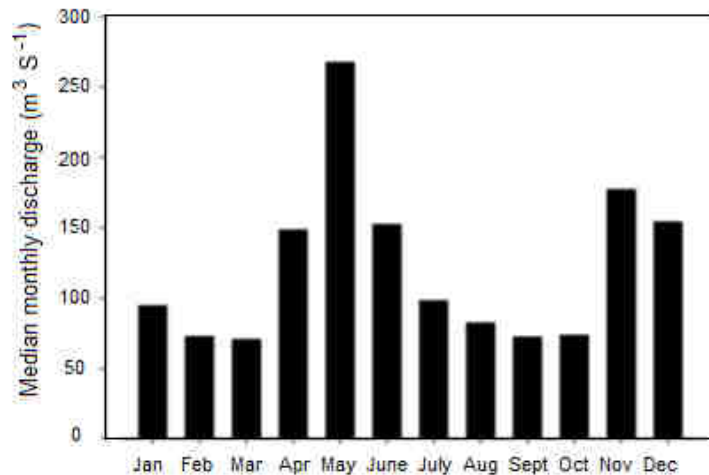


Figure 2.8 Distribution of median monthly discharges for the Tana River (1941–2011) (Source: Tamooch et al., 2012).

2.5.2 Coastal lakes

There are three coastal lakes in Kenya namely Lake Jipe, Lake Chala, and Lake Kenyatta. The Lake Jipe with an approximate surface area of 28 km² has an average depth of less than 5 m. The Lake is transboundary with drainage from Mt. Kilimanjaro and Pare mountains in Tanzania. The Lake basin sits on top of the Kilimanjaro aquifer. Lake Chala, is surrounded by a 100 m high crater rim in a caldera on the borders of Tanzania and Kenya on the eastern edge of Mount Kilimanjaro. The

lake is fed by groundwater flows from Mount Kilimanjaro and drained underground. Lake Kenyatta is a freshwater oxbow lake located in Lamu County fed by the Tana River basin, which drains the Mt Kenya and Aberdare regions.

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Chapter 3 : Coastal Ecosystems and Biodiversity

Kenya is endowed with biologically rich coastal and marine ecosystems ranging from terrestrial forests, mangroves, coral reefs, seagrass beds, estuaries and sand dunes. These ecosystems provide important goods and services such as; habitats for fish and other aquatic and terrestrial organisms, erosion control, provision of wood and non-wood forest resources, provision of food, water and industrial resources to millions of people along the coast. This chapter highlights the status of these ecosystems and their associated biodiversity; pressures that threaten their long-term integrity and productivity; as well as management interventions. Collectively, major pressures impacting on coastal ecosystems and biodiversity, include; over-exploitation of resources, habitat degradation and transformation, pollution, and climate change.

3.1 Terrestrial forests and eastern arc mountains

Terrestrial coastal forests in Kenya are found on a system of low ridges between 100 and 300 m above sea level forming a mosaic of lowland forest patches, woodlands, bushlands and thickets with mostly infertile soils (Figure 3.1). These forests are primarily defined by geographic location but the term could also encompass certain ecological or vegetation characteristics as well as climatic effects (White, 1983). In this report, the former is largely applied where administrative boundaries are used to encompass forests within the coastal counties of Kwale, Mombasa, Kilifi, Tana River, Lamu, and Taita-Taveta.

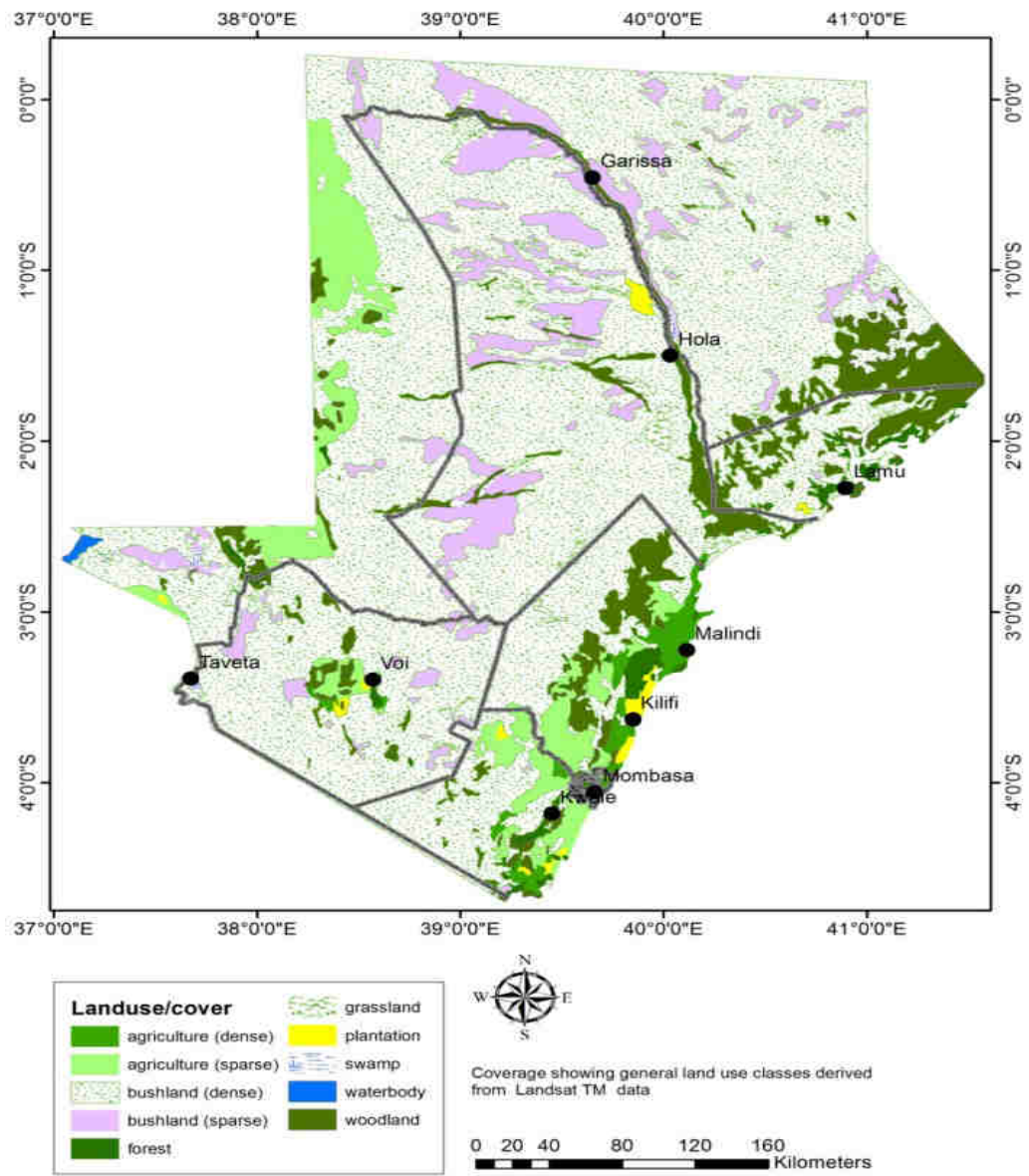


Figure 3.1 Land use/cover along the Kenya coast (Source: Landsat TM data)

The Eastern arc mountains forests represent raised massifs separated by lowland woodlands and savannas in Kenya and Tanzania. With direct influence of the Indian Ocean, eastern arc mountains have been shown to be an important center of endemism and species richness for both plants and animals. The Taita Hills forests form the northernmost part of the Eastern Arc Mountains, and contains several restricted range species such as the black-and-rufous elephant shrew, east coast akalat, *Sheppardia gunningi*, and plain-backed and Uluguru violet-backed sunbirds.

3.1.1 Status and trends

The area of terrestrial coastal forests in Kenya is estimated to range from a low of 66,000 ha to a high of 450,000 ha (Burgess et al., 2000). These wide variations arise from lack of clear definitions of what constitutes coastal forests (Githitho, 2004). The total area of natural forest in Taita Hills is approximately 600 ha, mostly in fragmented form with a closed canopy forest of about 200 ha. In addition, 120 ha of land in Taita Hills is protected as forest reserve. Apart from Arabuko Sokoke, Shimba Hills, and Boni-Dodori that are large, most coastal forests are threatened as a result of fragmentation resulting in loss of biodiversity (Table 3.1). Some of the fragmented patches are as small as 1 ha. Recent biodiversity surveys indicate coastal forests as rich in biodiversity rich, and hosting a number of threatened species (KCDP 2014, 2015; Box 1).

Table 3.1 Coverage and legal status of terrestrial forests within the coastal counties of Kenya

County	Forest	Area (ha)	Legal Status
Kilifi	ArabukoSokoke	42,000	Forest reserve
	Madunguni	1,000	Forest reserve
	Mwangea Hill	2,000	Trustland/ private
	Nzovuni	500	Trustland/ private
	Dakatcha woodlands	32,000	Trustland
Kwale	Shimba Hills	19,242	Forest reserve
	Mkongani (West & north)	2,479	Forest reserve
	Mwaluganje	1,414	Forest reserve
	Mwache	417	Forest reserve
	Buda complex, Mrima, Dzombo, Marenje, Gonja	5,080	Forest reserve
	Kilibasi	500	Trustland
Tana River	Wayu	42,512	Forest reserve
	Kokani	61,495	Forest reserve
	Bangali	119,373	Forest reserve
	Mbalambala, Hewani, Mwina	10,298	Forest reserve
	Kipini	22,016	Provisional forest
Lamu	Witu Lamu	4,676	Forest reserve
	Boni/ Lungi	39,925	Forest reserve
	Panda Nguo	41,316	Forest reserve
	RasTenawi	2,000	Trustland
Taita Taveta	Forest Reserve (incl. Fururu, Mwandogo, Ngangao etc.)	1108	Forest reserve
	Trust Land (incl. Kasigau, Kalangu, Mwarang'u etc.)	5275	Forest reserve
All counties	Kaya (over 50 sites)	2,840	National Monuments

Adapted from KFS, 2015, Samoilys et al., 2015—means no information available.

Box 3.1. Biodiversity profile of Shimba Hills and Arabuko Sokoke forest

Biodiversity of Shimba hills	Biodiversity of ArabukoSokoke forest
<p>*A botanical survey conducted by KWS in 2014 revealed a total of 620 plant species;33 of which falls under IUCN’s species of special concern.</p> <p>*Fifty (50) species of reptiles and amphibians including Usambara Garter snake, Usambara green snake and Lindner’s dwarf toad which have either only been recorded for the 1st time in Kenya or only recently documented.</p> <p>*Number of birds vary with season with up to 112 recorded during wet season</p>	<p>* There are three forest types identified in ArabukoSokoke: undifferentiated mixed forest, <i>Cynometra</i> and <i>Brachystegia</i> forest</p> <p>*Biodiversity survey in 2014 revealed 32 mammalian species including Sokoke bushy-tailed mongoose (vulnerable) and Aders’ duiker (endangered)</p> <p>* Four-toed Sengi increased in occupancy between 2010 and 2015</p> <p>*36 bird species encountered including the Amani sunbird an endangered species</p>

3.1.2 Drivers, impacts, pressures and response strategies

The main drivers of change in the coastal and eastern arc mountain forests are population growth, high poverty levels, inadequate management capacity, and weak governance. Governance issues are linked to increased human-resource interaction, political interference, and the overlapping mandates of government agencies. For instance, Shimba Hills is gazetted as both forest reserve and a national reserve reducing management effectiveness.

Overexploitation of forest resources is one of the key pressures contributing to fragmentation and loss of biodiversity. Additionally, inappropriate land-use and widespread encroachment into the forests due to agriculture and pastoralism pose serious threats leading to land degradation (Samoilys et al., 2015). Other forms of pressures on coastal forests include illegal hunting of wildlife, intentional grass fires, illegal timber harvesting for charcoal and building, illegal trade on fauna and flora (Samoilys et al., 2015). Mining poses a significant threat to coastal forests given that large reserves of titanium have been discovered within Kwale to Kilifi Counties and underneath Arabuko-Sokoke Forest (CEPF, 2005). Cast and strip mining of titanium in Kwale County involves clearing of vegetation reducing forest cover (Chelagat, 2015). The, plans for mining operations have environment restoration activities. However, some of the indigenous plant species may be lost.

Forest Conservation and Management Act (2016) continues to promote devolution of forest governance in the country as well as community participation through establishment of Community

Forest Associations (CFA). Most of the CFAs in Lamu and Tana River counties are at a formative stage while those in Kilifi, Taita-Taveta and Kwale are already functional (Table 3.2).

Table 3.2 A List of Community Forest Associations (CFAs) along the Kenya coast

County	Community Forest Association (CFA)	Area of operation
Kilifi	Gede Community Forest Association (GECOFA)	Around Mida
	Mtwapa Takaungu Kilifi MTAKIMAU	Kilifi and Takaungu
	Jilore CFA	Jilore Forest Station
	Sokoke CFA	Sokoke Forest Station
	Dakatcha CFA	Dakatcha Woodlands
	Magarini Mangrove CFA	Magarini
Kwale	Gongoni Gazi Community Forest Association (GOGACOFA)	Gogoni, Gazi, Makongeni
	Mrima, Marenje, Dzombo (MRIMADZO)	Mrima, Marenje, Dzombo
	Mwazaro, Bodo, Buda, Funzi (MWABBOFU)	Mwazaro, Bodo, Buda, Funzi Island
	Vanga, Jimbo, Kiwegu (VAJIKI)	Vanga, Jimbo, Kiwegu
	SHIKOFA	Shimba Hills
Lamu	LAMACOFA	Mkunumbi, Lamu Island, Manda, Siyu, Magongoni, Dodori Creek, Wange Creek, Pate Island
	Mangrove Cutters Association	Lamu
Tana River	MAMACOFA	Sabaki, Gongoni, Marereni, Kurawa
Mombasa	MOKICFA	Mombasa and Kilindini
Taita Taveta	KICOFCEA	Taveta, Kitobo
	NGACOFA	Ngangao forest
	KASICOFA	Kasigau forest
	CHAKOFA	Chawia forest
	VUCOFA	Vuria Forest
	SACOFA	Sagalla forest

Source: KFS, Coast

County governments have taken cognisance of the need for environmental conservation and have therefore integrated issues touching on coastal forests in their County Integrated Development Plans (CIDP 2013-2017). With the development and operationalisation of Forest Rules 2010 which was provided for under Section 59 of the Forest Act 2005, clear guidelines have been put in place on legal requirements for producers, transporters and traders engaged in charcoal business (Gathui et al., 2011). In addition, Charcoal Producers Associations (CPAs), whose role is implementation of the guidelines including reforestation, have been formed in order to streamline the implementation of these rules.

Under the national forest program, KFS has put in place initiatives to boost forest cover in the country, including coastal forests. An interactive online landscape atlas has also been developed

guide reforestation and afforestation efforts. The degraded natural forest areas that have potential for restoration and areas suitable for afforestation in the coastal area are shown in Figure 3.1.

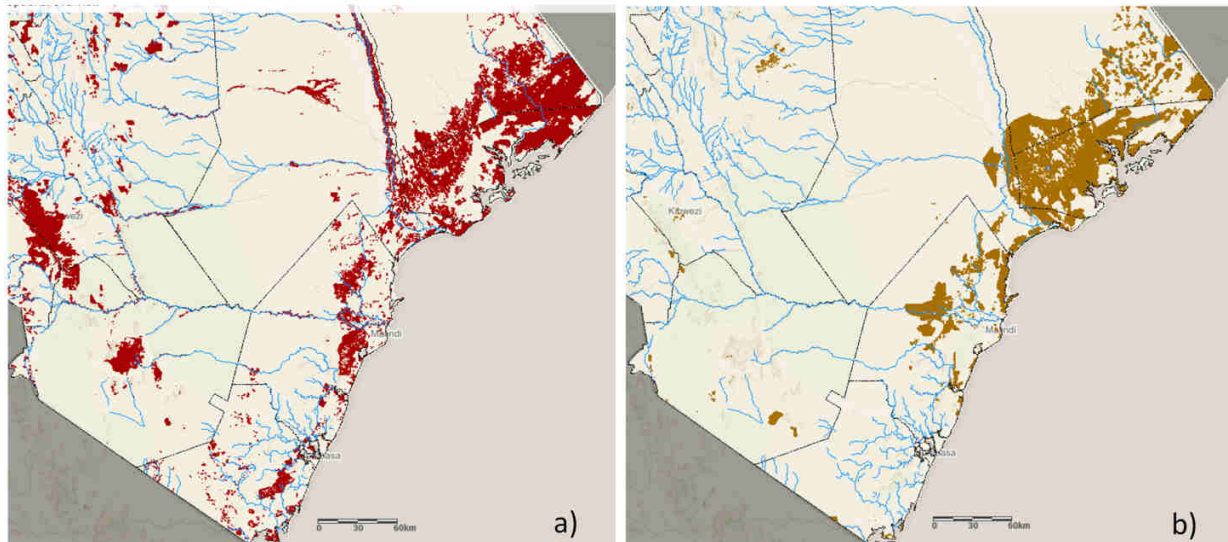


Figure 3.2 Tree-based landscape restoration map of coastal Kenya showing potential areas for (a) rehabilitation of degraded natural forests and (b) afforestation of natural forests (KFS, 2016).

3.1.3 Policy and management options

In order to guide sustainable management of coastal forests, the following measures need to be put in place.

- Review criteria for defining coastal forests and the vegetation types to ensure consistency in estimation of both temporal and spatial variations in forest cover for the determination of trends
- Develop and implement targeted forest management plans to tackle localized forest degradation while factoring the provisions of respective County Integrated Development Plans
- Empower the technical and financial capacity of CFAs to effectively develop and implement forest management plans
- Establish a seed banks to preserve the genetic diversity of indigenous threatened plant species

3.2 Mangrove ecosystems

Mangrove forests are a common feature along the Kenya coast between high and low water marks of the spring tides (Figure 3.2). They provide goods and services that are of economic, ecological, and environmental value at local, national and international levels (Government of Kenya, 2017). Mangrove wood is harvested for firewood and building materials, while the ecosystem provides habitat for fish and other wildlife, protect shoreline erosion, and regulate climate through carbon capture and storage. It is on this basis, that the Total Economic Value (TEV) of mangroves in Kenya has been estimated at KES. 269,450 per ha/yr as detailed in Table 3.3.

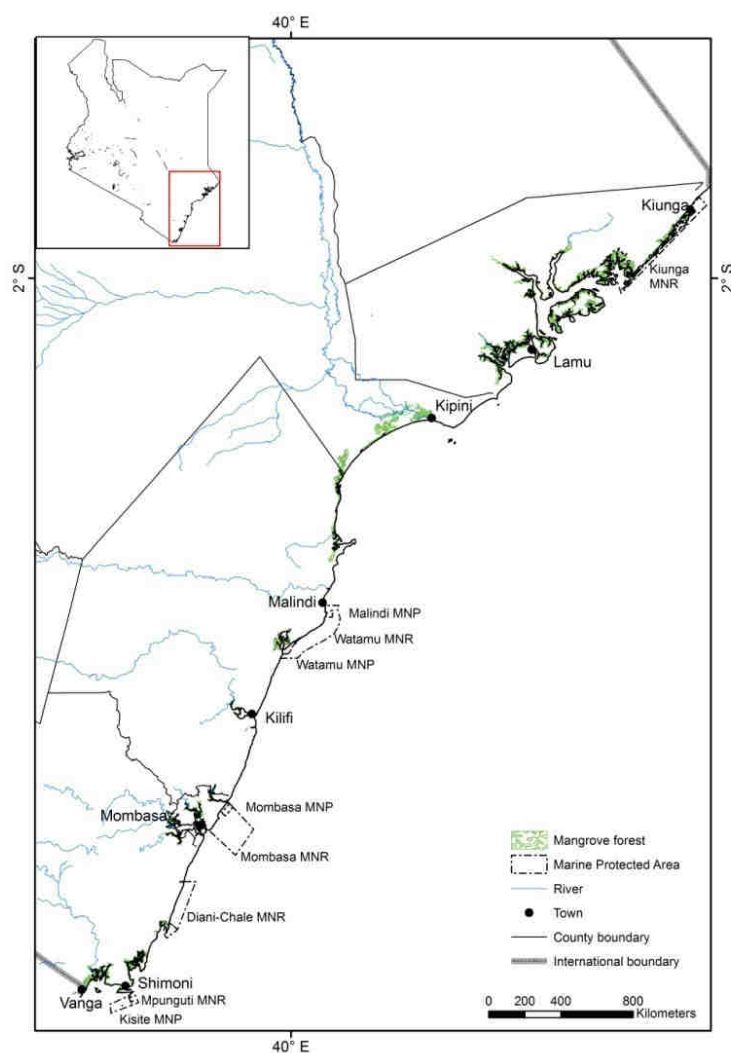


Figure 3.3 Mangrove distribution within the five counties along the Kenya coast

Table 3.3 Valuation of mangrove ecosystem in Kenya (Source: Kairo et al., 2009)

Product and services	KES ha ⁻¹ yr ⁻¹
Building poles	30,660
Fuelwood	4,505
Onsite fisheries	9,613
Beekeeping	1,250
Integrated aquaculture	408
Education and research	65,470
Tourism	782
Carbon sequestration	21,896
Shoreline protection	134,866

3.2.1 Status and distribution of mangroves in Kenya

The total area of mangroves in the Kenya is estimated at 61,271 ha; with Lamu County accounting for over 60% of the total cover, followed by Kilifi, Kwale, Mombasa and Tana River (Table 3.4). Reported estimates of mangrove coverage in Kenya show discrepancies arising mainly from differences in methodologies and description of what constitute mangroves among other reasons. The 61,271 ha estimates in the development of the national mangrove management plan (Government of Kenya, 2017), is significantly higher than the 54,000 ha and 47,000 ha estimates by Doute et al. (1981) and Kirui et al. (2012) respectively. The management plan re-analysed the 1990s medium scale (1:25,000) aerial photographs for mangroves on the entire coastline; whereas Doute et al. (1981) and Kirui et al., (2012) used Landsat imageries to map the forests. There is certainly a critical need to invest in aerial surveys to accurately map the mangrove areas in Kenya.

Table 3.4 Mangrove areas in the five counties along the Kenyan coast (Government of Kenya, 2017)

County	Forested mangrove area (ha)	% Cover
Lamu	37,350	61
Tana River	3,260	5
Kilifi	8,536	14
Mombasa	3,771	6
Kwale	8,354	14
Total	61,271	100

3.2.2 Drivers, impacts, pressures and response strategies

Similar to terrestrial forests, mangrove coverage in Kenya has continued to decline. Between 1985 and 2009, the country lost an average of 17.8% (or 0.70% by area per year) of mangroves (Kirui et al., 2012). Most of the losses were observed in Kilifi and Tana River counties (Table 3.5). Losses and degradation of mangrove forests in Kenya stems from over-exploitation of wood and non-wood products, conversion of mangroves areas to other land uses such solar salt works, infrastructure development, and pollution effects. Climate change is taking toll on the remaining mangroves, particularly through sea-level rise, aridity, and flooding. One of the major drivers that has led to conflicts and exacerbated the deterioration of mangroves has been inadequate linkages among different stakeholders. At community levels, lack of recognition of customary rules governing subsistence use of mangrove resources has resulted to user conflicts. It may be difficult to predict trends in areas where harvestable products have been depleted owing to the dynamics of the drivers.

Table 3.5 Mangrove forest cover per county along the Kenya coast from the year 1985 to 2010 (Source: Kirui et al., 2012)

Region	Mangrove cover (ha)				Percentage loss per county as at 2010
	1985	1992	2000	2010	

Lamu-Kiunga	23,371	22,629	20,661	20,482	12.4
Tana River	10,434	9,119	7,350	6,450	38.2
Mida Creek	3,300	3,184	3,009	2,939	10.9
Kilifi	474	274	123	114	75.9
Mombasa	3,360	3,075	2,846	2,816	16.2
Gazi - Vanga	14,049	13,602	12,945	12,790	9.0
Total	55,288	51,883	46,934	45,590	17.5

Despite the decline in mangrove cover, there have been increased interests on conservation, rehabilitation, and sustainable utilization of mangrove resources in Kenya. To improve the management of mangroves in Kenya, the government developed a national mangrove ecosystem management plan for the 2017-2027 period (Government of Kenya, 2017). This is the first management plan for mangroves in Kenya that aims to enhance ecosystem integrity and the contributions of mangroves to the economy through sustainable management and rational utilization. Aspects of co-management, equitable use, access and tenure for the communities living within and adjacent to mangrove ecosystems have been highlighted in the management plan in line with Forest Management and Conservation Act (2016) and other environmental laws in Kenya.

Additionally, local communities living adjacent to mangroves have come up with conservation groups through which income generating activities are promoted while conserving the mangroves (Okello et al., 2011). Most of these livelihood and income generating activities revolve around reforestation of degraded areas, beekeeping, integrated aquaculture, and ecotourism (Government of Kenya, 2017). To tap on climate change opportunities, an innovative carbon offset project was initiated at Gazi bay with the sole aim of restoring and protecting mangroves through sale of carbon credits. The captured carbon, amounting to 3000 tCO₂/year are traded in the voluntary carbon generating approximately KES. 1.0 m/yr to the community (<http://www.planvivo.org/project-network/mikoko-pamoja-kenya/>). There are plans to expand similar carbon offset projects to other mangrove areas in Kenya.

3.2.3 Policy and management options

In order to improve the management of mangrove resources the following actions are recommended:

- Implement the National mangrove ecosystem management plan
- Produce accurate mangrove forest cover maps using medium-scale aerial photographs (1:25000) to delineate zones for development, utilization, protection and rehabilitation;
- Strengthen institutional capacity of agencies responsible for mangrove management
- Upscale enforcement of regulations on the exploitation of mangroves for fuelwood and building purposes;
- Establish permanent sample plots (PSP) in the counties in order to provide incremental data on growth dynamics for forest management planning;

- Formulate and implement tourism development plans and other forms of recreational activities in mangrove areas to increase benefits to communities

3.3 Seagrass beds

3.3.1 Status and trends

Seagrasses are marine angiosperms with a worldwide distribution. In Kenya, seagrasses occur in sheltered tidal flats, lagoons and creeks with the exception of the coastal stretch adjoining the Tana Delta (UNEP, 1998). Compared to mangroves and coral reefs, seagrasses have received limited scientific attention despite the important role they play in providing nurseries, breeding, and feeding grounds for commercially important fishery species. Seagrasses support marine foodwebs and are thus important in nutrient cycling and carbon sequestration (Björk et al. 2008). They serve as a primary food source for threatened and endangered species such as the green turtle (*Chelonia mydas*), the hawksbill turtle (*Eretmochelys imbricata*) and the dugong (*Dugong dugon*) (IUCN, 2010). In addition, sea grasses buffer wave action reducing coastal erosion, while the structure of their leaves act as traps for suspended sediments (Björk et al. 2008).

Seagrass beds in Kenya are estimated to cover a surface area of about 33,600 ha, with the most extensive cover occurring in Lamu-Kiunga area, Malindi - Ungwana Bay, Watamu, Mombasa, Diani-Chale, and Shimoni-Funzi bay (KWS, 2013). Twelve (12) species of seagrass have been recorded along the Kenyan coast (Government of Kenya, 2009; Table 3.6). These comprise the short-lived, 'pioneering' forms: *Halophila ovalis*, *Halophila minor*, *Cymodocea rotundata*, *Halodule uninervis*, *Halodule wrightii*, *Halophila stipulacea*, *Syringodium isoetifolium*, *Zostera capensis*, and the long-lived, 'climax' species represented by *Enhalus acoroides*, *Thalassia hemprichii*, and *Thalassodendron ciliatum* (Mariani and Alcovero, 1999). *Zostera capensis* is categorized as a species of least concern in the IUCN red list. (UNEP, 1998).

Table 3.6 Distribution of seagrass species along the Kenyan coast (x = areas where the species are found)

Name of species	County						
	Kwale			Mombasa	Kilifi		Lamu
	Funzi-Vanga-Shimoni	Gazi	Diani-Chale	Mombasa	Bofa	Watamu	Lamu-Kiunga
<i>Cymodocea rotundata</i>	X	X	X	X	X	X	X
<i>Cymodocea serrulata</i>	X	X	X	X	X	X	X
<i>Enhalus acoroides</i>	X	X					X
<i>Halodule wrightii</i>	X	X	X	X	X	X	X
<i>Halodule uninervis</i>	X	X	X	X	X		
<i>Halophila minor</i>	X	X	X				
<i>Halophila ovalis</i>	X	X	X			X	X
<i>Halophila stipulacea</i>	X	X	X	X		X	X

<i>Thalassia hemprichii</i>	X	X	X	X	X	X	X
<i>Thalassodendron ciliatum</i>	X	X	X	X	X	X	X
<i>Syringodium isoetifolium</i>	X	X	X	X	X	X	X
<i>Zostera capensis</i>	X	X			X		

3.3.1 Threats to seagrass ecosystems in Kenya

Seagrass ecosystems are threatened by fishing activities including beach seining and trawling. Overfishing of sea urchin predators, particularly triggerfish, has also contributed to explosion of sea urchins, *Tripneustes gratilla* leading to degradation of seagrass beds, particularly; *Thalassodendron ciliatum* (McClanahan, 2000). For instance, in Diani-Challe and Watamu sea urchin herbivory is associated with a 50% reduction of *T. ciliatum* (Uku et al., 2007). Other major stressors include pollution, dredging and boating activities exacerbated by climate change effects.

3.3.2 Drivers, pressures, impacts and response strategies

Seagrass beds are undergoing continued degradation leading to losses of cover and biodiversity in many areas with rates of degradation varying from one site to the other (Githaiga et al., 2015). Degradation of seagrass beds negatively impacts coastal communities since they derive livelihoods from this resource. The Kenya government has developed a management and conservation strategy for coral reefs and seagrass ecosystems (KWS, 2013). The strategy is guided by six strategic objectives focusing on threats and mitigation measures. The feasibility of seagrass restoration has also been conducted in Diani-Chale and Wasini with varied success (Daudi et al. 2013, KCDP 2015). Promising results on the recovery of seagrass beds and associated fauna have been demonstrated (Daudi et al., 2013).

3.3.3 Policy and management options

Seagrass ecosystems are closely connected to coral reefs and mangroves in terms of biodiversity and biophysical characteristics. As such, threats facing one of the ecosystems will impact on the other. In order to conserve and safeguard seagrass beds, the following actions are recommended:

- Determine the seagrass distribution, coverage and species composition using high-resolution imageries and ground-truthing to identify degraded areas in need of restoration;
- Strengthen legal and policy framework governing seagrasses in Kenya
- Implement the Coral Reef and Sea grass Ecosystem conservation Strategy 2014-2018;
- Increase awareness on the value of seagrass ecosystems, threats facing them, and consequences of their loss and degradation

3.4 Sand dunes and sandy beaches

3.4.1 Status and trends

Sediment from eroding corals, shells and materials brought from the hinterlands by rivers get deposited on the coast to form sand dunes (Plate 3.1) and sandy beaches. Prevailing winds blowing from the sea piles beach sand to form dunes. Sand dunes and beaches provide important breeding, feeding and nesting habitats for diverse fauna including sea turtles, birds and crabs among others. They also support fresh water provision in underground aquifers and help buffer against sea level rise and storm surges. Economic activities associated with sand dunes and sandy beaches include coastal tourism (Plate 3.2), mineral exploration, and sand harvesting. Sand dunes supplied by sediment from Sabaki and Tana River are prominent features of the coastlines in Lamu Tana River and Kilifi counties.



Plate 3.1 Sand dunes in Malindi (Photo credit: James Kamula)



Plate 3.2 Public recreation at Jomo Kenyatta Public Beach, Mombasa (Photo credit: James Kamula)

3.4.2 Drivers, pressures, impacts and response strategies

Dunes and beaches are dynamic due to the physical processes of currents, tides, winds and sedimentation. Encroachment by tourism infrastructure development is one of the key issues impacting on sandy beaches and sand dunes (Plates 3.3). Degradation of sandy beaches and sand dunes through sand harvesting and improper waste disposal is also a major threat. Solid waste including plastics and other forms of marine debris on beaches not only lead to a loss of aesthetic value, but also reduces the quality sea turtle nesting habitats and threatens the survival of sea turtle hatchlings as well as other benthic animals. Aquifers in sand dunes are also susceptible to contamination from septic tank effluents leaching from adjacent settlements.



Plate 3.3 Shoreline erosion triggered by shoreline encroachment at Shelly beach, Likoni, Mombasa (Photo credit: James Kamula)

Although shoreline change is a continuous natural process, the intensity of change is influenced by development activities along the shoreline and beaches. A shoreline management strategy, developed in 2010, has been developed to guidance on shoreline development and address the environmental issues of the coastal shoreline. Implementation of the strategy will be key to mitigate the threats facing shoreline habitats includeing sandy beaches and sand dunes.

3.4.3 Policy and management options

In order to conserve and safeguard sandy beaches and sand dunes, the following actions are recommended:

- Implement the shoreline management strategy to protect beaches and sand dunes
- Profile all the beaches and implement long-term beach and shoreline change monitoring programme to inform decision-making and planning of shoreline protection interventions
- Incorporate beach monitoring and protection in National and County Development Plans
- Develop guidelines on sustainable utilization and conservation of sand dunes and beaches
- Strengthen and enforce relevant regulations to protect beaches and shoreline habitats from developments
- Accreted shoreline areas are ecologically sensitive and vulnerable. Such areas should be mapped and gazetted as public land/areas
- Develop and implement programmes to address marine litter and other land-based sources of pollution on coastal beaches
- Enhance awareness on the value of beaches and sand dunes and consequences of their loss and degradation

3.5 Coastal wetlands

3.5.1 Deltas and estuaries

Wetlands occupy 14,000 km², representing 3 – 6% of the land surface in Kenya, depending on the season (Government of Kenya, 2013). Along the coast, these wetlands are represented by deltas, estuaries, tidal marshes, mangrove swamps, freshwater and constructed wetlands. Tana is the biggest delta in Kenya with an estimated area of 130,000 ha. It is a wetland of both local and international importance having been designated as Ramsar Site in 2012. The Delta is also an Important Bird Area (IBA) and the second most important estuarine and deltaic ecosystem in Eastern Africa with extensive floodplains and diverse mangrove systems (Hamerlynck et al, 2010).

Another major wetland along the coast is the Sabaki estuary, which covers an area of 600 ha. The estuary consists of sandbanks, mudbanks, dunes, mangroves, seasonal, and permanent freshwater pools. Sabaki estuarine is an Important Bird Area (IBA) providing habitats for migratory and resident birds. Other important animal species include baboons, monkeys, antelopes, crocodiles, and hippopotamus; that attracts visitors to the site.

3.5.2 Coastal lakes

There are three major lakes in the coastal region of Kenya, namely; Lake Kenyatta (Mkunguya), Lake Jipe and Lake Chala. Lake Kenyatta in Lamu County is the largest of the three with a surface area of 496 km² and is part of the lower Tana River basin. Lakes Jipe and Chala, on the other hand, are transboundary in nature, stranding between Kenya and Tanzania border in Taita-Taveta County. Coastal lakes and their riparian areas support a rich biodiversity (Table 3.7, Plate 3.4) as well as vital economic activities of the surrounding settlements. They are also a source of water to the adjacent communities and wildlife.

Table 3.7 Biodiversity of the coastal lakes (KCDP, 2014)

Lake	Biodiversity
Kenyatta	Over 306 plant species including those of special concern are found within the mixed vegetation types, including wooded grasslands, shrublands, overstorey forests and onshore vegetation on bogs.
	105 species of invertebrates including 26 species of butterflies, 13 of bees, 3 of ants, 2 of wasps, 49 of beetles, 2 of cockroaches, 3 of snails, 4 of dipterans, 3 of true bugs & several unidentified species of spiders, scorpions and millipedes; some of which falls under species of special concern.
	Over 23 species of waterbirds at Lake Kenyatta. The most abundant species are African Open-billed Stork, Cattle Egret and White-faced Whistling Ducks. Small mammal assemblages of the immediate surroundings, including rodents, bats, shrews, lagomorphs, mesocarnivores, hyraxes, and lorrisids
	An endemic Lorissid primate, <i>Galagoides cocos</i> is found in the forests around the lake
Jipe	The lake is known for its endemic fish species, water birds, mammals, wetland plants and lake-edge swamps, which extend about 2 km from the shoreline (Maltby, 2009)
	Vegetation dominated by bulrush (<i>Typha domingensis</i>) locally known as “Gugu maji” that grows out from the lakeshore forming floating ‘islands’ and fringing the lake edges.
	Swards of <i>Cyperus laevigatus</i> , <i>Sporobolus spicatus</i> and <i>S. macranthus</i> , and also papyrus, being the major plants as well as 50 others found on the landward side.
	One of the few places in this part of Eastern Africa where the Lesser Jacana and the Purple Gallinule are common and where the Madagascar Squacco Heron, Black Heron, African Darter and African Skimmers are often seen.
	Herbivores, carnivores, ungulates, reptiles are among the different wildlife species that have adapted to the environment around the Lake Jipe catchment area. These include zebras, impalas, gazelles, hippopotamus, crocodiles, water monitors, otters and elephants.
Chala	Home to endemic Lake Chala tilapia <i>Oreochromis hunteri</i> which is critically endangered as per IUCN red list of threatened species (Bayona et al., 2006)



Plate 3.4 Elephants grazing along the riparian zone of Lake Jipe (Photo credit: Stephen Mwangi)

3.5.3 Drivers, pressures, impacts and response strategies

Pressures in coastal wetlands and lakes in Kenya are driven by among others; unsustainable human activities within and adjacent the catchment areas and in the wetlands; lack of co-ordinated and holistic policy guidelines as well as climate change. Communities within and adjacent to coastal wetlands and lakes practice mixed farming, fishing, sand collection among other economic activities which are the major drivers of change (Table 3.8). Frequent drought and abstractions of water upstream, either for irrigation or energy, results in alteration of sediment dynamics downstream. Tana Delta and the Athi-Sabaki estuary are now showing evidence of shoreline change resulting from reduced freshwater flow and increased sedimentation. The impacts of these changes include loss of critical habitat and species, resource use conflicts and loss of livelihoods. These changes have eroded the ecological and socio-economic values and services derived from these wetlands.

Table 3.8 Major drivers, pressures, and impacts of the changes in coastal wetlands in Kenya

Underlying Sectors	Pressures	Impacts
Agriculture	<ul style="list-style-type: none"> • Excessive abstraction of fresh water • Unregulated diversion of water for irrigation • Conversion of wetlands for agriculture and settlement • Overgrazing 	<ul style="list-style-type: none"> • Water scarcity due to high water demand • Changing river course • water pollution and solid waste management • Resource use conflicts

Sand mining	<ul style="list-style-type: none"> • Sand over harvesting 	<ul style="list-style-type: none"> • Soil erosion/sedimentation • Reduced hydrological capacity • Loss of critical habitat and species • Invasive species
Fisheries	<ul style="list-style-type: none"> • Use of illegal/ destructive fishing methods • Over exploitation of fisheries resources 	
Forestry	<ul style="list-style-type: none"> • Overexploitation of forest products 	
Tourism	<ul style="list-style-type: none"> • Conversion of wetlands for tourism development • Wastewater discharge and pollution 	
Energy	<ul style="list-style-type: none"> • Excessive abstraction water • Alteration in freshwater flows and sediment loadings 	

Among the coastal lakes, Lake Kenyatta has no restriction to resource exploitation; hence, the lake faces a number of challenges ranging from encroachment, selective felling of riparian vegetation, overgrazing, soil harvesting and impact of invasive species such like as *Prosopis juliflora* and aquatic plants (Plate 3.5). Indirect threats include excessive abstraction of underground water in form of numerous shallow wells and boreholes sunk by surrounding local community to draw underground water for domestic use and irrigation agriculture. As a result, overgrazing of large herds of cattle owned by the local communities is among the major forms of pressure in this lake.

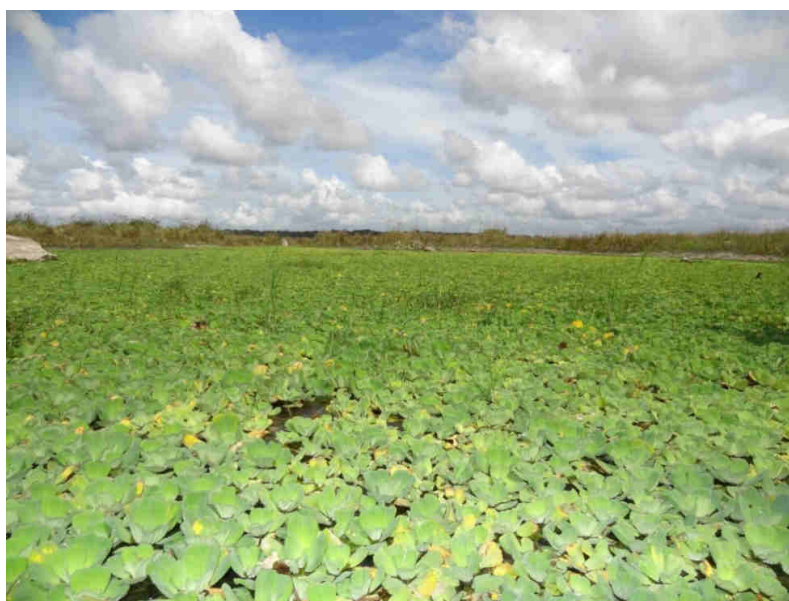


Plate 3.5 The invasive species water cabbage *Pistia stratiotes* in the shores of Lake Jipe (Photo credit: Stephen Mwangi)

Lake Jipe is facing numerous environmental and management challenges including: lake recession, sedimentation, deteriorating water quality, increased salinity and accelerated weed invasion. These

changes potentially affect the biodiversity and provision of ecosystem services. The catchment is facing human-induced changes due to land use activities and diversions of River Lumi for agriculture and domestic use. The lake ecosystem is now at risk from environmental degradation owing to the heavy sedimentation leading to rapid growth and spread of the macrophytes, especially emergent *Typha domingensis*, which have colonized a large proportion of the lake. Sedimentation is as a result of soil erosion in the riparian areas arising from anthropogenic activities including settlement and agriculture. As a consequence, the fishery once relied on heavily in the Taita-Taveta region has since collapsed due to the changes in water quality among other factors Fisheries (Plate 3.6).



Plate 3.6 Fishermen in a traditional vessel in Lake Jipe (Photo credit: KCDP)

Response strategies to conserve wetlands include: ratification of the Ramsar Convention (Ramsar, 1971) in 1990 to address sustainable utilization of wetland resources; and formulation of the National Wetlands Conservation and Management Policy (2016) to guide the management and use of wetlands in the country. Site specific management plan has been developed e.g for the Tana Delta. The focus of the management plan is renewing efforts by the local community and other stakeholders to sustainably utilize the resources within the delta. A management plan for Lake Jipe has also been developed.

3.5.4 Policy and management options

In order to conserve and safeguard coastal wetlands and lakes, the following actions are recommended:

- Prepare and maintain an inventory of all wetlands in Kenya coast
- Develop and implement targeted integrated wetlands management plans to promote conservation and sustainable use of these resources
- Strengthen enforcement of wetlands regulations and other relevant regulations to protect coastal wetlands from unsustainable developments and use

- Implement long-term wetlands monitoring programme to inform decision-making and planning of wetlands conservation interventions
- Develop ecotourism ventures to encourage participation of communities in conservation of wetlands;
- Creating awareness among the local communities to enable them embrace conservation and management of wetlands

3.6 Coral reefs, rock shores and hard bottom habitats

3.6.1 Status and trends

Coral reefs and rocky shore ecosystems occur all along the coast except at the mouths of the major rivers, the Tana and Sabaki (Figure 3.4). Overall, coral reefs occur within hard or rocky substrates, from shallow inshore waters of < 1.5 m to about 25-45m depth (Obura, 2012). The southern reefs in Kenya are almost contiguous fringing reefs with scattered lagoonal patchy reefs, whereas the northern reefs are discontinuous and falls within a system of barrier islands and mangrove forest. Coral species diversity decreases as one moves northwards along the coast; with Kisite-Mpunguti in the south having the highest diversity (203 coral genera), followed by Lamu (173) and Kiunga (167) in the north (Obura, 2012). With little human disturbance, healthier corals with abundant fish in Kenya occurs in MPA's (Muthiga, 2009).

Coral reefs and rocky shores harbour rich biodiversity of birds, fish, crustaceans, molluscs, and echinoderms. In turn, the rich biodiversity supports people's livelihood through fisheries, tourism and cultural heritage (Obura, 2012). They also provide protective services provided by coral reefs and associated ecosystem against extreme events such as storm surges and even tsunamis.

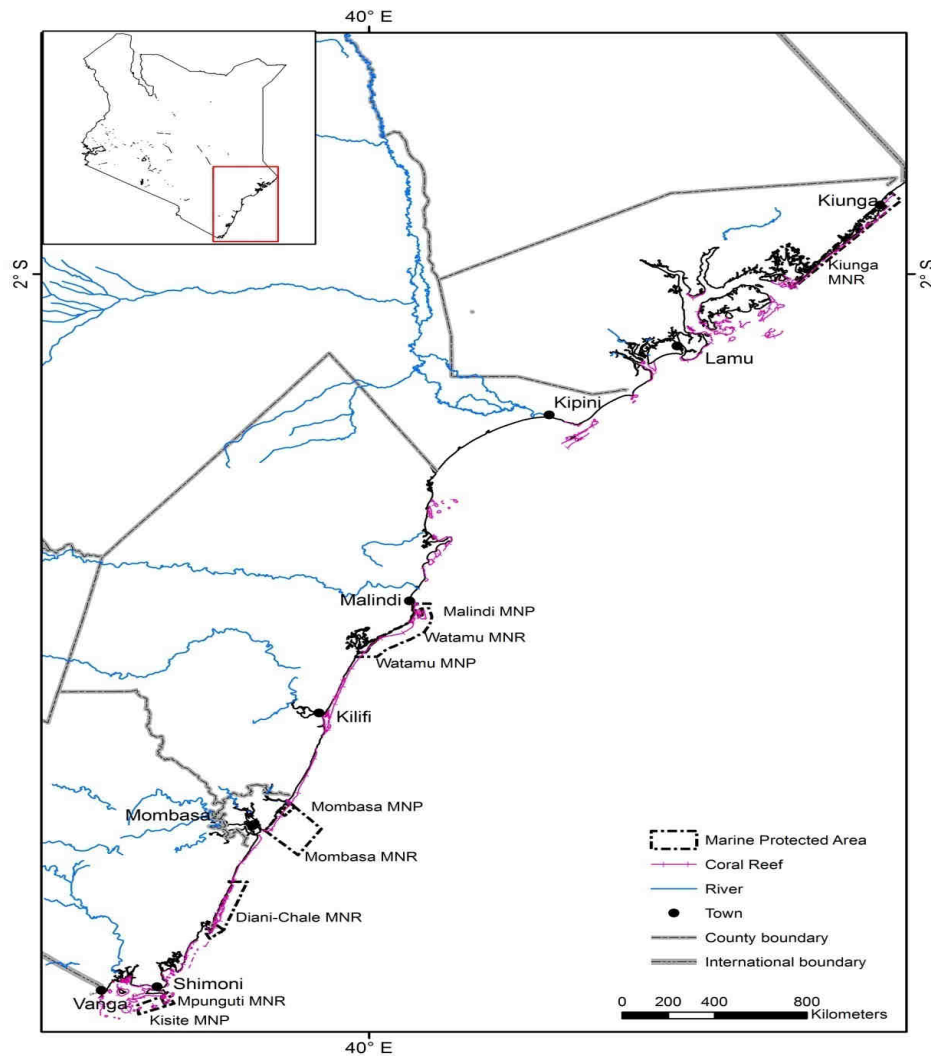


Figure 3.4 Map of the Kenyan coast showing major reefs and nationally gazetted MPAs (Source: Samoily et al., 2011)

The change in coral cover between 1998 and 2016 is shown in Figure 3.5. Turf algae cover was higher from 2000 to 2008 and declined in the following years, while hard coral cover was low 1998 to 2005 and increased steadily during the following years. The recovery of hard coral cover in the different reefs especially after the 1998 bleaching event was variable, with reefs in MPAs showing slightly higher recovery than open access reefs. Hard coral cover in MPAs has increased to 15 to 40% from about 8-10% following the regional 1997/98 ENSO bleaching event. Compared to fully protected areas, open access reefs show less than 50% of the hard coral cover in MPAs.

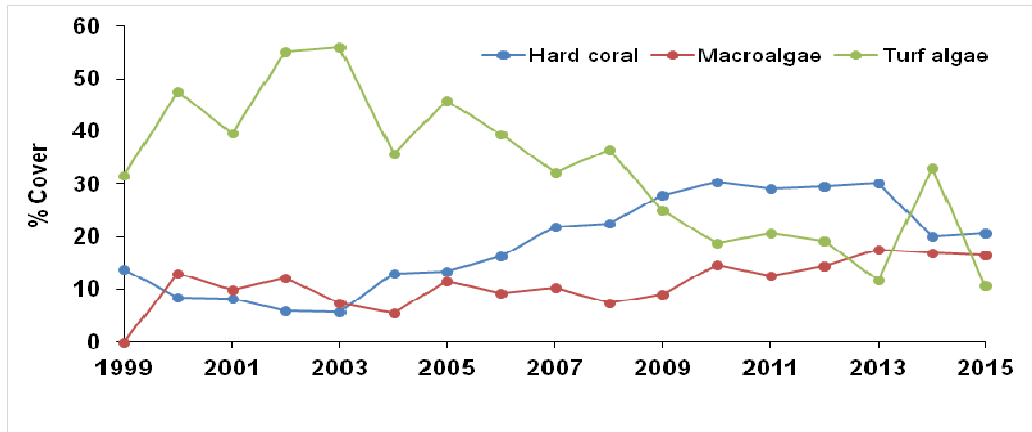


Figure 3.5 Trends in percent cover for major benthic functional groups (hard coral, macroalgae and turf algae) between 1999 and 2016 in Kenyan reefs (Adapted from Mwaura et al. 2017).

3.6.2 Drivers, pressures, impacts and response strategies

Human and natural induced stressors drive changes in the coral reef and associated biodiversity. Over-exploitation of marine living resources, urban pollution, coastal development and tourism are among the main anthropogenic pressures that can cause significant decline of coral reefs and consequently reduce their functionality. The following are the main pressures impacting the coral reef ecosystem:

Climate change: The impact of coral bleaching and mortality induced by warming of sea surface temperature is a major driver of coral declines worldwide (Atewerben et al., 2011). There is evidence of climate-induced events affecting indirectly coral reef fish abundance (Cinner et al., 2007). On the long-term, the ocean warming alters the distribution of organisms and may drive some species to extinction (McClanahan et al., 2012). Mass bleaching and mortality of corals in Kenya was experienced in 1997/98, 2001, and 2010 (Figure 3.6). The highest recovery was in MPA as compared to open access reefs that show lowest hard coral coverage and highest algal turf. During the 1997/98 bleaching event, coverage of hard corals in MPAs dropped from 40% to < 10% (Ateweberthan and McClanahan, 2010). Overall, conditions of coral reefs in Kenya have improved since 2000, as indicated by cover of major benthic functional groups – hard corals, macroalgae and turf algae.

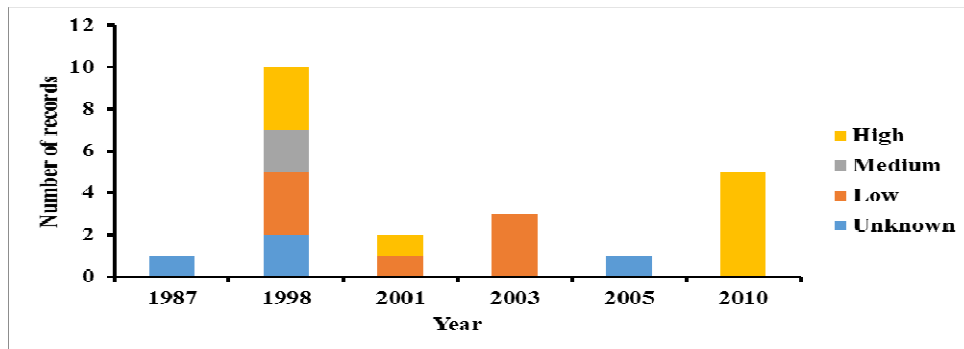


Figure 3.6 Coral bleaching and mortality records reported during 1987 - 2010 (Source: http://www.reefbase.org/global_database/default)

A recent coral bleaching event was observed during the April – May 2016 period. Approximately 60% of all coral colonies assessed were bleached and up to 20% mortality was observed in some sites (Figure 3.7).

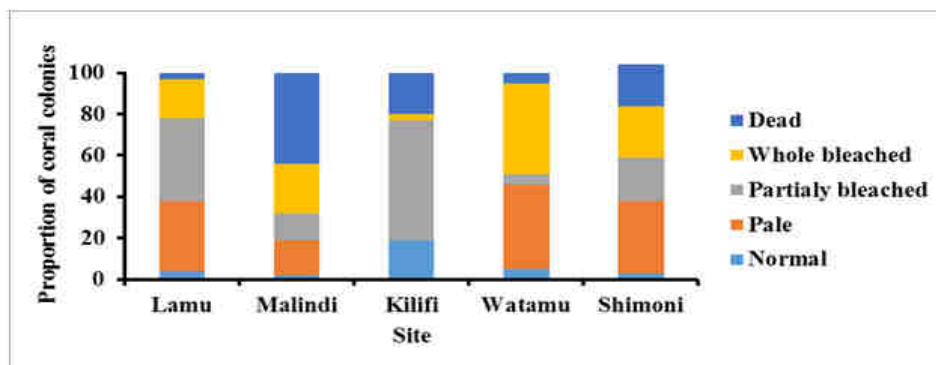


Figure 3.7 The bleaching status of coral colonies in sampled sites during 2016 along the Kenya coast (Adapted from Mwaura et al. 2017)

Over-exploitation of resources: Over-harvesting of reef resources has been associated with reduction in commercial fish species such as groupers, sweetlips and snappers (McClanahan et al., 2012). Many coastal residents unable to secure formal jobs resort to fishing as access to marine resources is largely uncontrolled.

Destructive fishing practices: Bottom-dragging gears such as seine nets and high levels of trampling of corals by speargun fishers cause widespread physical damage to coral communities and ultimately destroy the reef (KWS, 2013).

Tourism pressure: Heavily visited reefs result to breakages of branching corals which provide shelter to small juvenile and cryptic fish (KWS, 2013). The development of hotels and tourist

resorts on beaches adjacent to coral reefs also contribute to the degradation of reef habitat through sewage or wastewater discharges into the nearshore waters (KWS, 2013).

The responses to mitigate impacts on coral reef and seagrass ecosystems include the development of a conservation strategy for Kenya for the period 2015-2018 (KWS, 2013). This strategy seeks to address issues affecting coral reefs through building linkages and synergies among public and private sectors, local communities, experts and general stakeholders. The strategy is guided by six strategic objectives focusing on threats, and mitigation measures to coral reefs and seagrass ecosystems. Marine Protected Areas (MPAs) contribute to the conservation and management of coral reef ecosystems in Kenya. This entails partial or full restriction of use or extraction of resources. There are currently 4 marine parks and 6 marine reserves all under the management of KWS. At the local scale, coastal fishing communities have embraced community-based conservation through establishment of Community Conservation Areas (CCAs) in order to enhance sustainable fisheries and other livelihood options such as eco-tourism (Table 3.9).

Table 3.9 Existing CCAs, year of establishment and area protection

Name of CCA	Year established	Level of management intervention	Number of fishers involved
Kuruwitu	2006	No-take zone	108
Tiwi (Nyari)	2009	No-take zone	40
Wasini	2008	Seasonal closure	31
Kibuyuni	2010	No-take zone	81
Bureni	2010	No-take zone	27
Kanamai	2011	No-take zone	99
Tradewinds	2009	Gear restriction	73
Jimbo	**	Gear restriction	75
Vanga	**	Gear restriction	217
Iweni, Lamu	2010	Gear restriction	23

** Not demarcated (Source; WCS, 2012)

There has been trial experiments to assess the suitability of coral species for culture at the Mombasa Marine Park (Kimani et al., 2014, Plate 3.7), as well as collaborative initiatives to restore degraded coral reefs involving communities at the south coast of Kenya at Wasini (Murage and Mwaura 2015, Plate 3.8). The collaborative initiatives entail hands-on training on coral gardening as well as development of a step-by-step guidebook on coral transplantation (Figure 3.7a). Initial transplantation trials have given survival rate of 75% and improved fish density by two folds within one year (Mwaura et al., 2015).



Plate 3.7 Transplanted coral fragments in Mombasa Marine Park after a few months of growth (Photo credit: Gladys Okemwa)



Plate 3.8 Training session on coral restoration (Photo credit: Jelvas Mwaura)

3.6.3 Policy and management options

In order to enhance conservation and management of coral reefs in Kenya, the following management strategies are recommendations:

- Encourage community-based protection and restoration of coral reefs
- Develop viable mechanisms to reduce the use of destructive fishing gears
- Implement the Coral Reef and Sea grass Ecosystem conservation Strategy 2014-2018
- Raise public awareness on the value of coral reefs, threats facing them, and consequences of their loss and degradation
- Promote long-term monitoring of coral reefs and bleaching events

3.7 Offshore and deep sea habitats

3.7.1 Status and trends

Deep sea habitats constitute the physical features of the sea bottom including soft bottom habitats, hard or rocky habitats, sea mounts as well as sea valleys; whereas pelagic habitats include the water column which is penetrated by light as well as the dark parts where light does not penetrate. Kenya's deep sea habitats remain largely unexplored hence very little is documented about their status. However, during recent surveys, 3 seamounts have been observed at depths ranging between 2750 - 3500 m and measuring 800m, 1500m and 2000m and averaging 890 km² (Harris et al., 2014). Although their contribution has not been estimated, seamounts form high productivity ecosystems by supporting upwelling (ASCLME/SWIOFP, 2012a).

Longline and purse seine fisheries are the main extractive economic activities in the Kenyan EEZ. Trials for commercial deep water trawling for crustaceans and demersal fish are also ongoing following research surveys during the South West Indian Ocean Fisheries Project (Plate 3.9). Deep sea oil and gas exploration are ongoing, particularly, in the northern part of the Kenyan coast off Lamu Island.



Plate 3.9 Deep water crustacean trawl catch by MV Vega (Photo by Edward Kimani)

3.7.2 Drivers, pressures, impacts and responses

The main driver of change in deep water and pelagic ecosystems is global climate change that has been associated with increased CO₂ levels in the atmosphere. Kenya is a major gateway for shipping within the East African region. Increasing shipping traffick poses a potential threat to the environment through ship discharges of waste, pollution, acoustics and accidental oil spills.

Kenya has ratified a number of international and multilateral agreements that have provisions for the protection of marine resources, including the United Nations Convention for Law of the Sea (UNCLOS 1982), FAO code for responsible fisheries (1985), United Nations Framework on Climate Change and International Convention for the Prevention of Pollution from Ships (MARPOL Convention, 1973/78) while the regional agreements including the Nairobi Convention (1985), Port State measures agreement (2016) that assist in protection of coastal and marine resources. Nationally, the government has increased investment in the deep sea research through acquisition of marine research vessel (MV Mtafiti).

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Chapter 4 : Species of Conservation Concern

Species of conservation concern include those that are rare, endemic or show evidence of local population declines. Most of the species are generally long lived, slow growing, late maturing and produce few young ones making them vulnerable to anthropogenic impacts. Some are listed under the IUCN Red List of Threatened Species as critically endangered, endangered, vulnerable, or near threatened species. They include marine mammal species (Cetaceans and Sirenians), sea turtles, bony fishes and elasmobranchs (sharks and rays), and terrestrial species (mammals, reptiles, birds, amphibians, and plants).

4.1 Status and trends

4.1.1 Cetaceans

Whales: Seven species of whales have been recorded within Kenya waters. The most common species is the humpback whale (*Megaptera novaeangliae*). Other species include the minke whale (*Balaenoptera acutorostrata*), bryde's whale (*Balaenoptera edeni*), the toothed sperm whale (*Physeter macrocephalus*), the killer whale (*Orcinus orca*), the false killer whale (*Pseudorca crassidens*), the melon headed whale (*Peponocephala electra*) and most recently the blue whale (*Balaenopteramusculus*) (Kiszka et al., 2008; Barber et al., 2016). Three species are listed as endangered and three as vulnerable (Table 4.1).

Dolphins: Five species of dolphins have been sighted within Kenya's marine waters (the Indo-Pacific bottlenose dolphin (*Tursiops aduncus*); the common dolphin (*Delphinus delphis*) the Indo-Pacific humpback dolphin (*Sousa plumbea*), the spinner dolphin (*Stenella longirostris*), the spotted dolphin (*Stenella attenuate*). Three other species, the striped dolphin (*Stenella coeruleoalba*), Fraser's dolphin (*Lagenodelphis hosei*), and risso's dolphin (*Grampus griseus*) are also reported to occur (Kiszka et al., 2008).

Table 4.1 List of threatened marine mammals in the WIO and their status (adapted from UNEP-Nairobi Convention and WIOMSA, 2015)

IUCN Red List	Common names	Species	Global Distribution
Endangered	Sei whale	<i>Balaenoptera borealis</i>	Cosmopolitan
	Blue whale	<i>Balaenoptera musculus</i>	Cosmopolitan
	Fin whale	<i>Balaenoptera physalus</i>	Cosmopolitan
Vulnerable	Sperm whale	<i>Physeter macrocephalus</i>	Cosmopolitan
	Dugongs	<i>Dugong dugon</i>	Indo-West Pacific

Efforts to monitor and document sightings of marine mammals along the Kenya coast by the Kenya Marine Mammal Network (KMMN) have contributed new insights on species distributions and their relative abundance. Sighting surveys conducted between May 2011 and September 2013 reported 681 marine mammal sightings represented by 12 cetacean species and 1 dugong (Table 4.2). The Indo-Pacific bottlenose dolphins and humpback whales (Plate 4.1) were the most sighted within the Watamu-Malindi area (364 sightings) and the southcoast area along Diani to the Pemba channel (305 sightings). Pilot whales were sighted around Diani, Pemba Channel and Watamu, sperm whales were sighted near Malindi, and a killer within the Watamu banks. In 2016, a sperm whale stranding was reported at Ngomeni, and a group of migrating false killer whales at the Watamu banks. The Indo-Pacific bottlenose dolphin constituted 70% of the dolphin sightings followed by spinner dolphins (15%). The most common locations of sighting included: Kwale (96), Malindi (52), Kilifi (5), Lamu (2), Mombasa (1), and Tana River (1). Another marine mammal species, the Sub-Antarctic fur seal, was found entangled in a gillnet in Lamu in 2015 and released alive. The frequency of cetacean sightings is highly seasonal, for example humpback whales are frequently sighted between the months of July to October coinciding with the peak breeding and calving periods.

Table 4.2 Relative abundance of marine mammals reported by volunteers based on surveys coordinated by the Kenya Marine Mammal Network (2011-2013)

Species	Scientific name	2011	2012	2013	Total	IUCN Red list
Bottlenose dolphin	<i>Tursiops aduncus</i>	71	191	122	384	Data deficient
Humpback whale	<i>Megaptera novaeangliae</i>	5	77	116	198	Least concern
Spinner dolphin	<i>Stenella longistris</i>	1	23	8	32	Data deficient
Humpback dolphin	<i>Sousa plumbea</i>	4	11	12	27	Near threatened
Common dolphin	<i>Delphinus capensis</i>	1	0	0	1	Data deficient
Unidentified dolphin		0	26	0	26	
Pilot whales	<i>Globicephala macrorhynchus</i>	0	4	1	5	Data deficient
Orcas	<i>Orcinus orca</i>	2	1	0	3	Data deficient
Dwarf Minke whale	<i>Balaenoptera acutorostrata</i>	0	0	2	2	Least concern
Bryde's Whale	<i>Balaenoptera edeni</i>	0	0	1	1	Data deficient
Sperm whale	<i>Physeter macrocephalus</i>	0	1	0	1	Vulnerable
Unidentified whale		0	1	0	1	
Dugong	<i>Dugong dugon</i>	0	0	0	0	Vulnerable
Grand Total		84	335	262	681	

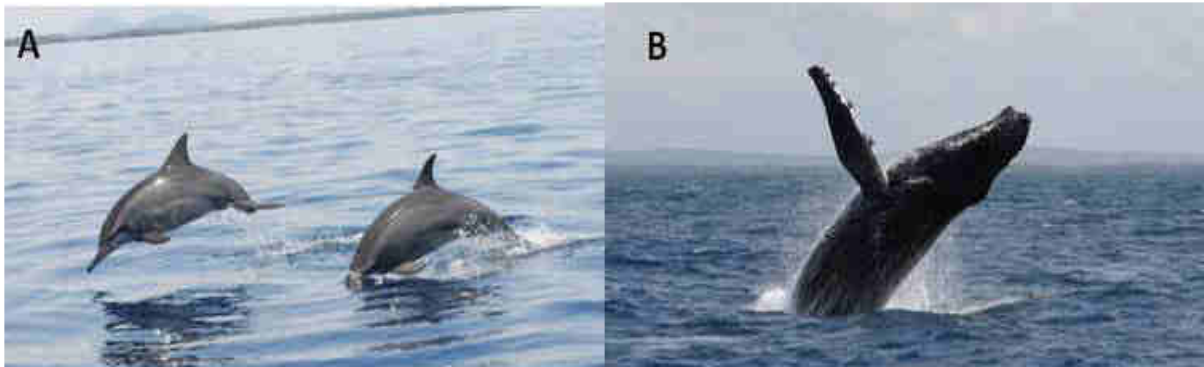


Plate 4.1 Indo-Pacific bottlenose dolphins (A), and humpback whale (B) in Shimoni (Photo Credit: Chloe Corne, GVI)

4.1.2 Sirenians (Dugongs)

The dugong (*Dugong dugon*) is the only living species in the mammalian family Dugongidae. The Dugong is classified as vulnerable to extinction on the IUCN Red list and designated in the Wildlife Conservation and Management Act 2013 as a protected species. Dugong populations in Kenya have declined drastically over time. In the 1960s, they were reportedly abundant having been observed in groups of upto 500, mostly off the south coast (Husar, 1975). Later reports recorded only 8 (Ligon, 1975) and only two were sighted during recent surveys in December 2016 and March 2017 during aerial census surveys conducted by the Kenya Wildlife Service. The relatively pristine Kiunga Marine National Reserve (KMNR) is considered the most important area for dugongs in Kenya (Jarman, 1961, Eros, 1992, WWF & EAME 2004).

4.1.3 Sea turtles

Five species of sea turtles, the green turtle (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), olive ridley (*Lepidochelys olivacea*), loggerhead (*Caretta caretta*) and leatherback (*Dermochelys coriacea*) occur in Kenya. Green turtles, hawksbills, loggerheads, and leatherbacks are pan-tropical (occurring in tropical regions of all continents); while olive ridleys are distributed within the Indo-Pacific region. The global status of the five turtle species based on the IUCN Red List and their local occurrence is shown in Table 4.3. The green turtle is the most common species in Kenya constituting approximately 97% of reported nests, followed by the hawksbills (2.5%) and olive ridleys (0.5%) (Olendo et al., 2017). There are general uncertainties on the status of local sea turtle populations in Kenya; however, anecdotal evidence based on fishery perceptions indicates declining turtles on nesting beaches and at sea (Wamukota and Okemwa 2009). The islands of the Lamu archipelago and the Malindi-Watamu-Kipini area provide the most important sea turtle nesting areas. Notable in-water concentrations of turtles have been observed e.g. within Mpunguti/Wasini, Takaungu, Watamu, Ungwana Bay and Lamu (Morley et al., 2011).

Table 4.3 List of threatened sea turtles in Kenya

Common Name	Scientific Name	IUCN Red List	Occurrence in Kenya	Activity
Green turtle	<i>Chelonia mydas</i>	Endangered	Very common	Nesting, Foraging
Hawksbill	<i>Eretmochelys imbricata</i>	Critically endangered	Common	Nesting, Foraging
Olive ridley	<i>Lepidochelys olivacea</i>	Vulnerable	Rare	Nesting, Foraging
Leatherback	<i>Dermochelys coriacea</i>	Critically endangered	Very rare	Foraging
Loggerhead	<i>Caretta caretta</i>	Endangered	Very rare	Foraging

Regional tagging efforts of sea turtles in the South West Indian Ocean (SWIO) region reveal migrations through Kenya and genetic studies group Kenya’s sea turtle stock as part of the Northern SWIO stock (Bourjea et al., 2015). Furthermore, a regional status evaluation scored olive ridleys to be at high risk and highly threatened within the Western Indian Ocean region calling for prioritized conservation of the species (Wallace et al., 2011). Collaborative community based beach monitoring and conservation efforts contribute significantly towards assessing the status of sea turtle populations and enhancing the survival of sea turtle populations along the Kenya coast. Long-term monitoring of selected nesting beaches at the Lamu archipelago, which hosts the most important nesting beaches for sea turtles in Kenya, shows a relatively stable trend from 1997 to 2013 attributed to collaborative community conservation efforts (Figure 4.1).

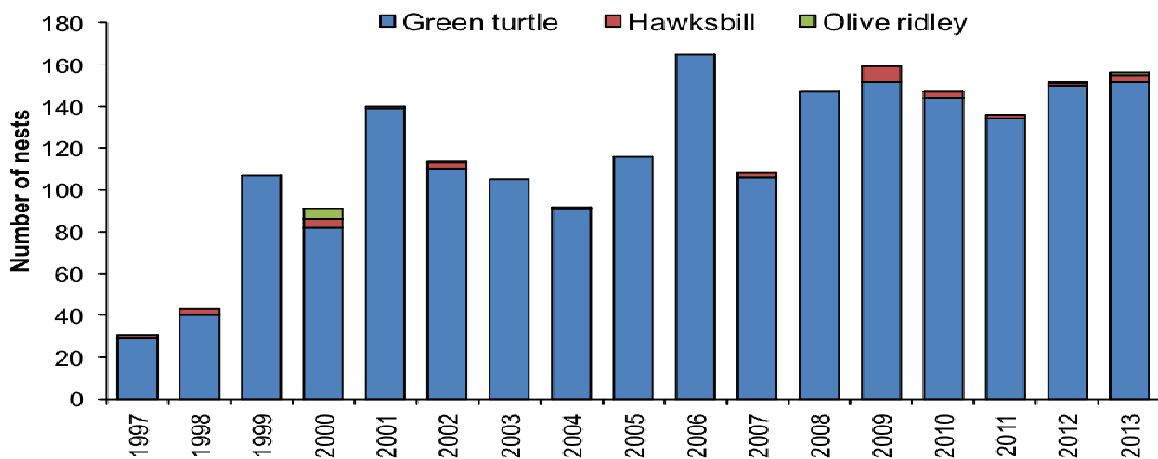


Figure 4.1 Nesting patterns of sea turtles at the Lamu archipelago based on monitoring from 1997 to 2013, (Source: WWF-Kenya)



Plate 4.2 A nesting green turtle (*Chelonia mydas*) going back to the sea at a nesting beach in Lamu (Photo credit: Mike Olendo)

4.1.4 Bony fishes and elasmobranchs

Bony fishes (*Osteichthyes*) are a diverse taxonomic group of fish that have skeletons primarily composed of bone tissue, as opposed to cartilage. Elasmobranchs are cartilaginous (*Chondrichthyes*) and comprise of sharks, rays, skates and sawfish. The species of conservation concern include 16 shark species (2 endangered and 14 vulnerable), 4 ray species (1 critically endangered, 3 vulnerable), all species of sawfish and 8 finfish species (1 endangered and 7 vulnerable) including two seahorse species (Table 4.4).



Plate 4.3 Species of skate and rays –The round ribbontail ray (*Taeniura meyeni*) (A), and *Himantura urnark* (B), *Dayastis spp.* (C) in Shimoni (Photo credit: Nina Wambiji)

Table 4.4 Bony fishes and elasmobranch species of conservation concern in Kenya (Source: IUCN, 2014).

Group	IUCN Red list Category	Species
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Bonyfishes	Critically endangered	<i>Oreochromis hunter</i>
	Endangered	Humphead wrasse (<i>Cheilinus undulates</i>)
	Vulnerable	Green humphead parrotfish (<i>Bolbometopon muricatum</i>) Giant grouper (<i>Epinephelus lanceolatus</i>) Blue marlin (<i>Makaira nigricans</i>) Blacksaddled coral grouper (<i>Plectropomus laevis</i>) Bigeye tuna (<i>Thunnus obesus</i>) Spiny seahorse (<i>Hippocampus histrix</i>) Great seahorse (<i>Hippocampus kelloggi</i>) Spotted seahorse (<i>Hippocampus kuda</i>)
Sharks	Endangered	Scalloped hammerhead (<i>Sphyrna lewini</i>) Great hammerhead (<i>Sphyrna mokarran</i>)
	Vulnerable	Pelagic thresher (<i>Alopias pelagicus</i>) Bigeye thresher (<i>Alopias superciliosus</i>) Common thresher shark (<i>Alopias vulpinus</i>) Oceanic whitetip shark (<i>Carcharhinus longimanus</i>) Sandbar shark (<i>Carcharhinus plumbeus</i>), Great whit shark (<i>Carcharodon carcharias</i>) Shortfin mako shark (<i>Isurus oxyrinchus</i>) Tawny nurse shark (<i>Nebrius ferrugineus</i>) Sicklefin lemon shark (<i>Negaprion acutidens</i>) Short-tail nurse (<i>Pseudoginglymostoma brevicaudatum</i>) Bowmouth guitarfish (<i>Rhina ancylostoma</i>) Whale shark (<i>Rhincodon typus</i>) Giant guitarfish (<i>Rhynchobatus djiddensis</i>) Zebra shark (<i>Stegostoma fasciatum</i>)
Rays	Critically endangered	Honeycomb stingray (<i>Himantura uarnak</i>) Giant manta (<i>Manta birostris</i>) <i>Rhinoptera javanica</i> (Flapnose ray)
Sawfish	Endangered	Narrow sawfish (<i>Anopristis cuspidata</i>)
	Critically endangered	Green sawfish (<i>Pristis zijsron</i>)

4.1.5 Birds

Kenya's bird species diversity is rich with a total of 1,034 species. About 41% are found along the coastal shoreline (Lewis & Pomeroy 1989), of which 43 species, and 171 are palaeartic migrants migrating southwards during the European winter from October to March (Dowsett, 1980). Important Bird Areas (IBAs) refer to places or sites of international significance for the conservation of birds and other biodiversity and have been recognised worldwide as practical tools for conservation and sustainable use of the natural environment (Barasa et al., 2014). There are 18

IBAs along the Kenya coast which host globally threatened species, restricted-range species and exceptionally large numbers of congregating birds (Figure 4.2).

Shorebirds and seabirds: A diverse assemblage of migrant shorebirds and seabirds including crab-plovers, sandplovers, gulls, terns, noddies, shearwaters congregate to forage in intertidal mudflats, reef flats, tidal creeks, mangroves, estuaries, saltpans, beaches and rocky cliffs. Tenewi Island in Kiunga, Whale Island in Watamu and Kisite Island in Shimoni provide important breeding areas for Roseate Terns, while erratic nesting is observed at the other sites. The Tenewi Islands host the world’s largest breeding colony was estimated to be 8000 to 10,000 pairs. Other Important Bird Areas (IBAs) hosting high assemblages of and terns include the Tana River Delta and Mida Creek. Rare species such as the Glossy Ibis, Purple Heron, Common Snipe and the Grey-headed Gulls have been sighted in Watamu.

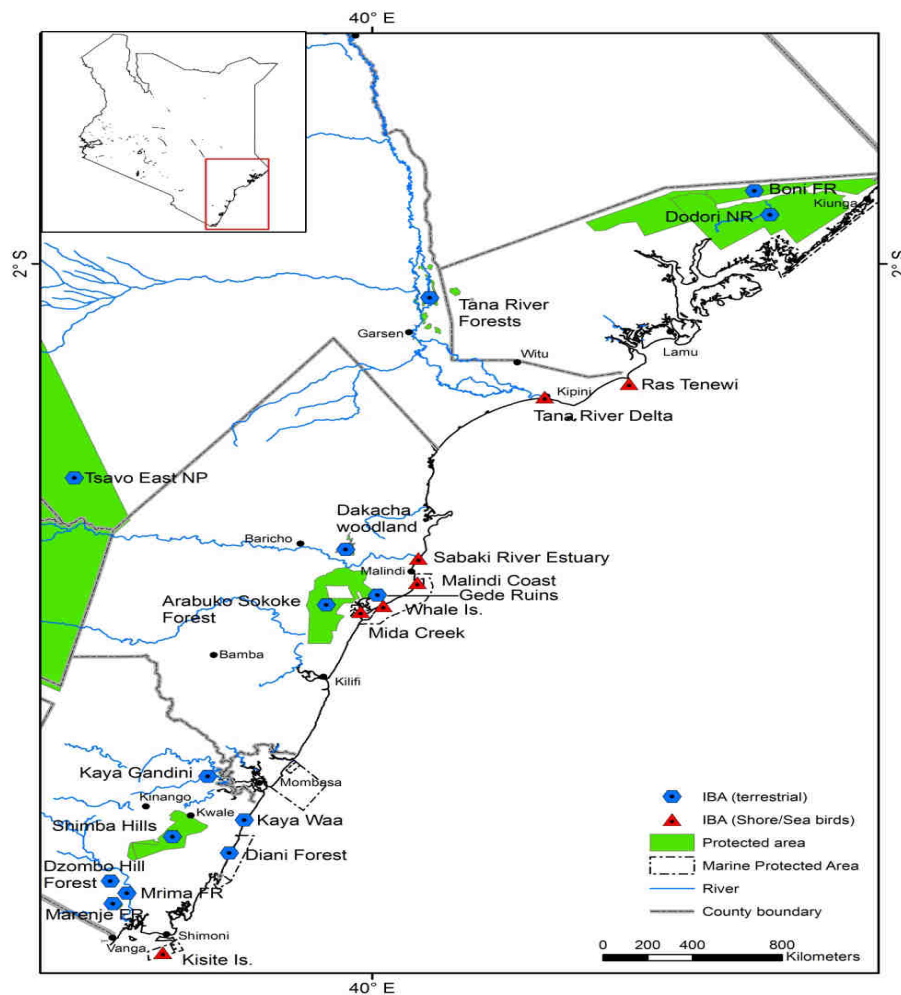


Figure 4.2 Important Bird Areas along the Kenya Coast (Source: KeNODC 2017)

Terrestrial birds: Coastal forests host a high diversity of bird species, many of which are endemic or have small distributions. As such, at least 27 breeding birds have been identified as endangered or threatened in Kenya, including the endemic Taita apalis (*Apalis fuscigularis*) and Taita thrush (*Turdus helleri*), the Sokoke scops-owl (*Otus ireneae*); and the Basra reed-warbler (*Acrocephalus griseldis*) which are endemic to coastal forests (Table 4.3). The Arabuko-Sokoke Forest is internationally important for the conservation of 5 globally endangered bird species.



Plate 4.4 Fischer's Turaco (*Tauraco fischeri*) at Shimba Hills National Reserve (Photo credit: Tomokazu Fukui-JICA)

Other important bird areas include Shimba Hills Reserve, the Diani Forest, Dzombo Hill forest, the Dakatcha Woodland and the newly established Boni - Dodori Forest which is documented to host 283 bird species from more than 61 different families including 5 threatened and 6 Near Threatened including Fischer's Turaco (Plate 4.4), as well as 27 Palearctic Migrants (PM), 24 Afro-tropical Migrants (AM) and 16 East African Coastal Biome (EAC) species (Barasa et al., 2014; Figure 4.2).

Table 4.5 Terrestrial bird species of conservation concern along Kenya coast (Sources: Barasa et al. 2014, Otieno et al. 2016)

Common name	Species	Status	Habitat
Amani Sunbird	<i>Anthreptes pallidigaster</i>	Threatened, EN	Arabuko-
African Crowned eagle	<i>Stephanoaetus coronatus</i>	Regionally threatened	Witu forest
Basra reed warbler	<i>Acrocephalus griseldis</i>	E	Boni and Dodori
Chestnut fronted helmet	<i>Prionops scopifrons</i>	Endemic	Witu forest
Clarke's Weaver	<i>Ploceus golandi</i>	E	Arabuko-Sokoke

East Coast Akalat	<i>Sheppardia gunning</i>	NT	Arabuko-Sokoke
Fishers Turaco	<i>Tauraco fischeri</i>	Endemic, NT	Witu forest, Bon-
Little yellow flycatcher	<i>Erythrocerus</i>	Regionally threatened	Witu forest
Saddle-billed stork	<i>Ephippiorhynchus</i>	Regionally threatened	Witu forest
Scaly babbler	<i>Turdoides squamulata</i>	Endemic	Witu forest
Sokoke Pipit	<i>Anthus sokokensis</i>	T	Arabuko-Sokoke
Sokoke Scops Owl	<i>Otus ireneae</i>	E	Arabuko-Sokoke /
Southern Banded Snake-	<i>Circaetus fasciolatus</i>	NT	Witu forest / Boni-
Spotted Ground Thrush	<i>Geokichla guttata</i>	T	Arabuko-Sokoke
Taita Thrush	<i>Turdus helleri</i>	CE	Taita hills
Taita Apalis	<i>Apalis fuscigularis</i>	CE	Taita hills
Malindi Pipit	<i>Anthus melindae</i>	NT	Malindi

4.1.6 Terrestrial mammals

Recent efforts to document the terrestrial mammal biodiversity in coastal forests includes the use of infrared camera traps, which has provided new insights on the presence of at risk species. A list of terrestrial mammal species of conservation concern along the Kenya coast is shown in Table 4.6. A survey conducted between 2010 and 2011 reported 38 species including 32 species at Boni-Dodori forests and 20 species at Arabuko-Sokoke forest (Andanje et al., 2015). Among the species are two of Kenya's rarest mammals, the endemic Tana River Red Colobus (*Procolobus rufomatiitus*) and Tana River Mangabey (*Cercocebus galeritus*) with population levels estimated to range from 1000 to 1300 individuals (Butynski and Mwangi, 1994) and reported be further declining. A population of 'critically endangered Aders' duiker, *Cephalophus adersi* only thought to be restricted in Arabuko-Sokoke forest and Zanzibar were sighted in Boni forest (Andanje et al. 2011, Amin et al, 2015). The Sable antelope (*Hippotragus niger roosevelti*) is a rare species that is endemic to the Shimba Hills National Reserve. Although it is listed as 'least concern' in the IUCN Red List, the Kenyan subpopulation has declined alarmingly from ~265 individuals in the 1960s to about 60 (KWS, 2012).

Table 4.6 List of terrestrial mammal species of conservation concern along the Kenya coast (Data sources: Andanje et al., 2011, 2015; Barasa et al., 2014; KFS, 2015)

Common Name	Scientific Name	IUCN Status	Forest
Ader's Duiker	<i>Cephalophus adersi</i>	CE	Arabuko-Sokoke

Common Duiker	<i>Sylvicapra grimmia</i>	V	Boni Dodori
Harvey's Duiker	<i>Cephalophus harveyi</i>	Conservation dependent	Witu
African elephant	<i>Loxodonta Africana</i>	V	Arabuko-Sokoke
Haggard's Oribi	<i>Ourebia ourebia haggard</i>	V	Boni-Dodori
African Elephant	<i>Loxodonta Africana</i>	V	Shimba
Giant Sengi	<i>Rhynchocyon sp</i>	Conservation dependent	Boni Dodori
African Wild Dog	<i>Lycaon pictus</i>	E	Boni - Dodori
Golden-rumped sengi	<i>Rhynchocyon chrysopygus</i>	E	Arabuko-Sokoke
Lesser Elephant Shrew	<i>Elephantulus rufescens</i>	NT	Witu
Lion	<i>Panthera leo</i>	V	Witu
Leopard	<i>Panthera pardus</i>	V	Boni-Dodori
Topi	<i>Damaliscus lunatus topi</i>	NT	Boni-Dodori
Sokoke Bushy-tailed	<i>Bdeogale omnivore</i>	V	Arabuko-Sokoke t
Suni	<i>Neotragus moschatus</i>	Conservation dependent	Witu
Tana river red colobus	<i>Procolobus rufomitratu</i>	Conservation dependent	Tana river
Crested mangabey	<i>Cercocebus galeritus</i>	Conservation dependent	Tan river
Sable antelope	<i>Hippotragus niger roosevelti</i>	Least concern	Shimba Hills National Reserve

4.1.7 Other terrestrial species

Other terrestrial species of conservation concern include reptiles, amphibians and plants, many of which are endemic to coastal forests (Table 4.7). Witu forest reserve is known to hold at least nine species of threatened plants including *Euphorbia tanaensis* which is endemic to the area (KFS, 2014). Only four *E. tanaensis* trees remain in Kenya, out of an estimated 20 trees in the whole world (KFS, 2014).

Table 4.7 Other coastal and marine threatened species in Kenya (Sources: Andanje et al., 2015; Mbuvi et al., 2015; Mitto et al., 2015; KFS, 2015). IUCN Red List status (V= vulnerable, NT = near threatened, T = threatened, E= endangered, CE = critically endangered, LC= least concern).

Fauna/Flora	Common name /	Species	Status	Location
Frogs	Forest Spiny Reed Frog	<i>Hyperolius sylvaticus</i>	T	Shimba Hills
	Shimba Hills Reed Frog	<i>Hyperolius rubrovermiculatus</i>	T	Shimba Hills

	Shimba Hills Banana	<i>Afrivalus sylvaticu</i>	T	Shimba Hills
	Sagalla caecilian	<i>Boulengerula niedeni</i>	E	Taita Hills
	Taita Hills Warty Frog	<i>Callulina dawida</i>	CE	Taita Hills
Reptiles	Kenya sand boa	<i>Gongylophis colubrinus</i>	Protected	Lake Jipe
	Leopard tortoise	<i>Stigmochelys pardalis</i>	Protected	Lake Jipe
	Nile crocodile	<i>Crocodylus niloticus</i>	Protected	Lake Jipe
	Nile monitor	<i>Varanus niloticus</i>	Protected	Lake Jipe
	Southern African	<i>Python natalensis</i>	Protected	Lake Jipe
Plants	Shrub	<i>Afrocanthium kilifiense</i>	V	Mwaluganje
	Shrub	<i>Afrocanthium</i>	V	Shimba Hills
	Shrub	<i>Allophylus chirindensis</i>	V	Shimba Hills
	Shrub	<i>Aristogeitonia monophylla</i>	V	Mwaluganje
	Shrub	<i>Bauhinia mombassae</i>	E	Shimba Hills
	Shrub	<i>Brachylaena huillensis</i>	NT	Mwaluganje
	Shrub	<i>Buxus obtusifolia</i>	V	Mwaluganje
	Tree	<i>Caesalpinia insolita</i>	V	Mwaluganje
	Creeping rhizome	<i>Calloopsis volkensii</i>	NT	Shimba Hills
	Tree	<i>Chytranthus obliquinervis</i>	V	Lake Kenyatta/Shimba
	Tree	<i>Cola uloloma</i>	V	Shimba Hills
	Tree	<i>Combretum tenuipetiolatum</i>	CE	Rabai forest
	Tree	<i>Commiphora obovata</i>	NT	Shimba Hills
	Tree	<i>Cynometra suaheliensis</i>	V	Mwaluganje
	African blackwood	<i>Dalbergia melanoxylon</i>	Protected	Witu forest
	Shrub/ Tree	<i>Diospyros greenwayi</i>	V	Shimba Hills/ Witu
	Shub/ Tree	<i>Diospyros shimbaensis</i>	E	Shimba Hills
	Mombasa Cycad	<i>Encephalartos hildebrandtii</i>	N	Mwaluganje
	Voi Cycad	<i>Encephalartos kisamb</i>	T	Taita forest
	Tree	<i>Erythrina sacleuxii</i>	NT	Lake Kenyatta
	Shrub	<i>Erythrococca pubescens</i>	LC, rare	Mwaluganje
	Tree	<i>Euphorbia tanaensis</i>	CE	Witu forest
	Shrub	<i>Isolona cauliflora</i>	V	Shimba Hills
	Fern	<i>Memecylon fragrans</i>	V	Mwaluganje/
	Herbaceous climber	<i>Momordica leiocarpa</i>	R	Mwaluganje
	Tree	<i>Nesogordoniaholtzii</i>	R	Shimba Hills
	Tree	<i>Oxyanthus pyriformis</i>	E	Shimba Hills

	Shrub	<i>Pavetta tarennoides</i>	R	Shimba Hills
	Shrub / Tree	<i>Sterculia schliebenii</i>	V	Shimba Hills
	Shrub / Tree	<i>Thecacoris usambarensis</i>	E	Mwaluganje
	Shrub / Tree	<i>Uvariadendron kirkii</i>	V	Mwaluganje
	Shrub / Tree	<i>Vepris sansibarensis</i>	V	Mwaluganje
	Shrub / Tree	<i>Vitellariopsis kirkii</i>	V	Mwaluganje

4.2 Drivers, pressures, impacts and response strategies

As identified in the previous State of Coast Report (Government of Kenya, 2009), human induced pressures continue to impact on populations of species of conservation concern. Major drivers include increasing coastal populations, poverty, overexploitation of resources, habitat destruction due to infrastructural development and urbanization.

Cultural value is an important driver of species population declines, especially for marine mammals, sea turtles, sharks, birds and some plants. Many of the species are valued by coastal communities as a source of protein from meat and eggs or for their medicinal properties.

Poaching is driven by poverty and the availability of lucrative illegal markets. Kenya is a signatory to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) which bans trade in protected species. However, inadequate collaboration by law enforcement institutions presents a challenge in enforcement of anti-poaching laws.

Overfishing from commercial, artisanal, subsistence and recreational fishing activities is a major threat. Artisanal fisheries are a key source of pressure on finfish and shark populations along the Kenya coast. Direct exploitation for local consumption of shark meat is substantial (Barnett, 1996). Shark oil products are processed locally from the liver, while shark teeth and jaws are sold to tourists. Kenya represents an important transshipment point for shark fins within the WIO. Thus, demand for Kenya's shark fins, particularly from Asia, is a major driver of overfishing. A steady decline in shark fin exports from Kenya occurred between the 1990 and 1995 from 10 mt in 1990 to 4.3 mt in 1995. There was also a rise in value between 2006 to 2015 with the lowest value of Ksh.31.9/Kg being reported in 2008 and the highest value of Ksh.721.6/Kg being reported in 2015 (Figure 4.3).

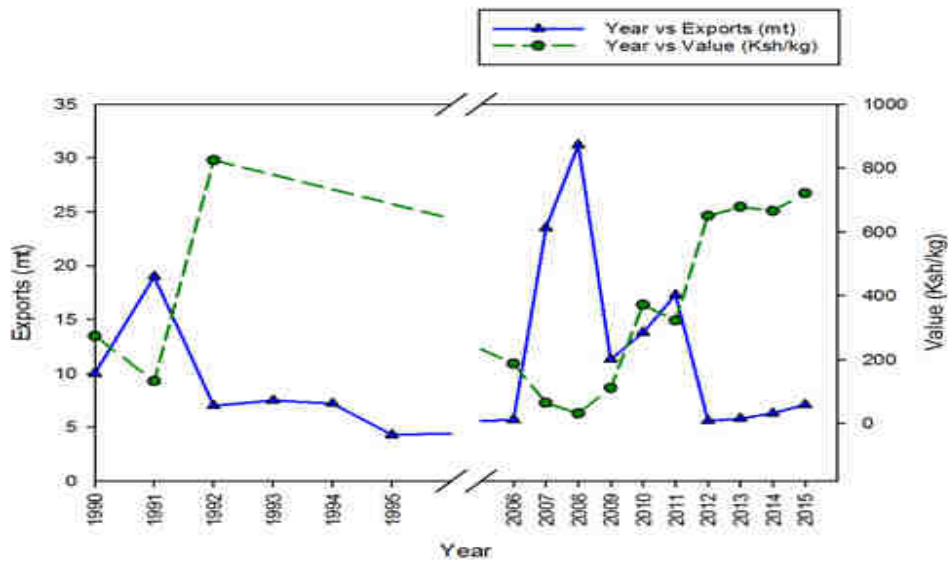


Figure 4.3 Shark fin exports in metric tons and export value in Ksh/Kg between 1987-1995 and 2006-2015 (KFS statistics)

Bycatch in fishing gears such as trawlers, drifting nets, seine nets, longlines gillnets, ringnets cause mortalities and are by far the most critical of the threats (Wamukoya et al., 1996, Amir et al., 2002; Kiszka, 2012). Captured individuals either drown and/or are injured during disentanglement by fishermen. Sightings of dead and stranded marine turtles and mammals (Plate 4.5) are often documented and tend peak during the Northeast monsoon season when fishing effort is more intense.



Plate 4.5 A dugong captured accidentally in a gillnet (*jarife*) within fishing grounds in Msambweni and brought to shore by fishermen in April 2017 (Photo credit: Gladys Okemwa)

Environmental pollution includes marine debris from land-based and sea-based sources, oil spills from vessels, chemicals including persistent heavy metals and slowly degraded organic chemicals like polychlorinated biphenyls (PCBs). Microplastics which develop from the breakdown of big plastics are ingested when mistaken for food resulting in mortalities and increased susceptibility to pathogenic infections. For example, incidences of *fibropapilloma* virus in sea turtles are now frequent.

Noise pollution has impacts on animal communication systems and behaviour by masking acoustic signals related to territorial defence, mate attraction, alarm calls among others (Warren et al., 2006). Noise pollution from offshore activities related to oil and gas exploration and seismic surveys may have acoustic impacts on marine mammals and sea turtles and may include damage to the hearing system or behavioural changes after exposure (McCauley et al., 2000; Walker, 2001; Stevens et al., 2005).

Habitat degradation emanates from various human activities related to exploitation of resources and urbanization. Poor management of terrestrial habitats has resulted in land fragmentation, which is increasingly having a negative impact on vulnerable terrestrial birds and mammals. Loss and defragmentation of forest habitats is occurring through deforestation from illegal charcoal production and unsustainable wood extraction (Muoria et al., 2013). In the sea environment, fishing methods such as trawling, dynamite fishing and beach seines destroy critical breeding and foraging habitats for cetaceans and marine turtles. Exploration of mineral resources such as titanium mining in Kwale County also contributes to environmental degradation in both terrestrial and marine environments.

Infrastructural developments lead to defragmentation of terrestrial and marine habitats resulting in loss of wildlife corridors and increased human-wildlife interactions. Urbanization has also resulted in decreased vegetation cover, which adversely affects the distribution of terrestrial mammals in their native habitats due to reduced food availability. The building of structures such as seawalls along the shoreline has led to a loss of suitable sea turtle nesting grounds and drives shoreline erosion. Other associated effects include ecological light pollution which impacts on sea turtles and migrating birds by causing disorientation from interference with natural homing cues (Gauthreaux and Belser, 2006).

Coastal tourism and recreation may negatively impacts on marine mammals and sea turtles. Activities such as dolphin-watching in Malindi-Watamu MPA and Kisite-Mpunguti MPA can cause short-term migrations or changes in individual activity and impact negatively on tourism (Christiansen et al., 2010; Pérez-Jorge et al., 2015, 2016). Marine mammals and sea turtles are also vulnerable to injury from boat strikes especially during peak seasons when there is increased boat traffic. Recreation on beaches is also associated with trampling, picnicking and discarding of litter which degrade sea turtle nesting beaches.

Climate change associated with increasing temperatures and sea level rise have the potential for increased temperatures on nesting beaches, which may affect hatchling sex ratios, and increasing sea level rise resulting in an inundation of nests and reduced hatching success. Similarly, conditions on land are progressively getting hotter and drier leading to a loss of suitable habitats for terrestrial animals.

Kenya is a signatory to international instruments treaties, conventions and trade instruments such as CBD, CITES, UNCLOS, CMS and measures have been incorporated in existing national regulatory frameworks including EMCA CAP 387, Wildlife Conservation and Management Act (2013), and the Fisheries Act (2016). Interventions by KWS include protected areas and reserves within which these iconic species are continuously being monitored and protected. Species-specific conservation and management strategies have been developed by KWS for the conservation of endangered and threatened terrestrial mammals. In 2011, KWS launched a national sea turtle conservation strategy, which provides a coordinated framework for the conservation of sea turtles and their habitats in Kenya through advocacy, education, public awareness, communication, targeted research and monitoring to address the threats to their survival. The strategy also lays the foundation for community based initiatives.

4.3 Policy and management options

The following strategies are proposed to mitigate pressures facing species of conservation concern at the Kenya coast:

- Implement provisions of international treaties, conventions and trade instruments such as CITES, UNCLOS, CMS;
- Improve enforcement of existing regulatory frameworks (EMCA, Wildlife Act, Fisheries Acts);
- Develop and implement strategies and management plans including a National Marine Mammal Conservation Strategy and a National Plan of Action (NPOA) for sharks;
- Mainstream activities to conserve species of concern into County governments' development agenda; and provide technical support in the formulation and implementation of collaborative management frameworks;
- Develop effective monitoring, control and surveillance systems especially outside marine protected areas;
- Promote public awareness on the status and importance of conservation
- Strengthen community participation and 'citizen science' in research and monitoring through capacity building and financial support to boost collective action and conservation capacity;
- Develop of a comprehensive by-catch management plan to enhance the survival of incidentally captured species;
- Enhance research and monitoring of species of special concern to establish species composition, population sizes, species movements and mortality rates
- Encourage ecotourism initiatives to minimize targeted exploitation and promote a conservation ethic;
- Identify and protect important areas used as foraging and breeding and rehabilitate degraded areas; and
- Develop and implement national guidelines and strategies to manage domestic waste and reduce pollution.

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Chapter 5 : Coastal Communities

5.1 Ethnic and cultural diversity

The unique composition of people in the coast of Kenya is linked to the rich history of connections between native Kenyan populations and the long distance traders. The interactions of people from various continents who mingled and intermarried with the native residents of the Kenyan coast generated the Swahili culture and ethnic diversity of the coast. The Swahili culture gave rise to Kiswahili language that emerged between the 10th and 14th centuries as the main language of the coastal people, existing alongside several other local dialects (Sinclair and Richmond 2011). Kiswahili was declared a national language in 1963 and remains the dominant language in the region even as globalization makes an impact on the lives of the coastal communities in Kenya (Caplan and Topan 2004).

The native coastal communities include the Mijikenda (Giriama, Chonyi, Digo, Rabai, Duruma, Jibana, Kauma, Kambe and Ribe), Swahili, Pokomo, Bajuni, Orma, Sagala, Taita and Taveta. The vulnerable and marginalized coastal communities include Aweer/Boni, Waatha, Munyoyaya, Malakote/Ilwana, Sanye, Wakifundi, Washirazi, Wachwaka and Makonde. The coast also has immigrants from inland Kenyan communities, Arabian nations, Asia, Somalia, Europe and the Americas. The dominant Mijikenda community occupies an expansive area of land from Kwale County (from the Tanzania border in the south) to the northern limit of Kilifi County. Due to its accessibility and socio-economic dynamics, which offer ample opportunities for livelihoods and leisure, the Kenyan coast has over the centuries attracted many different ethnic and racial groups (UNEP, 1998).

5.2 Population distribution and growth rate

Population size and distribution at the coast of Kenya is driven by natural population growth, immigration due to availability economic opportunities, proximity to social amenities, and administrative settlement policy (Hoorweg et al., 2000). Opportunities in sectors such as tourism, maritime activities, construction and commerce have attracted people to migrate from other parts of the country to settle in the coast. The coastal region of Kenya -is 14.2% of Kenya's land mass and has a population of 3.3 million people that translates to 8.61% of the total Kenyan population (Government of Kenya, 2010).

The population density of the coast region is showed in Figure 5.1. The coast region has an average population density of 40 persons per km² which is lower than the national average of 66 persons per km². Most of the land has low population density. However, there are very high density areas particularly along the coastline and in urban centres like Mombasa, Malindi and Kilifi, Ukunda and

Malikani. The density is highest in Kilindini at 4,493 persons per km² while the lowest is in Lamu with 16.2 persons/km² (Table 5.1). Other areas with relatively high populations are Lamu, along the River Tana and the Taita highlands.

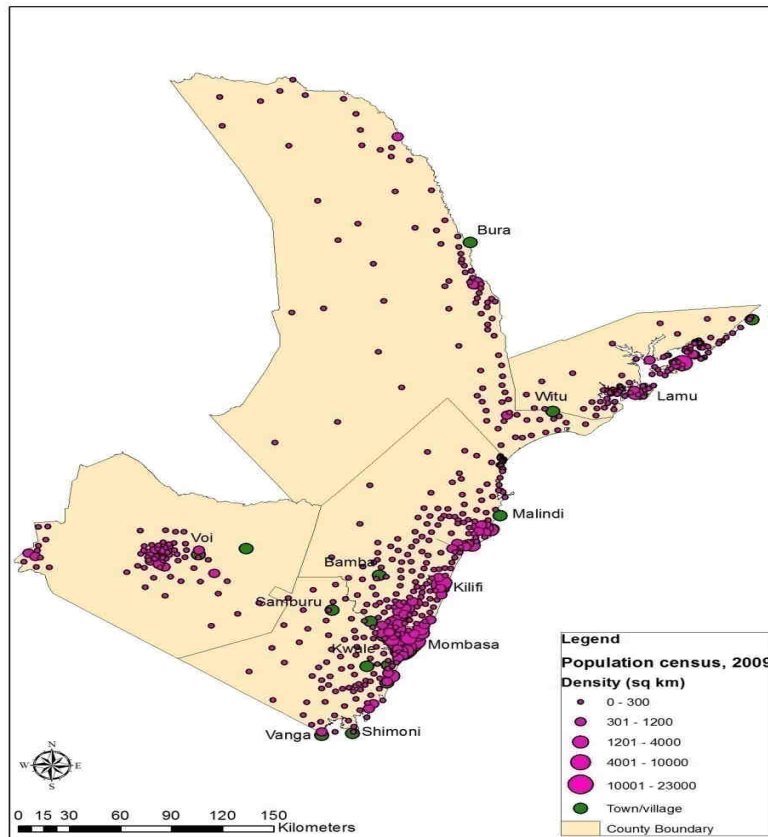


Figure 5.1 Population densities in Kenya Coastal counties (KeNODC, 2016)

Approximately 44% (1,463,120 people) of coastal people reside in urban centres (Table 5.1). Mombasa County is the largest urban centre with 97% of the population dwelling within the city. Since most of the coastal urban centres are located in close proximity to important ecosystems such as estuaries, mangrove swamps and coral lagoons, the high population exerts excessive pressure and threaten the sustainability of the coastal ecosystems.

Table 5.1 Population data across Coastal Counties (Government of Kenya, 2010)

Demographic Profile	Mombasa	Kilifi	Lamu	Kwale	Taita Taveta	Tana River	Total (Coast)	Total (Kenya)
Population Size	939,370	1,109,735	101,539	649,931	284,657	240,075	3,325,307	38,610,097
# of Males	486,924	535,526	53,045	315,997	145,334	119,853	1,656,679	19,192,458

# of Females	452,446	574,209	48,494	333,934	139,323	120,222	1,668,628	19,417,639
Male/Female Ratio	108	93	109	95	104	100	99	99
Youthful population (18-35 Yrs)	401,664	304,327	30,928	177,494	84,297	62,177	1,060,887	11,729,183
Population growth Rate	4	7	3	3	1	3	3	3
Population Density(Persons/Sq.Km)	4,293	88	16	78	17	6	40	66
Urban Population	939,370	285,482	20,238	117,676	64,289	36,065	1,463,120	11,545,571
Rural Population		824,253	81,301	532,255	220,368	204,010	1,862,187	27,064,526
Area (Sq.Km)	219	12,609.7	6,273	8,295	17,128	38,466	82,816	581,313.2

Figure 5.2 shows the population size of the coast counties from the 1962 and 2009 population census. The annual population growth rate for Kenya Coast in 2009 was 2.9% compared to 3.5% in 1999 (Government of Kenya, 2010). The overall growth rate of the coast counties is 2.88, slightly lower than the national average of 3.0%. It is projected that the coastal population will increase from 3.3 million in 2009 to about 4.4 million people by 2019. The highest growth rate was in Kilifi (7.38%) while the lowest growth rate was in Taita-Taveta (1.44%). Besides the natural population growth the coast region attracts internal and external emigrants who contribute to the increase in population. The coastal region's rich biodiversity, sandy beaches and cultural heritage attracts about 60% of Kenya's domestic and international tourist visits.

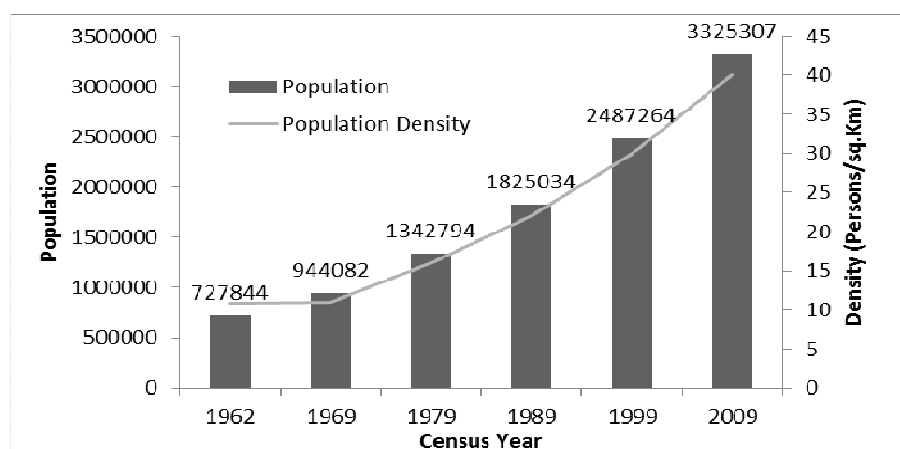


Figure 5.2 Population growth pattern of Kenya Coast between 1962 and 2009. (Source: CIDPs for Coastal Counties, 2013-2017; Republic of Kenya, 2010)

Population growth across all coastal counties over time is shown in Figure 5.3. Kilifi, the most populous county, has the highest population followed by Mombasa and Kwale. The high population growth rate in Kilifi is attributed in part to and the emergence of fast growing urban and peri-urban tourism hot-spots like Kilifi town and Mtwapa which have attracted in-migrations for social and economic opportunities. The anticipated developments in Lamu County including Lamu Port-

Southern Sudan-Ethiopia Transport (LAPSSET) project, power generation from wind and coal will continue to attract in-migrants looking for economic opportunities in the coast region.

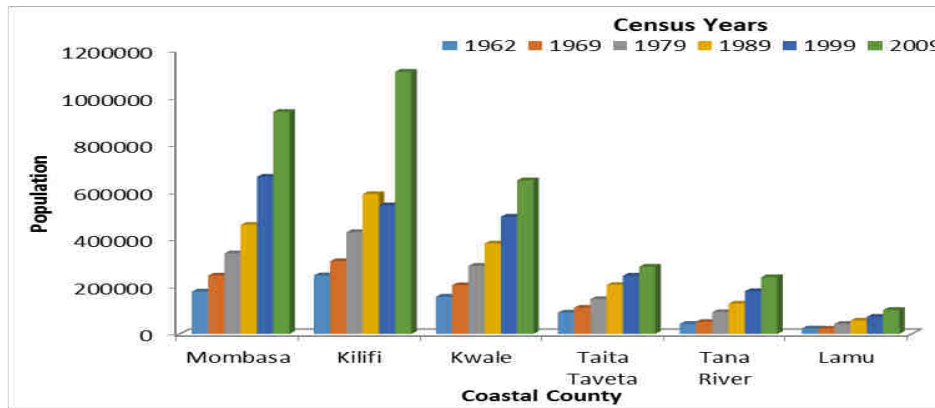


Figure 5.3 Population (numbers) of coastal counties (Government of Kenya Census, 1962-2009),

5.3 Migration trends

Due to its trading history that spanned over centuries, the Kenyan coast attracted immigrations from other parts of the country and internationally. Non-native people at the coast constitute about one quarter of the coastal population (KCS, 2013). In 2009, the coast received 67,849 (6%) in-migrants and released 42,008 (4%) emigrants. This makes Kenya's coastal region to be a net importer of in-migrants. Labour migration into the region can be traced as far back as 1895, when large numbers of people from Central and Nyanza provinces moved to Mombasa to work on the Kenya-Uganda Railway line and coastal plantations. Conflicts over resource use peaked in 2012 and 2013 between the Orma who are pastoralists and the Pokomo who are mainly farmers resulting in migration from Tana River District (presently Tana River County).

5.4 Social wellbeing

5.4.1 Access to social services

The Kenya vision 2030 identifies access to social services as a foundational pillar to economic transformation and alleviation of poverty. According to Vision 2030, the social pillar aims at promoting equitable social development in a clean and secure environment with specific interventions in education, health, environment, urbanization, gender and vulnerable groups, and sports (Government of Kenya, 2014).

A survey conducted in 2013 by the Kenya National Bureau of Statistics (KNBS) and Society for International Development (SID) exploring Kenya's inequality showed that when the poverty line is estimated as Ksh 1,562 and Ksh 2913 for rural and urban dwellers respectively, the severity of

poverty was highest in coast, with Tana River and Kwale counties having the highest poverty (44-49%) of the population while the lowest was at Lamu (4-11%). The interaction between the poor coastal communities and the environment has resulted in undesirable consequences that have accelerated not only poverty levels but also the rate of environmental degradation throughout the region.

5.4.2 Education

The coast region has one of the lowest literacy levels in Kenya. According to government statistics, both Kwale and Kilifi Districts had the highest primary school enrolment rate while Lamu and Taita-Taveta Districts continued to lag behind the other counties in enrolment rates (Figure 5.4). The low enrolment rate is attributed mainly to poor facilities and infrastructure, lack of trained teachers, and early marriage of girls, particularly in the rural areas. As at 2009, there was no established universities at the coast. There is a significant disparity in literacy levels between men and women, and between urban and rural areas. Kilifi, Tana River and Kwale Districts have the highest disparities, with literacy levels of men being much higher than of women (Hoorweg et al., 2000).

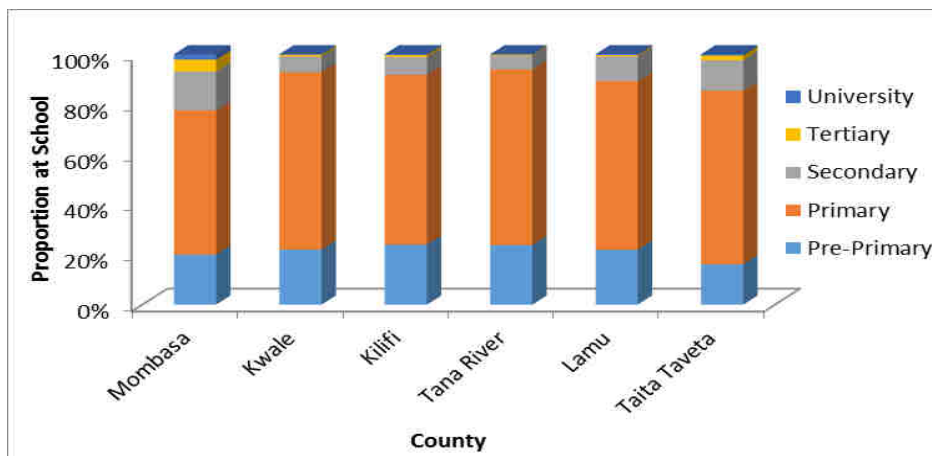


Figure 5.4 Enrolment of youth in academic institutions across coastal counties (Source: Government of Kenya 1999, 2009).

5.4.3 Health

Kenya Coast region has a total of 579 health facilities comprising of 30 hospitals, 38 health centres, 235 dispensaries, 199 clinics and medical centres, 26 nursing and maternity homes, 34 institutional health facilities and 7 special treatment centres (Table 5.2). In all coastal counties, the doctor-patient ratio still falls short by far, of the 1:600 standard set by the World Health Organization. Severe environmental degradation has consequences on human and ecological health. Whereas

health and environment inter-linkages are undeniable, relevant legal and policy interventions rarely take cognizance of this interconnectedness.

Table 5.2 Health infrastructure at Kenya Coast

County	Hospitals	Health Centres	Dispensaries	Clinics & Medical Centres	Nursing & Maternity Homes	Institutional	Special Treatment	Doctor: Patient	Average Dist. To Facility
Mombasa	10	9	38	31	18	19	4	1:11875	0.55
Kilifi	8	12	56	122	7	3	-	1:42625	-
Kwale	5	6	46	33	1	-	1	1:76741	7.00
Taita Taveta	3	7	33	5	-	8	2	1:19138	5.00
Tana River	2	6	44	4	-	4	-		6.00
Lamu	2	8	18	4	-	-	-		5.00

5.4.4 Water supply and sanitation services

The main sources of freshwater at the Kenyan coast are the Tiwi boreholes, Mzima springs in Taita-Taveta, Marere springs in Kwale and Baricho Treatment Works at Sabaki River. In 2009, 11% of the population in the coast of Kenya had access to well water, 10.7% to stream/river water, 9.2% to pond water; 6.4% to borehole water and 5.8% to dam water (Government of Kenya, 2000). Wastewater treatment at the coast of Kenya is presently inadequate. In the entire coast region there is only one wastewater treatment plant in Mombasa serving a small percentage of the city. Only 30% of the population of Mombasa Island and 15% of the population of the Mombasa Mainland West is connected to sewerage services; the rest is either served by septic tanks or cesspits, including pit latrines. Over 65% of the coastal population is served by pit latrines, around 6% has a water closet and 16% has no provision for sewerage services whatsoever (GOK, 2001).

5.4.5 Social capital

Social capital refers to the means of accessing various forms of resources and support through networks of social relations. In rural communities, livelihoods are not only shaped by access to common property resources but also by economic opportunities and the social relations. Social capital is a tool for poverty reduction and therefore, it remains critical in the development of the rural economies where extended family ties are a primary occurrence. social capital may be embedded in society rather than in any one individual and is aimed at transformation of societal welfare in terms of increased growth in social, economic, political and cultural changes (Ellis,2000; Grootaert and Bastelar, 2002b; Aker, 2007).

In most of the coastal region, the source of financial services for rural households is predominantly informal finance mechanisms that are savings-led taking several variants of rotating and savings

and credit associations (ROSCAs), also referred to as the *merry-go-rounds*. Out of the eight sources of social capital (OECD, 2001), the commonly found sources within the coastal communities include: the extended family, SMEs and the local community organization e.g. the BMUs, women ROSCAs. It should however be noted that, this is greatly influenced by factors like the number of economically active persons in the household, education, health, duration of residence in current community, members away from home earning cash wages and trust (KMFRI,2014; Unpublished) . Formal cooperative societies with distinct identities and legal status also form part of social capital. Table 5.3 shows the distribution of cooperative societies within the six Counties at the coast. Taita-Taveta County has the highest number of Cooperative societies and youth groups.

Table 5.3 Distribution of cooperative societies and groups across the six counties

County	Cooperative societies/groups				Self-help groups
	No. registered	Membership	Women	Youth	
Mombasa	241	35,987	877	884	782
Kwale	-	-	1,018	709	186
Kilifi	5,921		1,726	627	3,568
Tana river			340	385	405
Lamu	33;13(active)				1,345
Taita Taveta	7,459		1,328	1,534	4,597

Source: County Integrated Development Plans 2013 (Mombasa, Kwale, Kilifi, Tana River, Lamu and Taita Taveta)

Despite the devolution efforts that have been put in place following the promulgation of the new constitution in 2010, income disparities continue where it is estimated that 50% of the households within the coast region earn approximately KES10, 000 per month (Kenya Coast Survey, 2013). A government survey carried out in 2002 found that poverty levels range from 30% in Bura in Tana River District to 84% in Ganze in Kilifi district (Government of Kenya, 2002). Poverty levels have however declined to 44-49% in Tana River and Kwale counties (Government of Kenya, 2013). However the poverty levels and inequities in coast Counties are still some of the highest in Kenya, with Tana River County having the lowest mean expenditure and the five counties with the worst income inequality (measured as a ratio of the top to the bottom decile) being in the Coast (KNBS, 2013). This high level of poverty does not augur well for the coastal environment, since the poor are more likely to resort to unsustainable resource-use practices in an effort to meet immediate survival needs. For instance, the increase in the number of artisanal fishermen in the near-shore fishery has led to overexploitation, as evidenced by decreases in daily catch size (McClanahan and Mangi, 2001). Because many artisanal fishermen in the coastal region cannot afford fishing gears

with which to fish offshore, some have resorted to more destructive fishing techniques that produce higher short-term yields but have disastrous effects on long-term productivity and biodiversity (SDF, 2005).

It is noteworthy that as a general trend, poverty leads to over-use and destruction of natural resources, where short-term livelihood goals are pursued at the expense of long-term environmental sustainability. There is need to ensure that environmental concerns are integrated into development planning and that development plans lead to the empowerment of local communities to engage in sustainable livelihood activities. Industrial development, which was for many years confined to Mombasa district and its environs, is now expanding towards the rural coastline and hinterland in other coastal districts (Government of Kenya, 2002 a, b). It is hoped that this trend, together with the development of eco-tourism, improvements to coastal and upcountry agricultural practices, intensified mining activities, and enhanced access to social services in rural areas will work in concert to curb the high rate of migration from rural to urban areas. Slower immigration would serve to ease the pressure on service delivery in the few developed urban centres, and make coastal environmental management easier.

5.6 Historical and cultural heritage

The Coast region has numerous historical and archaeological sites, including old mosques, tombs, mounds and walls of ancient city houses, many of them linked with the development of the Swahili culture in East Africa. A number of these historical sites, such as Mombasa Old Town) and Lamu Old Town have been designated Conservation Areas and are managed by the National Museums of Kenya. Several historical and archaeological sites, e.g. the Siyu Fort, have been declared National Monuments under the National Museums and Heritage Act (2006) of the Laws of Kenya. These cultural and historical sites serve as important tourist attractions for both local and foreign tourists. However, only a few of them, such as the Fort Jesus in Mombasa, have been well marketed. Today, some of the early trading settlements, including Mombasa, Lamu, Kilifi and Malindi, have become important modern business centers.

5.6.1 Kaya forests

Kayas forests are cultural sacred sites of the Mijikenda, governed by customary laws, considered to be an intrinsic source of ritual power and the origin of cultural identity, used for prayer for members of the particular ethnic group. The settlement, ritual centre, and enclosure associated with the forest are also part of the *kaya*. In the present day, the *kaya* is also referred to as a traditional organizational unit of the Mijikenda. It is estimated that, along the coast there are over 50 Kaya forests that have been identified across the counties where the Mijikenda sub-tribes exist particularly in Kwale (Msambweni, Kinango), Mombasa, and Kilifi (Kaloleni, Malindi). Eleven (11) of these Kayas which are located within Kilifi and Kwale counties have been inscribed as the

Sacred Mijikenda Kaya Forests, a UNESCO World Heritage Site. These forest sites spread over 200 km with each covering between 30 and 300 hectares in size (Government of Kenya, 2008; UNESCO). They are regarded as the abodes of ancestors and are revered as sacred sites and, as such, are maintained as by councils of elders. Traditional knowledge has been crucial to the conservation of the *Kaya* forests, with their treasure trove of plant, animal and fisheries resources. However, with the conversion of many coastal people to christianity and islam, the cultural and spiritual significance of the forests is eroding, threatening their very survival. To achieve the continued existence of *Kaya* forests the integration of traditional knowledge into resource management, planning and scientific research is important.

5.6.2 Vulnerable and marginalized groups

Vulnerable and marginalized groups (VMG) can be classified as clusters of individual who possess distinctive attributes in terms of their customs, and are social-economically excluded. Recent studies have established that in the coastal region, there are seven vulnerable and marginalised groups communities (Table 5.4) which are distributed across five counties with an exception of Mombasa county (KMFRI, 2014;Unpublished).

Table 5.4 Distribution of the vulnerable and marginalised groups within the coast region (Source: KMFRI, 2014)

VMG Communities	Description of the VMGs
Waatha	Originated from Shungwana and are related with the Oromos. They are divided into seven clans and are heavily dependent on forest resources which explain their settlement near forests. Their distribution is around Dabaso, Bombi, Tana river and Galana river
Munyoyaya	Originated from Ethiopia and is part of the Oromos. They are distributed along Tana river where they are engaged in fishing and farming.
Boni/Aweer	Their livelihood is heavily dependent on hunting and gathering and are found around Witu (Pandanguo and Jima), Hindi (Bargoni) and Kiunga (Milimani, Bodhei, Basuba, Mangai, Mararani, Kiangwe).
Saanye	The Wasanye engage in farming, fishing and harvesting of honey. They are found around Mapenya, Mkunumbi, Ndambwe, Witu and Kipini in Mpeketoni.
Wakifundi	Are located in Shimoni-Mkwiwi where they are heavily dependent on fishing as well as other small scale businesses e.g.sale of cowrie shell and curios.
Waillwana/ Malakote	They are found around Madogo in Tana River County.
Wachwaka	They are distributed around Shimoni-Kibuyuni areas where their main economic activity is fishing, engagement in mariculture activities and farming.
Makonde	They are found in Kwale county around Makongeni where they are mainly farmers and fishers

Over time, the VMGs have been marginalized to a level that impact negatively on their social and economic progress. Although the majority have attained primary level of education, they lack access to secondary schooling and therefore this limits their opportunities for employment. Consequently, this has contributed to high levels of poverty among the VMG households. The VMGs engage in several economic activities (small scale business, casual work, subsistence fishing and mariculture for those living in the proximity of the ocean) with a majority engaging in subsistence farming while traditionally, some of these groups for instance the Boni, practiced hunting and gathering (KMFRI, 2014;Unpublished).

To address marginalization, the VMGs require capacity building to facilitate their engagement in co-management initiatives and formulation of conflict resolution mechanism (KMFRI, 2014; Unpublished). It is also worthwhile to initiate affirmative action programmes which could include allocation of equalization fund to the marginalized societies with the aim of improving integration of VMGs in developmental activities as well as the introduction of alternative livelihoods.

5.6.3 Gender equity

Gender equity gender equity at the Kenyan coast hinges heavily on the religious, cultural and economic dynamics of the different communities that inhabit the region. The major dimensions that impact on gender equity are reproductive health, empowerment and the labour market. Deep-rooted religious, traditional and cultural values militate against gender equity with regard to opportunities for equitable sharing of household and societal responsibilities, inheritance, employment, etc. For instance, 48.6% and 42% of men work in the formal and informal sectors respectively. The corresponding figures for women are 34.8 and 55.1% respectively (Hoorweg *et al.*, 2000), indicating that men have greater access to formal work than women. Because of the gender disparities that exist at the coast, women have not been fully integrated into the environmental management process. For example, women are generally under-represented in coastal community-based organisations (CBO) established to deal with environmental issues. This is significant, as the two main occupations of women at the coast—farming and cooking—rely completely on natural resources. Cooking requires fuel wood or charcoal, which is already scarce, yet women lack the environmental awareness and decision-making power to make changes in their energy-use patterns. Traditional farming techniques, which can be degrading to the environment, continue to be used even as farmland becomes increasingly scarce and depleted. Women’s involvement in environmental CBOs and NGOs, as well as their involvement in decision-making in these and at the household level, is critical for improved natural resource management at the coast.

5.7 Impacts of population growth on the environment and response strategies

The rapid human population growth combined with existing poor resource management have led to rapid degradation of the coastal environment. Impacts include over-exploitation of nearshore fisheries, degradation of mangrove areas, shorelines change, cultural erosion and resource-use conflicts. The high population growth rate also places significant direct pressure on services like housing, healthcare education and other social amenities. Population growth due to high fertility may exacerbate resource scarcity in areas where a large proportion of the population already relies on natural resource-based livelihoods including agriculture, grazing, forest products, and fishing for income and subsistence (MEA, 2005). There is no doubt that the human population will continue increasing and the state of the environment will worsen. Therefore, there is need for sustainable utilization of the natural resources for the benefit of the present increasing population and future generations of the Kenya coast.

Family planning programmes are already being implemented in the coast of Kenya to contain the rapid population growth. The success of these programmes however need to be evaluated and the programmes be strengthened. There is an urgent need for mainstreaming population issues within development sectors, especially intervention measures for conserving the environment. ICZM approach has made advances at the coast by promoting integration of environmental concerns into development strategies and plans. Mainstreaming population management initiatives into the ICZM efforts needs to be enhanced. Urbanization should be controlled through guided spatial planning and decentralization of services, infrastructure, social amenities and economic opportunities that attract people to the more developed urban areas.

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Chapter 6 : Land and Water Resources

6.1 Land resources

The coast of Kenya is endowed with land that supports various economic activities. Land by its nature is one of the major factors of production in all economic sectors, including agriculture, forestry, mining, wildlife, mining and energy production. The main land uses at the coast of Kenya include agriculture, tourism, urbanization, human settlements, industry and warehousing, fishing, ranching/grazing, conservation areas, mining and quarrying. At the coast, protected land in form of Forest Reserves, National Reserves and National Parks make up a large part of the land area (Figure 6.1). The largest protected area in Kenya, the Tsavo National park lies partly Taita-Taveta county.

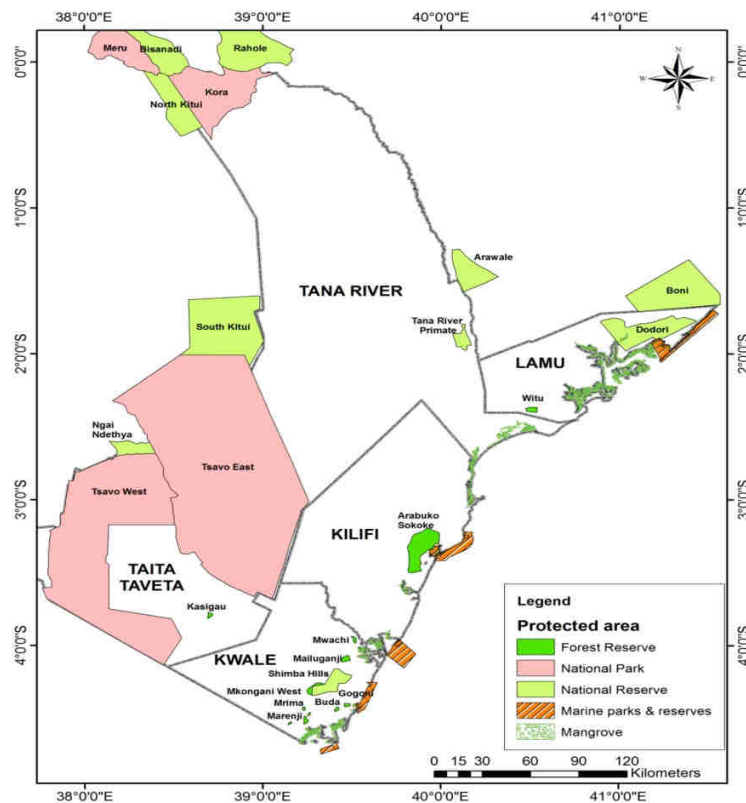


Fig 6.1 The forest reserves, national parks, and reserves at the Coast region (Source: KeNODC, 2016)

The total area, arable land and, non-arable land, forests and reserves is shown in Table 6.1. In the agricultural context, land (soil type and condition), has a strong influence on crop production that ensures food security. Optimal land use however requires a clear understanding of the land availability, land potential, and an array of the economically feasible enterprises alongside a proper

mix of the basic inputs that will produce the desired results. The situation in the coast is however different since big tracts of land is owned by absentee landlords and many people occupy them as squatters. Measures have been taken by the National and County Governments to settle squatters by establishing settlement schemes where possible in response to the problem of landlessness among the population residing in various counties.

Table 6.1 The total arable and non-arable land, forest and national reserves and parks in coastal counties.

County	Land area in km ²				National reserves and parks
	Total	Arable	Non Arable	Forest	
Kilifi	12,300.2	6,891.2	5,164	245	
Taita-Taveta	17,059.1	2,055	4,249.2	104.9	10,650
Tana River	38,862.2	2,547	29,798.7	3,457	3,059.5
Kwale	8,270.2	733.2	5,286.55	2,250.45	
Lamu	6,273.1	5,517	328.1	428	
Mombasa	229.9	9	216.52*	4.38	
Total	82,994.70	17,752.40	45,043	6489.73	13,710

Source: County Integrated Development Plans 2013-2017 for Kilifi, Taita-Taveta, Tana River, Kwale, Lamu and Mombasa Counties.*Built up area for industrial, commercial, tourism and residential purposes.

Traditionally, access to land and land rights was arranged according to customary law, which empowered a person who first cleared and cultivated a parcel of land to own it. Ownership of land by such a person was recognized even if such land was temporarily abandoned and left to revert to bush (Hoorweg, 2000). Although most of the land has been largely adjudicated, issuance of title deeds in many parts of the coast has delayed.

6.1.1 Land tenure system

The land tenure system at the coast of Kenya is characterized by a situation where most of the land occupied by the indigenous Kenyans are still held under communal customary tenure since most of the land have not been adjudicated to allocate formal ownership rights individuals who need the land rights. However, there are areas which have been adjudicated under the Land Titles Act and people have been allocated the legal individual tenure (Wayumba, 2004). Another characteristic is that vast tracks of land are owned by absentee landlords. Such tracks of land have been occupied by squatters who believe they have the right of ownership because they have occupied and lived in these parcels for tens of years. Over the years, the Government has acquired some of the farms and converted them to settlement schemes such as Magarini, Mtondia Roka, Shimba Hills among others.

Land tenure at the Kenyan coast is an emotive issue among local communities who feel that they have not been given due consideration right from the time of the first adjudication in 1908. Consequently, most of the land occupied by the indigenous people of the coast were not adjudicated to give them private property rights, but were instead alienated as crown land (Wayumba, 2004). The situation is however being addressed by the current Government and there are prospects that it will be fully resolved soon.

6.1.2 Land use patterns

Kilifi County

Land in Kilifi County is mainly used for crop farming, livestock rearing, fish production, forestry, mining and tourism. Fifty six percent of the land is useful for agriculture, while 44% can be utilized for irrigation. Food crops occupy 52,519 ha while cash crops occupy 47,681 ha of land. It is estimated that 11.3% of the households in the county are landless. Consequently, informal and unorganized settlements on private land have emerged in Malindi, Kilifi and Mtwapa towns to cater for the landless. Many people in the rural parts of the county have no title deeds with more than 60 percent of the residents of Kilifi County lacking title deeds resulting in incidences of landlessness which in turn contributes to high poverty levels in the county. Absence of title deeds has discouraged long term investments on the land.

The mean land holding size in the county is 3.04ha per household. This indicates that majority of households have relatively large farms. The mean holding size for large scale farmers is 8.09ha. The main land related challenges in the County included ineffective regulation of land use and inadequate planning and development due to lack of physical development plans, low budgetary allocation, historic land problems, inadequate policy frame work, lack of housing data base, non-availability of key County statistics for planning, and lack of integrated infrastructure development master plan.

Taita-Taveta County

Taita Taveta County has a total land area of 17,059.1 km². Of this, total arable land is 12,685 km². The rest is range land, suitable for livestock rearing. Approximately 4,307.2 km² of land is non-arable. The percentage of arable and non-arable land area is 12% and 88% respectively. Additionally, the two National Parks cover an approximate area of 10,650 square kilometres which translates to about 62% of the total land area. Water bodies cover approximately 16 km leaving about 22% of County land for settlement and agricultural activities. Land available for household farming activities is reduced drastically due to the presence of 28 ranches which combined, cover an approximate area of 773.5 km. The average size of the ranches is 2,762.5 Ha. Large scale sisal farming for fibre production further reduces land available for settlement and household farming

activities. Rain-fed agriculture is the dominant activity by most households as a subsistence and/or economic undertaking. The average farm holding in the areas that have agricultural potential ranges between 0.5 ha to 30 ha, while that of rain fed agriculture ranges between 2 ha - 20ha.

Table 6.2 Average land holding by type of use

Type of use	Average farm size in ha.
Small scale farmers in the highlands	0.4
Small scale farmers in the midlands	1.3
Small scale farmers in the lowlands	4.8
Large scale sisal farming	7,400

Food crops occupy a total of 18,125 ha of land while horticulture occupies 3,296 ha. The land is communally owned with approximately 35% having title deeds. Land adjudication is currently going on with a view to issuing title deeds to land owners.

Tana River County

The land in the county is largely non-arable covering 29,798.7 km. The rest is either under forest 3,457 km, arable land covering 2,547 km and 3,059.5 km under national reserves. The mean holding land size in the county is 4 ha, especially in the Hola and Bura irrigation schemes. Most of the land in the County does not have title deeds with only about 4.3 per cent having title deeds. Most of the Land in Tana River County has not yet been adjudicated. Ninety percent of the land is either trust land or government land. The inhabitants do not therefore have title deeds which can be used as security to acquire loans from banks. This is a major loophole which land prospectors can take advantage of acquiring land at the expense of the locals and can be potential source of conflicts. The absence of individual or group parcels of land title deeds has led to underutilization of land resources.

The incidence of landlessness is high at 95.7 per cent with a majority of the communities in the county living as squatters since they hold no titles to the land they occupy. There has been a major invasion by squatters into Chakamba area of Tana Delta, which is a designated grazing corridor; Kurawa holding grounds, a Government land for livestock holding; Majengo area by Ijara people and Madogo area is also invaded by people from Garissa in search of pasture and water for their animals. The challenge for the county is therefore to ensure that land regimes in the county are favourable for productive activities.

Kwale County

Land in Kwale County is divided into four major topographic features namely the Coastal Plain, Foot Plateau, Coastal Uplands and Nyika Plateau. The Coastal Plain has a strip of land that consists of corals, sands and alluvial deposits. The Foot Plateau has a flat plain surface with high potential permeable sand hills and loamy soils. It is composed of Jurassic rocks and sandy hills consisting of Magarini sands ideal for sugar cane growing. The county is also known for its white sand beaches. The Coastal Uplands which is also known as Shimba Hills is an area of medium to high agricultural potential. It is made up of five sandstone hills namely Shimba Hills, Tsimba, Mrima and Dzombo. The Nyika Plateau is a semi-arid area with largely poor soil. The Nyika Plateau is characterized by basement rock system with the exception of occasional patches of reddish sand soils and occupies over a half of the county. The main economic activity here is livestock rearing.

Kwale County is divided into agro-ecological zones in terms of agricultural potential with medium potential and marginal lands constituting 15% and 18% of the total land area respectively. The rest of the land, about 67% is range, arid and semi-arid land suitable only for livestock and limited cultivation of drought resistant crops. Part of the land (approximately 2,250 km²) is under forest cover with gazetted forests covering 350.45 km² and non-gazetted forests covering 1,900 km². The gazetted forests include Shimba Hills, Gogoni, Buda, Mrima, Marenje and Mwache. All gazetted forests are on public land and planted forests fall on both private and public land. The ungazetted forests are mainly the indigenous Kayas which are sacred sites and maintained by the MijiKenda Councils of elders. The County also has mangrove forests at Gazi, Bodo/Funzi and Vanga. Key land uses include agriculture, urbanization, tourism in the sea front land, conservation especially national reserves, and mining.

A significant portion of land has been converted to urban development in Kwale County. There are three main towns namely Ukunda-Diani, Kwale and Msambweni. In addition, there are 68 trading centres spread across the county. Diani/Ukunda town is endowed with clean and pristine beaches with 26 beach hotels of three to five star rating. The town has sacred Kaya forests around it namely Diani, Likunda, Kinondo, Tibwa, Mivumoni and Chale. It has a commercial centre covering Diani and Ukunda. The section of the town that runs along the beach road has residential and commercial premises to cater mainly for the tourism industry. It also has low to middle class residential estates along the Mombasa–Lunga Lunga road and high cost residential cottages along the beach road. A lot of space is still available in these areas for further development of residential estates. The Base Titanium Mining fall in the upper part of Ukunda town and provides great potential for growth in terms of commercial facilities and residential services. Diani-Ukunda has a town zoning and infrastructure plan which is being implemented by the County Government. Kwale town which has a geographical area of 51.9 km² has undertaken physical planning and zones for commercial and social utilities including markets, industries, cemetery, and education and Technical Vocational Education and Training (TVET) institutions have been provided. A quarter of the town is occupied by

or reserved for public offices and other utilities. The town borders the Shimba Hills national reserve which also serves as an important attraction for tourists.

Msambweni is the third classified town in Kwale County. It covers an area of 41.46 ha with a total population of 22,576 people. The town has provision for public utility land, part of which is occupied by the county hospital, government offices, medical training college and that earmarked for construction of a market centre. The town has beaches with cottages whose potential is yet to be fully exploited. The western outskirts of the town have extensive deposits of silica sand which can be used to establish glass and other industries. The Kwale International sugar nucleus farm and factory is expected to endear further growth of the town. Zoning and infrastructure planning for the town has been prioritized to pave way for its development.

Lamu County

Lamu has land surface area of 6,273.1 km² which is composed of 5,517 km² of arable land, 649.7 km² of non-arable land, 130 km² of coastline and 308 km² under water mass. The bulk of arable land is in Lamu West. Based on the physiographic and climatic conditions, the county is classified into five Agro-Ecological zones namely coastal lowlands, coconut cassava zone, cashew nut-cassava zone, livestock millet zone and lowland ranching zone.

Like other parts of the coast where land ownership issues have remained sensitive, land tenure in Lamu has remained unresolved for long with the local communities, the Boni and Bajuni communities, living without land titles for years. There are 13,000 households that have title deeds, making 42% of the county households. About 71% of the households that have title deeds are located in Lamu West while most households in Lamu East do not have land ownership title deeds. Consequently, land has remained public except in places where settlement schemes were established and land parcels formally allocated to people and ownership documents issued. The lack of land titles by the local communities has remained an emotive issue but the Government is in the process of issuing title deeds. Most of the landowners are also keeping their land parcels idle, without much economic benefits. The county suffers from poor land use with unplanned villages with very low population mushrooming up overstretching existing social services.

Part of land in Lamu County is covered by human settlement which is influenced by the population dynamics, soil fertility, availability of productive resources, other natural resources and general production capacity. The settlements have changed in size and form in response to the changing economic and social development particularly the development of the Lamu Port which is part of the Lamu Port-South Sudan-Ethiopia-Transport Corridor (LAPSSET) Project.

Mombasa County

Land use within Mombasa County is dominated by human settlement, industry and warehousing. There is rapid urbanization and proliferation of unplanned settlements due to rapid population increase. The informal settlements do not have access roads, drainage systems, water and provision of social amenities. The settlements have been categorized into high density low income, high density medium income, high density high income, medium density low income, medium density medium income, medium density high income, low density low income, low density medium income and low density high income.

Estimates done by JICA team of Experts for the Mombasa County Government in 2016 show that the land area available for development within Mombasa county is 134 km². Mombasa town planning scheme was first developed 1926 setting aside specific areas for industry and warehousing, port and other urban functions, served by either railway road network. Efforts to develop a new plan has been going on during the last few years.

Mombasa has different types of land tenure regimes namely public land, private land, community owned land, squatting (unofficial occupation of government land by private individuals), land allocated temporarily to specific groups such as people displaced from their land by government projects and tenancy-at-will privately owned areas. A significant proportion of land is owned by absentee landlords who enter into temporary lease agreements with local residents and institutions through agents. Most of the land in Mombasa that was originally occupied under customary tenure has been adjudicated and titles issued..

6.2 Water resources

Water forms one of the basic natural resource for the sustainable development and human wellbeing. In the coast of Kenya, most of the water consumed is obtained from rivers, lakes, springs, ground water aquifers, sand dunes and shallow wells. Scarcity of fresh water may lead to serious social conflicts and unrest. On the other hand, industrial and domestic effluent lowers the quality of surface and underground water.

6.2.1 Sources of fresh water

The main sources of fresh water at the coast are surface water (rivers, lakes, dams and wells) ground water, and rainwater (roof catchments). The rivers that discharge water in to the Indian Ocean at different points and the flow rates are shown in Table 6.3. Among the rivers, River Tana and River Athi/Sabaki, obtain their water from the highlands in Central Kenya mainly the Mount Kenya and the Aberdare Ranges, and discharge the largest volumes of water into the Indian Ocean while also providing fresh water for various agricultural, domestic and industrial uses. The water discharge from the rivers follows the bimodal precipitation pattern with the extent of their watershed environment defined by the dynamics of seasonality. Owing to the large volume of water

from their sources, the Tana and Athi/Sabaki rivers system is perennial (Mwaguni et al, 2016), while the other rivers are seasonal. River Uмба in the southern part of the coast is trans-boundary with the source in the Usambara Mountains in Tanzania.

Table 6.3 Main rivers in the coast of Kenya with their sources, area transverse and mean volume of discharge (Source: County Integrated Development Plans for Tana River and Kwale Counties)

River	Source	Area traversed	Volume M ³ /D
Tana	Mt. Kenya & Aberdare Ranges	Tana River County	10,958.9
Athi-Sabaki	Mt. Kenya & Aberdare Ranges		3,548
Marere	Marere spring, Shimba rain forest	Shimba Hills National Park	2087
Pemba	Marere spring, Kinango area	Kinango-Tsunza	7605
Mkurumudzi	Shimba Hills	Shimba Hills – Msambweni	9917
Uмба	Usambara Mountains	Lunga-lunga-Vanga	6104
Ramisi	Chenze Ranges	Marerani-Shimoni	8190
Mwachema	Majimboni-Msulwa	Majimboni-Gombato Diani	341.73
Mwache	South Samburu	South Samburu	-

Most of the piped water used in the coast region currently comes from surface water mainly from the Tana and Athi-Rivers. The Baricho water treatment works at Sabaki River supplies piped water to Mombasa, Malindi and Kilifi. However, shallow ground water aquifers are found in Kwale and Lamu counties. Water Resources Management Authority (WRMA) classifies the Tiwi and Lamu Island aquifers in Kwale and Lamu counties as strategic and supply significant of water in areas without an alternative sources of water (Barasa et al. 2016). The Tiwi aquifer has good quality water and is recharged from ground flow from the west and possible leakage from seasonal swamps directly overlaying the aquifer. The Gongoni-Msambweni aquifer which occurs in Kwale has high yields of good quality water and is recharged by rainfall and leakage from River Mkurumunzi while the Mombasa Island and Lamu Island aquifers has shallow aquifer directly recharged by rainfall. Unlike other coastal areas a significant amount of water in Lamu is collected from rainfall using *djabias* which are man-made rain water collection surfaces made of iron sheets or concrete with a large holding tank. Other sources of freshwater in the coast are Mzima springs in Taita-Taveta, Marere springs in Kwale.

6.2.2 Demand and supply of fresh water

Most of Kenya as well as the coast region is water deficient. The main activities that demand a lot of water at the coast include water abstraction for irrigation, domestic supplies, industrial use, tourism, livestock and mining. Large parts of the Tana River basin have been earmarked for large scale irrigation agriculture within the current economic development plan (Vision 2030). Sugarcane farming is also going on at Ramisi in the south coast of Kenya. Water demand for domestic supplies has increased due to rapid growth of population particularly in the main towns along the coast. In addition, there are industrial activities in Mombasa, tourism developments particularly

tourist hotels, restaurants and entertainment joints that have increased along the coast, and mining of minerals such titanium that require large volumes of water. To meet the demand for energy, there are plans to increase the number of hydroelectric power stations in the Tana River. The demand for water exceeds the supply in the coast region. For example the demand for piped water in Kilifi County is 200,000m³ against a supply 130,000m³ (Comte et.al. 2016). The demand for piped water in Mombasa is 182,000m³/day against a supply of about 43,000m³/day (Mombasa County Government, 2013). Most of the households obtain piped water, although less households get the water directly piped into the dwellings. Other important sources of water are wells and bore holes as well as water supplied by vendors.

Table 6.4 Sources of water for households in Coastal counties (Sources: KFS 2010 Survey)

County	Pond/ Dam	Lake	Stream	well/bor ehole	Piped into dwelling	Piped	Djabia	water vend or	other	Total
Mombasa	1102	33	340	59143	31055	11095 5	323	6560 1	147	2686 99
Kwale	25370	265	10970	45131	3080	31361	701	2544	125	1195 47
Kilifi	26218	511	8636	42476	14151	93557	1418	1221 5	582	1997 64
Tana River	3691	460	12703	20399	800	5024	82	1706	2549	4741 4
Lamu	1396	1396	532	11402	1732	5030	1652	265	29	2343 4
Taita Taveta	617	617	16368	7532	4639	37451	134	4081	52	7149 1
Total	58394	3282	49549	186083	55457	28337 8	4310	8641 2	3484	7303 49

6.3. Drivers, pressures, impacts and response strategies

The changes in land use are driven by population growth and economic development. The demand for agricultural land for national food security including large scale farming and ranching is high particularly in Lamu and Tana River counties. Urbanization as well as tourism developments has led to change in land use patterns reducing agricultural land to urban developments. The increased need for shipping and other forms of transport has led to changes in substantial land to infrastructure developments including ports, railways and roads. The main pressure on land management in the coast region is land tenure which has made it difficult for physical planning to be undertaken. Overall, there is no quantitative data on changes in land use in the different parts of the coast making spatial planing difficult.

The key impacts of land use changes are manifested in increased land acquisitions, community resentfulness and conflicts with existing land use and community goals, resettlements and displacement of communities; urban sprawl and expansion of uncontrolled urban development; informal settlements; inadequate or inexistent infrastructure provisioning (water supply, sewerage/drainage, solid waste management, energy supply, etc); population changes (immigration and growth); and general insecurity. From an ecosystem perspective, there are also impacts related to enhanced vulnerability of maritime zones and sustainability of ecosystem services; shoreline changes; pollution and waste management; and conditions that potentially threaten Kenya's environmental vision under vision 2030, SDGs and other international obligations and commitments.

The key response instruments are policies responses, governance instruments as guided by acts and regulations, such as the Kenya land Commission, land control boards and adoption of International Best Practices (IBPs) as proposed in National Development Plans and County Integrated Development Plans requiring spatial planning process for land use and land allocation.

The main drivers of the changes in fresh water use patterns in the Coastal region are increased population, urbanization, demand for irrigation water for food and cash crops that use large volumes of water and industrialization. The pressures on the water resource include increased water demand from the main River systems for power generation, irrigation and domestic use. Excess water abstraction from the underground aquifers has resulted in salt intrusion and contamination in some areas. Competition for available water by various users particularly between agriculture and livestock herders in Tana River has resulted in user conflicts.

The responses for the increase in water demand particularly include the development of the sewerage master plan for coastal urban centres, rehabilitation of the existing water supply and waste water management systems such as the Kizingo waste water treatment plant, Construction of the Second Baricho Wells (Northern Bank) and associated pipelines, and the Mazeras – Nguu Tatu reservoirs, and the completing of the Second Mzima Pipeline project, one of the Vision 2030 flagship projects and requires an estimated funding of USD 400 Million. The extraction of groundwater has intensified through drilling of boreholes. More than 4,500 have been drilled in the Tana River basin to access groundwater as an alternative source of potable water supplies. Majority of the boreholes now require rehabilitation due to non-yielding of the water resource. Consequently, new boreholes have to be dug deeper in order to access the water (Mwaguni et al, 2016; Government of Kenya, 2002). There is need to quantity of groundwater at the coast and the extraction/replenishments dynamics for planning in order to maintain the quality of borehole water for and sustainable management. Furthermore, recent interventions include construction of Mwache dam, catchment rehabilitation and development of waste water integrated management plan.

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Chapter 7 : Economic Activities

In the coastal region, the main livelihood activities are fishing, mangrove harvesting, and tourism along the coast, while in the hinterland subsistence farming and livestock rearing (pastoralism) are the major occupations. The economy in the urban centres derives mainly from maritime and harbour activities, tourism and commerce. Tourism, in particular, depends heavily on the rich biological diversity and health of the environment. The main activities that support the economy and livelihoods of the coastal region include tourism, fisheries, agriculture, forestry, ports and shipping, and mining. According to the KNBS (2016), the activities contribute differently to the coastal economy i.e. tourism (45%); ports and shipping (15%); agricultural industry (8%); Fishing (6%); Agriculture (5%); forestry (4%); and mining (2%). The economic activities support many livelihoods through small-scale businesses and other associated activities that depend and impact on the environment at different scales.

7.1 Coastal tourism

Tourism is one of the biggest and most diverse industries in Kenya, contributing 4.1% (KES 87.1 billion) of national GDP in 2014 (KNBS, 2016). Coastal tourism is dependent on a range of niches i.e. national parks and reserves (both marine and terrestrial), coastal beaches, conferences and events segment, museums and historical sites, wildlife safari and ecotourism. The tourism industry drives economic activities in other sectors such as hotels, travel agents, airlines and other passenger transportation services. Travel and tourism generated 206,500 jobs directly in 2014 (3.5% of total employment) and was forecast to grow by 1.2% in 2015 to reach 209,000 (3.4% of total employment) (World Travel and Tourism Council, 2015).

The tourism sector at the coast is influenced by a diversity of attractions including national parks, game reserves, and beaches. Moreover, the scope of activities has expanded to promote cultural heritage, history, folk arts and crafts, and the natural environment through community eco-tourism (Ondicho, 2000). The number of tourists fluctuates seasonally reducing during the rainy season (Figure 7.1). In 2014, bed-night hotel occupancy at the coast, with an exception of lodges, contributed 40.1% of the national total, but declined to 37.8% in 2015 (KNBS, 2016). This is also evident from the declining number of tourists that arrived at the coastal region through Moi International Airport between 2012 and 2015. In addition, there has been a general decline in the number of tourists visiting parks and reserves at the coast since 2011 with the lowest figures being in 2015 that could be associated to the drop in arrivals during the time (Figure 7.2). The sector's suppressed performance is associated to security concerns, particularly in the coastal region, which triggered negative travel advisories from international markets. Additionally, the aftermath of Ebola outbreak in West Africa in 2014 slowed international visitor arrivals in 2015.

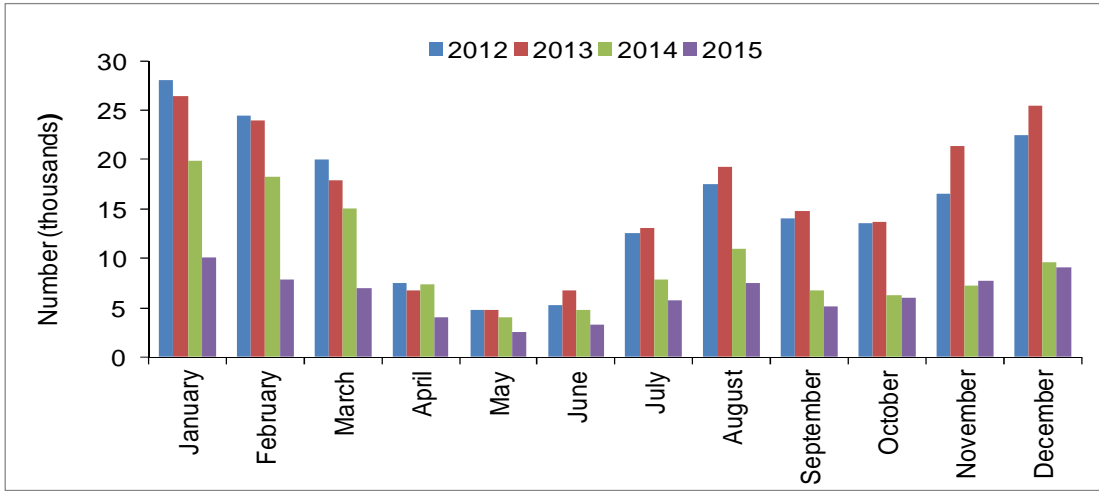


Figure 7.1 Monthly visitors arrival through Moi International Airport (MIA) (2012 - 2015) (Source: KIPPRA, 2013; KNBS, 2014, 2015, 2016)

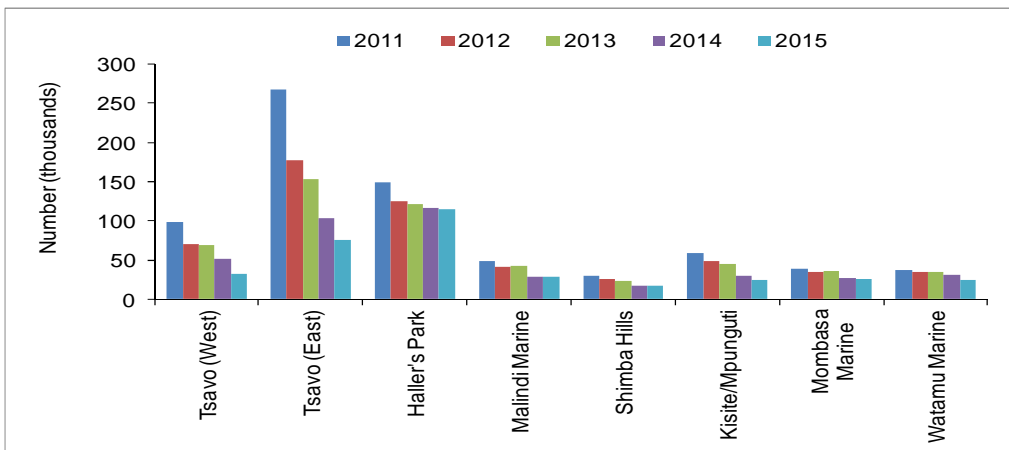


Figure 7.2 Trends of tourist numbers in the parks and reserves along the coast region between 2011 and 2015 (Source: KNBS, 2014, 2015, 2016)

The number of tourists to coastal museums, snake parks and historical sites have contributed between 23 - 32% of the total national numbers (Table 7.1). Although the visitors to small parks and reserves like Arabuko Sokoke were not included in the numbers due to their small contribution, a drastic increase in the number of visitors to Fort Jesus was observed in 2015 while the rest of the sites recorded decreases. Visitors to Fort Jesus increased by 7.0 per cent from 113.4 thousand in 2014 to 121.3 thousand in 2015, which could be associated to expansion of local tourism and proximity to international airport.

Table 7.1 Number of visitors to museums, snake parks and historical sites at the coast from 2011 to 2015 and percentage contribution the national numbers

Museums, snake parks and historical sites	Number of visitors				
	2011	2012	2013	2014	2015
Fort Jesus	168,797	127,562	152,118	113,373	121,278
Gede	54,003	43,131	54,584	47,498	39,856
Lamu	4,949	2,638	2,828	1,726	1,478
Jumba la Mtwapa	8,381	5,731	7,374	5,743	4,344
Malindi Museum	30,232	17,920	26,059	20,990	14,685
KilifiMnarani	2,351	1,615	818	2,527	1,194
Swahili House	596	323	310	268	40
Rabai Museum	87	0	1	0	0
Pate Sites	34	2	1	10	0
German Post office	84	145	67	51	4
Percentage contribution to national numbers	32%	24.1%	31.7%	27.8%	23%

7.2 Port development and shipping

Maritime transport of goods and passengers accounts for 15% of the coastal economy. The Mombasa Port at Kilindini is not only the largest sea port in Kenya, but also one of the largest and most important ports serving other landlocked neighboring countries along the East African coast such as Uganda, Rwanda, Democratic Republic of Congo and Southern Sudan. Mombasa port is connected to the world's major ports and handles between 1,684 and 1,832 vessels annually sailings to Europe, North and South America, Asia, the Middle East, Australia and the rest of Africa. Cargo handled at the port has continued to increase steadily from 2011–2015, a trend that is likely to continue. The containers throughput increased by 33% between 2011 and 2015, while convectional cargo and bulk dry cargo increased by 65 and 66% respectively (Table 7.2).

Table 7.2 The volumes ('000 DWT) of shipping traffic (2011 - 2015) (Source: KPA, 2016)

Imports	2011	2012	2013	2014	2015
Containerized cargo	5226	5954	5974	6524	6955
Conventional cargo	1298	1302	1726	1830	2143
Dry bulk	3807	4811	4913	5231	6350
Liquid bulk	6607	6665	6537	7192	7232
Total (imports+exports)	19726	21920	22307	24875	26732
Transshipment	227	143	174	732	518
Vessel calls	1684	1763	1768	1832	1694

The capacity of the port has remained fixed over a long period of time; and as a result, the volume of containers being received has increased beyond the port's capacity. However, there are some recent expansions which have been implemented to improve cargo-handling capacity. In an effort to increase the port capacity, the container terminal has been expanded by constructing additional berths. Moreover, the construction of Phase I of the Second Container Terminal completed in 2016 will provide additional capacity of 550,000 Twenty-Foot Equivalent Units annually. The government is also developing a second commercial port at Manda Bay, Lamu to tap into the South Sudan and Ethiopian Markets under the LAPSSET project.

Other smaller ports which handle smaller vessels include; Old Port, located at Tudor Creek, old Lamu port which has been used for dhow trade for over 2000 years, and the Shimoni port that handles small vessels transporting goods to Tanga and Zanzibar. Other designated ports along the coast of Kenya include Funzi, Takaungu, Kilifi, Mtwapa, Vanga, Lamu, Kiunga, and, Ngomeni and Malindi, which are all useful in their own capacities.

7.3 Coastal agriculture

Agriculture has been identified as one of the key sectors under the economic pillar of Kenya's vision 2030. Over 70% of the inhabitants are farmers. However, the agricultural production has remained low in the coastal areas due to frequent depressed rainfall trends and practicing of subsistence farming (Ministry of Agriculture, 2015). Over 75% of the coastal area is semi-arid and is dependent on rain fed agriculture (Jaetzold and Schmidt, 1983). Coastal areas contribute to production of varied food and cash crops (cashew nuts, bixa, coconut, cotton, sisal, sugarcane, rice, mango, cassava, maize, beans, sweet potatoes, tomatoes, watermelon, banana and a number of vegetables and horticultural products). The region also supports livestock for provision of various products (milk, eggs and meat). Thus, the sector significantly supports livelihoods and economy of the coastal region.

The coastal region is classified into five agro-ecological zones of which 21.3% (1,707,625 hectares), that is mainly along the coastal strip, is classified as a high crop capability zone; whereas 0.27% (21,871 hectares) is classified as a medium capability zone and 78% of the available land as low capability zone (KCDP, 2015a).

7.3.1 Crops

Cash crops farmed at the coast include; cashew nuts, bixa, coconut, cotton, sisal, sugarcane, rice, oranges and mangoes; whereas food crops include maize, sweet potatoes, banana, watermelon, cassava, passion fruits, beans and sorghum. A summary of some of the crops and their production status as farmed in different coastal is presented in Table 7.3. The crops are either destined for local household consumption (e.g. cassava and maize) or for export (e.g. bixa and rice).

Table 7.3 Some of the farmed crops and their production status in different counties

Crop	County where farmed	Coastal production estimates	Source
Cashew nut (<i>Anacardium occidentale</i>)	-Kilifi - <i>Main producer</i> -Kwale -Lamu	- 22,140 MT (2014) - 2.1 million trees - 68,950 farmers	-Kenya Nut Processors Association
Bixa (<i>Bixaorellana</i>)	-Kwale- <i>Main producer</i> -Lamu	-3360 MT (2001) - 5,600 hacters	-Kenya Bixa Company -Muhindi (2013) -Gitu and Nzuma (2003)
Coconut (<i>Cocos nucifera</i>)	-Kwale - <i>Main producer</i> -Kilifi -Lamu -Mombasa -Tana river -TaitaTaveta	-129,369 MT (2014) -258 million trees	-AFFA, 2014 -MOA, 2015
Mango (<i>Mangifera indica</i>)	-Kilifi - <i>Main producer</i> -Lamu -Kwale -Tana river	226,264 MT – 2014	-MOA, 2015
Rice (<i>Oryza sativa</i>)	-Kwale -Tana river – <i>Main producer</i>	5,261 MT – 2014 -3,163 ha	-MOA, 2015 -AFFA, 2014
Sisal (<i>Agave sisalana</i>)	-Kilifi -TaitaTaveta	-25,340 MT	-MOA, 2015 -AFFA, 2014
Maize (<i>Zea mais</i>)	-Lamu – <i>Main producer</i> -Kwale -Kilifi -Mombasa -TaitaTaveta -Tana river	79,873 MT-2014	-MOA, 2015
Cassava(<i>Manihot esculenta</i>)	-Lamu -Kwale -Kilifi- <i>Main producer</i> -Mombasa -TaitaTaveta -Tana river	-246,709 MT - 2014	-MOA, 2015
Beans (<i>Fabaceae</i>)	-Lamu -Kwale- <i>Main producer</i> -Kilifi -Mombasa -TaitaTaveta -Tana river	-842 MT – 2014	-MOA, 2015
Sweat potatoes (<i>Ipomoea batatas</i>)	-Lamu -Kwale -Kilifi – <i>Main producer</i> -Mombasa -TaitaTaveta -Tana river	- 7,490 MT – 2014	-MOA, 2015
Pineapples (<i>Bromeliaceae</i>)	-Kilifi- <i>Main producer</i>	Not know	

Production of most food crops is minimal, mostly at subsistence level, with large annual fluctuations due to dependency on seasonal rains. However, the production of cash crops such as sisal and sugar cane is significant. Over the last few years, sugarcane farming has been established as a major cash crop in Kwale county providing direct and indirect employment (Kwale Sugar Board annual report, 2012, AFFA, 2014).

7.3.2 Livestock

Livestock at the coast range from cattle, goats, poultry, bees, sheep, donkey and rabbits among others. Livestock farming is an important agricultural activity at the coast and varies greatly from large scale dairy farming by companies in Kilifi County to domestic zero grazing units for milk production, and nomadic herding mainly for meat production particularly in Tana river and Kilifi counties. The coastal region has over 85 major livestock ranches with only 25 currently operational. Most of the ranches are located in marginal lands of the coastal region, which make up 69% of the total area. Overall, Tana River County has the highest of cattle population between 2010 and 2014 with significant annual increments in most of the Counties (Figure 7.4).

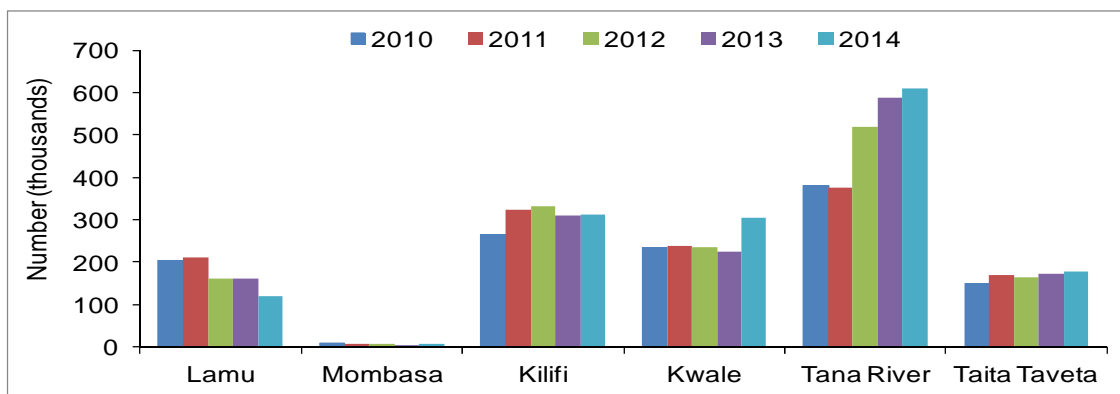


Figure 7.3 Distribution of cattle a cross the six coastal counties (2010 -2014) (Source: Economic Review of Agriculture, 2015)

Kilifi County leads in poultry production providing 43% (1,235,000 poultry) of the total that was produced from all the coastal counties in 2014 (ERA, 2015). The distribution of sheep, poultry, donkey and goats in the different coastal counties is detailed below (Figure 7.5).

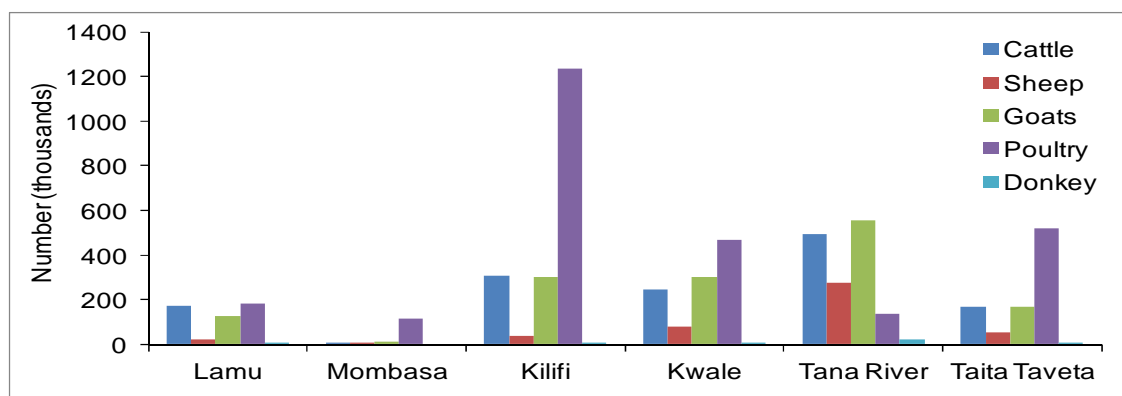


Figure 7.4 Average livestock distribution in numbers across the coastal counties (2010 -2014) (Source: MoA 2015)

7.4 Marine and coastal fisheries

7.4.1 Capture fisheries

The importance of the fisheries and aquaculture to the livelihoods and food security of coastal communities is well documented (FAO, 2016). Capture fisheries provide about 80% of the total income to 70% of Kenya’s coastal communities (Malleret-King et al., 2003). About 90% of the production is by small scale artisanal and subsistence fishers. There has been a general increase in fishing pressure along the coast with about 13,426 small-scale fishers reported to be involved in fishing in 2016, compared to 12,748 in 2014, 13,706 in 2012 and 12,077 in 2008 (Government of Kenya, 2016). There are about 3,000 small-scale fishing crafts in the fishery.

Annual fisheries production generally ranges from 5,000 MT to about 9,000 MT since 1981, and valued at 1.8 billion Ksh in 2015. The catches are mainly composed of demersal reef fish dominated by rabbitfish, parrotfish and emperors, pelagic species include tuna, mollusks, crustaceans including prawns and lobsters, octopus and squids (Figure 7.5a). There are challenges in the enumeration of catch statistics, compounded by the multispecies and multigear nature of the fisheries in addition to porous landing sites. However, reconstruction of the catches estimate that annual production is likely to be 2.8 times higher than the officially reported estimates, placing the estimated catches at about 16,000 – 18,000 tonnes presently (Le Manach et al., 2015, Figure 7.5b).

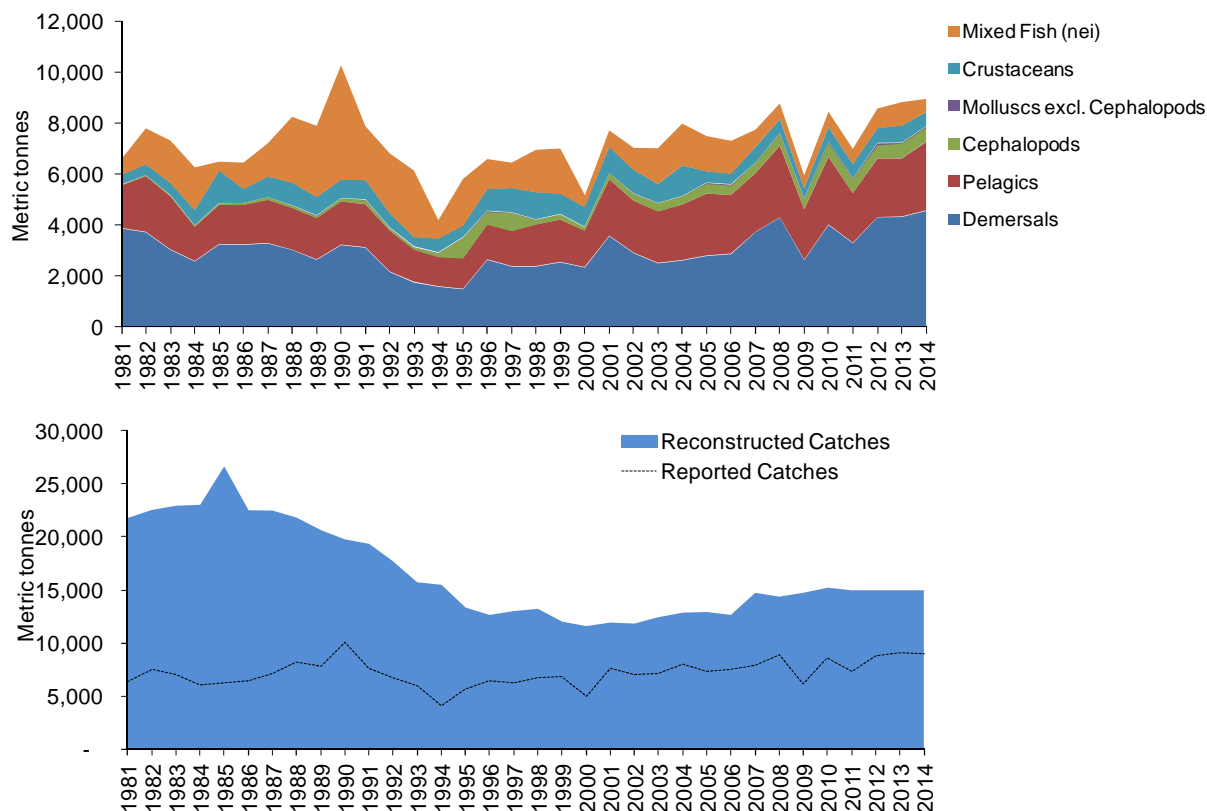


Figure 7.5 A comparison of long-term trends in marine fisheries production for Kenya based on (a) officially reported catches (Source: FAO, 2016) and (b) reconstructed catches (Source: La Manach, 2015)

The offshore fishery potential is estimated to be between 150,000 - 300,000 MT worth Ksh 21 - 42 billion. The fishery is mainly exploited by foreign nations through annual fishing licences, and targeting skipjack, yellowfin and bigeye tuna. There are about 30 - 40 purse seiners and 4 - 9 long liners that are licensed to fish in the Kenya EEZ annually (Table 7.4). The revenue generated through licensing of the Distant Water Fishing Nations to access the tuna resources is about USD 350,000. However, there is also a high potential to generate more revenue through levies based on the actual catches. Other offshore fisheries include the semi-industrial shrimp fishery (3 trawlers) and recreational fishing. The offshore fishery experiences significant losses from Illegal, Unlicensed and Unregulated (IUU) fishing. Although empirical data for the country is not available nationally, the losses are globally estimated to be between 20 - 30 percent. Due to limited capacity to monitor the catch and fishing effort in the EEZ, the level of exploitation remains unclear.

Table 7.4 Fishing licenses issued by Kenya to distant water fishing nations (2010 - 2014)

Year	2011		2012		2013		2014	
	PS	LL	PS	LL	PS	LL	PS	LL
Spain	13		14		14		14	

France	9		9		13		11	
Mayotte	4		4					
Rep. Korea					3		1	
Mauritius					2		2	
Seychelles	8		7		7	2	7	5
China								3
Taiwan						2		
Oman								1
TOTAL	34	0	34	0	39	4	35	9

Marine fish and fish products are exported to various countries worldwide including aquarium fish which provide the highest value added product obtained from reefs. As the largest exporter of marine aquarium fish in the Western Indian Ocean region, Kenya annually exports about 230,000 to 350,000 fish and 100,000 invertebrates valued at over 2 million US dollars. Aquarium fish are currently exported to 26 destinations (an increase from 15 in 2005) including the EU (Germany and UK), USA, China, South Africa, Japan, Israel and United Arab Emirates. The number of species targeted has increased from 48 species in 1980s, 193 species in 2005 (Okemwa et al., 2009) to approximately 250 species in 2015 (Okemwa et al., 2016). of which wrasses and damselfishes are the most collected Thirty-two species make up 80% of the catches with the cleaner wrasse, *Labroides dimidiatus* being the most collected. A semi-quantitative risk assessment showed that four species: *Pomacanthus maculosus*, *Pomacanthus chrysurus*, *Amphiprion allardi*, and *Amphiprion akallopisos* to be at high risk of overexploitation (Okemwa et al., 2016).

7.4.2 Aquaculture

The aquaculture sector has a potential to stimulate economic growth and contribute to poverty reduction in Kenya. Mariculture development has been embraced to help meet the deficit from capture fisheries and to diversity livelihood opportunities for coastal communities.

Mariculture development in Kenya has made great strides in the last decades, through development and adoption of simple innovative technologies. In 2007, the total area under mariculture was 6.9 ha (79.7% earthen ponds, 20.3% crab cages and 0% seaweed farms). The area has since increased to 103.5 ha; earthen ponds 80%, seaweed farming 18% and mud crab cages 2% (Mirera, 2007; Mwaluma et al., 2016; Mirera, 2016). Consequently, the number of community groups undertaking mariculture ventures excluding seaweed farming has increased four-fold and two-fold for pond culture and crab cage culture respectively.

Total production from mariculture is currently 76 MT, and is based on diverse species including: milkfish (*Chanos chanos*), mullets (*Mugil cephalus*), mud crabs (*Scylla serrata*), seaweeds (*Eucheuma denticulate* and *Kappaphycus alvarezii*), and prawns (*Ferrenopenaeus indicus* and *Penaeus monodon*) (Mwaluma, 2002; Wakibia et al., 2006; Mirera, 2009; Mirera and Ngugi, 2009). Seaweeds account for approximately 63.2% of the total production (Figure 7.3).

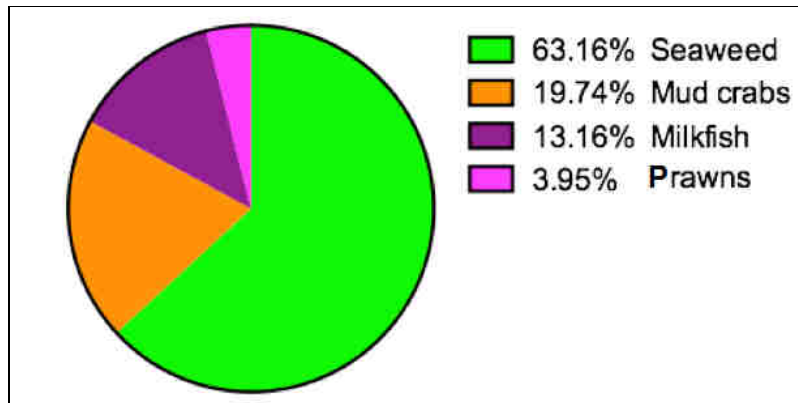


Figure 7.6 Annual mariculture production in Kenya showing the percentage contribution by species in 2015 (Source: Mirera, 2016; Mwaluma et al., 2016)

7.5 Coastal Industries

7.5.1 Mining

Minerals are among natural resources that are important for national economic and social progression of a nation. There are several mineral occurrences in Kenya coast (Table 7.5). However, most of the minerals remain un-quantified and unexploited. Mining is a traditional socio-economic activity done by wealthy people as well as very poor people. Nationally, the contribution of mining and quarrying to the GDP increased from 0.8% in 2014 to 0.9% in 2015 and registered an increase of 13.1% to 13.8% of the total number of persons employed in the sector (KNBS, 2016).

Apart from traditional mining of coral limestone for building blocks and cement manufacture, minerals such as Titanium are now being exploited. Currently, titanium is leading mineral exported from the coast. Titanium produces 455,000 tonnes of ilmenite, 85,000 tonnes of rutile equivalent to 14% of the world's rutile output and 32, 000 tonnes of zircon annually (Base Titanium, 2016; KNBS, 2016). Coal is also a major mineral at the coast and the government is considering developing a coal-fired power plant in Lamu County. A summary of other minerals found at the Kenyan coast is provided in Table 27. The national value of mineral output rose by 14.7 per cent from KES 21. billion in 2014 to KES 24.2 billion in 2015 attributed to high earnings from the export of titanium minerals from the coast (KNBS, 2016).

Table 7.5 Registered minerals and their occurrence at the Kenyan Coast (Government of Kenya, 2015)

County	Registered Minerals
Taita-Taveta	Iron Ore, gemstones, Manganese, Graphite
Kwale	Gemstones, Heavy mineral sands (titanium minerals), Silica sand, Rare earth elements, Niobium, Coral limestone, sandstones
Kilifi	Titanium, minerals, manganese, Barytes, Gypsum, Gemstones, Coral limestone, Halite (salt), Pozzolana
Tana River	Gypsum
Mombasa	Gypsum, Coral limestone, Clay
Lamu	Coral Limestone, Bituminous coal

7.5.2 Industrial sector

Manufacturing

The industrial sector accounts for almost 20% of Kenya's economic activity and is dominated by manufacturing and energy production with a GDP contribution of 10.0-11.8% annually between

2011 and 2015 (KNBS, 2016). Nationally, the sector grew by 3.5% in 2015 compared to 3.2% in 2014 (KNBS, 2016). Formal employment in the sector rose by 2.7% from 287.4 to 295.4 thousand persons in 2014 and 2015 respectively; while the Export Processing Zone (EPZ) recorded improved performance in employment, exports, imports, and expenditure on local goods and services while total sales increased by 12.1 per cent to KES 64.1 billion in 2015 (KNBS, 2016).

The coastal region has a good share of the manufacturing sector due to its strategic position to the port of Mombasa. It is home to Kenya's oil refinery which processes imported crude petroleum mainly for the domestic market. A number of steel manufacturing companies provide significant employment for the coastal people. Kenya has seven designated export processing zones (EPZ) of which 4 are based at the coast i.e. Mombasa, nearby Kilifi, Malindi along Kenya's North coastline and Voi (African Development Bank, 2013). Most of the manufacturing industries at the coastal region are located in Mombasa county (Mvita and Changamwe areas), Kilifi county (near Mtwapa, Kilifi and Mazeras Towns), Kwale county (Msambweni and Tiwi), Taita Taveta (Voi) respectively while Lamu and Tana river lack manufacturing industry zones (Table 7.6).

Table 7.6 Status of the manufacturing sector development at the Kenya coast

County	Industry	Location	Number
Kilifi	Rhino cement company	Rabai	1
	Mombasa cement company	Vipingo	1
	Steel products (fabrication)	Mazeras and Mariakani	1
	Salt production companies	Gongoni and Marereni	8
	Commercial starch production	Mazeras	1
	Power generation	Mazeras	1
	Soft drinks (coca cola and picana)	Mtwapa	2
	Export processing zone (EPZ)	Mtwapa and Mazeras	Many
	Sisal fibre production industry	Vipingo	1
Kwale	Coastal calcium limited	Waa	1
	Base titanium	Msambweni	1
	Kenya Bixa limited	Tiwi	1
	Kwale international sugar company	Msambweni	1
	Water distilling companies	Shimba hills	2
Lamu	No manufacturing industry	None	None
TaitaTaveta	Sisal fiber production industries		
	Milk cooling plans		2
Tana River	Soft drinks –Coast Development Authority	Hola	1
Mombasa	Export processing industries (EPZ)	Changamwe	Many
	Oil refineries	Mvita	1
	Glassware	Varied locations	Many
	Flour mills	Varied Locations	Many
	Car assembling plants	Varied locations	Many
	Cement company	Bamburi	1

Salt production

Salt mining is a major industrial sector based exclusively at the coastal region. The sector has potential to help Kenya transform into a middle-income country under Vision 2030 (Ocholla et al., 2013). Production of processed refined salt in the coast increased by 8.7 per cent between 2014 and 2015 (KNBS, 2016). However, the quantity of salt produced rose by 12.8 per cent to 303,452 MT in 2015 from about 170,000 MT recorded before 2009 (Government of Kenya, 2009).

Before 2009, salt production was mainly from eight operational salt work companies occupying more than 7,922 ha within the Malindi-Marereni area (Government of Kenya, 2009). Currently, there are 6 salt manufacturing companies and many artisanal salt producers in the salt production region of Malindi whose area runs into several hectares. Salt is mainly marketed to Uganda as the main destination for Kenya's salt exports in 2015. Other countries that provide market for processed salt in the region include; Rwanda, Burundi and Congo.

Salt consumption in Kenya has been on the rise as more households consumed more iodised salt in 2016 (100%) compared to 2009 when the consumption was 97.6% (WHO, 2007; <http://www.tradingeconomics.com/kenya/consumption-of-iodized-salt-percent-of-households-wb-data.html>). The increase in salt consumption in Kenya is associated to increase in human population and lifestyle changes.

7.6 Support services

The services that are essential for the development of economic activities in the coast of Kenya include road, air, water and railway transport, energy, freshwater supply and sanitation. Despite these services being the basic pillar for economic competitiveness they have remained largely inadequate.

7.6.1 Transport services

Road transport

Road transport plays a central role in development of all sectors of the coastal economy. Table 7.7 shows the length of classified and unclassified road network in the six coastal counties. Mombasa county has a total of 476.46 km of classified roads; while Kwale county has 1,483.1 km. Kilifi and Tana River counties have a classified road network of 2,008 km and 1,108 km respectively. Taita Taveta has a total of 1,589 km of classified roads while Lamu county only has 6 km.

The number of vehicles on the roads has increased dramatically, particularly in Mombasa which is a commercial hub, resulting in frequent traffic jams along major routes. It is important to note that the vehicle emissions impact on the environment. Based on the recent developments by County and

national governments, a good audit of the different road networks and the impact on the environment in the coastal region is needed.

Table 7.7 Length of different types of roads in the counties of the coast of Kenya (Government of Kenya, 2013a, b, c, d, e, f)

Type of surface	Mombasa (km)	Kilifi (km)	Kwale (km)	Tana River (km)	Lamu (km)	TaitaTaveta (km)
Bitumen	257.17	326.2	187.7	449	6	199
Gravel	127	542.3	425.2	659	-	138.2
Earth	91.29	1,139.5	871.2	-	-	1251.8
Unclassified	-	-	-	2,269	688.6	-

Rail Transport

Rail transport is the second-most important transport mode after roads. It is particularly important for transporting bulky goods from the Mombasa port to the hinterland. The railway network in Mombasa is concentrated in the industrial areas. The Kenya Government has constructed a Standard Gauge Railway (SGR), which replaces the rail passenger transport between Mombasa and Nairobi. The SGR, which became operational in April 2017, is anticipated to ease pressure on the roads in the long term thereby reducing road maintenance costs and by extension the environmental impacts of vehicular emissions.

Air transport

Air transport supports tourism, transportation of high-value exports and perishable goods as well as the promotion of regional integration. Moi International Airport in Mombasa is the largest airport at the coast followed by Malindi and Lamu airports. In addition, Kilifi County has two airstrips at Kilifi and Kijipwa while Kwale County has two airstrips at Ukunda/Diani and Shimba Hills. There are plans to expand the airport and airstrips in Kilifi to cater for the expected increase in number of visitors and residents. Taita Taveta County has 17 airstrips with six located in Taveta, 5 in Voi and 6 in Mwatate (Table 7.8). These include two private airstrips, one located in Mwatate and the other in Taveta. Some airstrips are located in the Tsavo National Park.

Table 7.8 Airports and airstrips at the coast of Kenya

County	Number of airports	Number of airstrips
Mombasa	1	0
Kilifi	1	2
Kwale	0	4
Tana River	0	7

Lamu	0	13 (11 public & 2 private)
Taita Taveta	0	17 (15 public & 2 private)

7.7 Drivers, pressures, impacts and response strategies

Kenya's economic development blueprint (Vision 2030) targets to attain 10% economic growth annually towards being a middle-income country by 2030. Agriculture, tourism, mining and fisheries are among the main sectors driving the coastal economy. Growth of these economic sectors is therefore driven by the push towards economic development, compounded by rapid, population growth. Although pressures may vary by sector, the impacts are cumulative and include a general loss of biodiversity and degradation of habitats. However, climate change is an overarching pressure on all sectors that directly depend on natural resources particularly agriculture and fisheries. The drivers, pressures, impacts, and response strategies among the key economic sectors are further discussed and summarized in Table 7.9.

Tourism

The direct effects of tourism include loss or degradation of habitats leading to a loss of species diversity. The impacts of high influx of tourists within coral reef areas include pollution, trampling of corals and intertidal areas. There are a number of community eco-tourism initiatives linked to conservation of natural resources that have been registered locally which provide direct benefits to local communities. They are currently acting as a source of employment to a number of youths in all the coastal counties. Examples of such groups include Dabaso conservation group, Mida Creek Conservation Community, Kuruwitu conservation group, Msambweni conservation, Kibodo conservation trust.

Shipping

Port and shipping development at the Kenya coast is driven by economic activities taking place in Kenya and the hinterland (Uganda, Rwanda, Burundi, Congo) served by the port of Mombasa. In addition, the independence of South Sudan has led to increased shipping traffic for manufactured commodities. The increased shipping traffic and associated port activities impacts on the environment through pollution from accidental oil spills, solid and toxic waste discharge. To mitigate the harmful effects of shipping, all developments should be subjected to EIA and compliance monitoring on regular basis. There is also a need to ensure compliance with environmental regulations and international conventions such as the International Convention for the Prevention of Pollution from Ships (MARPOL). A national multi-agency oil spill response committee (NOSRC) has been established. In 2010, the committee lead by KMA revised the National Oil Spill Response Contingency Plan (NOSRCP) to ensure proper management and handling of any spills.

Agriculture

Growth in the agriculture sector at the coast region is driven by the demand for food from increasing human population leading to the conversion of land into settlement and agricultural production. Post-harvest losses along the value chain is also a major pressure on agriculture production. Runoff of agricultural fertilizers and pesticides into coastal rivers and lakes impacts on surface and groundwater. The concentration of livestock within riparian areas further leads to direct degradation of watershed areas resulting in severe erosion and sedimentation impacting on coral reefs and other marine biodiversity. The proliferation of non-native invasive species such as *Prosopis juliflora* (*mathenge*) in Tana River has resulting in a range of environmental effects including reduction in biodiversity, dessication of limited water resources, loss of grazing pasture and other traditional uses of land. Other climate related pressures are due the dependency on seasonal rainfall that is becoming sporadic. The search for pastures has increased the movement of livestock from other regions e.g. from northeastern region to the coast region thus creating resource use conflicts.

Fisheries

The increasing need for food and income for the expanding human population and growing market demand for fish and fishery products is the main driver of overexploitation of fisheries resources at the coast. The open access nature of coastal fisheries results in unlimited access to fisheries resource is the main pressure compounded by weak governance systems. The pressures on fisheries resources are also due to limited alternative livelihood options for fishing communities.

The impacts from the capture fisheries and mariculture include loss of biodiversity, changes in community structure and ecosystem productivity, and loss of habitats. There is increasing use of non selective, destructive and illegal fishing gears, which poses a major threat to the fishery resource and biodiversity in nearshore ecosystems (Figure 7.2). In particular, beach seines capture up to approximately 70% juvenile fish jeopardising the natural regeneration of the stock (Mangi and Roberts, 2006). There is also increased fishing pressure on high value aquarium fish species including angelfishes, *Pomacanthus* species and anemonefishes *Amphiprion* species, which has reduced their populations (Okemwa et al., 2016).

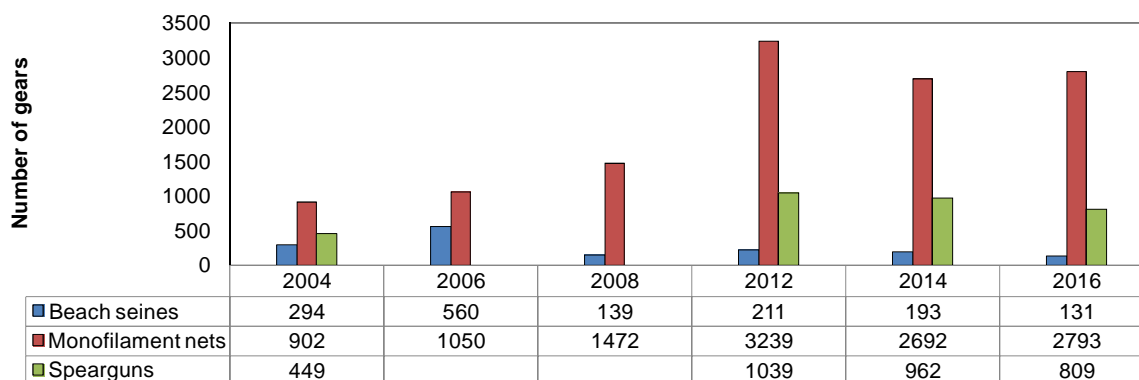


Figure 7.7 Temporal trends in the use of illegal gears along the Kenya coast (Source: Government of Kenya, 2014)

New fishery policies, guidelines and management plans have been developed to control the negative impacts of fisheries informed by stock assessments (Box 2). In addition, Kenya has embraced the implementation of Fisheries Improvement Projects (FIPs) supported by the Marine Stewardship Council to promote sustainable lobster fishing practices while others like tuna and octopus are proposed. The new Fisheries Development and Management Act 2016 has strengthened management capacity through creation of the Kenya Fisheries Service (KeFS), Kenya Fish Marketing Authority (KFMA) and the Fisheries Council. The new Constitution has devolved aquaculture development to counties.

Box 2. The status of fishery management plan development and their expected outcomes.

Fishery	Status	Expected out comes
Prawn fishery management plan	gazetted in 2010	Regulate the Malindi-Ungwana Bay shallow water prawn fishery
Lobster fishery mangement plan	Ongoing	Shallow water lobster fishery certification and invrovement
Small and medium pelagic fishery management plan	Ongoing	Improved management of small and medium pelagic fishery
Small-scale purse seine fishery management plan	Ongoing	Regulate use of small-scale purse seines (ring nets)
Aquarium fishery management plan	Ongoing	Regulate the marine aquarium fishery

A Vessel Monitoring System (VMS) has been installed to improve Monitoring Control and Surveillance (MCS) in marine waters. Furthermore, acquisition of a research vessel (RV Mtafiti) has boosted research capacity in the EEZ. Also there are efforts to procure a new OPV in the near future that will enable the Kenya Fisheries Service (State Department of Fisheries and Blue Economy) to patrol the EEZ and secure the fishery resources.

Mining

The need to diversify sources of revenue steered by the global demand for rare earth minerals is a major driver of the increase in mining at the Kenya coast. Major environmental impacts in the sector are land degradation through removal of vegetation cover leading to loss of biodiversity and change of landscape. Responses to mitigate the impacts of mining include: enforcement of Mining Act 2016 to promote sustainable mining in the region, enforcement of the EIA/EA Regulations, compliance monitoring by NEMA and the ministry of Mining.

Manufacturing

The manufacturing sector is mainly driven by market dynamics associated with demand. Pressures may include the cost of production including labour and energy and availability of raw materials. In particular, processing of horticultural crops at the Kenya coast is affected by poor road-networks leading to high post-harvest losses and hence poor utilization of harvested resources. The environmental impacts of the manufacturing sector include pollution from the release of harmful by-products into the air, water and soil. Salt production in Gongoni, Malindi, has resulted in mangrove areas being converted into areas for solar salt production. Continued expansion of salt production in the area has led to salinization of fresh ground and surface water, pollution through discharge of mother liquor into creeks, habitat destructions and coastal erosion and flooding caused by the construction of dykes (Ocholla et al., 2013). These activities significantly impact water quality and availability for human use in addition to the negative impacts on marine life such as juvenile fishes, fish eggs and mangrove saplings. Further there are salinization effects on soil that has had far reaching consequences on food security and livelihoods of the people (Ocholla et al., 2013).

In order to combat the environmental consequences resulting from salt production in Malindi the Kenya Association of Manufacturers (KAM) and Ufadhili Trust have been undertaking awareness campaign for all stakeholders on sustainable salt extraction practices. They have also helped to establish salt sub-sector forums to foster better relationships between the salt harvesting companies in Malindi-Marereni area and the local communities in the area. Other interventions include: development of strategies for dialogue and joint dispute resolution; compliance monitoring and enforcement of regulations; and undertaking studies aimed at understanding the impacts of salt extraction and possible mitigation measures.

Table 7.9 The main drivers and pressures of economic activities and responses to environmental change

Sector	Drivers	Pressures	Impacts	Responses
Tourism	<ul style="list-style-type: none">•Need for revenue•High visitations by tourists to the coast region	<ul style="list-style-type: none">•Uncontrolled tourism and associated infrastructure developments	<ul style="list-style-type: none">•Degradation and loss of critical habitats•Increases air Air and noise	<ul style="list-style-type: none">•Ecotourism• Community protected areas,•Development of tourism

		<ul style="list-style-type: none"> •Competition by resource users 	<p>pollution due to tourism transportation</p> <ul style="list-style-type: none"> •Decline of biodiversity •Overuse of water resources for recreational facilities 	<p>guidelines</p> <ul style="list-style-type: none"> •Education and awareness on best practices
Port and Shipping	<ul style="list-style-type: none"> •Growth of shipping business 	<ul style="list-style-type: none"> •Alternative use of waterways (tourism, fishing) •Dredging of ports •Disposal of solid waste from ships 	<ul style="list-style-type: none"> •Loss of nearshore habitats, •Water pollution, • Spread of invasive species •Change of seabottom habitats 	<ul style="list-style-type: none"> •Pollution control measures •Spatial planning
Agriculture	<ul style="list-style-type: none"> •Increased demand for food •High population increase 	<ul style="list-style-type: none"> •Land tenure •Invasive species • Competition by other forms of land use Climate change and variability •High post harvest losses 	<ul style="list-style-type: none"> •Degradation of arable land •Eutrophication of fresh water sources resulting in phytoplankton blooms Land conversion Contamination soil and surface water by pesticide 	<ul style="list-style-type: none"> •Land adjudication, •Diversification to drought resistance crops •Development of disease and pest resistant crops •Land suitability mapping
Fisheries	<ul style="list-style-type: none"> •Increased demand for food and income •High unemployment 	<ul style="list-style-type: none"> •Use of destructive fishing methods, •High post harvest losses 	<ul style="list-style-type: none"> •Decline in fishery production, •Ecosystem degradation • Decline in catches 	<ul style="list-style-type: none"> •Community based management (BMUs) •Development of CCAs, •Fisheries management plans
Mining	<ul style="list-style-type: none"> •Need for economic development •Demand for minerals and other materials 	<ul style="list-style-type: none"> •Limited local value addition <p>Competition for water resources</p>	<ul style="list-style-type: none"> •and Biodiversity loss and H •habitat degradation and fragmentation •Soil, air, ground water and surface water contamination •Land use conflicts 	<ul style="list-style-type: none"> •Development of regulations •areas restoration of exhausted mines
Manufacturing	<ul style="list-style-type: none"> •The need for employment and revenue 	<ul style="list-style-type: none"> •Demand for inputs from natural 	<ul style="list-style-type: none"> •Soil, air, ground water and surface water 	<ul style="list-style-type: none"> •Development of manufacturing zones

	generation income • Demand for manufactured products •	resources,	contermination Displacement of people • Sanitation and noise pollution • Improper waste disposal	• Conduction of EIAs and develop environmental plans •
Salt production	• The need for employment and revenue generation • Population growth	• Demand for the product	• Loss of Mangrove Forests • Loss of biodiversity • Salination of ground and surface water • Water Pollution	• Spatial planning

7.8 Policy and management options

The following management options are recommended:

- Develop mechanisms to minimize post-harvest losses and value addition in the agricultural and fisheries sectors
- Strengthen community based management of environment and local natural resources
- Strengthen research and monitoring on biophysical changes due to environmental impacts of economic activities
- Monitor and enforce pollution standards and other environmental regulations
- Rehabilitate exhausted mining sites
- Develop guidelines for use by small scale miners,
- Sensitize landowners, commercial companies and small scale miners on EIA/EA regulations.
- Implement environmental and fishery management plans
- Strengthen enforcement of regulations on illegal gears, and develop alternative fishing technologies

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Chapter 8 : Major Threats and Impacts on Coastal and Marine Biodiversity

The coast region has in the last one or so decades experienced heightened socio-economic development leading to threats and impacts on the coastal and marine environment including pollution, physical alteration and destruction of habitats, invasive species which are accelerated by climate change and variation. Major infrastructure developments including the Standard Gauge Railway (SGR), Port expansion projects (Lamu and Mombasa) and plantation agriculture have added the pressure on the coastal and marine environment. Apart from the major development projects, the existing industrial establishments and expansion of urban centers have also continued to exert pressure on the marine and coastal environment. This chapter describes the status and impacts of overarching threats to the coastal ecosystems and discusses existing response strategies, policies and provides the management recommendations to mitigate the impacts.

8.1 Pollution

Environmental pollution is mainly driven by population growth and industrial development through heightened industrial and domestic waste generation. Increased waste production has continued to exert pressure on available waste disposal facilities owing to inadequacy of resources to increase their capacity in tandem with increasing waste generation. The end result is continued discharge of raw wastewater into waterways in the major urban centers including Mombasa, Malindi and Lamu. Other sources of pollution include oil spills and chemical pollution both from activities on land as well as the sea. The key sources of pollution affecting coastal and marine environments include air pollution, sewage discharge, and solid waste and nutrient enrichment of water bodies.

Most of the larger coastal urban centers and their suburbs lack sufficient sanitary services such as water, sewer and solid waste disposal systems resulting in the use of septic tanks, soak pits, pit latrines and open drains. In rural areas, lack of waste management is prevalent due to lack of sanitary services leading to the discharge of raw sewage and solid waste including non-biodegradable material and plastics into the environment. Sanitation problems occur particularly in areas where the water table is high and the bedrock is shallow therefore restricting the depth of the pit latrines. Human waste may seep through the bedrock leading to the contamination of groundwater wells. Local communities may suffer serious health effects, possibly attributable to consumption of contaminated ground water.



Plate 8.1 Sewage flowing into the Makupa creek from Kibarani dumpsite, Mombasa. Fish in the creek is likely to suffer from effects of bioaccumulation of heavy metals from the sewage. This in term pose health risks to people eating fish from the creek (Photo credit: James Kamula).

Sewage discharge estimates for urban settlements in the coast regions are not available. As an indication, Table 8.1 provides a snapshot of annual rates of sewage discharge at various points of Tudor creek in Mombasa County.

Table 8.1 Sewage discharge input at some raw sewage discharge sites (Source: KMFRI, 2006)

Discharge Site	Location	Sewage flow rate (M ³ /year)
Mikindani	S 04 00 502 E039 38 234	17,061,083
Makande KPA	S 04 01 954 E039 39 331	988,824
Tudor Mburukenge	S 04 01 860' E039 39 485'	20,536
Nyali bridge	S 04 02 485 E039 40 260	143,469
Coast general	S 04 02 821 E039 40 412	196,687
Madobini (Old town)	S 04 03 237 E039 40 649	559,872

Mombasa municipality is the largest producer of solid waste at the Kenyan coast estimated at over 400 MT per day (assuming 0.5Kg solid waste per individual daily). About 50% of the solid waste is disposed at the Kibarani dumpsite located along the shores of Makupa creek in Mombasa (Plate 8.2). The dumpsite has been reported to be contaminated by variety of toxic heavy metals including Lead, Cadmium and Mercury, and is a potential source of contamination to the immediate marine environment (Kamau 2001; Kamau et al., 2006, Kosore et al., 2017). Moreover, proliferation of illegal dumpsites in urban centers has continued unabated owing to weak solid waste management systems in all coastal counties. The counties have designated solid waste disposal sites but have inadequate capacity for waste collection and disposal. The management of the dumpsites is also

poor due to lack of dumpsite management plans. The Kibarani dumpsite in Mombasa County was re-located to a new site in Mwakirunge in 2002 but continue to be used, a clear demonstration of the management challenges.



Plate 8.2 Kibarani dumpsite showing solid waste disposal on the shores of Makupa creek, Mombasa County (Photo credit: Brian Osweta)

Most non-biodegradable solid waste end up being washed down into the sea. Marine debris/litter injures and kills marine life, interferes with navigation safety, and poses a threat to human health. The shoreline and waterways are polluted with a wide variety of marine debris ranging from metal and plastic cans and bottles, plastic bags and other containers, to abandoned fishing nets and vessels. An estimated 14,000 Kg of plastic and other non-biodegradable waste were collected in 3 hours during The International Coastal Cleanup day in September 2016 along selected parts of the Kenyan coastal strip in an effort to reduce the amount of plastic waste dumped into the ocean and to highlight the impact of plastic waste locally and globally. A majority of the trash and debris in the beaches comes from storm drains and sewers, as well as from shoreline and recreational activities such as picnicking and beachgoing. Globally, there is a growing concern of the human health implications of microplastics, which are microscopic pieces and granules of plastics, being taken up in the fisheries food chain. Microplastics have already been detected in the fish food web in Kenya waters (Plate 8.3).

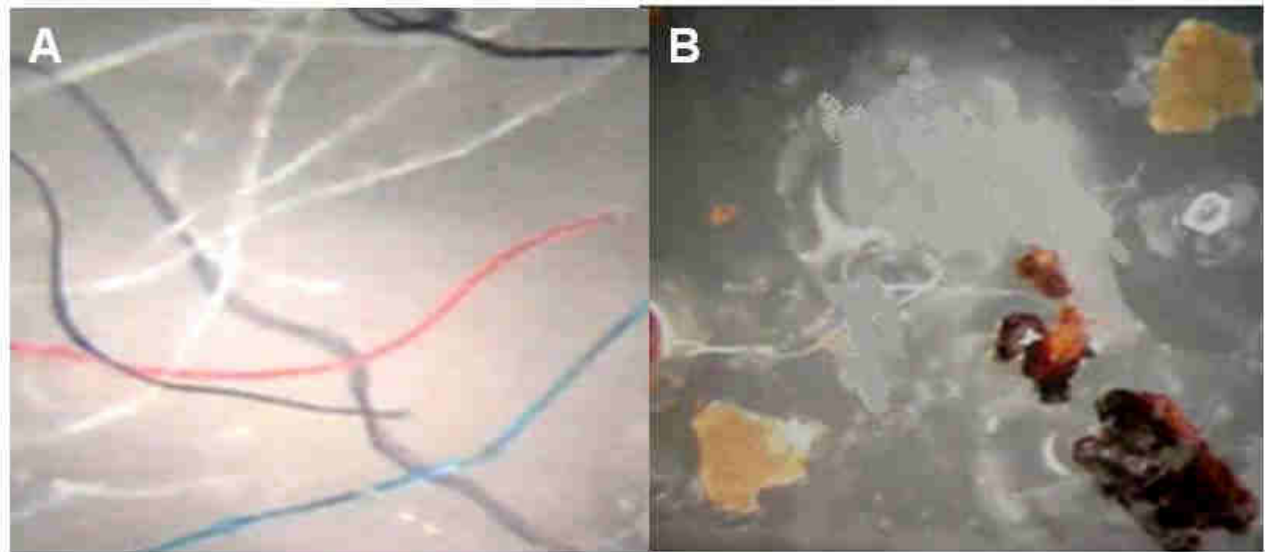


Plate 8.3 Microplastics filaments obtained from digested zooplankton in Kenya's marine water (magnification x40)

8.2 Eutrophication

Large amounts of nutrients from agriculture and sewage effluents end up in rivers, lakes and other water bodies leading to eutrophication. The impacts of eutrophication include algal blooms and hypoxia. The direct socio-economic impacts are reduced water quality leading to toxicity or mortality of fish and invertebrates. The Athi-Galana-Sabaki River, has been reported to experience abnormal algal growth indicative of eutrophication (Plate 8.4). The source of nutrients into the river system is mainly from upstream agricultural activities and discharge of raw sewage into the water bodies (KMFRI, 2013).



Plate 8.4 Eutrophication at Galana River (Photo credit: Joseph Kamau)

Algal blooms at the Kenya coast have been associated with fish kills in both marine and freshwater environments. Three plankton species *Falcatus ankistrodesmus*, *Falcatus coelastrum*, and *Falcatus scenedesmus* have been identified in the waters of River Galana. The first fish kills occurred in the area were reported in 2009, and later in July 2011. Mulletts were the most affected fish species. Other species included moray eels, catfish and *tilapia* species while species of mudfish were notably not affected.

8.3 Physical alteration and degradation of habitats (PADHs)

Physical Alteration and Destruction of Habitats (PADH) has continued to be a major threat to the coastal ecosystems leading to either loss or decreased provision of important ecosystem goods and services (Government of Kenya, 2010). The affected habitats include; coastal forests which are cleared for agriculture, fuel wood and timber, mangrove forests for settlements, salt works and aquaculture, coastal sand dunes for the development of upmarket luxury and tourists facilities. Magarini area in Kilifi County has lost extensive mangrove forest to salt works and deforestation (Plate 8.5). More recently, there has been an upsurge in the implementation of large national infrastructure development projects. These include the LAPSSSET project that include a seaport at Lamu county, railway line, pipeline and road connecting Southern Sudan to the Indian Ocean and the standard gauge railway line from Mombasa to Kisumu through Nairobi. These large projects permanently alter habitats and impact biodiversity.



Plate 8.5 Deforested mangrove forest for establishment of salt ponds in Magarini District, Kilifi County (Photo credit: James Kairu)

Around the coastal lakes and rivers, high levels of erosion and siltation occur partly due to the nature of erratic rains, and destructive land use practices such as farming along the riparian zones of rivers and steep mountain slopes, deforestation and overgrazing. Between 9 and 14 million MT of sediment is estimated to flow through the Tana River into the Indian Ocean. Soil erosion (rill, sheet and gully erosion) in the catchment areas of Lake Jipe has led to severe siltation. The gullies (“korongos”) are the main waterways through which millions of tons of soils are carried to Lake Jipe via the Lumi River, which has favoured the growth of macrophytes such as bulrush (*Typha domingensis*) hampering transport and fishing activity. Mining of stone, sand and soil in the catchment areas has also exacerbated siltation. The resulting impacts include increased water turbidity and a decrease in the productivity of the habitats.

Overharvesting of mangroves, destructive fishing methods such as beach seines and bottom trawling, construction of seawalls adjacent to beaches are among the major factors contributing to PADHs along the coastline. Uncontrolled and unplanned development along the beach or shoreline continues unabated thus increasing incidences of beach erosion. These have implications on the integrity of the shoreline due to severe storms and sea level rise (Plate 8.6; Shaghude et al., 2013). The loss of beaches and infrastructure to shoreline erosion is a widely reported problem in the coast, affecting turtle nesting areas, fish landing sites, beaches, and properties adjacent to the shoreline. Construction of seawalls for coastal protection has aggravated the problem, causing erosion downstream of the site.



Plate 8.6 Sea front buildings threatened by erosion at Bamburi (Source: Shaghude *et al.* 2015; Arthurton, 2003)

Other economic activities causing profound modification of critical coastal habitats include mining and sand harvesting. Mining and salt farming are regarded to have the most significant impacts on water quality and its availability in the coast region. Clearing of mangroves for salt extraction is quite extensive at Gongoni-Kurawa area in Malindi while sand harvesting is happening in large swaths of land in Malindi and Kwale. A total of eight operational salt works are in Gongoni-Kurawa area and occupy more than 7,922 ha of tidal swamps, producing 70,000 MT raw of salt annually (Government of Kenya, 2017).

8.4 Invasive species

Invasive species may be native or alien and are considered as a primary threat to integrity and functioning of marine and coastal ecosystems. The risks of species invasiveness are especially high if the ecosystems of origin and introduction are climatically similar (Nellemann *et al.*, 2008). Some invasions have significant ecological and socio-economic impacts including displacement of species and loss of livelihood. Alien invasive species may threaten native species directly as predators, competitors, disease vectors or by altering habitats. At least 22 plant species are reported to be invasive in coastal forests. A list of invasive species is presented in Table 8.2. The major threats of invasive species include:

- The loss of biodiversity due to; preying on native species, competing for space with native species, hybridisation causing genetic dilution, changes in ecosystem function, and decreased water quality;
- Economic and cultural impacts due to; interference with fisheries stocks, costs of clean up or control, damage to infrastructure, and loss of livelihood from mass die offs;

- Human health and wellbeing impacts resulting in; decreased recreational opportunities, increased incidences of parasitic and bacterial infections;
- High financial and management costs

Table 8.2 Invasive species along the Kenya coast, general impacts and current invasive status (Source: Global Invasive Species Database, Centre for Agriculture and Biosciences International, 2016)

Group	Species	Year of arrival	General ecosystem impacts	Potential socioeconomic impacts	Invasive status at the Kenya Coast
Invertebrate	<i>Acanthaster planci</i> <i>crown-of-thorns starfish</i>	Not known	Predation of corals by <i>Acanthaster planci</i> , upsurge of coral diseases and increased vulnerability of corals to temperature-related stresses. The impacts of coral predation can be severe and long-lasting. In some reefs 90% of live coral cover is lost due to <i>A. planci</i> outbreaks	Reduced fish yields	Mild
Plants	<i>Prosopis juliflora</i> (<i>mathenge</i>)	1983	An aggressive large shrub which especially invades riparian, arid, and semi-arid regions. It form's impenetrable thickets reducing native biodiversity and displacing valuable pasture species , Reducing ground water resources,	Damages fishing equipment Thorns can kill livestock when ingested Negatively impacts livelihoods	Serious Reported in Tana River Delta
	<i>Pistia stratiotes</i> (Nile cabbage)	A free-floating aquatic plant.	Outcompeting other native plants and reduced biodiversity,	Serious	Serious
	<i>Sphenoclea zeylanica</i> (<i>Wedgewort</i>)	This weed species is native to African and has spread as a weed across the world.	loss of feeding and breeding grounds for fish and other aquatic fauna. May cause nutrient load from decaying weed biomass and also lead to anoxic conditions		Serious
	<i>Salvinia molesta</i> (<i>Kariba weed</i>)	A free-floating aquatic plant native to south-eastern Brazil and first reported in Kenya in 1984. Invasive in lakes			Serious

		and rivers.			
	<i>Maesopsis eminii</i> <i>Umbrella tree</i>				Serious Serious
	<i>Rubus sp</i> (<i>Bramble fruit</i>)				Serious Serious
	<i>Cedrela odorata</i> (<i>Spanish cedar</i>)				Serious Serious
Bacteria	<i>Vibrio cholerae</i>				Life threatening health risks, may persist in shellfish and plankton Minimal
Bird	Indian house crow <i>Corvus splendens</i>	1947	Displaces native species by destroying their habitats	An urban pest, damages crops, hazardous at airports,	Serious

8.5 Climate variability and adverse weather patterns

The changing global climate has had widespread impacts on marine ecosystems worldwide under the influence of rising emission of greenhouse gases such as carbon dioxide, methane, and nitrous oxide, resulting in sea level rise and elevating sea surface temperatures (Doney et al., 2012). The increase in sea surface temperatures and resulting thermal stress has devastating effects on the habitat structure of coral reef ecosystems (Mwaura et al., 2017). Currently Kenya's global greenhouse gas (GHG) emission is low, this may however change after significant number of priority development initiatives outlined in Vision 2030 and its Medium Term Plans are implemented.

In Kenya, agriculture and GHG inventory account for approximately two-thirds of national emissions, mainly from livestock and deforestation. Energy demand is the next largest emitting sector accounting for about 16 % followed by transportation at about 10 % of emissions. . Industrial processes and waste contribute about 4 % and 1% of GHG emissions respectively. However, the current total emissions by Kenya account for less than 1 %of the total global emissions. Globally, averaged combined land and ocean surface temperature data as calculated by a linear trend, show a warming of 0.85 (0.65 to 1.06) °C, over the period 1880 to 2012 (Figure 8.1).

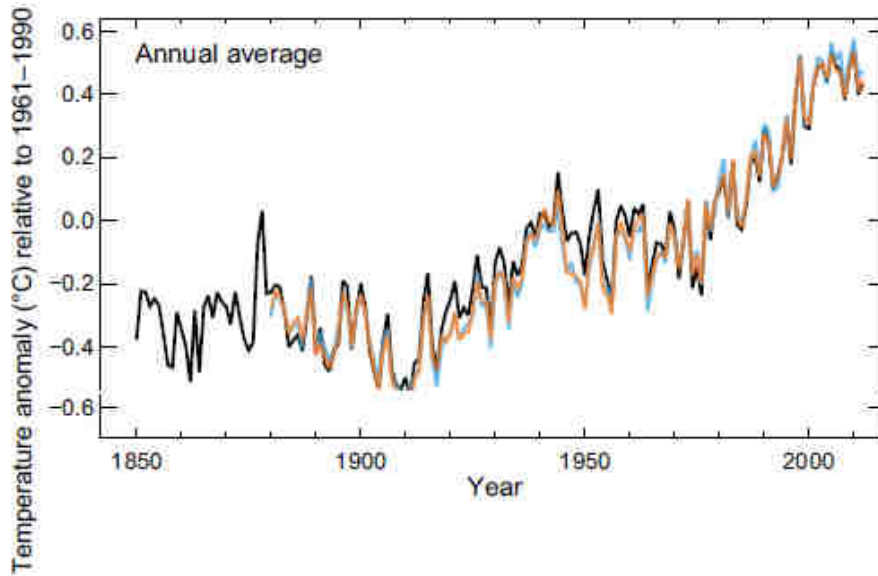


Figure 8.1 Observed global average combined land and ocean surface temperature anomaly 1850-2012

The country's drought cycles have reduced from 20 years (1964-1984), to 12 years (1984-1996), to 2 years (2004-2006), to a yearly occurrence of drought recorded in the period between 2007 and 2012. These manifestations of climate change constitute a serious threat to Kenya's natural environment and the economic and physical systems, on which the country's sustainable development and future prosperity depends.

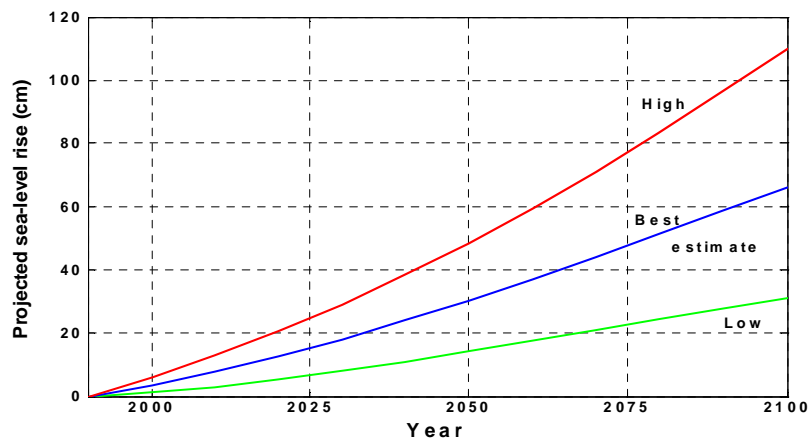


Fig 8.7 Projected Global MSL Rise - IPCC (2013)

8.6 Drivers, pressures, impacts and response strategies

The drivers, impacts, pressures and responses of major threats to biodiversity are shown in Table 8.3 below.

Table 8.3 The drivers, impacts, pressures and responses of major threats to biodiversity

Drivers	Impacts	Pressures	Responses
Need for industrial development	<ul style="list-style-type: none"> • Environmental air pollution, increased health risks due to pollution 	<ul style="list-style-type: none"> • Absence of waste management systems 	<ul style="list-style-type: none"> • Pollution mitigation measures
Increasing human population	<ul style="list-style-type: none"> • Over-exploitation of natural resources and environmental degradation 	<ul style="list-style-type: none"> • Lack of alternative livelihood options 	<ul style="list-style-type: none"> • Resource use management plans • Enhance monitoring, control and surveillance • Development and implementation of management plans
Growing global market demand for high value products	<ul style="list-style-type: none"> • Decrease of biodiversity and community structure, Changes in food web dynamics 	<ul style="list-style-type: none"> • Poaching and illegal harvesting, • The open access nature of the fisheries 	<ul style="list-style-type: none"> • International laws and conventions
Increased international trade	<ul style="list-style-type: none"> • Exploitation of species • change of community structure 	<ul style="list-style-type: none"> • Climate change • Land use characteristics 	<ul style="list-style-type: none"> • Monitoring and surveillance

The drivers of change are associated with economic growth and industrialization, the impacts include decline in of natural habitats and biodiversity; reduction of water quality and recharge for ground water aquifers; loss of shoreline protection services provided by coral reefs and mangroves, all of which ultimately lead to a loss of livelihoods and increased poverty amongst local communities. Responses by the administration include guidelines for the implementation of potential

any permanent structure in EIAs and environmental audits within the NEMA Act. In the coast there are a number of habitat reserves, which are administered by the KWS Act including the Eastern Tsavo, Arbuko-sokoke forest reserve and a chain of marine protected areas which form natural biosphere reserves. Regulations under the Kenya Forest Service are used to control harvesting of timber from coastal and marine forests. In addition, there have been efforts to establish community forest and marine protected areas which go along way to preserving natural habitats.

In the Mombasa County, some limited interventions have been made by the Government to improve the County service coverage of storm water drainage systems. Further, a deliberate effort should be put in place to develop sanitation systems and enhance the existing systems to accommodate the ever increasing domestic sewage load is needed. In particular, the efficiency of the Kipevu sewage treatment plant should be enhanced to increase throughput, and the pumping throughput of the Mikindani station should be enhanced.

In 2002, the Mombasa Municipal solid waste dumpsite was moved and located at Mwakirunge, a place 15 km from the town centre and away from the marine environment. The area has relatively impermeable geological formations dominated by shales, which minimize contamination of groundwater through leaching. Nevertheless, the official re-location of the dumpsite, solid waste collection and disposal in Mombasa is still being conducted at Kibarani dumpsite which continues to encroach the Makupa creek. Solid waste disposal at Mwakirunge should employ a sanitary solid waste disposal model to ensure air flight path safety and limit GHG emission through methane harnessing, as well as enhance aesthetic value. Implementation and update existing management plans, such as Lake Jipe Basin Integrated Management Plan (2009-2014) and the Taita Taveta District Development Plan (1997-2004) through a collaborative effort by the National and the County Government to mitigate pollution impacts is also recommended.

To mitigate the impacts of sea level rise and shoreline erosion, the development of structures at the shore are subjected to EIA before construction. This includes the enforcement of the 60 m setback rule for any new structures, including seawalls when licensing such structures. Kenya has developed a shoreline management strategy, which needs support and implementation.

Controlling species invasions has some challenges associated with inadequate border controls and quarantine safeguards, inadequate trans-boundary and regional mechanisms for joint action, inadequate research and monitoring for information on the magnitude of invasion and impacts, and high costs of mitigating impacts. However, the establishment of monitoring programs in vulnerable areas such as ports, rivers, fish landing sites to detect biological invasion and subsequent environmental changes in the receptor communities is important. The development of regional and international cooperation programs and capacity building on the monitoring and control of invasive species is key where trans-boundary invasions may occur.

Kenya policy towards GHG emissions reduction include increased geothermal electricity generation, switching movement of freight from road to rail in the transport sector, reforestation in the forestry sector, and agroforestry in the agricultural sector. Interventions have been made to sequester carbon through carbon offsetting using the blue carbon ecosystems model e.g Mikoko pamoja project in Gazi, south coast of Kenya.

The Kenya Adaptation to Climate Change in the Arid Lands (KACCAL) project represents an effort of the World Bank and UNDP to assist the Government of Kenya to meet its climate adaptation objectives. KACCAL is designed to help embed climate change perspectives in the activities carried out by the Arid Lands Resource Management Project (ALRMP). The ClimDev-Africa Special Fund (Administered by the African Development Bank) has provisionally awarded a project to Pilot a sustainable integrated sanitary solid waste disposal landfill to mitigate climate change.

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Chapter 9 : Governance of the Coastal and Marine Environment

The coastal and marine environment in Kenya is governed by a number of legal, policy and institutional frameworks. These include the Constitution of Kenya 2010, Environmental Management and Co-ordination (EMCA), Cap 387 as well as several other sector-based laws. In addition, Kenya is signatory to various international and regional instruments related to the coastal and marine environment. This chapter reviews the progress made in development and implementation of legal, institutional and policy frameworks for the coastal and marine environment. Management and policy recommendations to improve governance of the coastal and marine environment have also been made.

9.1 Policy, legal and regulatory framework

9.1.1 The Constitution of Kenya, 2010

The Promulgation of the Constitution of Kenya, 2010 brought with it many gains for the environment sector in the country. Unlike in the old constitution where environmental provisions were superficial the current constitution has made specific and express provisions on the environment and the right of Kenyans to a clean and healthy environment. For the first time, land and environment is directly linked in the new constitution. Guiding principles on the governance of land and the environment have been provided. Further, the constitution obliges the state to ensure sustainable exploitation, management and conservation of the environment and its natural resources. The principle of sustainable development has been entrenched in the Constitution (article 10 2(d)) as one of the national values and principles of governance. Article 60 (1) (e) provides for sound conservation and protection of ecologically sensitive areas. On forest cover, the State is obligated to work to achieve and maintain a tree cover of at least 10% of the land area of Kenya.

A number of measures are outlined in Article 69 as a way of realising State obligations to the environment. These are encouraging public participation in the management, protection and conservation of the environment; protect genetic resources and biological diversity; establish systems of environmental impact assessment, environmental audit and monitoring of the environment; eliminate processes and activities that are likely to endanger the environment; and utilise the environment and natural resources for the benefit of the people of Kenya. Moreover, the constitution created the national and county governments and each given mandates on the environment and natural resources. Devolution of environmental management to the lowest level of government is bound to improve management of the environment including the coastal and marine resources. On the country's regional obligation on environment Art 2 (5) and (6) provides that any international law that the country signs automatically becomes part of the Kenyan law.

The strengthened provisions on the environment and land in the constitution 2010 have enhanced the profile and value of the country. The status of the environment including the coastal environment is bound to improve tremendously if the provisions are fully enforced.

9.1.2 Environmental legislation

Environmental Management and Co-ordination Act Cap 387: During the writing of the first State of Coast report, the Environmental Management and Co-ordination Act (No. 8 of 1999) was relatively new and not many of the institutions and regulations created under this act were tested. The act has been amended by the Environmental Management and Co-ordination (Amendment) Act, 2015. The amended Act has redefined the following terms in reference to the coastal zone:

- Coastal zone to mean the geomorphologic area where the land interacts with the sea comprising terrestrial and marine areas made up of biotic and abiotic components or systems coexisting and interacting with each other and with socio-economic activities.
- The exclusive economic zone (EEZ) has been redefined according to the United Nations Convention on the Law of the Sea.
- Wetlands to include areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres
- Indigenous knowledge means any traditional knowledge of sources, components, capabilities, practices and uses of, and processes of preparation, use and storage of plant and animal species and their genetic resources.

The Amended EMCA 2015 has also redefined natural resources by adopting the meaning provided in Article 260 of the Constitution of Kenya 2010. On institutional framework for management of the environment the amended EMCA 2015 provides for County Environment Committees and roles of the County Governments in implementation of EMCA have defined. Such roles include, for example, preparation of County Environment Action Plan, which used to be District Environment Action Plans in EMCA 1999 among others. Full and effective implementation of the changes in the amended EMCA is anticipated to result in improved conservation and management of the management including the coastal and marine resources. A summary of the relevant EMCA regulations that have implications on coastal resources is presented in Table 9.1.

Table 9.1 Relevant EMCA regulations and the implications on coastal resources

Regulation	Article	Implications on coastal resources
Guidelines on EMCA (water quality and effluent monitoring), 2006	EMCA (Section 50)	Water quality is considered in terms of both public health and aesthetic value. Schedule 6 and 7 provides guidelines of discharging waste water into public sewers and public water. These are relevant to water quality in coastal waters used for

		bathing and recreation
Air quality regulations, 2014	EMCA (Section 78)	Sets out ambient air quality standards requisite to protect human health and allow adequate margin of safety. NEMA may declare an area a controlled area for the purpose of controlling emissions from the controlled facilities under Schedule 14. This is relevant to the manufacturing and processing installations in various places in the coastal region.
Environmental (Impact, Audit and Strategic Assessment) regulations 2009	EMCA (Section 43(c))	Three items in the regulation i.e. Strategic Environment Assessment, Strategic Environment Plan and Environmentally Sensitive area looked at in totality, provides guidance on conservation of the coastal habitats including mangroves, dunes, seagrass beds and coral reef ecosystems.
Environmental management and coordination (waste management) regulations, 2006		Regulates all categories of waste including industrial and hazardous ones, in terms of segregation, transportation, treatment and disposal. These wastes have the potential to alter or destroy various types of coastal ecosystems
Environmental management and coordination (controlled substances) regulations, 2007	EMCA (Section 39(c))	The controlled substances are grouped in three categories and are essentially ozone depleting substances. The regulations prescribe storage, distribution, transportation or handling. Ozone depleting substances have the potential according to IPCC to cause adverse impacts on weather and influence climate change. The changes may include increase of CO ₂ , SST and coral bleaching.
Environmental management and coordination (conservation of biological diversity and resources, access to genetic resources and benefit sharing) regulations, 2006	EMCA (Section 36(a))	Introduction of exotic species has a bearing on management of ship ballast water. Continued exploitation of some indigenous wood species for wood carving may threaten these species. The inventory of threatened, endangered and rare species will enable the country to take stock of various organisms such as sea turtles, hump-back whales, dolphins and dugongs as well as the Tana River Mangabey and the Red Colobus. Conservation trust funds under the regulations will also strengthen conservation measures.
Environmental management and coordination (wetlands, river banks, lake shores and sea shores management) regulations, 2006	EMCA (Section 29(b))	These regulation is relevant to management of beaches and the adjoining coastal lagoons, prominent coastal lakes such as Lake Jipe and Lake Kenyatta and management of various rivers such as Tana, Sabaki, Ramisi etc. These systems are experiencing impacts in various levels as mentioned elsewhere in this report.

9.1.3 Sector-based laws

Fisheries Management and Development Act 2016.

This Act provides for the conservation, management and development of fisheries and other aquatic resources to enhance the livelihood of communities dependent on fishing and to establish the Kenya Fisheries Services. The objective of this Act is to protect, manage, use and develop the aquatic resources in a manner which is consistent with ecologically sustainable development, to uplift the living standards of the fishing communities and to introduce fishing to traditionally non-fishing communities and to enhance food security.

The Land Act 2012

This Act repealed the Land Acquisition Act cap 295. The new Act mandates the National Land Commission to take appropriate action to maintain public land that has endangered or endemic species of flora and fauna, critical habitats or protected areas and to identify ecologically sensitive areas that are within public lands. The Act requires the Commission to undertake an inventory of all land based natural resources, and reserve public land for any purposes, including environmental protection and conservation. The Act further empowers the Commission to make rules and regulations for the sustainable conservation of land based natural resources such as:

- Incentives for communities and individuals to invest in income generating natural resource conservation programmes;
- Measures to facilitate the access, use and co-management of forests, water and other resources by communities who have customary rights to these resources;
- Procedures for the registration of natural resources in an appropriate register;
- Procedures on the involvement of stakeholders in the management and utilization of land based natural resources; and
- Measures to ensure benefit sharing to the affected communities.

Land Control Act

The main objective of the Act is to provide for the control of transactions in agricultural land. Therefore, dealings in agricultural land are controlled in the sense that the transacting parties must obtain consent from the relevant land control board that has jurisdiction within the area in which the land is located. Controlled dealings include: sale, transfer, lease, mortgage, exchange, partition, sub-division or other disposal of agricultural land. The purpose of controlling dealings in agricultural land is to ensure: that the productivity of the land in question is assured; that dealings in agricultural land are fair and beneficial to both parties; and that the parties are able to farm well and develop agricultural land adequately.

The Land Control Act is an important legislation for the Coastal Zone. A large part of land in the coastal zone of Kenya is agricultural land. There is also a growing practice of converting existing agricultural land into commercial properties through sub-division and creation of industries.

Similarly, land dealings that result in the unsustainable use of agricultural land will impact negatively on environmental integrity hence the importance of this Act.

Physical Planning Act of 1996

The Act provides for the preparation and implementation of physical development plans. Sections (4) and (5) of the Act provides that development should be in harmony with environmental considerations. The Act further provides that proper planning of land use in the coastal zone is important and critical in ensuring various economic and environmental interests are accommodated in the use of land. The Director of Physical Planning is empowered to prepare regional physical development plans and local physical development plans. Development of land within a certain area must be done in compliance with the physical development plan for that area and with the development permission of the local authority in charge of that area. Such powers are currently exercised by the respective county governments.

The County Governments Act 2012

The Constitution of Kenya 2010 article 6 defines the devolution of territory of Kenya into counties. The State Department of Devolution which falls under the Ministry of Devolution and Planning is responsible for overall coordination of implementation of devolution policies. The County Governments Act 2012 which repealed the Local Government Act elaborates on the county governments' powers, functions and responsibilities. The Act clarifies how the County Governments shall perform their Constitutional mandate, which includes implementation of specific Government policies on land resources conservation. Unlike in the previous Act, the new Act requires that there shall be a five year integrated development plan for each County and clarifies that cooperation in planning between the National and County Governments shall be done within the context of the Inter-Governmental Relations Act, 2012. Each of the 6 counties in the Coastal Region have developed respective 5 year County Integrated Development Plans (CIDP) for 2013 – 2017.

Tourism Act 2011

The tourism sector is governed by the Tourism Act 2011. This Act repealed Kenya Tourism Development Corporation Act (Cap 382). The Act provides for 'the development, management, marketing and regulation of sustainable tourism and tourism-related activities and services.' Sustainable tourism is imperative given the heavy socio-economic reliance of the coastal zone on tourism.

Section 3 of the Act requires the Cabinet Secretary responsible for tourism to formulate and publish in the Gazette a national tourism strategy once every five years. Participation of the public in the formulation of the strategy is a key requirement. To safeguard the environment from tourism

activities the Act prohibits the discharge of effluent into the environment including wildlife habitats and ecosystems.

Forest Conservation and Management Act, 2016

The Act gives effect to article 69 of the Constitution, to provide for the development and sustainable management, including conservation and rational utilization of all forest resources for the socioeconomic development of the country. It requires the development of a National Forest Policy and a Strategy. Both the national and county governments have roles on forest management. Forests between low and high water are categorized as public forests wherein lies Mangrove forests. Any forest may duly be declared a nature reserve. Provisions of section 42 of the Act relate to Conservation of the indigenous forests. Protection of tree species is covered in the Act. Permission for quarrying in forest land is addressed.

Maritime Zone Act 2012

The Act consolidates the law relating to the territorial waters and the continental shelf of Kenya. It provides for the establishment and delimitation of the exclusive economic zone of Kenya. It also provides for the exploration and exploitation and conservation and management of the resources of the maritime zones of Kenya.

Kenya Ports Authority Act, 2014

The Act creates the Kenya Ports Authority (KPA). The Authority is responsible for all the maritime port infrastructure in Kenya.

Kenya Maritime Authority Act, 2012

The Act establishes the Kenya Maritime Authority as a body with responsibility to monitor, regulate and coordinate activities in the maritime industry, and for all other matters connected therewith and incidental thereto. Functions of the agency include advice government on legislative and other measures necessary for the implementation of relevant international conventions, treaties, and agreements to which Kenya is a party.

Agricultural and Food Authority Act, 2013

The Act established Agriculture and Food Authority. The Act provides guidelines for proper development of land for agriculture and fishing purposes. The guidelines would be implemented by respective county governments. The Act emphasizes on good husbandry and requires regulating salination, acidification and saltification of soil.

Mining Act, 2016

The Act has no guidelines on prospecting and sustainable mining. The Act is also silent on

protected areas, RAMSAR sites and ecologically sensitive areas. Therefore it must be assumed that any application for mining and prospecting would then be subjected to the due process under EMCA, the National Land Commission Act, 2012, the Community Land Act, 2016 and the Land Act, 2012. This would also ensure adequate public participation.

9.2 Regional and international instruments

The Constitution of Kenya 2010 Art 2 (5) and (6) recognises international conventions to be part of Kenyan laws once the same are ratified/signed. This is an important development since the last State of Coast Report in 2009. The table below provides a summary of key international agreements and conventions that are considered most important for conservation of coastal and marine resources in Kenya.

Table 9.2 International legal instruments relevant to management of coastal and marine resources

Convention/Agreement	Focus Area
Nairobi Convention	development and protection of the coastal and marine resources in the Western Indian Ocean (WIO) region
Ramsar Convention	conservation and wise use of wetlands and their resources
Convention on Biological Diversity	Conservation, sustainable use and sharing of benefits arising from the use of biodiversity
The Convention on Migratory Species (CMS)	Conservation of terrestrial, marine and avian migratory species
Convention on International Trade in Endangered Species of Wild Fauna and Flora(CITES)	Regulation of trade in species which are endangered or which may become endangered if their exploitation is not controlled
United Nations Framework Convention on Climate Change (UNFCCC 1992)	Climate Change mitigation and adaptation
United Nations Convention on the Law of the Sea (UNCLOS, 1982)	Provides the legal framework within which all activities in the oceans and seas must be carried out
African Convention on the Conservation of Nature and Natural Resources, 1968 (as revised in 2003).	Natural Resource Conservation
International Convention on Oil Pollution Preparedness, Response and Cooperation (1990)	Oil spills/pollution at Sea

9.3 Institutional frameworks

Various national institutions have been established to support governance of the coastal and marine environment as well as the resources within (Table 9.3).

Table 9.3 National institutions by sector and their functions in relation to the marine and coastal environment and resources

Sector	Institution	Function	Status
Environment	National Environment Complaints Committee	Receive and investigate environmental complaints and to undertake public interest litigation on behalf of citizens on environmental matters	Implemented
	National Environment Management Authority	General supervision and coordination on all matters relating to the environment, and to be the principal instrument of government in the implementation of policies relating to the environment Formulation and implementation of the Coastal Zone Management Plan management and conservation of rivers, lakes and other wetlands	Exists
	County Environment Committee	Oversee the proper management of the environment within their respective county domains	Exists
Fisheries	Kenya Fisheries Service (KeFS)	Responsible for the conservation, management and development of Kenya's fisheries resources	Functioning
	Kenya Marine and Fisheries Research Institute	KFS in consultation with the KMFRI, approves and coordinate research activities in relation to matters falling within the scope of the Fisheries Management Act.	Functioning
Land	National Land Commission (NLC)	Management of land in the entire country including the coastal and marine environment	Functioning
	County Land Management Board	Give consent prior to registering an instrument affecting a transaction of land	Functioning
	The Director of Physical Planning	Prepare regional physical development plans and local physical development plans	Established
	County Planning	County Integrated Development Plans	Developed for all the 6 counties
Tourism	Cabinet Secretary	Formulate and publish in the Gazette a national tourism strategy once every five years	Established

Sector	Institution	Function	Status
	Tourism Regulatory Authority	Regulate the tourism sector regulate tourism activities and services countrywide, in accordance with the national tourism strategy	Unknown
	Tourism Fund	Finance the development of tourism products and services	Unknown
	Tourism Research Institute	Collect and analyze information, for the sector and other clients in the private and public sectors	Unknown
	Kenya Association of Hoteliers and Caterers (KAHC)	Umbrella organization bringing together hotels, lodges, restaurants, membership clubs and prominent airline caterers whose common theme is to render services in the hospitality industry	Functioning
	Kenya Association of Tour Operators (KATO),	represents the interests of a number of tour operators in Kenya offering air safaris, incentive travel group safaris, custom safaris for individual travellers, camping safaris (luxury & budget), Indian Ocean & Coast holidays, cultural & community Safaris, Golf Safaris, Agro Safaris, special interest safaris (e.g. mountaineering, deep sea fishing, horse riding)	Functioning
	Mombasa and Coast Tours Association (MCTA)	Promotes inbound and domestic <i>tourism</i> to the Kenya <i>coast</i> region,	Functioning
	Tourism Finance Corporation	Provide financial assistance to investors or entrepreneurs in the tourism sector including small and medium and community based enterprises for development, expansion and maintenance of tourism activities and services;	Unknown
Forest	Kenya Forest Service	Conserve, protect and manage all public forests in accordance with the provisions of the Forest Act, 2016	Functioning
	Forest Conservation Committee	Make recommendations to the KFS Board and to the relevant county government in relation to the conservation and utilisation of forests;	Unknown
	Forest Conservation and Management Trust Fund	Nurture, promote and support innovations and best practices in forest conservation and development	Unknown
	Community Forest Association	Group of local persons who have registered as an association or other organization established to engage in forest management and conservation	Unknown

Sector	Institution	Function	Status
	National Museums of Kenya	Conservation of Kaya forests as part of monuments	Functioning
Maritime	Kenya Maritime Authority	Monitor, regulate and coordinate activities in the maritime industry, and for all other matters connected therewith and incidental thereto	Functioning
	Kenya Marine and Fisheries Research Institute	Conduct research on critical habitats including mangroves, coral reef ecosystems, seagrass beds and pelagic and deep water systems and general fish ecology	Functioning
	Kenya Ports Authority	Management of sea port infrastructure and cleaning the environment therein	Functioning
Agriculture	Agriculture and Food Authority	Guidelines for proper development of land for agriculture and fishing purposes	Unknown
Mining	Mineral Rights Board	Areas where mining operations may be excluded and restricted	Unknown
	Cabinet Secretary	Maintain a database of geoscience and information is kept and maintained; and is made available to the public on request.	Unknown
Wildlife	Kenya Wildlife Service	Conserve and manage national parks, wildlife conservation areas, and sanctuaries under its jurisdiction; prepare and implement national park management plans; set up a county wildlife conservation committee in respect of each county;	Functioning

9.4 Governance issues, challenges and response strategies

Despite the improvements made in governance of the coastal zone, issues and challenges still exist which require urgent attention in order to improve governance of the coastal zone and associated resources. In respect to capacity many government agencies continue to face capacity constraints in the form of inadequate financial and technical resources. Low funding affects the capacity of the institutions to create and sustain technical and other capacities necessary for carrying out their mandates. There is need to boost the level of resource allocations to agencies as well as invest in personal recruitment and training to address this issues.

Public awareness on the importance of the coastal and marine environment and the need to take an active role in safeguarding the environment still remains low. The government and other non-state actors need to take advantage in the improved legal frameworks providing for community participation in environmental management to enhance community stewardship in resource

management. Efforts to fully empower community groups including BMUs; CFAs; WRUAs among others need to be enhanced.

Additionally, effective enforcement of environmental laws and regulations remains a challenge despite the much improved legal and policy environment for the conservation of the coastal and marine environment. This is mainly being occasioned by limited staff and financial resources. As a result compliance with the regulatory requirements by the regulated community in various sectors continues to be wanting. This can be addressed through improved resource allocations and employment of adequate officers.

In respect to policy development and management planning a lot of progress has been made. However implementation of the policies and resource management plans and strategies remains a challenge owing to inadequacy of financial resources for their implementation. As the government makes improvement in policy development and planning there is need to also prioritise implementation of the policies and plans to address the issues on the ground.

All the coastal counties (Mombasa, Kwale, Taita Taveta, Lamu, Kilifi, Tana River) have developed respective county Integrated development plans (CIDP) for 2013-2017. This presents an opportunity to review the implementation and effectiveness. It is not clear at what stage succeeding plans are. The application of ICZM also continues to face issues and challenges in the region despite the progress made to date. The major issues include:

- Conflicting and overlapping legal and policy frameworks;
- Limited sharing of information amongst stakeholders;
- Low level of awareness and understanding of ICZM as a tool for coastal zone management;
- Poor attitude by sectoral agencies towards integration.

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Chapter 10 : Emerging Issues

Emerging issues can be defined as positive or negative issues which are not yet generally recognized but may have significant impact on human and/or ecosystem health in the 21st Century' (Munn et al 1999). They are associated with developments that may cause changes in trends of human activities and the environment or may result from lack of adequate policy, action or leadership on an existing issue, which may become more significant or more urgent in the future (Munn et al. 1999). The emerging issues in the Kenya coast are reported the section below.

10.1 The Blue Economy

Blue Economy is marine-based economic developments which lead to improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities (UNEP 2013). It involves redefinition of oceans as “development spaces” that if subjected to adequate spatial planning can integrate “conservation, sustainable use, oil and mineral wealth extraction, bio-prospecting, sustainable energy production and marine transport” in order to alleviate poverty, generate employment, and promote equity.

The littoral states representing the Indian Ocean Rim Association (IORA) countries are considering harnessing blue economy for economic and social development (Mohanty et al., 2015). The rapid population growth in Kenya especially in the coastal region requires the development of the blue economy sector to optimize the use of marine resources in the development process while creating employment opportunities for improved economy growth and livelihoods of the coastal communities. Blue economy can offer Kenya a great opportunity for sustainable, clean, equitable blue growth in both traditional and emerging sectors as she strives to achieve her Vision 2030 and the recently established UN Sustainable Development Goals (SDGs). The main sectors for development in the blue economy include shipping and port services, fisheries, tourism, aquaculture, energy, biotechnology and seabed exploration and mining and desalination of sea water to supply fresh water.

The key issues that are likely to emerge as the blue economy develops in Kenya include rapid population expansion, over-exploitation and degradation of coastal and marine resources and marine pollution. In preparation to the potential environmental impacts of Blue economy, Kenya is developing the blue economy strategy, sensitivity mapping review and upgrade, strategic environmental assessment, coordinated monitoring and surveillance, and development of coast guard services.

10.2 Major development projects

Whereas a large potential of Kenyan blue economy is believed to have remained untapped or unexplored, Kenya recognizes that mega infrastructures (a key economic pillar in Kenya's Vision 2030) may play an important role in accelerating economic development in the coast region. The country is therefore investing heavily in infrastructure projects that, collectively, will promote blue economy development. These projects are equally significant given their expected impacts in altering water flow regimes to coastal areas, increase in air and water pollutions and increased pressure on coastal resources among other impacts.

The mega infrastructure developments include the LAPSSET project, offshore Oil and Natural Gas exploration and production, the proposed coal fired power generation project in Lamu, proposed wind power generation at Mpeketoni, development of resort cities and large scale agriculture.

10.2.1 The Lamu Port and South Sudan Ethiopia Transport

The Lamu Port and South Sudan Ethiopia Transport (LAPSSET) corridor is one of Kenya Vision 2030's flagship infrastructure development projects. LAPSSET will develop a new transport corridor from the new port of Lamu through to Ethiopia and South Sudan. Once completed, the project will open up the Northern parts of Kenya and facilitate transportation and mining exploration activity in the region. The development will also include a crude oil pipeline from Hoima (Uganda) to Lamu (Kenya) with branches to South Sudan. This pipeline is expected to ease the current reliance on Mombasa Port for refined products to the North of the country and will thus reduce the cost of refined products across the region.

The Port of Lamu is a second seaport in Kenya which is being developed to serve the expanding import and export cargo base. The Port will reduce over-reliance on Mombasa Port and play a significant role in trans-shipment to the eastern and Southern Africa region, thus creating a new hub in the Kenyan economy. The port is expected to handling over 24 million tonnes of cargo through the 32 new berths that are expected to be built by 2030. The development of Lamu Port will also include the construction of port associated infrastructure such as causeway, port access road, railway yard, water and electricity supply, port building and other port related services. The environmental impacts likely to result from the project include clearing of mangroves to pave way for berths and other infrastructure construction; population increase resulting from employment and business opportunities by the project; pollution increase; and increased pressure on coastal resources among other impacts. There is need to put adequate measures to mitigate these potential impacts on the environment.

10.2.2 Oil and gas exploration

Explorations of oil and gas by Australia's Pancontinental Oil and Gas have discovered reserves about 100 km off the Mombasa coastline, with high prospects of finding further commercial quantities in Lamu Basin area. It has been estimated that the quantity of oil already discovered in Kenya (off Mombasa and Lokichar Basin in Turkana County) will contribute KES 880 billion (USD 10 billion) to the economy. Moreover, the potential of the offshore oil & gas sector is not fully exploited with many belts having remained unexplored. However, the development of new technologies for exploration and mining provides hope for more offshore oil discoveries. Advancing technologies are also expected to open new frontiers of marine resource development especially in the field of bio-prospecting and mining of seabed mineral resources. These will together lead to increased demand for ports and shipping services which is expected to flourish as seaborne trade grows in the future.

Offshore oil exploitation is prone to oil spillage and petroleum pollution which is normally associated with massive death of marine organisms and disruption of the structure and function of ecosystems. As investment in oil and gas exploration in the sea increases there is need for this to go hand in hand with enhancement of the level of preparedness by the government and stakeholders to respond to potential oil spill incidents through capacity building.

10.2.3 Mombasa Port Improvement Project

Mombasa Port is the largest and busiest port on the East Coast of Africa. A project to increase the Port's efficiency was launched in June 2014 to handle an approximate 10% annual increase in cargo traffic. The project involved construction of additional berths, container terminals, and dredging of the channel. This project has already resulted in significant reductions in the number of days it takes for cargo clearance to only three (3) days from previous ten (10) days. The benefits of such efficient operations at the Port to the promotion of blue economy cannot be underscored enough and it is clear that further improvements will secure Kenya's places as the region's centre for the trade and transit.

10.2.4 Large scale water supply projects

A number of large-scale water supply projects mainly involving construction of large scale water dams have been proposed for the coast region. These include the proposed Mtonga High Grand Falls Dam; Thwake Dam in Sabaki River; and Mwache dam in Mombasa. The High grant falls dam will cover 165 km² dam and is aimed at promoting irrigation and supply clean water in Eastern province and Tana River regions while Thwake Dam aims at harnessing the water flow from Athi River and Thwake Rivers to provide water supply for domestic, livestock, irrigation, hydropower and even industrial activities in Makueni County. The High Grand Falls Dam will also be used to generate between 500MW and 700MW of electricity. Mwache dam is aimed at supplying water to

Kwale and Mombasa Counties. It is a Vision 2030 priority project and is included in the Water Supply Master Plan for Mombasa.

The three large-scale water supply dams are likely to intercept huge amounts of sediments from their catchments and alter flow regime of Tana River; Sabaki River and Mwache River respectively. This will have significant ecological impacts downstream particularly in the coastal zones. Construction and operationalisation of the dams should mainstream measures to mitigate potential environmental and social impacts.

10.2.5 Resort cities (Diani, Kilifi and Lamu Resort Cities)

The proposed resort cities' flagship project aims to develop resort cities in Diani, Kilifi and Lamu in order to boost the economy by making the coastal region a preferred tourist destination through optimizing the rich tourism potential and by attracting economic activities. The resort cities are expected to host five-star hotel facilities, golf-courses, leisure parks theatres and amusement parks. The potential environmental impacts are population increase due to job and business opportunities, pollution, increase freshwater consumption and housing demand among others.

10.2.6 Lamu Coal Power and Wind Power Stations

The proposed Lamu Coal Power Station will be developed on 975.4 acres of land and will feature a 210 meter tall smoke stack with a potential of producing 1,050 MW and will create between 1000-2000 jobs. The power generated will be transmitted to Nairobi via a new 520 kilometres, 400 kilovolt electricity transmission line. The proposed Lamu Wind Power Station will be located in Baharini Village, near the town of Mpeketoni and will produce 90 MW wind-power.

10.3 Large scale agriculture projects

Agriculture is the backbone of Kenya's economy and central to the Government of Kenya's development strategy. More than 75% of Kenyans make some part of their living from agriculture predominantly from small-scale farming mainly in the high-potential areas which accounts for 75% of the total agricultural output and 70% of marketed agricultural produce.

The key large scale agriculture projects are the sugar farming project in Kwale by Kwale International Sugar Company Limited (KISCOL); and the Kulalu Galana Food security project. The KISCOL project is ongoing while the Galana Kulalu irrigation project is in the pilot phase. While it is possible that these projects will spur economic development in the coast through job creation and revenue generation the projects are also likely to have significantly impact on the marine environment through release of excess nutrient from fertilizer utilization, industrial discharges (water pollution), increased sediment discharge and air pollution from the industries.

Adequate environmental management measures need to be put in place to manage the potential negative impacts.

10.4 Mineral prospecting

Prospecting for minerals including titanium, zircon and ilmenite in larger parts of Kwale and Kilifi counties for future exploitation is going on. When fully developed, exploitation of these minerals will likely cause displacement of populations, water issues, pollution, loss of habitats and degradation of sensitive habitats, and loss agricultural land. Mineral and oil exploration in the seabed EEZ is already going on with potential impacts to the marine environment.

10.5 Maritime safety and security

Maritime piracy, characterized by the rise in maritime insecurity off the coast of Somalia between 2008 and 2011 and extended to the Kenyan waters, has negatively impacted on the country's maritime and tourism industry. Illegal, Unregulated and Unreported (IUU) fishing has also been observed to have several negative effects on Kenya. It deprives the government of badly needed license fees, tariffs, taxes, and other revenues. IUU fishing in fact represents a further erosion of state authority in the maritime domain. In addition, the same factors that lead to escalation of IUU fishing are also allow other transnational maritime threats to develop. These threats include international trafficking in drugs, arms, and people. While oceangoing merchant vessels are an important means for transporting these illicit goods, smaller fishing boats and dhows that move among the region and between small and large ports play a very big role (Ghassan and William, 2013). These smaller fishing vessels may also play a role in moving Al-Shabaab terrorists to and from Somalia, escalating insecurity not only in Kenya but in the WIO region as a whole.

To curb IUU fishing and other emerging maritime security threats, Kenya has already acquired a deep sea research vessel for use by KMFRI, the MV. Mtafiti. The Kenya Fisheries Service (KeFS) is also procuring a state-of-the-art offshore patrol vessel to manage most of these threats, and several other interventions are in place or in the pipeline. These interventions will also ensure a constant presence in all the Kenyan ocean waters, and act as deterrence.

However, piracy has been curtailed over the last few years by international naval forces patrols, armed security on board of merchant ships, and avoidance of the high-risk area. Kenya has also commissioned the first Information-Sharing Centres (ISCs) as recommended by the Djibouti Code of Conduct concerning the repression of piracy and armed robbery against ships in the Western Indian Ocean and the Gulf of Aden. The centre has been established to facilitate practical measures for the suppression of piracy and armed robbery against ships, by ensuring a coordinated, timely and effective flow of information. Kenya has additionally established Regional Maritime Rescue

Coordination Centre (MRCC). With the improved maritime security, Kenya expects increased maritime activities at the port of Mombasa which will in turn expand regional trade in Kenya, Uganda, Burundi and Congo.

10.6 Climate change

Climate change is a growing threat to the growth and sustainability of marine resources. Climate change has profound implications for marine ecosystems and the economic and social systems that depend on them (Hughes et al., 2006). Some of the impacts of climate change observed around the world include sea water warming, increasing floods and droughts, erratic and extreme weather, rising sea level, coastal erosion, saltwater intrusion, ocean acidification, the upsurge of invasive species, coral bleaching, distinct seasonal changes and coastal erosion.

A recent assessment of climate change shows that low-income countries will be the most affected by climate change over the next century with warmer days and nights, more unpredictable rains, and longer heat waves. The extended periods of drought in the coastal regions are eroding livelihood opportunities and community resilience to climate change. As a result, these communities are resorting to undesirable coping strategies that are harming the environment and impacting negatively on household nutritional status, further undermining long-term food security (IPCC, 2007).

It has been reported that global warming will negatively impact on marine biodiversity including planktons, corals, and fisheries communities. It will also cause fundamental changes in the broader marine environment i.e. in water chemistry, food availability, and prevalence of diseases. Coral bleaching from rising seawaters temperatures and ocean acidification due to increases in atmospheric carbon dioxide are some of the expected impacts along the Kenyan coast. Coral reefs mortalities may lead to loss of habitats (and associated biodiversity) which are potential sites for fisheries and tourism activities. As threats to marine environments continue to grow with the increase in human population and industrialization, it is critical to expand the scope and effectiveness of marine management efforts. Some of the responses to emerging issues include:

10.7 Seascape approach to conservation

Seascapes typically include government-authorized protected areas that address special management needs, and provide an opportunity for government agencies to coordinate their efforts voluntarily to secure more effective regional management. The seascape approach provides a comprehensive governance framework to unite and motivate practitioners across biologically and socially important areas to a collectively strategy to enhance overall conservation success (Atkinson et al., 2011). The approach aims to build coalitions among governments, corporations, and civil

society to improve ocean governance by highlights the importance of achieving effective governance across sectors and at all levels, from local to regional. This approach adds value by facilitating repetition of successful projects across a wider area; allowing economies of scale; tackling large-scale threats; enabling more efficient designs of MPA networks; taking account of connectivity issues and migratory species; filling the ‘missing link’ between site-based projects and national/international initiatives.

10.8 Network of protected areas

Network of protected areas has a number of advantages including the ability to protect whole ecosystems and interdependent habitats, so that biologically connected ecosystems can be included within the same management area. These networks can be designed for endangered species protection, fishery enhancement, or to regulate user conflicts and resource extraction. The network of protected areas involve the traditional marine protected areas managed by KWS and newly created co-managed marine areas. The co-managed marine areas are also referred to as Community conservation areas (CCAs). These have been described earlier in the report in Table 3.9. Unlike the traditional marine protected areas which have been established through the wildlife conservation act the co-managed marine areas have been established through the BMU Regulations 2007 by coastal fishing communities in collaboration with the State Department of Fisheries and other stakeholders. The effectiveness of co-managed areas has however not been fully demonstrated as the benefits are not yet as clear as those in traditional marine protected areas managed by KWS (Mwaura and Murage 2013).

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Chapter 11 : General Conclusions and Recommendations

Introduction

The first state of coast report published in 2009 formed the baseline for the development of the ICZM Action plan. This report provides an update of the report and includes new data and information on the coastal environment, as well as demographic and economic developments that have occurred since. The current report provides new information based on a consultative process of data collation and synthesis that was undertaken with resource managers and experts. The report provides new information that was not previously covered on land and water resources in addition to an expanded section detailing the overarching emerging environmental issues. The Driving-Pressures-State-Impacts-Response (DPSIR) framework was used to identify and prioritize issues as well as the responses to mitigate anthropogenic impacts and inform the preparation of the report.

11.1 The coastal environment

Drivers of change in the bio-physical environment of the Kenya coast include an increasing human population, economic developments and climate change. The global effects of industrialization have resulted in an increase in greenhouse gas (GHGs) emission to the atmosphere causing the much-debated global warming, which has continued to accelerate the melting of glaciers and thermal expansion of seawater causing sea level rise estimated to be approximately 3 mmyr⁻¹ (IPCC, 2013). The downstream impacts of land and freshwater resources exploitation, particularly in agriculture, require an integrated approach to the management of catchment areas to sustain human settlement adjacent to flood plains, deltas, and estuaries.

Furthermore, shoreline erosion has increased and it presents a great risk to shoreline developments and biodiversity. Kenya has developed a shoreline management strategy which supports the implementation and enforcement of the 60m set-backline rule besides other measures to safeguard the shoreline. Implementation of the strategy need to be prioritised to guide shoreline investments and biodiversity conservation. Creating a balance between development and environmental interests in the coast requires pursuance of an integrated response and management of issues. More efforts need to be put in implementation of legislations and policies already in place to support the integrated management approach. These include the newly enacted ICZM policy, the Environmental Management and Coordination Act CAP 387 and other sectoral policies, strategies and management plans. The full implementation of these instruments and continuous evaluation of their success is recommended.

11.2 Coastal ecosystems and biodiversity

Human development has increasingly impacted on Kenya's coastal ecosystems leading to a loss of biodiversity and decline of ecological services and functioning. Since most of the coastal urban centres are located close to important ecosystems such as estuaries, mangrove swamps and coral lagoons, the high population density exerts excessive pressure that threaten the sustainability of the ecosystems. Impacts include over-exploitation of nearshore fisheries, degradation of mangrove areas, shorelines change, cultural erosion and resource-use conflicts.

The most impacted ecosystems are the terrestrial and coastal forests, wetlands, and coral reefs. Under the Wildlife Act, a number of forest reserves have been established including the Eastern Tsavo, Arabuko-sokoke forest reserve, in addition to a chain of marine protected areas, which form natural biosphere reserves. Regulations under the Kenya Forest Service help to control harvesting of timber from coastal and marine forests. In addition, there have been efforts to establish community forest and marine protected areas that go a long way to preserving natural habitats. The community conservations areas need legal recognition and support so that the efforts and benefits of conservation can be realised within the coastal communities.

Under the devolved system of government, the management of most of the terrestrial ecosystems now lies with the county governments, which are required to include resource conservation and management in their development plans. Furthermore, community based management of local natural resources is also being encouraged in the new constitution. There has been remarkable increase in the number of community conservation groups in the coast region during the last 7 years. In addition, regional networks for transboundary resources such as fisheries, coral reefs should be established. Recommended management actions include preparation of accurate resource maps to identify and demarcate zones for development, utilization, protection, rehabilitation of forest resources, community training programs on rehabilitation, establishment of permanent sample plots (PSP) for research and management planning, and inclusion of forests in tourism development plans.

11.3 Species of conservation concern

Interventions that have contributed to sustaining species of conservation concern include protected areas and reserves within which these iconic species are continuously being monitored and protected. Species-specific conservation and management strategies have been developed for sea turtles and terrestrial mammals touching on education, public awareness, communication, targeted research and monitoring to address threats. The recommended actions to mitigate pressures facing species of conservation concern include strengthening enforcement of existing regulatory frameworks and legislation (EMCA, Wildlife Act, Fisheries Acts); and mainstreaming the conservation of species of concern into County governments' development agenda; and provide

technical support in the formulation and implementation of collaborative management frameworks. Community participation in monitoring or ‘citizen science’ should also be promoted through capacity building and financial support to boost collective action and hence conservation outcomes.

11.4 Coastal populations and urban growth

The Kenya coast is a net immigration region with population growth rate of 2.9%, slightly lower than the national average of 3.2% (Government of Kenya, 2010). The average population density is lower than the national average and most of the land has low population density. However, the coastal strip and the urban areas including Mombasa, Malindi and Kilifi have relatively high population densities of up to 4,493 persons/km², while the lowest density of 16.2 persons/km² is in Lamu.

A survey conducted in 2013 by the Kenya National Bureau of Statistics (KNBS) and Society for International Development (SID) showed that poverty gap is most severe at the Kenya coast, within the Tana River and Kwale ranging from 44 - 49% of the population, while the lowest poverty gap is at Lamu ranging from 4 – 11%. Literacy at the coast region is also low with a significant disparity between men and women, and between urban and rural areas (Hoorweg et al., 2000). This high level of poverty and illiteracy does not augur well for the coastal environment, since the poor are more likely to resort to unsustainable resource-use practices in an effort to meet immediate survival needs. There is an urgent need for mainstreaming population issues within development sectors, especially intervention measures for conserving the environment and poverty alleviation. ICZM approach has made advances at the coast by promoting integration of environmental concerns into development strategies and plans. Mainstreaming population management initiatives into the ICZM efforts needs to be enhanced. Additionally, education and awareness on environment issues and capacity building to implement environmental policies at county government level need to be enhanced. Urbanization should be controlled through proper spatial planning and decentralized services, infrastructure, social amenities, and economic opportunities that attract people to the more developed urban areas.

11.6.1 Land resources

As reported earlier in this report land in the coast supports key economic activities including tourism, agriculture, mining, forestry, industry and settlement. Each of the coastal counties, except Mombasa, have large parts of their land in conservation and forest areas serving as reservoirs of biodiversity, water catchment areas and other ecological purposes.

One of the key issues facing land resources in the coast is the long-standing unresolved land tenure system which has held back development and often resulted in civil unrest in the coast region. Optimal land use requires a clear understanding of the land tenure, availability, land potential, and

an array of the economically feasible enterprises alongside a proper mix of the basic inputs to produce the desired results. The situation in the coast is however different since big tracts of land is owned by absentee landlords and many people occupy them as squatters who believe they have the right of ownership because they have occupied and lived in these parcels for tens of years. Some of the land held under customary law has however been largely adjudicated under the Land Titles Act, but issuance of title deeds in many parts of the coast has delayed.. This has made land tenure issue potentially explosive with frequent evictions of and re-occupations followed by lengthy arbitrations reducing the use and value of land at the coast.

In response to the issue of landlessness and land tenure among the population residing in various counties, measures are being taken by the National and County Governments to settle squatters where possible. The Government has over the years acquired some of the farms and converted them to settlement schemes for the landless. Further, the central Government set up a national land commission to address the issue of land tenure nationally. The County governments are also preparing urban plans to guide land use. For instance, Mombasa town planning scheme that was first developed early in the century is being reviewed while Kwale county has urban plans for Kwale, Ukunda and Masambweni townships. Policies responses, governance instruments are guided by acts and regulations, such as the Kenya Land Commission, land control boards and adoption of International Best Practices (IBPs) as proposed in National Development Plans and County Integrated Development Plans requiring spatial planning process for land use and land allocation.

11.5 Water resources

The coast region of Kenya is challenged with the rising demand for fresh water due to the ever-growing needs of urban populations in addition to large scale irrigation agriculture and power generation needs. Most of the water consumed at the coast is surface water from rivers, lakes, shallow wells and rainwater. There is a high dependence on alternative sources of potable water including boreholes to access groundwater for domestic and industrial use in the region. In Tana River County for example, more than 4,500 bore holes have been drilled as an. Urban areas experience a high degree of groundwater contamination by microbial contaminants, especially in high-density housing settlements, attributed to onsite sewage disposal methods dominated by pit latrines and septic tank / soak pit systems (Munga et al., 2005).

There is need to ensure that the management of the land use in river catchment areas as well is integrated with the needs of downstream communities. Rehabilitation of the existing water supply and waste water management systems in Mombasa is ongoing. Quantification of groundwater and the extraction/replenishment dynamics is required for planning in order to maintain the quality of borehole water for sustainable management. Desalination of seawater for domestic and commercial also need to be explored as a long-term solution to the fresh water shortages being experienced.

11.6 Economic activities

Enormous natural resources for economic development exist in the coastal region. Most of these have been either under exploited or poorly exploited and therefore have not achieved their full potential in contribution to socio-economic development of the region. One of the key renewable resources at the coast region is fisheries and other natural resources in the EEZ of Kenya. Exploitation of the fishery resources continues to be traditional through rudimentary gears and vessels that mainly fish within the reef and thus cannot exploit huge fisheries outside the reef to support food security in the coast region. The offshore fishery continues to be exploited by licensed and unlicensed vessels from Distant Water Fishing Nations from Asia and Europe. The policy direction within the Blue Economy initiative to increase the benefit from the offshore fisheries is to develop a local fishing fleet as well as land based fish handling and value addition infrastructure. Realisation of this requires support from the County Governments and the National government. Whereas aquaculture has a huge potential in contributing to the coastal economy, it's currently impeded by lack of clear guidelines and policies to support investment. In addition, support capacity such as hatcheries to produce fish seed for the farmers is a prerequisite to the development of mariculture.

Much of the agriculture at the coast is small scale and for subsistence, with a high dependency on rains, which are seasonal. Furthermore, the choice of farmed crops and livestock may not be suitable for the respective agro-ecological zones, thereby affecting production and subsequently leading to environmental degradation through soil erosion and over grazing. Other impacts on the environment by agriculture include discharge of agro-chemicals into water systems; water diversion in rivers; and soil erosion among others. There is need to promote good agricultural practices in order to address these environmental issues in the sector.

The manufacturing sector adds value to most of the products produced in the coast region besides providing jobs to many Kenyans and revenue to the government. The sector however continues to impact negatively on the environment mainly through pollution. The sector need to embrace cleaner production technologies to minimise air, water and soil pollution. Awareness and enforcement of appropriate regulations also needs to be enhanced.

In the mining sector, the extraction of minerals and industrial materials including limestone salt extraction and titanium at the coast region continues to grow bringing investment and development to the region. These developments have huge impacts in creating employment in addition to improving the economy. However, the significant environmental consequences associated to such developments need to be minimised in addition to making realistic environmental degradation mitigation measures. The cement industry has set a good example by afforesting the exhausted limestone quarries to productive forest ecosystems. These good practices in addition to awareness

and enforcement of the regulations on the restoration on mined areas needs to be increased in the sub-sector.

Coastal tourism is a significant contributor to the economy of the coast region, stimulating the development of the hotel industry and other tourism support services in towns like Mtwapa, Ukunda, and Malindi. However, the sector has been negatively impacted by insecurity in the region after the insurgency of terrorism acts. The more recent years 2014 and 2015 have seen a serious downturn of tourism activity resulting in a drastic decline in the number of visitors arriving at Moi International airport. This implies that the livelihoods previously supported by the sector have had to resort to other alternative economic livelihoods such as fishing, mangrove cutting, and even mining. Therefore, there is need to establish mechanisms that promote peace and tranquillity in the region in order to have a thriving coastal tourism sector. Generally, the different products originating from the coast region lack high value market outlets. Most of the markets provide none competitive prices to the farms and producers especially agricultural and fisheries products. Marketing support, value addition, and branding the products will enhance the benefits to the region.

In respect to climate change, Kenya's policy towards GHG emissions reduction include increased geothermal electricity generation, movement of freight on rail, reforestation in the forestry sector, and agroforestry in the agricultural sector. In the coast region interventions have been made to sequester carbon through carbon offsetting using the blue carbon ecosystems model e.g. Mikoko Pamoja project in Gazi as well promotion of local adaptive capacity through water provision initiatives such as those promoted by CDA through the Kenya Climate Change Adaptation programme. Recognition and upscaling of these initiatives in addition to promotion of cleaner production mechanisms by the government and the private sector is recommended.

11.7 Major threats

Threats to coastal and marine habitats are mainly driven by socio-economic activities and human population increase. The major threats to the environment include pollution from domestic and industrial effluents, solid wastes, and shipping operations; climate change; alteration of habitats; and widespread of invasive species. Responses to mitigate such impacts include subjecting development projects to environmental impact assessment (EIA) as provided for by the Environmental Management and Coordination Act CAP 387. In respect to pollution abatement, the systems for solid waste collection and treatment in the urban centres are rudimentary and ineffective. There is need to develop sanitation systems and enhance the existing systems to accommodate the ever-increasing domestic sewage load. Additional recommendations to address the major threats to the coastal and marine environment are described in chapter 8.

11.8 Governance

The government has enacted several legislations related to natural resource management as required by the Constitution (2010). The laws that are relevant to the coastal and marine environment management include EMCA CAP 387, Fisheries Development and Management Act (2016), the Land Act (2012), Land Control Act, the County Government Act (2012), the Tourism Act (2011) the Physical Planning Bill (2015) Tourism Act (2011), Forest Conservation and Management Act (2016), Pollution Control Act (2016) and the Maritime Act 2012 These and other laws and policies are described in detail in chapter 9. The marine protected areas under Wildlife Act 2016 provides for the establishment of community protected areas.

Institutions created after 2009 relevant to the coast and marine environment management include the National Environment Council, County Environment Committees,; the State Department of Fisheries and Blue Economy, Kenya Fisheries Service and the Fisheries marketing Authority under the Fisheries Act; as well as the Tourism Board under the Tourism Act. The new arrangements have also changed the implementation of management of the regulations leaving more responsibilities on the county governments for implementation. MCA CAP 387 is the regulatory framework for managing the environment and defines the coastal zone, the EEZ and wetlands. The Act provides for County Environment Committees and roles of the County Governments in implementation of EMCA. The Act was amended mainly to align it with the new constitution and improve environmental governance.

11.9 Emerging issues

As reported earlier in this report the coast region is experiencing a number of emerging issues. Among these is the Blue Economy. The sectors for development in the blue economy include shipping and port services, fisheries, tourism, aquaculture, energy, biotechnology and seabed exploration and mining and desalination of seawater to supply fresh water. The key issues that are likely to emerge as the blue economy develops include over-exploitation and degradation of coastal and marine resources and marine pollution among others. Marine spatial planning is critical to guide the zoning and harmonious implementation of the various blue economy activities while mainstreaming environmental concerns. Other measures include undertaking strategic environmental assessment, sensitivity mapping where necessary and coordinated compliance monitoring and surveillance.

Besides the blue economy, Kenya is planning mega infrastructure projects, including the LAPSSET, proposed resort cities, large scale farming initiatives aimed at improving food security and other local developments whose cover the coast region. Other emerging concerns, which have the potential to affect economic development and the environment include mineral prospecting, security, climate change, large scale water supply projects, oil and gas exploration and development

of offshore shipping infrastructure. While these projects will have direct benefits to the coastal communities and the economy, they may also have far-reaching environmental as well as social negative impacts. The potential environmental impacts include clearing of habitats to create space for projects; population increase as a result of job and business opportunities by the projects; pollution; and increased pressure on coastal resources among other impacts. There is need to put adequate measures to mitigate these potential impacts on the environment.

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