REPUBLIC OF KENYA

MINISTRY OF ENVIRONMENT AND MINERAL RESOURCES





MASTER PLAN FOR THE CONSERVATION AND SUSTAINABLE MANAGEMENT OF WATER CATCHMENT AREAS IN KENYA

SEPTEMBER 2012

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF PLATES

ABBREVIATIONS AND ACRONYMS

£	Sterling Pound
a.s.l.	above sea level
ABS	Access and Benefit Sharing
ASAL	Arid and Semi-Arid Lands
CAAC	Catchment Area Advisory Committees
CDA	Coast Development Authority
CDF	Community Development Fund
CDM	Carbon Development Mechanism
CFA	Community Forests Associations
CK2010	Constitution of Kenya 2010
CMS	Catchment Management Strategy
COP	Conference of Parties
CSOs	Civil Society Organisations
DAAD	Deutscher Akademischer Austausch Dienst
DEC	District Environment Committees
DNA	Deoxyribonucleic Acid
DRSRS	Department of Resource Survey and Remote Sensing
E	East
EAC	East African Community
EBS	Elder of the Burning Spear
ECOSOC	Economic Social Council
EMA	Environment Management Association
EMC	Environment Management Committees
EMCA	Environmental Management and Coordination Act
ENNDA	Ewaso Ng'iro North Development Authority
ENSDA	Ewaso Ng'iro South Development Authority
ENSO	El Niño/La Niña-Southern Oscillation,
ERSWEC	Economic Recovery Strategy for Wealth and Employment Creation
EU	European Union
FCPF	Forest Carbon Partnership Facility
FDC	flow duration curves
GIS	Geographic Information System
GoK	Government of Kenya
Ha	Hectares
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome
ICRAF	World Agroforestry Centre
ICS	Interim Coordinating Secretariat – Mau Forest Complex
IGA	income generating activities
IPCC	Intergovernmental Panel on Climate Change
ITCZ	Inter-Tropical Convergence Zone
IWRM	Integrated Water Resource Management
JTMP	Joint Transboundary Management Plan
KARI	Kenya Agricultural Research Institute
KEFRI	Kenya Forestry Research Institute
KEHS	Kenya Economic and Household Survey
KenGen	Kenya Generating Company
KEPSA	Kenya Private Sector Association
Kes.	Kenyan Shillings
KFS	Kenya Forest Service
KKV	Kazi Kwa Vijana
km	Kilometres
KMD	Kenya Metrological Department
KVDA	Kerio Valley Development Authority
KWS	Kenya Wildlife Service
LBDA	Lake Basin Development Authority
LVEMP	Lake Victoria Environment Management Programme
m	metres
M&E	monitoring and evaluation

MDG	Millennium Development Goals
MEMR	Ministry of Environment and Mineral Resources
MERECP	Mt. Elgon Regional Ecosystem Conservation Programme
MoA	Ministry of Agriculture
Mt.	Mountain
MTEF	Medium Term Expenditure Framework
MTP	Mid-Term Plan
N	North
NALEP	National Agriculture and Livestock Extension Programme
NCCRS	National Climate Change Response Strategy
NEAP	National Environment Action Plan
NEMA	National Environment Management Authority
NGO	Nongovernmental Organisation
NMK	National Museum of Kenya
NR	Natural Resources
NRUA	Natural Resource Use Association
NWCCP	National Water Catchment Conservation Programme
NWCMP	National Water Catchment Management Programme
NWFP	non-wood forest products
PELIS	Plantation Establishment and Livelihood Improvement Scheme
PES	Payment of Environmental Services
PPP	Polluter Pays Principle
PRSP	Poverty Reduction Strategy Paper
PVC	Polyvinyl Chloride (Plastic)
RDAs	Regional Development Authorities
REDD	Reducing Emission from Deforestation and Forest Degradation
R-PP	Readiness Preparation Proposal
S	South
SCMP	Sub-Catchment Management Plan
SLM	Sustainable Land Management
SoE	State of Environment
SST	sea surface temperatures
TARDA	Tana and Athi Rivers Development Authority
UNEP	United Nations Environment Programme
UNESCO	United Nation Educational Scientific and Cultural Organisation
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollars
V2030	Vision 2030
W	West
WAP	Water Allocation Plans
WCA	Water Catchment Areas
WDC	WRUA Development Cycle
WRMA	Water Resource Management Authority
WRUA's	Water Resource User Associations
WTSF	Water Service Trust Fund
WTTF	Water Towers Trust Fund

FOREWORD

According to international standards, Kenya is categorised as a 'water scarce' country. The country currently has available 400m^3 per capita per annum of renewable freshwater resources in comparison to the 1,000m^3 per capita per annum recommended by the United Nations.

Water scarcity challenges facing our country have worsened in recent decades. While the country had 647m3of renewable freshwater resources per capita per annum in 1992, these water resources have declined by more than 200 m^3 per capita per annum since that time.

The situation can be attributed to a range of human and environmental causal factors. At independence, many dams and water-pans were dug to supply water for farming, domestic and industrial use. Over time, these have become degraded, silted and even inhabited. Rapid population growth has exerted immense pressure on the quality and quantity of water and other vital natural resources. The State of the Coast Report for Kenya, published by the National Environment Management Authority in 2009, indicated that climate variability and uncertainty has been the chief contributor to the degradation of water catchments, heavy siltation of dams and pans, and deterioration of water quality. Climate change is also contributing to the negative impacts on the country's water resources and presents serious implications for food and energy security and resource user conflicts.

It is necessary to acknowledge the severe degradation of water catchment areas that has affected Kenya's five water towers over the last twenty years. The Aberdare Ranges, Cherangany Hills, Mau Forest Complex, and Mounts Elgon and Kenya have become so severely impacted by human and environmental processes that even the existence of the rivers that drain the water towers is now threatened.

Our country realises that our economy, society and environment are founded on services provided by ecosystems. Water, biodiversity, quality soils, and air are fundamental to economic productivity and social wellbeing and must be protected to provide every Kenyan's constitutional right to a clean and healthy environment and if Kenya is to become a middle-income country by 2030 as set out in the country's development blueprint Vision 2030.

The Ministry of Environment and Mineral Resources is proud to launch this Master Plan for improved conservation and sustainable management of water resources in Kenya. I believe the conservation, restorationandmanagementofwatercatchmentareas will be greatly supported by the recommendations presented herein for the benefit of ecosystems and urban and rural livelihoods country-wide.

Hon. Amb. Chirau Ali Mwakwere, EGH, FCILT, MP
Minister for Environment and Mineral Resource

ACKNOWLEDGEMENTS

Tremendous individual and institutional efforts went into the research, fieldwork, analysis and writing of this Master Plan for the Conservation and Sustainable Management of Water Catchment Areas in Kenya.

I would like to acknowledge the vision and leadership provided by the Late Hon. John N. Michuki, EGH, MP, Minister for Environment and Mineral Resources. He emphasized the articulation of a spectrum of challenges and possible solutions while at the same time broadening the scope in which water catchment areas was defined. This enabled broader investigation of diverse drivers of degradation of water catchment areas and inclusion of otherwise less considered ecosystems such as dried up lagas, sand dunes and mountain ranges in the drier parts of the country which rarely appear in many other national documents.

The Ministry collaborated with many stakeholders from the academia, research institutions, civil society groups, and many other stakeholders to put together the report. It is through the valuable support and information provided by all stakeholders that the report was finalized. We wish to acknowledge the contributions of all.

The Taskforce established by the Ministry collated and synthesized the rich information into a document that can now guide practical and transformative actions for the sustainable management of complex ecosystems. Their efforts and commitment is highly appreciated.

The production of the Master Plan benefited from the financial support of the Government of Denmark through the Natural Resources Management Programme. The African Adaptation Programme funded by the Government of Japan through the United Nations Development Programme also supported aspects of the report. We are grateful to all.

Finally, our appreciation goes to all the people of Kenya whose right to a clean and healthy environment will be secured through fulfillment of their responsibilities to manage our natural environment.

Ali D. Mohamed, CBS
Permanent Secretary,
Ministry of Environment and Mineral Resources

GLOSSARY

Access	Obtaining, possessing and using genetic resources conserved, whether derived products and, where applicable, intangible components, for purposes of research, bio-prospecting, conservation, industrial application or commercial use
Agriculture	All farming activities including cultivation, agroforestry, beekeeping, livestock management and aquaculture
Alien species	Any exotic non-indigenous life forms originating from outside a given ecological location, accidentally or deliberately introduced to the location by human activity or by natural means
Benefit sharing	Sharing of benefits that accrue from the utilisation of genetic resources
Biological diversity	The variability among living organisms from all sources including, terrestrial ecosystems, aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, among species and of ecosystems
Biological resources	Include genetic resources organisms or parts thereof, populations, or any other biotic component or ecosystems with actual or potential use or value for humanity
Biosphere Reserve	Biosphere reserves are areas of terrestrial and coastal ecosystems promoting solutions to reconcile the conservation of biodiversity with its sustainable use
Catchment	1. The catching or collecting of water, especially rainfall 2. A reservoir or other basin for catching water 3. The water thus caught
Catchment area	1. The intake area of an aquifer and all areas that contribute surface water to the intake area 2. The areas tributary to a lake, stream, sewer, or drain 3. A reservoir or basin developed for flood control or water management for livestock and/or wildlife
Catchment Management Plan	A programme of measures that have been developed for the purposes of conserving and or improving the conditions of the catchment
Catchment Management Strategy	A document that has been prepared for the purpose of directing the management of the water resources within the catchment area

Climate Change	Directional change in climatic variables over a long-term period
Climate Change Vulnerability	The degree to which a system is susceptible to, or unable to cope with the adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity (IPCC, 2001)
Conservation	The care and management of a resource so that the resource maintains its ability to fulfil its functions and provide goods and services for present and future generations
Drainage basin	An area in which surface runoff collects and from which it is carried by a drainage system, as a river and its tributaries. Also known as catchment area, drainage area, feeding ground, gathering ground, hydrographic basin (McGraw-Hill, 2002)
Ecosystem	A biological environment consisting of all the organisms living in a particular area, as well as all the nonliving, physical components of the environment with which the organisms interact, such as air, soil, water, and sunlight
Endangered species	Any species which is in danger of extinction throughout all or a significant portion of its range due to man-made or natural changes in the environment or as may be declared by the relevant national or international authority
Environment	Includes the physical factors of the surroundings of human beings including land, water, atmosphere, climate, sound, odour, taste, the biological factors of animals and plants and the social factor of aesthetics and includes both the natural and the built environment
Environmental resources	Includes the resources of the air, land, flora, fauna and water together with their aesthetic qualities
Gene bank	A genetic sequence database, an annotated collection of all publicly available DNA sequences
Intra-county	Within county
Invasive plant	A plant that moves in and takes over an Ecosystem to the detriment of other species; often the result of environmental manipulation
Joint Transboundary Management Plan	A document that guides and controls the management of transboundary resources within an agreed framework and binds entries to work together
Land tenure	The relationship, whether legally or customarily defined, among people, as individuals or groups, with respect to land, its management and administration

Livestock	Includes cattle, horses, donkeys, mules, pigs, sheep, goats, camels and all other domesticated animals
Management Plan	A document that guides and controls the management of protected area resources, the uses of the area and the development of facilities needed to support that management and use
Migratory species	Species that move from one place to another in search of food or breeding habitats or other phenomenon on a regular basis
Mitigation	Measures taken to avert effects of an undesirable phenomenon
Natural resources	Include resources of the land, air, water, animals and plants including their aesthetic qualities
Natural water body	Any river, stream, spring, lake, swamp, pond or other water source flowing in a natural watercourse
Payment for Ecosystem Services	The practice of offering incentives to farmers or landowners or protected area managers in exchange for managing their land or resources to provide some sort of ecological service
Protected area	A clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values
REDD+	Reducing emissions from deforestation and forest degradation; includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries
Resource quality	In relation to a water resource, means the quality of all the aspects of a water resource including the: a. character and condition of the in-stream and riparian habitat; b. characteristics, condition and distribution of the aquatic biota; c. physical, chemical and biological characteristics of the water; d. quantity, pattern, timing, water level and assurance of in-stream flow; e. water quality stipulated for the reserves
Restoration	Regeneration or putting back a wetland, riverbank or lake shore or sea shore to the state it was in or near to what it was before it was modified
River	Includes a permanent and seasonal river
Riverbank	The rising ground from the highest normal water mark, bordering or adjacent to a river in the form of rock, mud, gravel or sand and in cases of flood plains include the point where the water surface touches the land, that land not being the bed of the river

Sensitivity Atlas	A set of Geographic Information System (GIS) based products, providing contingency planners and emergency responders with accurate and relevant information for preparedness and response to an occurrence
Sustainable Land Management	Managing land without damaging ecological processes or reducing biological diversity
Sustainable use	Present use of the environment or natural resources which does not compromise the ability to use the same by future generations or degrade the carrying capacity of supporting ecosystems
Threatened species	Any species of plant or animal that is likely to become an endangered species within the foreseeable future throughout or in a significant portion of its range or as may be declared by the relevant national authority
Transboundary Biosphere Reserve	Areas set aside for the conservation of organisms, ecosystems, and genetic resources that cross national borders
Transboundary Natural Resources Management	Any process of cooperation across national borders that facilitates or improves the management of natural resources, to the benefit of all parties in the area concerned (Griffin et al. 1999)
Trans-county	Across more than one county
Water	Includes drinking water, river, stream watercourse, reservoir, well, dam, canal, channel, lake, swamp, open drain or underground water
Water catchment	Also referred to as Drainage Basin or Water Basin
Watershed	1. An area that, because of topographic slope, contributes water to a specified surface water drainage system, such as a stream or river. An area confined by topographic divides that drains a given stream or river 2. (Catchment): The natural or disturbed unit of land on which all of the water that falls (or emanates from springs or melts from snowpacks), collects by gravity, and fails to evaporate, runs off via a common outlet 3. All lands enclosed by a continuous hydrologic drainage divide and lying upslope from a specified point on a stream; a region or area bounded peripherally by a water parting and draining ultimately to a particular watercourse or body of water 4. A ridge of relatively high land dividing two areas that are drained by different river systems
Watershed basin	The area draining into a river, reservoir, or other body of water

Wetland	Areas permanently or seasonally flooded by water where plants and animals have become adapted; including swamps, areas of marsh, peat land, mountain bogs, bank of rivers, vegetation, areas of impeded drainage or brackish, salt or alkaline; including areas of marine water the depth of which at low tide does not exceed 6 metres. It also incorporates riparian and coastal zones adjacent to the wetlands
Wetland products	Includes fish, fibre, fruit, papyrus, grass, soil, stone, gravel, sand and such other things as the Minister may, by statutory instrument, declare to be wetland produce

EXECUTIVE SUMMARY

Natural resources derived from the environment drive Kenya's economic growth and development, indeed sustaining the livelihoods of the Kenyan people. Over the years, the Kenyan population has increased rapidly thereby surpassing the natural capital (land and water resources), a situation that calls for the sustainable management of natural resources including water catchment areas. This is particularly important for a country, whose extensive areas (approximately 80% of the land mass) are categorised as drylands – essentially fragile ecosystems – where any form of degradation can be disastrous. In the past, this has been evident from the massive livestock and human losses associated with extreme climatic events (intense and frequent droughts and floods) experienced between 2008 and 2011.

With this in mind, the Master Plan for the Restoration, Conservation and Sustainable Management of Water Catchment Areas in Kenya has been developed for all water catchment areas in Kenya, including the five water towers, the sub-catchments, local catchments and those that have ceased to function as water catchments due to degradation. The Plan describes the rationale and justification as well as the goal, objectives, strategies and actions that will facilitate the realization of restoration, conservation and sustainable management of water catchment areas. This Plan will be implemented over a 19-year period from 2011 to 2030 in line with the Kenya Vision 2030 and the Constitution of Kenya, 2010. It takes into consideration the variability and diversity of the country, the devolved governance system according to the Constitution of Kenya 2010, and global conservation paradigms including the management of transboundary water catchments. In addition, it advocates for the adherence to key environmental management principles including Payment for Ecosystems Services and the polluter pays principles.

The Master Plan envisions a Kenya with well managed water catchment areas; its goal is to assure the conservation and sustainable management of water catchment areas. The Plan provides a detailed review of existing legislation, policies and other relevant documents relating to the management of water catchment areas, and identifies gaps and conflicts in the existing legislation and policies as well as weaknesses in the institutional framework. The environmental status, biodiversity and land use of the water catchment areas are described and remedial actions identified.

The Terms of Reference of the Taskforce, published in the Gazette Notice No. 7730 of 02 July 2010, guided the preparation of this Master Plan. The Terms of Reference were to:

a. prepare a work plan for the taskforce activities
b. study existing legislation, policies and other relevant documents relating to the management of water catchment areas and identify any gaps in the existing legislation, policies and other relevant documents
c. identify, map and document water catchment areas in the country including areas that have ceased to be catchment areas for reasons to be identified by the taskforce
d. document the environmental status of each water catchment area
e. recommend appropriate intervention measures for each water catchment area
f. prepare an action plan for the implementation of the recommendations
g. draft a Master Plan for the sustainable management of water catchment areas
h. identify potential sources of financial and human resources to facilitate the implementation of recommended interventions
i. elect its chairperson
j. identify and co-opt other members or any other resource, provided that the co-opted members do not exceed one third of the Taskforce

The Taskforce used various methods and datasets in collecting information and compiling the Master Plan, which defines intervention areas as any existing degraded environment that requires remedial action. From the analysis of the status of the waters catchments in Kenya, key outputs have been detailed in the workplan for the sustainable management of water catchment areas within the framework of the National Water Catchment Conservation Programme (NWCCP). The planning, implementation and monitoring of the activities identified in the Master Plan will involve multiple stakeholders as is required in the Constitution of Kenya 2010.

The main problems that need to be addressed in the conservation and protection of water catchment areas include:

a. weak institutional linkages and synergies
b. conflicting institutional mandates
c. lack of clear funding mechanisms for water catchment areas (WCA)
d. lack of integrated WCA monitoring and evaluation systems
e. inadequate flow of information on WCAs
f. low levels of awareness and capacity of stakeholders
g. degraded WCA
h. land degradation (and soil erosion) in WCA
i. poor management of water resources
j. water Insecurity
k. poor waste management
l. livelihood insecurity
m. overdependence on biomass energy
n. limited involvement of women and youth in WCA activities

Recommendations

Based on field observations and discussions with various stakeholders, the following intervention measures were recommended:

a. The establishment and implementation of a National Water Catchment Management Programme (NWCMP) – founded on governance structure that incorporates all stakeholders at national, county and community-level activities – to strengthen synergistic partnerships and adoption of conservation technologies and innovations
b. The comprehensive review, harmonisation, application and enforcement of policies, legislations, regulations and standards governing WCA including those covering transboundary water catchment areas and water bodies
c. Prioritising financing of national, county and community-level WCA conservation programmes; resources need to be mobilised from internal and external sources including through Clean Development Mechanism projects, carbon credits trading, Payment for Ecosystems Services fees, and the 2% allocation from devolved funds. Such funds should be consolidated into a Trust Fund and allocated proportionately to Ministries responsible for the management of environmental and natural resources, and appropriately included in their annual and forward budgets
d. The development and application of a results-based management system founded on an integrated monitoring and evaluation system such as E-PROMIS and other simpler data-capture tools at community and project level
e. Access to timely, quality information and knowledge to support WCA conservation is necessary; a communication strategy needs to be developed and promoted
f. Enhancing the use of disseminated technologies and innovations on WCA conservation, and developing practical skills and competency-strengthening programmes for all categories of stakeholders, especially corporations and communities
g. The research and promotion of resource-use efficiency including recycling and reuse to enable conservation of water resources
h. The improvement and promotion of water storage infrastructures like dams, pans, household roof-catchments, and road runoff harvesting, in appreciation of the fact that capturing and storing rainwater is instrumental in the attainment of water security across seasons and years

i. The strengthening the management of urban and industrial waste and sanitation systems in WCAs, as well as the enforcement of appropriate laws governing waste management

j. The identification and promotion of alternative livelihoods through small to medium size enterprises that are necessary for sustaining ecological quality of WCAs, in order to check the overreliance on natural resources

k. Promotion of renewable energy from alternative sources such as biogas, solar, wind and energy-efficient devices in order to alleviate the destruction of water catchment areas from the rural overdependence on fuelwood

l. The active involvement of youth and women in the design, development and implementation of WCA programmes in appreciation of the high proportion of youth in Kenya's demographic structure, and the effectiveness of women development groups in the implementation of community-based natural resources management programmes

A substantial amount of financial, technical and human resources is required for the rehabilitation, restoration and sustainable management of water catchment areas. Approximately Kes. 942 billion will be required for the National Water Catchment Conservation Programme at national, county and community level during the period 2011 to 2030. The funding will not be entirely new because during the 2011/12 financial year, the government allocation to WCAs programmes amounts to Kes. 100 billion. Additional funds will be mobilised from merging opportunities presented by climate change. For example, the Clean Development Mechanism and carbon credits trading. Schemes on Payment for Ecosystems Services present a huge potential because over 50% of her Lakes, rivers and aquifers and their associated catchments are transboundary.

1.0 CHAPTER ONE

INTRODUCTION

1

INTRODUCTION

Kenya is located between latitude 4°21' North and 4°28' South and between longitudes 34° and 42° East. The country covers a land area of 569,137km^2 and is almost horizontally bisected by the equator and vertically by longitude 38° East. Kenya has a diversity of landforms ranging from glaciated mountain peaks under permanent snow cover to the coastal plain. She is split by the Great Rift Valley into the eastern part – dominated by Mt. Kenya (5,200m) and the Aberdare Ranges (4,000m) – and the western part, which slopes down into Lake Victoria from the Mau Ranges and Mt. Elgon (4,300m).

Kenya, whose population currently stands at 38,610,097 according to the *2009 Kenya Population and Housing Census*, has over the last four decades recorded a high population growth. The rapid population increase has exerted immense pressure on the quality and quantity of natural resources including water, a situation that has been further compounded by climate variability. Recent reports from the Ministry of Environment and Mineral Resources (MEMR) indicate that Kenya's five water towers namely the Aberdare Ranges, Cherangany Hills, Mau Forest Complex, Mt. Elgon and Mt. Kenya have been so severely degraded that the existence of the rivers that drain them is threatened. In view of the fact that the country's renewable freshwater resources (400m^3) fall severely short of the UN recommendation of 1,000m3 per capita per annum, it is unsurprising therefore that Kenya is internationally categorised as a 'water scarce' country.

The conservation of pristine ecosystems is considered an important aspect of preserving nature to sustain the availability of nature-based environmental resources including biological diversity, clean air, fresh water, quality soils, and overall environmental and habitat health, which are vital for social wellbeing and economic development. Nevertheless, if not managed through efficient resource use and other environmentally sensitive mechanisms, the quest for economic development can deplete natural resources. For this reason, arguments abound on the need to formulate conservation strategies that put a premium on the principles of environmental conservation and sustainable development, especially in protected areas. These arguments are pertinent to the simultaneous pursuit of divergent agendas – conservation vs. development – which remains a major challenge for many developing countries wherein poverty eradication is a major national priority.

According to Galvin and Haller (2008), there are three main strategies for conserving protected areas, and these depend on the decision-making framework; the populist approach adopts a bottom-up strategy where decisions on appropriate actions rest with the local community, which is also responsible for providing leadership in the implementation of conservation programmes. The second approach, which considers poverty as the root cause of environmental degradation, seeks to provide alternative livelihoods to communities that depend on the natural resource that is to be conserved. In this case, conservation efforts may well be in conflict with development aspirations, necessitating the use of exclusion mechanisms to bar communities from accessing the conserved resources.

The third approach is founded on the principles of cost-benefit analysis, and here conservation takes a business model that requires action to be taken on the basis of perceived benefits and costs. However, quantifying and attributing value to abstract benefits of conservation such as clean air is a challenge that plagues the cost-benefit method, which is also hinged on principles of rational choice. The three approaches are relevant to any conservation programme but require the articulation of the role of the private sector beyond corporate social responsibility; furthermore, the assumption that poverty is the root cause of environmental degradation is inaccurate.

In the case of Kenya and based on the work of this Taskforce, it is considered that the three

conservation approaches are relevant depending on the socioeconomic and ecological circumstances. That Kenya's dependence on natural resources is inextricably linked to her poverty eradication efforts makes cost-benefit analyses imperative if the environment is to be sustainably conserved. This is especially considering that over the last forty years, Kenya's water catchment areas have been severely degraded (UNEP and MEMR 2009) by several drivers of degradation including rapid population growth, expansion of agricultural land, climate change, poor governance, inappropriate land-use practices and limited appreciation of the value of a clean and healthy environment in supporting quality life.

Certainly, there are significant benefits accrued from WCA, whose indigenous forests provide numerous ecosystem services such as trapping and storing rainwater, regulating river flows and preventing flooding. Other services include recharging groundwater tables, improving soil fertility, reducing soil erosion and sediment loads in river water, regulating local climate conditions, and acting as carbon reservoirs and sinks (GOK and UNEP, 2009). In addition, they serve as essential wildlife habitats, and are traditionally important to local communities for their cultural and divine significance. Indeed, approximately 2.9 million people (8% of the population) classified as forest-adjacent households by virtue of the fact that they live within a 5-kilometre radius of the forest, derive significant direct benefits from WCA.

Regardless of this, the costs and benefits of conserving WCA countrywide have not been determined, neither have the methods for undertaking conservation across the diverse ecosystems and the varied land-use practices been defined. Even so, few analyses of major WCA including the Mau Forest Complex and the Aberdare Ranges are available for reference and to guide action. The assessment of the Mau Forest Complex (GOK, 2009) and the study on the Aberdares' system demonstrate the great economic value of WCAs. Indeed, the annual economic value of the latter's products and services including biodiversity is Kes. 56.5 billion, and within the Complex, it is estimated that the economic gains from tourism, hydroelectricity generation and optimal tea production could exceed Kes. 20 billion annually (GOK, 2009). In addition, indigenous closed-canopy forests play a critical role as water catchments, as they increase infiltration, prevent surface runoff and contribute to the availability of water for hydroelectricity generation (which accounts for approximately 60% of Kenya's generated electricity) by reducing siltation of hydroelectric plants.

For this reason, the conservation and sustainable management of water catchment areas is of strategic importance to Kenya; not only does it address the need to sustain the availability of environmental goods and services such as clean water, quality soils and habitats, but also other socioeconomic development needs such as employment creation. Accordingly, the Kenya Vision 2030 – the national development strategy for Kenya – lists conservation of water catchment areas among the five priority programmes in the environment sector (GOK, 2008). Specifically, the social pillar of the Kenya Vision 2030, under which the environment sector falls, recognises the value of a cohesive society that enjoys equitable social development in a clean and secure environment. In addition, the Government has prioritised the environment sector as an important driver of socioeconomic development, and the Constitution of Kenya 2010 acknowledges that the environment is a heritage that must be conserved and managed for present and future generations. Indeed, Part 2 of Chapter 5 of the Constitution provides for the management and conservation of the environment in order to *inter alia* conserve biological diversity and ensure that the right of all to a clean and secure environment is upheld.

In support of these provisions, on 02 June 2010, the Hon. Minister for Environment and Mineral Resources gazetted an interdisciplinary Taskforce to develop a national Master Plan to guide the country's water catchment conservation programmes. The need arose out of recognition that the persistent and intense cyclical droughts and floods associated with climate change were indeed a proxy indicator of the extensive environmental degradation, and the intensifying scarcity of critical environmental

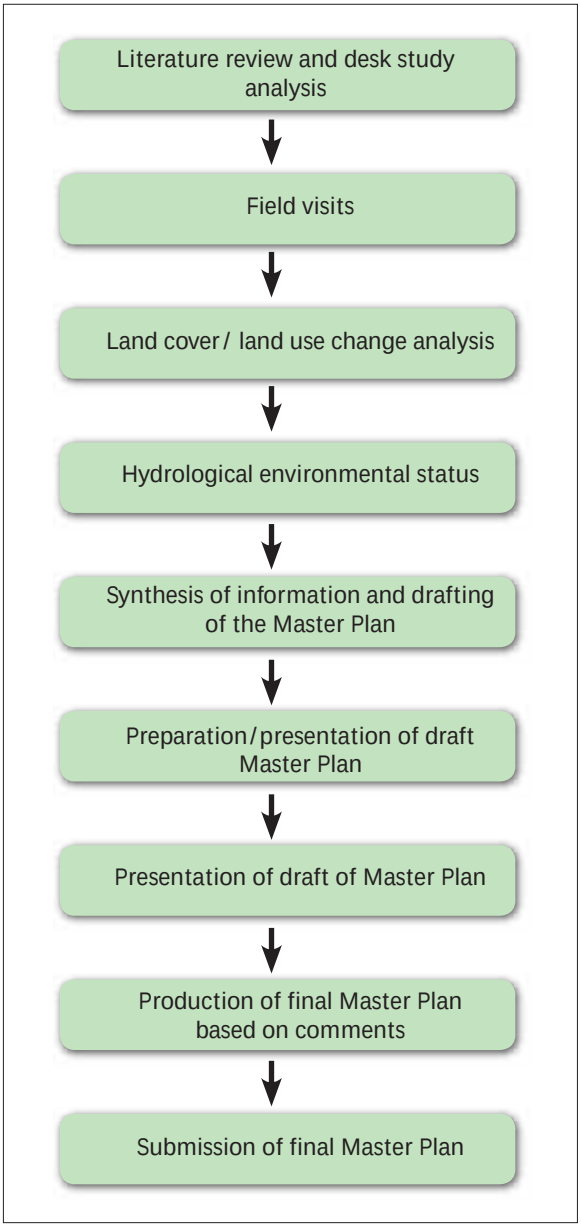
resources as water. The development of this Master Plan is therefore in appreciation of the fact that failure to conserve and protect the water catchment areas is likely to result in massive economic losses, human suffering and disintegration of the country's social fabric as inter-community conflicts over environmental resources intensify.

The Taskforce used various methodologies as indicated in Figure 1.1 to collect data and compile the Master Plan.
The vision of this Master Plan is for a Kenya with well managed water catchment areas, and its goal is to ensure the conservation and sustainable management of water catchment areas. The Plan provides a detailed review of existing legislation, policies and other relevant documents on the management of water catchment areas, and identifies gaps and conflicts in existing legislation and policies as well as weaknesses in the institutional framework. In addition, it describes the environmental status, biodiversity and land use of water catchments areas and proposes intervention measures, which are aligned with Kenya Vision 2030 and the Constitution of Kenya 2010.

In terms of scope, the Master Plan defines intervention areas as any existing degraded environment that requires remedial action. From the analysis of the status of the waters catchments in Kenya, key outputs have been detailed in the workplan for the sustainable management of water catchment areas within the framework of the National Water Catchment Conservation Programme (NWCCP). These include:

a. improved partnerships and participation of stakeholders in the management of water catchment areas
b. strengthened capacity of communities to implement WCA programmes
c. restored and protected water catchment areas
d. adoption of soil conservation and land use management practises
e. water resource conservation and management of all WCA
f. water storage infrastructure developed and maintained in all WCA
g. policies, legislations, regulations and standards governing the management of water catchment areas harmonised and enforced
h. improved management of urban and industrial waste and sanitation

Figure 1.1 Methodological approach for producing the Master Plan



i. pursuit of alternative livelihood options for sustainable resource use in water catchment conservation programmes
j. renewable energy technologies identified, developed and promoted
k. water catchment areas funding mechanisms streamlined and mainstreamed in budgets at all levels
l. strengthened monitoring and reporting systems for water catchment areas.

Ultimately, if Kenya is to achieve sustainable development, the conservation of the five water towers together with their sub-catchments, particularly those in ecologically fragile environments – specifically arid and semi-arid areas and the wetlands – is critical. This is in consideration of the significance of these remote fragile ecosystems to the livelihoods of the most vulnerable populations, whose production and consumption patterns are a major threat to such environments. Therefore, the national program proposed in this Master Plan will be established to guide outcomes that target poverty eradication, economic growth and most importantly a sustained quality environment. The planning, implementation and monitoring of the activities identified in the Master Plan will involve multiple stakeholders as is required in the Constitution of Kenya 2010.

2.0 CHAPTER TWO

ENVIRONMENTAL STATUS, LAND USE AND BIODIVERSITY

2

ENVIRONMENTAL STATUS, LAND USE AND BIODIVERSITY

2.1 INTRODUCTION

Natural resources derived from the environment drive Kenya's economic growth and development, indeed sustaining the livelihoods of the people. Water is a significant natural resource – and a key factor of production – whose availability in adequate quantities and quality has been challenged by several factors including rapid population growth. This growing human population calls for the sustainable management of water catchment areas if the demands of the current and future generations are to be met. For intervention measures to be successful, they will need to be applied to each water catchment area in its entirety i.e. including the biodiversity and land, soil, forest and water resources (Chapter 5, Constitution of Kenya 2010).

Approximately 80% of the land mass in Kenya is classified as drylands, which are essentially fragile ecosystems, wherein any form of degradation can be disastrous. The massive livestock and human losses associated with the recent extreme climatic events – intense and frequent droughts and floods – experienced between 2008 and 2010 provide sufficient evidence of this (Endeleo, 2010). Over the last three decades, similar cyclic extreme climatic events have been observed (GOK, 2010: National Climate Change Response Strategy, MEMR). Table 2.1.1 shows changes in forest types between 1990 and 2010, and clearly demonstrates that there has been a decrease in indigenous forests, forest plantations, bushlands and woodlands, all of which are significant water catchment areas.

Table 2.1.1 Changes in areas of forest types in Kenya (1990-2010)

Category of forest resource	Area ('000 Ha)				Annual Change ('000 Ha)
	1990	2000	2005	2010	
Indigenous closed Canopy Forest	1240	1,190	1,165	1,140	-5
Indigenous Mangroves	80	80	80	80	0
Open woodlands	2,150	2,100	2,075	2,050	-5
Public Plantation Forests	170	134	119	107	-3.15
Private Plantation forests	68	78	83	90	+1.1
Sub-total Forest land (total of above categories)	3,708	3,582	2,357	3,467	-12.05
Bush-land	24,800	24,635	24,570	24,510	-14.5
Farms with Trees	9,420	10,020	10,320	10,385	+48.25
Total Area of Kenya	58,037	58,037	58,037	58,037	0

(Source: FAO Forest Resource Assessment 2010: Country Report for Kenya)

Such evidence of continued land degradation calls for the conservation of not only the water towers but also other local catchment areas. The arid and semi-arid areas, which comprise the largest percentage of Kenya's land cover, are critical for the existence of local pastoralist communities, their livestock and wild animals living nearby. Other unique areas including the Shella sand dunes, oases in arid areas and rocky outcrops are significant sources of water catchment and require special restoration and management.

In this Chapter, the environmental status of water catchment areas is assessed and described in terms of the extent of the degradation experienced and the implications with regards to remedial action. The biodiversity status of the catchment areas is discussed in relation to the current land use and economic activities, and water catchment areas that have ceased to be are identified and explanations provided. The analysis forms the basis for the intervention and restoration programme of the Master Plan on Conservation and Management of Water Catchment Areas in Kenya.

2.2 WATER CATCHMENT AREAS IN KENYA

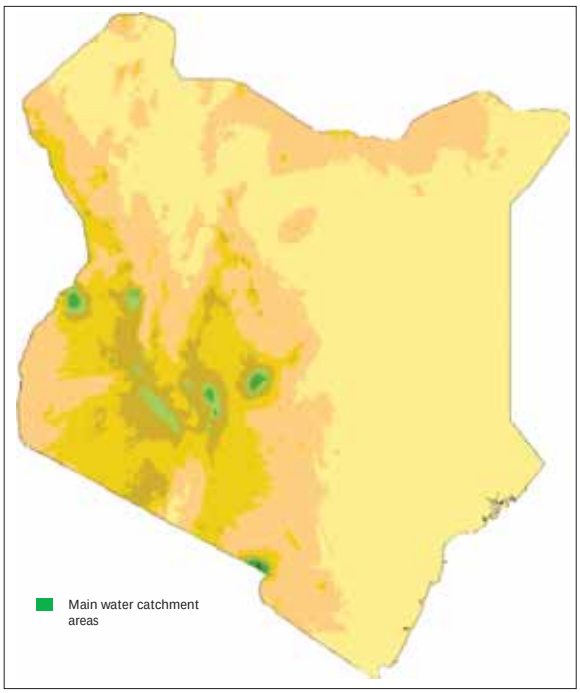
A water catchment area refers to an extent or area of land where water from rain and melting snow or ice drains downhill into a body of water, such as a river, lake, reservoir, estuary, wetland, sea or ocean. The water catchment area includes both the streams and rivers that convey the water and the land surfaces from which water drains into these channels, and is separated from adjacent basins by a catchment divide. The operational definition used in the Master Plan considers that the water catchment is concerned with not only the water but also the land and all the resources within the delineated area. Therefore, it considers the country's 5 water towers, namely the Aberdares, Cherangany, Mau, and Mts. Kenya and Elgon that form water drainage areas for Athi, Ewaso Ng'iro North, Lake Victoria, Rift Valley and Tana (Figure 2.2.1).

There are other smaller significant water towers and catchment areas in the country, including low mountains and hills in the drylands, which provide important sources of freshwater to the surrounding areas and are therefore vital to the pastoralist communities. These catchment areas include the hills in Machakos and Kitui, the Chyulu, Igembe, Manga, Maragoli, Ngong, Shimba and Taita Hills, and Mt. Kulal, Mt. Marsabit, Mt. Ndoto and Mt. Nyiru. Other significant catchments include the sandy reserves at the Kenyan Coast such as Shella Dunes of Lamu, and oases in the arid areas such as Loiyangalani in Marsabit. Plate 2.2.1 shows the Endau Hill in Kitui, a significant water catchment area within the drylands.

Plate 2.1.1 Exposure of rivers due to land use changes

Plate 2.2.1 Endau Hills and Mathews Ranges are water catchment areas in the drylands (Source: KEFRI)

Figure 2.2.1 The main water catchment areas of Kenya



2.3 PHYSIOGRAPHY, HYDROLOGY AND CLIMATE

Kenya is a country of diverse topography, hydrology and climate. Her five key physiographic features namely the lake basin, the plateaus, the Rift Valley, the coastal land, and the highlands characterise the country's climatic regions, while the hydrology is mainly influenced by the topography and geology. The topography rises from the low coastal plains to the highest elevation on Mt. Kenya (Batian) at 5,199m above sea level, and this allows for diverse ecosystems ranging from arid shrublands to dense mountain forests. Similarly, surface water availability varies greatly, with the Lake Victoria basin accounting for 60% of the country's surface water and the Tana catchment for 20%. Interestingly, the area under Lake Victoria basin comprises 8% of the total land area in Kenya, while Ewaso Ng'iro North, which occupies 36% of the total land area, accounts only for 2% of the total surface water. This shows that surface water resources are only concentrated in a small area of Kenya, a consideration that is important in conservation measures.

There are four major rivers namely Gucha-Migori, Nyando, Nzoia and Tana, which discharge in excess of 1,000 m^3/day (WRMA, 2010); other rivers with significant perennial flow are Mara, Sondu and Yala. A comparison of the rivers in different basins

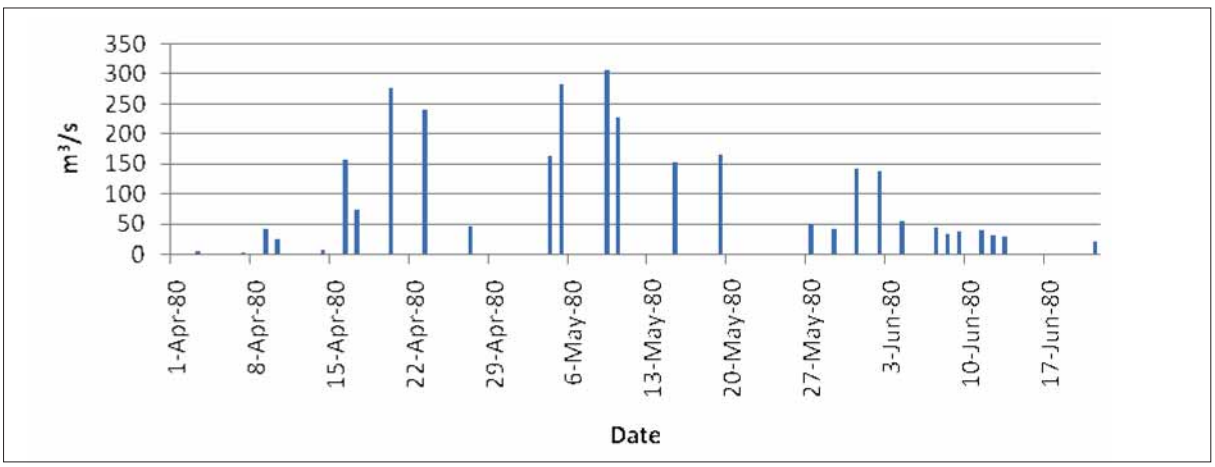
countrywide demonstrates the need for intervention upstream of the catchments in order to improve their conditions. The flow data plotted during high flows in April and June for rivers Athi (near Makueni) and Nyando (near Ahero) show that although both rivers are unregulated, the variability in Nyando is not as large as Athi's. The latter is very unsteady, with flow ranging from 74 to 277m³/s within a 6-day period compared to an increase of 10m3/s in Nyando over a period of 7 days (Figure 2.3.1). The two catchments compare well in terms of landforms, a dendritic drainage pattern, population density and economic activities but differ in land use, land cover and geology: the Nyando basin is dominated by volcanic hills and ranges with deep soils while the Athi basin is largely granitic metamorphic rock. The variability in flows could illustrate flow conditions in arid and moist climates.

Kenya's climatic regions are classified according to altitude above sea level: the coastal belt is generally hot and humid, and altitudes of 1,500m a.s.l. have moderate temperatures with maxima of 25°C and minima of 15°C, while at altitudes above 2,500m, frosts are common during the dry season with maxima of about 21°C or less. Areas on the windward side of water bodies generally receive higher rainfall and have more luxuriant vegetation compared to those on the leeward side.

Among the elements of climate, rainfall has the highest temporal (time) and spatial (space) variability. Indeed, the mean annual rainfall varies from as low as 200mm in the marginal areas of northern Kenya to as high as 2,000mm in the high potential areas. The 600mm isohyets form the boundary between semi-arid and humid climates while the 300mm isohyets delineate the arid from the semi-arid zones. Marginal areas are characterised by high rainfall intensities with the associated effects of water and wind erosion mainly due to the exposed top soils. This kind of variability, and the marginal to sub-marginal nature of rainfall distribution, is a serious drawback for the agricultural sector, which is the mainstay of the Kenyan economy.

Kenya's rainfall depicts very strong seasonality in harmony with the latitudinal migration of the Inter-Tropical Convergence Zone (ITCZ). There are bimodal and tri-modal rainfall distributions, with rainfall peaks generally occurring in April/May (long rains) and October/November (short rains) for bimodal rainfall regimes, and in July/August (mostly in western Kenya) for tri-modal rainfall regimes. In most areas, the long rains account for over 50% of the annual totals but in the southeastern lowlands of Kenya, the short rains are more significant and more stable.

Figure 2.3.1 Stream flow measurements in middle Athi April –June 1980



(Source: WRMA)

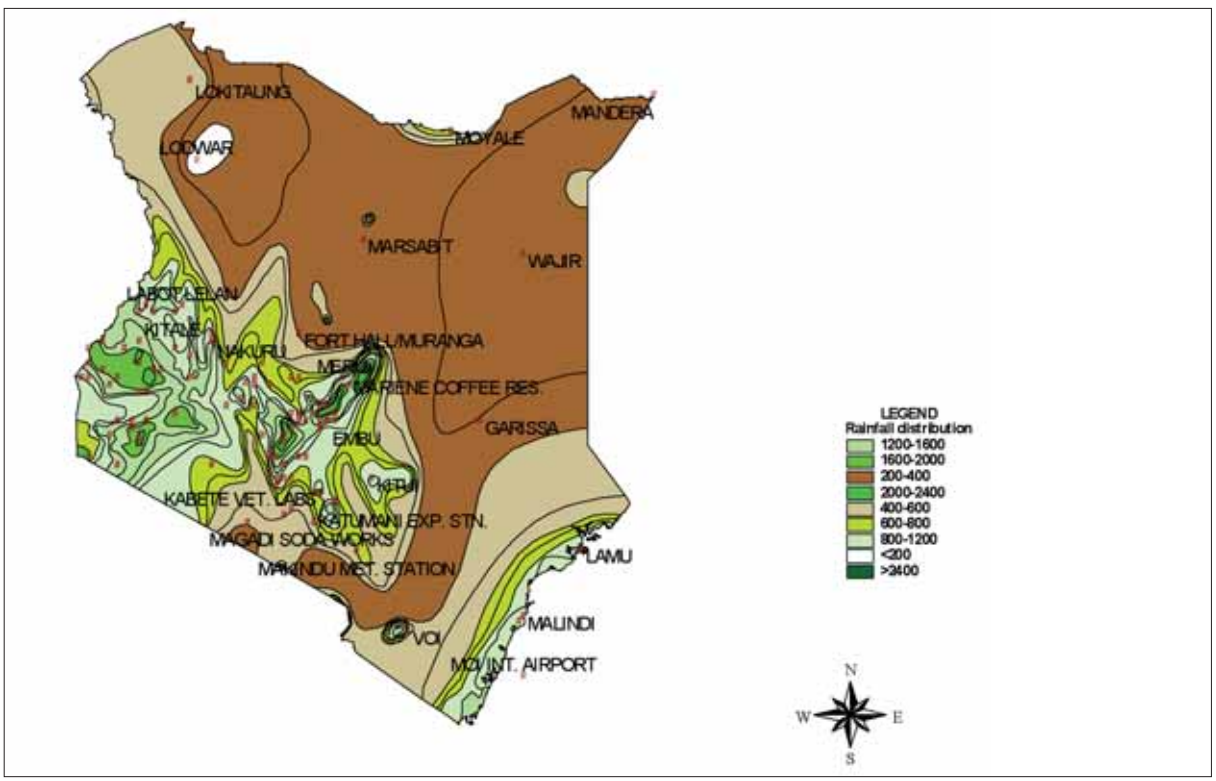
The northward and southward relative movement of the sun controls Kenya's climate as in the whole of the Eastern Africa region. The areas of maximum heating and therefore lowest pressures occur when the sun is approximately overhead, a phenomenon known as the equatorial heat trough or the ITCZ. The movement of this trough follows the movement of the sun but with a lag of 3 to 6 weeks behind the sun's time of greatest elevation. The fact that the sun is approximately overhead in March and again in September explains the bimodal rainfall pattern experienced in the region. The ITCZ is expected to be effective soon after the maximum intensity of rainfall, i.e. in April/May and October/November, when the synoptic pressure systems of the subtropical latitudes of the Sahara, Arabia, South Africa and Atlantic Ocean are intensive and there is a general transport of air masses towards the low-pressure zones of the equatorial regions. This results in well organised south easterlies and north easterlies meeting in a zone of convergence resulting in rainfall.

The large area of low pressure over Arabia and India has such great control that the southeast trade winds re-curve across the equator into a southwest monsoon over the Indian Ocean and the coast of East Africa and Somalia. Throughout the year, a trough of low pressure extends over Uganda and Lake Victoria so that there is always a tendency of afternoon convergence making the areas near the lake wet virtually throughout the year.

2.4 POPULATION AND LIVELIHOODS

Population, land use and livelihoods in Kenya are intricately linked, seeing as the Kenyan population is heavily dependent on land as a principal source of livelihood. Therefore, as the population continues to increase so does the pressure on land resources. According to the *2009 Kenya Population and Housing Census*, there were 38,610,097 people in the country

Figure 2.3.2 Rainfall distribution in Kenya



in 2009 aggregated into 8,767,954 households (2009 Kenya Population and Housing Census, GOK 2010). Figure 2.4.1 shows the population distribution and areas in Kenya with high population density, which as a result, are susceptible to degradation.

At the current growth rate of 3.0% (GOK, 2011: Economic Survey 2011, Kenya National Bureau of Statistics, 2011), the country is expected to increase to about 60 million people by the year 2030. Figure 2.4.2 illustrates how this increasing population will continue to present a big challenge to the realization of sustainable development.

The population structure in Kenya indicates that the country has a large proportion of young people, specifically 11,145,872 people between the age bracket of 15 to 29 years and 10,632,571 children between the age of 0 and 14 years (GOK, 2011: Economic Survey 2011, Kenya National Bureau of Statistics, 2011). As these children and youth grow, they will require gainful employment but with the current unemployment rate, very few employment opportunities exist. As a consequence, these will need to seek employment in the informal sector, whose main activities tend to rely heavily on natural resources such as forestry for carpentry, beekeeping and fishing, thereby increasing pressure on the country's natural resources.

2.4.1 Urbanisation and Settlement Trends

More than 75% of the population is concentrated in the high potential areas comprising only 20% of the land surface (Jaetzold and Schmidt, 1983), and these tend to be forest areas and sources of Kenya's major river basins. As the population

Figure 2.4.1 Population distribution in Kenya

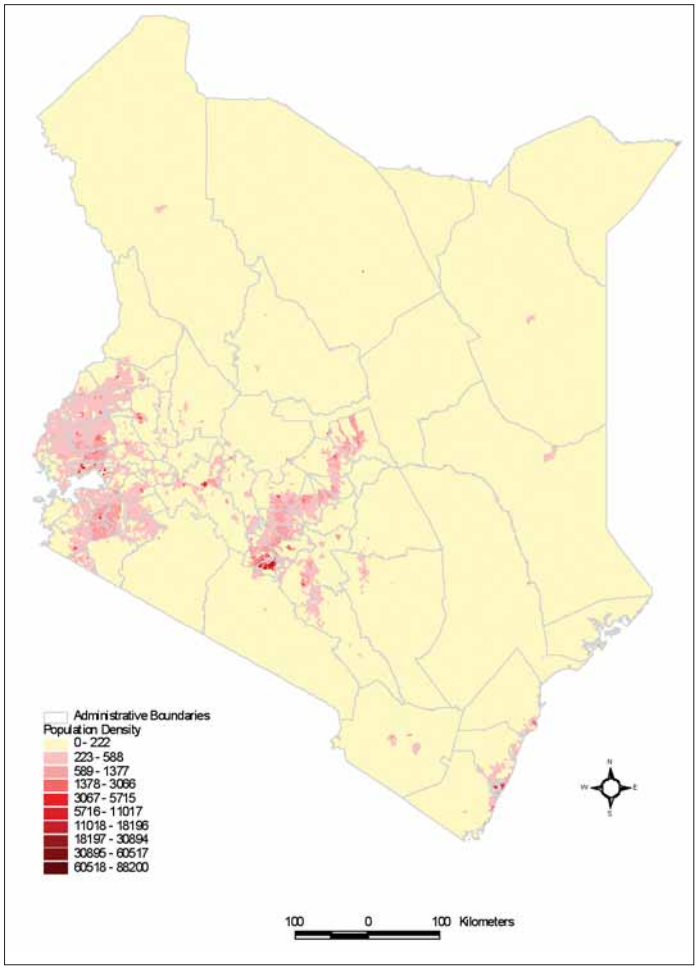
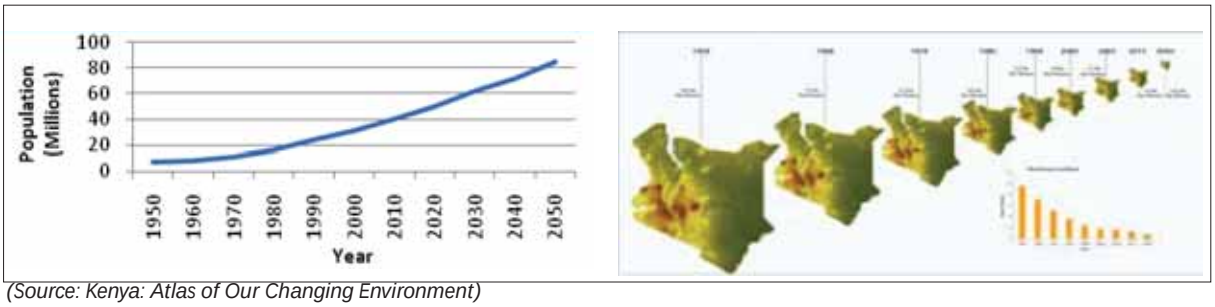


Figure 2.4.2 Trend of Kenya's population growth (1950-2050) and the shrinking land resource base



(Source: Kenya: Atlas of Our Changing Environment)

Table 2.4.1 Kenya's population in 2009 and the projected population in 2030

Age-group	2,009 (Census)			2030 (Projections)		
	Male	Female	Total	Male	Female	Total
0-4	3,000,439	2,938,867	5,597,716	4,800,702	4,702,187	9,502,890
5-9	2,832,669	2,765,047	5,597,716	4,532,270	4,424,075	8,956,346
10-14	2,565,313	2,469,542	5,034,855	4,104,501	3,951,267	8,055,768
15-19	2,123,653	2,045,890	4,169,543	3,397,845	3,273,424	6,671,269
20-24	1,754,105	2,020,998	3,775,103	2,806,568	3,233,597	6,040,165
25-29	1,529,116	1,672,110	3,201,226	2,446,586	2,675,376	5,121,962
30-34	1,257,035	1,262,471	2,519,506	2,011,256	2,019,954	4,031,210
35-39	1,004,361	1,004,271	2,008,632	1,606,978	1,606,834	3,213,811
40-44	743,594	732,575	1,476,169	1,189,750	1,172,120	2,361,870
45-49	635,276	637,469	1,272,745	1,016,442	1,019,950	2,036,392
50-54	478,346	477,860	956,206	765,354	764,576	1,529,930
55-59	359,466	352,487	711,953	575,146	563,979	1,139,125
60-64	295,197	298,581	593,778	472,315	477,730	950,045
65-69	183,151	207,612	390,763	293,042	332,179	625,221
70-74	160,301	179,000	339,301	256,482	286,400	542,882
75-79	99,833	118,675	218,508	159,733	189,880	349,613
80+	159,125	224,576	383,701	254,600	359,322	613,922
NS	1,810	1,761	3,571	2,896	2,818	5,714
TOTAL	19,192,458	19,417,639	38,610,097	30,692,464	31,055,667	61,748,131

(Source: GOK statistical abstracts 2010)

increases, so will the demand for land, resulting in further encroachment of forests and pressure on natural resources as people increasingly settle in water catchment areas. In turn, this will result in loss of wetlands, increased demand for pasture, clearing of vegetation, decrease in agricultural productivity due to change of land use, and an increase in water abstraction rates.

In most ASAL, settlement patterns are characterised by nomadic pastoralism, and the location of administrative headquarters and famine relief centres, which guarantee socioeconomic security. In the River Tana and Athi basins, settlement along the river is common among farming and pastoralist communities due to the availability of water, a practice that is a major source of conflict as it enhances the degradation of already fragile ecosystems. Ever since the energy sector was liberalised, people have purchased land in areas with high potential for geothermal well fields, in anticipation of investment in this type of energy.

Plate 2.4.1.1 Congestion in towns poses a threat to waste management
(Source: DRSRS)

Thanks to rural-urban migration, engendered by population movements in search of employment opportunities, Kenya's urban population is growing at a high rate. Currently, 32% of the population lives in urban areas (GOK, 2009: Kenya Population and Housing Census), resulting in an increase in the degradation of some areas as the demand for basic facilities such as housing, water and waste disposal increases. Only 41% of urban households have access to flush toilets leaving a large proportion of urban dwellers to utilise other methods of waste disposal. Many low-income urban residents live in poorly planned informal settlements, characterised by substandard housing, poor sanitation and a lack of other basic social infrastructure that have a high potential of affecting water availability and quality as illustrated in Plate 2.4.1.1.

To cater for the growing urban populations, the number of urban areas is also increasing rapidly – currently there are 277 urban areas in the country, with a population of 2,000 people and above (2009 Kenya Population and Housing Census). Certainly, this means that settlement areas and social amenities will need to increase commensurately as people move into forested areas and convert land currently used for agriculture as has been the case in the Karura and Ngong Forests, Kiambu and its environs, and Kitengela and Athi River. The two forests were excised, and the coffee farms in Kiambu and livestock pastures in Kitengela and Athi River converted to accommodate the growing urban population.

2.4.2 Energy and Livelihoods

In comparison with other sources of energy including hydro-, geothermal, wind and solar power, it has been established that biomass (fuelwood) is the most relied upon, with 67% of Kenya's population using firewood and another 17% charcoal for cooking (GOK, 2011: Economic Survey 2011, Kenya National Bureau of Statistics). The dependency on fuelwood as a source of energy is a major threat to forests particularly in the rural areas where 86% of the population use firewood and another 10% use charcoal for cooking. Nearly three out of four households (74.3%) use kerosene for lighting, 19% use electricity and 3.7% use firewood. If alternative sources of energy are not identified to meet the needs of a growing population, then this high usage of wood fuel poses a great threat to water catchment areas.

According to the Ministry of Energy (2010), Kenya is well endowed with a great geothermal resource potential, in excess of MW 7,000, that is capable of meeting all of Kenya's electricity needs over the next twenty years. Most of the prospects are within the Rift Valley – in Suswa, Longonot, Olkaria, Eburru, Menengai, Lake Bogoria, Lake Baringo, Korosi and Paka volcanic fields. Given its resource potential and in anticipation of future investment in this source of energy, people have purchased land in areas with high potential for geothermal well fields.

Kenya's potential source of wind power is quite substantial especially around the lakes including

Plate 2.4.2.1 High dependence on wood fuel
(Source: MEMR)

the Kano Plains and Marsabit, which has been identified as a potential site for installation of a wind powered electricity generation plant. Solar energy has for a long time been used for drying animal skins and clothes, preserving meat, drying crops and evaporating seawater to extract salt. It is utilised at various levels including household level where it is used for lighting, cooking and water heaters, and at community level, where it is used for vaccine refrigeration, rural electrification, and water pumping and purification.

Coal deposits in the Mui basin are being touted as a viable alternative source of energy following the Ministry of Energy's coal exploration in the Basin (sub-divided into four blocks as shown in Table 2.4.2.1) since 1999 to establish the quantity and quality of coal reserves and develop a roadmap for coal development. The potential uses of coal include domestic uses, conversion to liquid fuels, cement manufacture, electric power generation and iron ore smelting (steel industry).

2.4.3 Wildlife and Livelihoods

Kenya's tourism industry, largely dependent on wildlife, is a significant source of foreign exchange revenue (Gachenge, 2008) and one of the largest contributors to the economy. Indeed, the sector contributed close to Kes. 100 billion to the country's economy and generated up to 45% of Kenya's foreign exchange earnings from tourism and related activities in 2010. The sector has grown from strength to strength as the number of people visiting parks and game reserves increased steadily over the years, from 1,533,438 people in 1999 to 2,495,135 in 2007.

Some of the wildlife tourist sites are dependent on the water catchment areas; the sites near the Rift Valley including Maasai Mara and Lakes Nakuru and Elementaita draw their water from the Mau Forest

Table 2.4.2.1 Divisions of Mui basin for coal exploration

Block	Size (km^2)	No of drill Holes	Coal Intercepts
Zombe – Kabati	121.5	4	3
Itiko – Mutitu	117.5	7	3
Yoonye – Kateiko	131.5	57	32
Isekele – Karunga	120.0	4	2

(Source: Ministry of Energy, 2010)

Plate 2.4.3.1 Kenya's arid lands are richly endowed with wildlife
(Source: KWS and DRSRS)

Complex. The importance of these and other tourist attractions including Mt. Kenya, the Aberdares, Lake Bogoria, Shimba Hills, Saiwa Swamp and the marine parks, also emphasises the need for the conservation of water catchment areas. Table 2.4.3.1 illustrates changes in wildlife populations for selected animals from 2006 to 2010 – essentially the positive effects of conservation on elephant and wildebeest populations and the negative effects on buffalo, giraffe and waterbuck populations. From this, it is evident that the sustainable conservation of wildlife requires proper conservation of their habitats, which also form important water catchment areas.

2.4.4 Agriculture and Livelihoods

Agriculture is the mainstay of Kenya's economy, contributing approximately 24% of the GDP (GOK, 2011) and employing an estimated 3.8 million people directly in crop and livestock production and fishing, and another 4.5 million in off-farm informal sector activities. The Agriculture Act (Cap 318) of 1986 (revised) gives the Ministry of Agriculture the mandate

Table 2.4.3.1 Wildlife population for selected animals (2006-2010)

Species	Number of animals ('000) in specified years				
	2006	*2007*	*2008*	*2009*	*2010*
Elephant	17.5	19.7	19.4	20.9	22.6
Wildebeest	291.3	291.5	298.0	295	294.6
Grant's Gazelle	117.5	115	114	113.3	112.4
Buffalo	22.1	20.1	18.1	17.8	16.0
Giraffe	31.7	29.3	27.5	25.4	24
Burchell's Zebra	115.4	109.0	107.0	103.4	102.1
Thomson's Gazelle	45.1	45	47.4	47.5	47
Waterbuck	4.1	4.4	3.7	3.9	3.0
Impala	62.5	63.4	63.9	63.8	62.6

(Source: GOK, 2010 Statistical Abstracts)

to ensure the adoption of sustainable agricultural practices in order to protect and conserve the country's environment.

One of the strategic thrusts under the Agriculture Sector Development Strategy (ASDS) is transforming land use to ensure better utilisation of high and medium potential lands, increasing productivity, and development of ASAL for crops and livestock production. The key activities identified to promote better land-use practices include:

i. soil and water conservation where the Ministry's technical officers spearhead conservation efforts through laying of terraces and other measures mainly on small-scale farms with more than 12.5% slope
ii. promotion of water harvesting and management technologies to help farmers and local communities to harvest rainwater and surface runoff for domestic and food production
iii. riverbank protection for communities living along riverbanks and water bodies where stakeholders are sensitised and involved in pegging these rivers to demarcate areas to be left under natural vegetation
iv. involvement of stakeholders in the construction of water pans and small earth dams used for agroforestry nurseries, tree planting, food crop production, and watering livestock; each water pan has a sub-catchment area that is protected and conserved, contributing further to the overall conservation of natural resources
v. enforcement of the 10% farm forestry rule – gazetted by the Ministry in 2009 – requiring that a minimum cover of at least 10% of each farm holding be planted with trees or woodlot
vi. promotion of Integrated Farming Systems with the involvement of the Ministry's extension staff to increase productivity especially in urban and peri-urban areas.

The Government's policy for the fisheries' sub-sector is to maximise production by proper utilisation of resources. To expedite commercial aquaculture growth, the Government introduced the construction of fishponds under the Economic Stimulus Package (ESP) in the 2009/2010 financial year (GOK, 2010: Economic Stimulus Package), and constructed. 20,000 fishponds in 160 constituencies during the period. ESP targeted fish farming as an alternative source of livelihood, and a measure to reduce the demand for fish from conventional sources including Lakes Baringo, Jipe, Naivasha, Turkana and Victoria, River Tana and the Indian Ocean. However, fish farming has a negative impact on water conservation particularly in areas where some fish farmers practise fish farming in water catchment areas such as wetlands.

2.4.5 Livestock and Livelihoods

The production and distribution of livestock in Kenya is largely influenced by rainfall patterns, and since only 20% of the country is arable, the ASAL are

Plate 2.4.4.1 Inappropriate agricultural practices threaten the ecosystem and human health
(Source: MEMR and DRSRS)

most suitable for livestock production and wildlife conservation. Traditionally, nomadic pastoralism constitutes the dominant and the mainstay of the economy in the drylands, and this makes vegetation important for the provision of grazing and browsing resources. The pastoral production system operates by independent family units exploiting a common resource – water and grazing land – through privately owned and managed herds.

Among the pastoralists, frequent daily movement of herds between pastures helps prevent overuse of a single area's biomass and reduces disease and pest incidences in their livestock. Herd diversification (camels, cattle, donkeys, goats and sheep) ensures that both browsers and grazers are present, thus providing protection against the effects of an extended dry spell or a single disease that could wipe out an entire herd. This highly flexible system has evolved over time as the most efficient means of exploiting transient water and pasture under ecologically marginal conditions, available technologies and the prevailing economy (Chikamai and Odera, 2002).

With the alteration of hydrological regimes in catchment areas, frequent prolonged drought, poor land use and deforestation in some ecosystems, the livestock sector is seriously at risk, as are the other important activities in these ASAL – tourism and sand mining.

2.4.6 Indigenous Knowledge

Indigenous Knowledge can broadly be defined as the knowledge that a local community accumulates over generations of living in a particular environment. The role of indigenous knowledge in biodiversity conservation and sustainable management of water catchment areas can be great. This knowledge, which is based on, and deeply embedded in local experience and historic reality, has made it possible for communities to live in harmony with their environment for generations. It has guided people on how to sustainably utilise their natural resources using a variety of innovations to deal with environmental conservation and natural disaster management. It represents all the skills and innovations of a people and embodies the collective wisdom and resourcefulness of the community (Warren, 1992).

Development activities that work with and through indigenous knowledge and organisational structures have several important advantages over projects that operate outside them. Indigenous knowledge provides the basis for grassroots decision-making, much of which takes place at the community level through indigenous organisations and associations that identify problems and determine their solutions. Solution-seeking behaviour is based on indigenous creativity leading to experimentation and innovations as well as the appraisal of knowledge and technologies introduced from without. Local level

Plate 2.4.5.1 Nomadic pastoralism characterised by large herds of livestock
(Source: KEFRI)

knowledge and organisations provide the foundation for participatory approaches to development that are both cost-effective and sustainable.

The role of indigenous knowledge in conservation and sustainable management of water catchment areas in Kenya has to be viewed from the fact that people have depended on the biological resources for their wellbeing and survival for generations. The accumulated knowledge gained through this intimate relationship with nature is invaluable in decision-making on resource use, conservation and development options. Indigenous knowledge systems are participatory in nature and action, and exploiting their use in conservation would need the involvement of local communities, as these hold the key to the knowledge and problem-solving options within their environment.

The management of resources, for example grazing lands and water sources, in the hilltop forests by nomadic pastoralist communities indicates their deep understanding of the dryland ecosystems in a way that should be considered during land use development planning. The knowledge attached to decision-making on seasonal pasture rotation, for instance, should be a guide to land and resource management. Elsewhere, some communities as part of their cultural beliefs and practices manage sacred sites like the coastal Kayas of the Mijikenda, the Naimena Engiyo-Loita forest of the Maasai and the Ramogi Hill forest of the Luo. The strict control of resource use tends to conserve rare species, forests, water catchment areas and other natural resources.

Local communities with indigenous knowledge need to be recognised and involved in decision-making, particularly during the formulation and execution of all community-based projects. This goes hand in hand with dissemination and exchange of information for wider consumption within communities and development agencies, and among policymakers (Kabuye, 1996).

2.4.7 Women and Youth

It is important to note that gender dimensions in the use of water catchments influence their conservation. For instance, it has been observed that in areas where women are involved in conservation activities, the environmental status is well managed, a reality attributed to the fact that women are more involved in rural activities than men. Then again, women spend a lot of time in search of water, firewood and other domestic chores, leaving them with little time for activities related to conservation. Mainstreaming gender into policies, plans and budgets, affirmative action will ensure that women have good representation in various activities within the water catchment areas. Indeed, the Economic Survey 2011 advocates for an enhanced role of women groups in the conservation and protection of water catchment areas in view of the key role that they have increasingly played in development activities. In 2010, the country had 142,783 registered women groups with a membership of 5,579,639 members who mobilised Kes. 551.2 million, demonstrating that women may also be good at resource mobilisation.

Plate 2.4.7 The long wait by women and children to fetch water at a spring

Unemployment is one of the major challenges facing the youth, who currently comprise 32% of Kenya's population, as only about 500,000 young people join the labour market annually. In order to improve their livelihoods, many young people migrate to urban centres in search of employment, thereby increasing competition among unskilled labourers in urban areas. With high unemployment rates, limited skills, lack of resources and lack of opportunities, it becomes easy for the youth to be enticed into irregular activities such as crime, prostitution and substance abuse. Therefore, this valuable human resource needs to be exploited for the conservation of water catchment areas, as was successfully done during the implementation of the Trees for Jobs initiative, where many young people were involved in tree planting and nurturing, and bush clearing. In addition, 97,174 young people were engaged in tree-planting programmes and 8,878,978 trees were planted between 2007 and 2010.

2.4.7.1 Proposed Involvement of Youth in Catchment Rehabilitation

Since 2009, the Government of Kenya has promoted a policy aimed at planting and growing 7.6 billion trees by the year 2030. To this end, various programmes have been instituted by state and non-state actors with examples including the Trees for Jobs initiative of the Ministry of Youth Affairs and Sports, through which nine million seedlings will have been planted throughout the country over a six-year period beginning 2008 at a cost of roughly Kes. 1.38 billion.

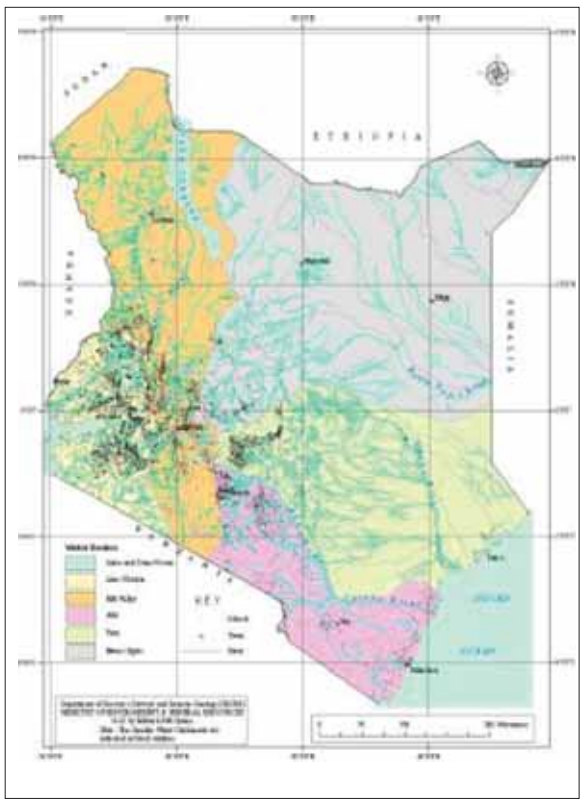
Full exploitation of tree-planting programmes through the registered 16,350 youth groups, 4,300 women groups and 4,200 selected Green Schools in the country, expands possibilities for the accelerated restoration of WCAs.

In 2010, the Ministry of Environment and Mineral Resources and the Ministry of Forestry and Wildlife created a joint tree-planting programme to support efforts aimed at attaining a 10% forest cover by the year 2030. For this to be attained, 200 million seedlings need to be planted yearly, and this requires that tree nurseries are established in 500 schools annually, with each school producing 500,000 seedlings, as presented in the 2011/12 annual budget. This estimate excludes the normal planting programme of Kenya Forest Service (KFS) and the numerous initiatives by non-state actors including financial institutions, community-based and faith-based organisations.

Working through schools has several multiplier effects including creating a critical mass of future environmental stewards, inculcating appropriate attitudes on environmental management to a high population segment, and imparting skills and knowledge to the youth. Figure 2.4.7.1 shows the density of *Green Schools* in water catchment areas.

Plate 2.4.7.1 Youth and women involved in cleaning river Nairobi and tending trees in nurseries (Source: DRSRS)

Figure 2.4.7.1 Distribution of Green Schools in Kenya



(Source: MEMR)

2.5 ECOSYSTEMS AND BIODIVERSITY STATUS

The term ecosystem is generally used to denote the physical and biological components of an environment considered in relation to each other, and these include plants and animals together with their environment: surrounding air, water, soil, sunlight, rocks etc. Ecosystems vary greatly in size and the elements that make them up but each is a functioning unit of nature (Campbell 2009). There is such a high level of interdependence among species and elements in an ecosystem that damage to, or the disappearance of, one part of an ecosystem is sure to have an impact on all the other parts.

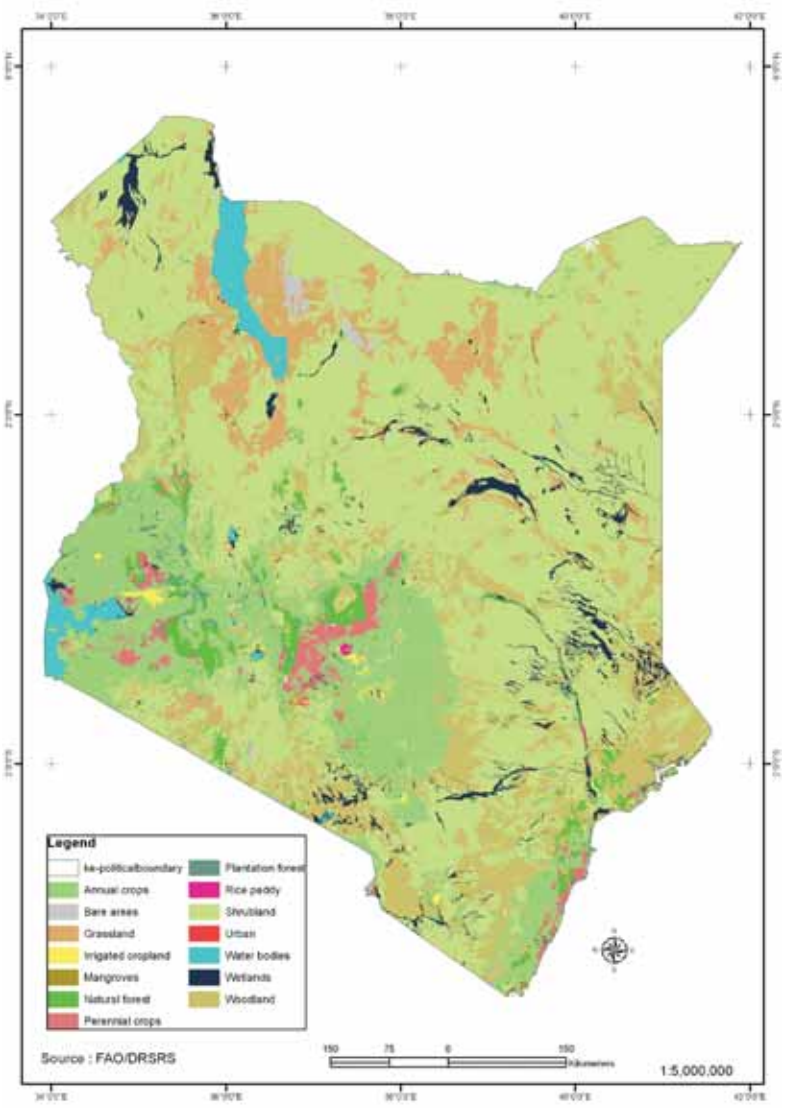
Biodiversity or biological diversity – a concept that originated as a plea for the preservation of the great wealth of plant and animal life in tropical forests (Trapnell, 1997) – is a measure of the relative diversity among organisms present in different ecosystems (Vreugdenhil et al., 2003). By the same token, forest biodiversity refers to the whole web of life – including trees, shrubs, herbs, fungi and animals – that is supported in a forest. Although accounting for only 2% of Kenya's land area, closed canopy forests harbour a large percentage of the nation's biodiversity (Beentje, 1994).

Rainfall and altitude are the two major factors that determine the distribution and growth of plants, thereby conceiving ecosystems with characteristic flora and fauna by which they are distinguished. Kenya's flora is particularly interesting because of the wide range of ecological and climatic conditions: 1,800 woody species have been identified (Beentje, 1994) but this number could be higher, and it is estimated that there are 6,000 to 7,000 species of vascular plants (Eberhard et al., 2010). Sadly, dramatic loss of biodiversity in water catchment areas has been and continues to be caused by human activities including direct harvesting of species, introduction of alien species, habitat destruction and various forms of habitat degradation including environmental pollution. In order to address issues related to the environmental status and biodiversity of the water catchment areas, prior knowledge of the ecosystems in which these water catchment areas are found is imperative, as this helps in monitoring rehabilitation and restoration activities.

2.5.1 Land Cover and Land Use

Kenya is endowed with diverse ecosystems including montane forest, dryland, wetland, marine and terrestrial mangrove ecosystems that are rich in flora and fauna. Figure 2.5.1.1 shows the land cover distribution while Table 2.5.1.1 shows the specific percentage of each land cover type. The figures show that the annual agricultural cropland constitutes only 15% while shrubland dominates the Kenya land cover at approximately 54%.

Figure 2.5.1.1 Land cover distribution in Kenya



(Source: FAO DRSRS Africover Project 2000)

2.5.2 Status of Key Water Catchment Ecosystems

This section highlights some of the important water catchment ecosystems, their biodiversity status, threats and the need for their conservation, and presents illustrative case studies on how some of them are being managed. The main ones presented are forest and dryland hills ecosystems and wetlands; details on their locations, main catchments and rivers, status and threats are provided in Appendix 4, Appendix 5 and Appendix 6.

2.5.2.1 High Montane Forest Water Catchment Ecosystems

The five major water towers namely the Aberdare Ranges, Cherangany, Mau Complex and Mts. Elgon and Kenya, are also the main forest ecosystems within which are natural vegetation types with characteristic biodiversity, largely determined by elevation and rainfall. Details of the typical natural vegetation types and the key tree species for each water catchment area are provided in Appendix 5. The natural vegetation types for the major water towers are:

- Afro alpine occurring above 3,800m a.s.l, found on Mts. Elgon and Kenya and the Aberdares only, and characterised by freezing temperatures, strong wind, shallow wet or marshy peaty soils on rock, and the absence of trees except Senecios, tussok grasses, Carex bogs, wiry herbs, mosses and lichens. There is minimal human or animal disturbance at these elevations and the major threat would be the effects of climate change.

- Mountain scrubland and moorland occurring at 2,500–3,800m and found in all water towers. It is characterised by very cold temperatures, thin wet or marshy peaty soils on rock, tussock-forming grasses and sedges, mosses, lichens and ferns are also common. There is minimal human and animal disturbance at these elevations and like in the Afro Alpine, the major threat would be the effects of climate change.

Table 2.5.1.1 Percentage extent of the different land cover types of Kenya

Land use Type	Area in Ha	% Coverage
Annual agricultural crops	898,664,439	15.42
Bare areas	24,869,544	0.43
Grassland	370,635,107	6.36
Irrigated cropland	15,709,530	0.27
Mangroves	6,600,512	0.11
Natural forest	129,685,530	2.23
Perennial crops	96,398,932	1.65
Plantation forest	18,030,787	0.31
Rice paddy	4,923,689	0.08
Shrubland	3,162,538,113	54.28
Urban	3,098,008	0.05
Water bodies	125,753,101	2.16
Wetlands	162,875,837	2.80
Woodland	806,716,871	13.85
Total	5,826,500,000	100

- Bamboo woodland and thicket occurring at 2,100–3,300m a.s.l. with rainfall above 1,200mm and recognised by the occurrence of bamboo in pure stands in closed canopy or patches or mixed with scattered trees but usually forming over 80% cover. This is a crucial vegetation type because most rivers, streams and springs start here and so does serious destruction by humans and animals through the intensive harvesting of bamboo and other woody species and cultivation.

- Drier montane forest occurring at 1,800-2,900m a.s.l., with annual rainfall totals of 700-1,350mm. This vegetation type, found in the drier, cold (leeward) slopes of mountains, is an important source of several rivers and springs. Unfortunately, there has been much destruction particularly through illegal logging, grazing, cultivation and settlements, charcoal burning and fires among others, resulting in severe degradation.

- Moist montane forest occurring at 1,600-2,450m a.s.l., with rainfall over 1,800mm. This forest ecosystem is found in the wetter (windward) slopes of mountains, and is characterised by a continuous stand of trees over 10m tall with closed canopy, relatively moist or wet floor, usually with carpet forming Selaginella kraussiana, lichens and epiphytic ferns – the tree fern, Cyathea manniana, is common along streams. This ecosystem, being an important source of several rivers and springs, faces potential destruction, as it is most suitable for the production of many staple crops such as potatoes and cabbages. Indeed, many of these areas have been cleared of natural vegetation and converted to agricultural land and plantations of exotic species.

Plate 2.5.2.1.1 Pure stands of bamboo in the Aberdares and Mau Forests
(Source: DRSRS)

Plate 2.5.2.1.2 A well conserved moist montane forest and similar forest ravaged by fire
(Source: DRSRS)

2.5.3 Biodiversity of Key Forest Water Catchment Areas

Kenya is among the world's top 50 countries in terms of species richness (IUCN, 1996), and has one of the highest numbers of total mammal species in Africa. In addition to being the heart of biodiversity wealth, Kenya's water catchment ecosystems are the backbone of much of the country's economic activities on which many livelihoods depend. Table 2.5.3.1 compares Kenya's biodiversity with that of selected African countries.

Table 2.5.3.1 Globally threatened species in Kenya compared to selected high-biodiversity African countries

Country	Mammals	Birds	Freshwater Fishes	Plants
Kenya	*359(a) 21(b) 43(c) 12 (d)*	*844(a) 6(b) 24(c) 2.8 (d)*	*unknown (a) unknown (b) 20 (c) unknown (d)*	*6000(a) 265(b) 158(c) 2.6 (d)*
Namibia	*154(a) 3(b) 11(c) 7.1 (d)*	*469(a) 1(b) 8(c) 1.7 (d)*	*102(a) un(b) 3(c) 2.9 (d)*	*3128(a) un(b) 23(c) .74 (d)*
Madagascar	*105(a) 84(b) 46(c) 44 (d)*	*202(a) 104(b) 28(c) 14 (d)*	*40(a) un(b) 13(c) 33 (d)*	*9000(a) 6500(b) 189(c) 2.1 (d)*
Uganda	*338(a) 6(b) 18(c) 5.3 (d)*	*830(a) 3(b) 10(c) 1.1 (d)*	*291(a) un(b) 28(c) 9.6 (d)*	*5000(a) un(b) 6(c) .12 (d)*
Tanzania	*316(a) 12(b) 33(c) 10 (d)*	*822(a) 24(b) 30(c) 3.6 (d)*	*un(a) un(b) 19(c) un (d)*	*10000(a) 1122(b) 406(c) 4.1 (d)*

Biodiversity: (a) total number of known species, (b) endemic species, (c) threatened species, (d)% of threatened taxa

(Source: 1996 Red List, World Conservation Monitoring Centre and IUCN)

The Mau Forest Complex is an example of the wealth in biodiversity of catchment areas, as it hosts several indigenous valuable plant and animal species (KIFCON, 1993) including the Bongo whose race, T. e. Isaaci, is endemic to Kenya. Other mammal species that are of international and regional conservation concern include the yellow-backed duiker, golden cat, giant forest hog, leopard spotted and striped hyena, buffalo, black and white colobus, black-fronted duiker and the African elephant. Other nationally endangered species found only in this forest include the potto, spotted necked otter and the striped hyena. The forest has a rich variety of birds representing the richest montane avifauna in the Eastern African region with 173 bird species having been recorded there, and is also rich in invertebrates, reptiles and amphibians.

Another biodiversity-rich water catchment is Mt. Kenya, a unique ecosystem with great cultural and biological significance, recognised as a Forest Reserve in 1932, established as a National Park in 1949, and designated a Biosphere Reserve under UNESCO Man and Biosphere Programme in 1978. In addition, the National Park and forest reserve area was in 1997 listed as a World Heritage Site for its notable landscape and outstanding flora and fauna. Mt. Kenya has various altitudinal zones of vegetation including moist forest, dry highland forest, bamboo, afro-alpine moorland and finally the snow and glacier belt (Appendix 5).

The floral diversity of these forests includes 882 plant species and subspecies belonging to 479 genera in 146 plant families (Bussmann, 1994). With much of Central Kenya forests gone, Mt. Kenya has become a refuge for rare and endangered plant and animal species once common in the region. These forests are also rich in medicinal plants and supplement the pharmaceutical requirements of the people.

2.5.4 Threats to Biodiversity of Forests and Water Catchment Functions

With forest ecosystems being vulnerable to natural shocks, mismanagement and unsustainable use, many are facing the threat of depletion, and as a result, the ecosystems and biodiversity of water catchments have been increasingly degraded. The rapidly growing population and increasing developmental needs within the high potential areas where catchments are concentrated have increased demand for fertile land, water, and energy, therefore putting considerable pressure on the resource base. The continued mining of catchment resources jeopardises biodiversity and essential ecological services and this will certainly increase poverty levels. In view of the two-way causal relationship between catchment degradation and poverty, it goes without saying that the majority of poor people depending directly on catchment resources for sustenance will be the most directly affected by degradation of the capital base.

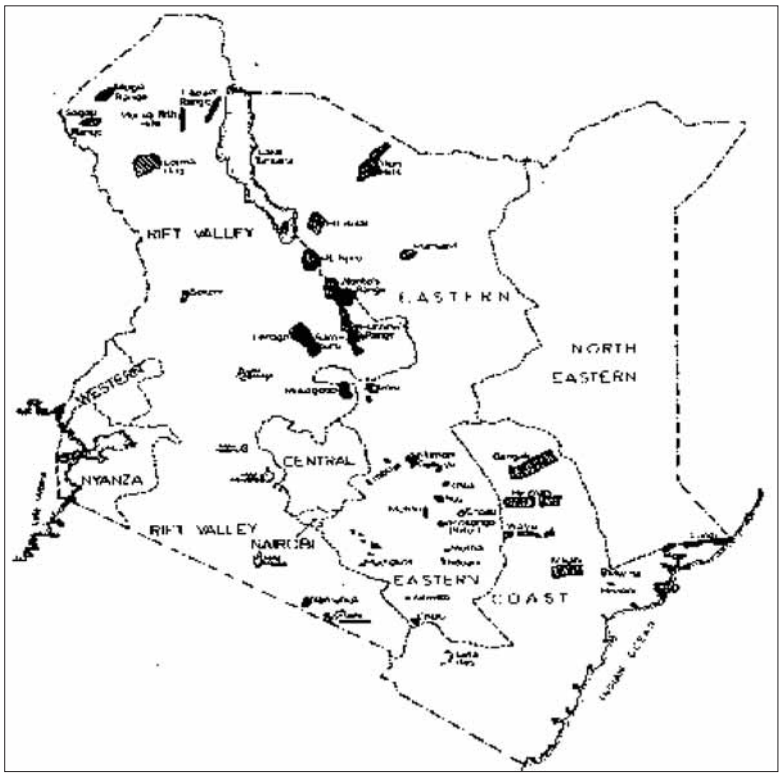
2.5.5 Dryland Water Catchment Ecosystems

Drylands make up approx. 80% of Kenya's land surface and support 25% of the human population, slightly more than 70% of the livestock population and 90% of the gazetted National Parks and Game Reserves. Generally, they are characterised by hot and dry climate with low, brief, erratic and sporadic annual rainfall, poor soils and scanty vegetation cover. These regions – in which droughts, conflicts and household food insecurity are commonplace – have the highest incidence of poverty in Kenya (Government of Kenya, 2000).

Extensive areas of Kenya's drylands are low-lying plains covered with thickets of thornbush, grassland and scattered trees – mainly Acacia and Commiphora species. These plains are dotted with isolated hills and low mountains (Figure 2.5.5.1 and Table 2.5.5.1), which when of sufficient height, trap and hold clouds or force moisture-laden winds into high altitudes where cooling causes condensation. These hilltops, which hold unique islands of forests supporting different flora and fauna (Gachathi, 1996), are explored in this section to demonstrate their importance as water catchments and biodiversity conservation areas, and their role in strengthening adaptation to climate change. See the Endau Hill case study (Figure 2.5.5.1).

Plate 2.5.5.1 Dry and very dry ecosystems of northern Kenya
(Source: KEFRI)

Figure 2.5.5.1 Gazetted dryland hilltop forests



(Source: KEFRI dryland Forestry Handbook)

2.5.5.1 The Importance of the Hilltop Forests at the Local Level

The impact of hilltop forest cover on microclimate (i.e. soil, temperature and soil moisture conditions) is significant, as it moderates the effects of temperature and wind, and significantly changes the humidity regime (Wass, 1995). These microclimates provide a much wider range of environmental conditions that are nonexistent under other dryland vegetation cover, and as a result support a wider range of species. The fact that these hilltop forests prevent rapid runoff of rainwater and help replenish springs and streams in the valleys below, makes them water catchments vital for the existence of pastoralists, domesticated and wild animals. Not only do these hills provide water, pastures and wild food plants during periods of drought, but also traditional herbs and medicines and a venue for socio-cultural activities such as traditional ceremonies and sacrifices. For this reason, the conservation of such biodiversity hotspots is of paramount importance (Myers et al., 2000).

2.5.5.2 Conservation and Management of Hilltop Forests by the Local Communities

Traditionally, the local communities have responsibly conserved and managed hilltop forests in the drylands through customs and unwritten rules and

Table 2.5.5.1 Dryland catchments

MOUNTAIN/HILL	CATCHMENT/RIVER	COUNTY
Mt. Marsabit	Local	Marsabit
Mt. Kulal	Local	Marsabit
Hurri Hills	Local	Marsabit
Mathews Range	Ewaso Ng'iro, Milgis	Samburu
Ndoto Mts	Local, Milgis	Samburu
Nyiru Mts	Local	Samburu
Kirisia Hills	Ewaso Ng'iro, Milgis	Samburu
Namanga/Ol Doinyo Orok	Local, Cross-Border, TZ	Kajiado
Emali Hills	Local	Kajiado
Chyulu Hills	Mzima, Tsavo, Galana	Makueni, Kajiado, Taita
Machakos Hills	Athi	Machakos, Makueni
Ol Doinyo Sabuk	Athi	Machakos
Endau Hill	Local	Kitui
Mutitu Hill	Local	Kitui
Mumoni Hill	Local	Kitui
Tugen Hills	Perkerra, Kerio, Suguta,	Baringo
Karasuk/Loima Hills	Turkwell	Turkana
Kasigau Mt.	Local	Taita-Taveta
Maungu Hills	Local	Taita-Taveta

regulations that govern the use and management of these forests. These communities have employed ecological management strategies in harmony with their fragile ecosystem by exploiting different ecological niches, even resisting the desire to have their animals graze in the hilltop forest where pastures are good (Karanja, Tessema and Barrow, 2002). Furthermore, harvesting of plant materials including herbal medicines is regulated by community rules and regulations effected by the elders.

2.5.5.2.1 Case Study of Endau Hill Forest

Endau Hill lies between the highlands and the coastal forests at 38o 38' East, 1o 16' South, rising from the general altitude of 500m a.s.l. on the plains to several peaks that summit at Matundu (1,400 m). Endau Hill Forest, which falls under the administration of the Zonal Forest Office in Kitui, is a gazetted forest that is legally owned by the Government and managed directly by the KFS. A Forester at Mwitika together with a Forest Guard and a Patrol Man stationed at Endau Trading Centre are responsible for the daily management of the 6,700 Ha forest, particularly the water catchments (Gachathi and Amwatta, 2005).

According to the local community, water is the most important commodity derived from this hill, a source of nearly 20 permanent water springs of which six have been tapped and piped down into huge tanks for use by the local community and their livestock. The permanent springs include Ngunya-imwe and Kausya springs supplying Ikisaya, Wazalani and Kathua markets, the Ikituku and Yongoni springs supplying Manjunja area, the Kangera and Kaundua springs supplying Mutalani, the Kibau spring supplying Koi primary School and Twamboi markets. The spring water is piped with support from various NGOs particularly the ASAL Programme and AMREF, while local communities manage the water through water committees.

Other important uses of Endau Hill are for grazing livestock during the dry season when all grass and palatable herbs have dried up, sourcing traditional herbs and medicines and for socio-cultural activities. The forest has become central to the culture of the local Kamba community living around Endau Hill, and is associated with various traditional ceremonies of great cultural and spiritual value. For example, each year before planting, a traditional ceremony is performed on sacred sites at Kwa Sio Sili and Kwa Muteyia, with people taking their seeds for blessings from their ancestors.

The case of Endau forest clearly exemplifies the importance of community involvement in the sustainable use and conservation of water resources and catchment areas, which could be replicated countrywide in the management of important environmental resources.

2.5.6 Threats to Biodiversity and Water Catchment Functions of ASAL Areas

The increased pressure on natural resources in the ASALs has led to the degradation of fragile ecosystems and resulted in a marked increase in resource-based conflicts as competition for scarce resources stiffens. Sadly, there are no formal regimes to manage and support the multiple functions of hilltop forests in a holistic manner, and the current formal knowledge base tends to focus either on adaptation to climate within farming or livestock systems or on biodiversity conservation in protected areas. Seldom does it focus on local level interaction between the two on which both people's adaptation options and biodiversity conservation depended, and this needs to be addressed.

2.5.7 Wetland Water Catchment Ecosystems

Kenya's wetland ecosystems, which cover between 3-4% of the total land surface, are considered the most diverse and productive, probably second only to forests (Wetlands International, 2011). Their importance and value range from ecological/ environmental to socio-economic functions, as they support a number of livelihood systems and cultural practices among Kenyans countrywide.

Plate 2.5.5.2 Honey is a major source of livelihood from natural resources in arid land forests (Source: MEMR)

The Kenyan landscape and wetlands are associated with rich biodiversity assemblages, unique to the different wetland types, and in some cases with endemic flora and fauna. The wetlands, stated as the richest sinks of carbon (IPCC, 2010), have special benefits to the overall ecosystems and livelihoods. They control floods and prevent soil erosion by storing excess amounts of water during heavy rainfall, thereby reducing floodwater volumes downstream. This in turn mitigates settlement disruptions similar to those on the lower courses of the Nzoia and Tana River basins that have become a common feature. The water is then discharged in small amounts, and it is through this slow movement of water that infiltration is enhanced and ground water and aquifers recharged. Similarly the slow movement allows silt and sediment retention and protects the riverbanks from erosion and reduces the flow of toxic substances from inflowing water thereby improving the quality of water downstream.

Wetlands are natural habitats for a variety of plants and animals some of which are endemic, endangered and migratory. They are therefore in-situ banks for genetic resources. This makes them unique sites for tourism, cultural activities and scientific research. As a source of hydroelectric power and raw materials (reeds such as Papyrus sp. and Phragmites sp.) for the cottage industry, wetlands support industrial growth. In addition, the edible plants, animals and fish that thrive in wetlands are a source of food.

2.5.7.1 Threats to Biodiversity and Water Catchment Functions in Wetlands

Despite the high productivity and provision of many benefits, wetland ecosystems are still facing serious threats. The main threats are those arising from poverty, poor policies, population pressures – specifically rapid human population growth, immigration, urbanisation and industrialisation. These lead to several problems in the wetlands

Plate 2.5.7.1 The Napuyapuyi Swamp which forms the upper catchments of the Mara River (Source: MEMR)

Plate 2.5.7.2 Fish farming is done in wetlands and this may compromise the quality of water (Source: MEMR)

including reclamation, pollution from domestic and agricultural discharge, eutrophication, overexploitation of resources, excessive extraction of water and invasion by alien invasive species. With time, these problems have intensified, resulting in serious ecological imbalances.

Serious cases of pollution include Lake Nakuru, which is threatened by industrial and domestic waste, Lake Naivasha by agrochemicals from horticultural enterprises and Tana River by agrochemicals and urban waste. In addition, Lake Victoria and associated wetlands are under threat of destruction by industrial effluent from sugar and paper industries, agro-chemicals and domestic waste. Indeed, most wetlands are increasingly showing symptoms of nutrient enrichment such as algal blooms, fish kills, prolific growth of macrophytes and murky foul water.

The main land use changes that have affected wetlands in Kenya include deforestation, encroachment onto catchment areas, and the reclamation and draining of wetlands for agricultural purposes. The deforestation of critical areas including the Mau, Mt. Kenya and the Aberdares forests has occasioned the destruction of various catchments such as the Tana River and Lakes Victoria, Nakuru and Baringo. The encroachment of catchments is a major problem that has been observed on the Yala Swamp, Lakes Naivasha, Baringo, Victoria and Ol Bolossat, and Tana River, as is the reclamation of many wetlands including the Yala Swamp and Tana Delta.

Given the fragility of wetlands, there is an urgent need to strike a balance between the environmental functioning of wetlands and their sustainable use for livelihoods. For this reason, there is desperate need for management regimes that guide the use, conservation and sustainable management of wetland biodiversity resources in Kenya. Such a policy, which would need to be tailored to the natural characteristics of individual wetlands, would contain guidelines on the conservation, wise use and management of these wetlands.

2.5.8 Invasive Species

A species is regarded as invasive if, having been introduced by human action into a location where it is not native, it becomes capable of establishing a breeding population without further intervention by humans and becomes a pest, threatening the local biodiversity (Space, et al, 2003). However, it is worth mentioning that some indigenous species can also be invasive, as is the case of Polygonum senegalense which has invaded Lake Ol Bolossat, *Phragmites mauritianus, Pistia stratiotes, Typha latifolius, Cyperus papyrus, Nymphaea spp and Ludwigia stoloniferus.*

Invasive aquatic species, both floating and submerged, pose serious threats to the country's lakes, rivers, dams and swamps, as they impede fishing, navigation and interfere with general water flow. Water hyacinth *(Eichhornia crassipes)* on Lake Victoria has chocked the socio-ecological functions of the lake, as has *Salvinia molesta*, which occupies large areas of Lake Naivasha, and occurs on Rivers Nairobi and Ramisi, Masinga Dam and other aquatic

Wetland Degradation: The Case Study of Tana Delta

The Tana Delta wetlands within Tana River District of Coast province are arguably Kenya's largest, most ecologically and biologically diverse, and socioeconomically important wetlands in Kenya. Covering an estimated area of 130,000 Ha, the delta supports a gallery of ecosystems ranging from forests to swamps to dunes to beaches and ocean, home to diverse exotic plants and animal species, some of which are listed as endangered. The delta is immensely valuable to the local people who have built an intricate relationship between their lifestyles and the dynamics of the delta's ecosystems.

Multinationals and local corporations are scrambling for a piece of the globally important Tana Delta wetland, on which they propose to grow food for export, biofuels and source minerals. There is a need for feasible development projects that will not only enhance the livelihoods of local communities in the areas but also promote sound conservation practices, but this is not the case in the Tana Delta where development projects are currently being promoted in absence of a land use plan.

Figure 2.5.7.1 The wetlands of the Tana Delta

ecosystems (Roimen et al., 2008). *Prosopis juliflora*, commonly known as *Mathenge*, is yet another alien invasive species that has invaded various water bodies and watercourses including Lakes Baringo, Turkana and Bogoria and Rivers Tana, Ewaso Ng'iro and Turkwell.

The Convention of Biological Diversity (CBD) recognises the significance of aquatic invasive species as a threat to biodiversity conservation, and is committed to the prevention and control of their spread globally.

The management of widespread invasions on transboundary water resources such as the water

Plate 2.5.8.1 Invasive species (P. senegalense, S. molesta and E. crassipes) in L. Ol Bolossat and L. Naivasha (Source: KEFRI)

hyacinth on Lake Victoria requires intergovernmental coordination, for example the Lake Victoria Environment Management Programme (LVEMP) involving many agencies from all the countries sharing the lake resource. It is also important to involve the neighbouring farming communities, which through using many agricultural inputs, provide ideal sources for nutrient loads that support growth of these weeds. This calls for the harmonisation of land use regulations in the catchment areas and around lakes.

2.6 STATUS OF WATER CATCHMENTS AND SUB-CATCHMENTS

The water catchments have a varied environmental status that is continually changing in terms of environmental status due to both anthropogenic and natural influences and can be categorised according to different levels of degradation. Appendix 6 shows the different levels of degradation analysed using satellite images from 1975 to 2010. This section contains a description of the major river systems, changes in vegetation cover and land use, and threats to the selected water catchments and sub-catchments. The status of selected catchments, sub-catchments and local catchments has been analysed in terms of trends in flow with the aim of detecting whether any land cover and land use may have had an impact on flows. Table 2.6.1 shows the list of selected catchments analysed.

2.6.1 Mt. Marsabit Catchment

Mt. Marsabit has a low mountain forest covering 15,700 Ha whose vegetation composition is typical of a dry upland mixed forest; it occurs at an altitude of 1,165 – 1,500m a.s.l. and is a local catchment area for several streams that provide water to the town. Figure 2.6.1.1 shows changes in vegetation cover and land use from 1989 to 2009. Land-use practices that threaten the existence of the mountain forest include encroachment, excessive water use, charcoal burning, firewood collection, grazing and climate change effects. Land cover changes from 1986 to 2009 (Figure 2.6.1.1) indicate that cropland and shrubland have been increasing at the expense of natural forests and grassland. The reduction of the natural forest threatens the water catchment role of the forest while the decreasing grassland threatens the livelihoods of pastoralist communities.

Marsabit Forest is considered a water tower by virtue of the fact that it is the source of water for the town and the highly populated surrounding communities that tap it for water, fuelwood and pasture for their livestock of which at least 50,000 graze the forest daily. Indeed, it has been noted that in the last five years, the water levels within the crater lakes of Mt. Marsabit have declined significantly and in some instances completely dried up – see plate 2.6.1.1.

With the expansion of Marsabit town, whose lacking sewer system contributes to the pollution of surface and ground water sources, the sustainability of the Marsabit catchment area has been called into question. Indeed, there are no reliable ground water sources in the catchment and the few productive

Table 2.6.1: Changes in Vegetation cover and Base Flow of selected catchments

SN	Catchment	Selected sub catchment	Size/Location/ Remarks	Percentage decrease in forest cover (1976-2009)	Decrease in base flow 1926-2000 (Mean %)	Remarks
1	Mt. Marsabit Forest	Mt. Marsabit	Local Forest catchment	20		Change in settlement patterns and change to sedentary livelihoods leading to a loss
2	Tinderet Sub catchment	Nyando	Main catchment area for Nyando River	25		Expansion of cropland
	Malewa Sub Catchment	Wanjohi	A significant water catchment for Naivasha	48	44	Subsistent agriculture
3	Mt. Kenya	Likii and Thiba	A major catchment for river Tana	29	49	Forest cover reduction due to agricultural activities
4	Kinale Sub catchment	Ndarugu	Found in Kikuyu escarpment. Significant for water source to Nairobi	3	14	Clearing indigenous forests for large scale tea plantations
5	Cherangany	Upper Nzoia	The main catchment for river Nzoia	46		Encroachment, high water use, illegal logging, charcoal burning, firewood collection, illegal grazing, cultivation
6	Nzoia River	Wuoruoya	A catchment with several subcatchment experiencing different levels of threat	25	6	Expansion of cropland causing flooding downstream
7	Njoro River	Njoro	Is the main catchment for Lake Nakuru	69	11	Forest clearance for agricultural activies
11	Shella Dunes catchmet	Shella Sand dunes	A significant but threatened catchment at the coast			Water front development activities
12	Taita Hills		A local catchment area for Voi River	78		Subsistence farming and high population pressure
13	Mt Kulal		A local catchment area in a dryland	6		Logging for fuel wood, building materials and construction, removal of the understory and grass fires,

Lake Paradise Marsabit Forest in 2005 with water (Source: KEFRI & MEMR)

Dry Lake Paradise in Marsabit Forest 2010

Plate 2.6.1.1 Changes in the levels of the water in Lake Paradise, Marsabit Forest Reserve

shallow wells, springs and pans are drying up. Bakuri, the major spring has recorded lowest flow in 10 years, while Sokote Ndiko and Sokote Buba have dried up for the first time in history. (Plate 2.6.1.1).The lack of a reserve means that all the water is abstracted as soon as it becomes available, and this needs to be addressed urgently through an integrated catchment management approach.

The problems facing the catchment can be attributed to changing settlement patterns and the change to sedentary livelihoods, with large livestock herds grazing in the forest. Though traditionally Marsabit Forest was a dry season grazing land, the immigration of pastoralist communities to the area has made grazing a permanent activity in the forest thereby destroying existing vegetation and hindering its regeneration. The population increase has precipitated forest encroachment, excessive water use, and increased demand for firewood, grazing land and charcoal; the uncontrolled sinking of boreholes is arguably the reason why Lake Paradise dried up.

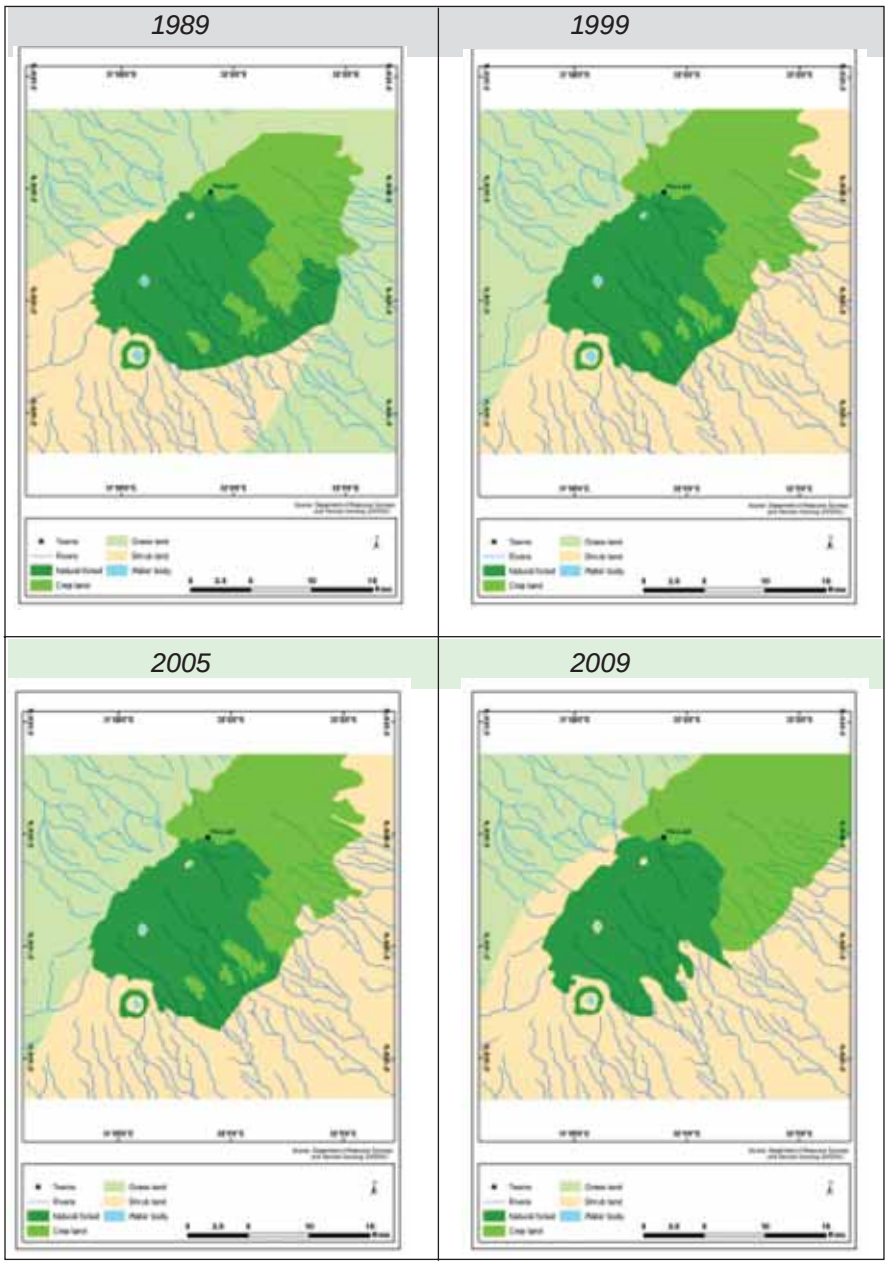
Plate 2.6.1.2 Marsabit Town and water scarcity

Some of the proposed interventions for the conservation of the Marsabit catchment include improving water harvesting and storage systems, which requires communities to construct or buy water storage tanks to harvest rainwater, and the construction of check dams for water harvesting in the laggas. Indeed, the construction of Marsabit dam is a milestone in this conservation effort since it ensures that all the runoff from the forest can now be tapped. Reducing excessive extraction of forest products would require that communities adopt the use of alternative energy sources (e.g. biogas and energy saving stoves) and livelihoods such as tourism, butterfly farming, beekeeping and carbon trading to diversify their incomes and reduce forest dependence. Adoption of agroforestry systems and practices would reduce pressure on the forest by providing wood products and fodder on farms while improving farm produce.

2.6.2 The Malewa Catchment

The Malewa Basin is located on western slopes of the Aberdare ranges; the basin is 625 km^2 in size, slopes at 18% to the west and varies from 2,066 to 2,788m in elevation. Ridges are sharp-crested, valleys vary from V-shaped for sub drainages to broad U-shaped for the major valleys, and the drainage pattern is dendritic. Stream density is high, around 6km/km^2

Figure 2.6.1.1 Changes in land cover types in Marsabit sub-catchment (1986-2009)



and the climate is classified as humid mesothermal with temperatures averaging 10°C in July and 21.6°C in September. Rainfall in the vicinity, as determined from data of Ol Jorok KARI station (altitude 2,574m, rainfall 820mm and Geta Forest station (2,788m, rainfall 1,196mm) is low compared to that of the windward stations in east Tutho, Murang'a (2,263mm and 2,314mm respectively). Nevertheless, within the catchment it varies with elevation (slight orographic effect) from 679mm at low elevations (Naivasha at 2,066m) to 1,196mm at high elevations and averages 800mm annually. Rainfall is distributed fairly evenly

Figure 2.6.1.2 Changes in land cover types in Marsabit sub-catchment -1986-2009

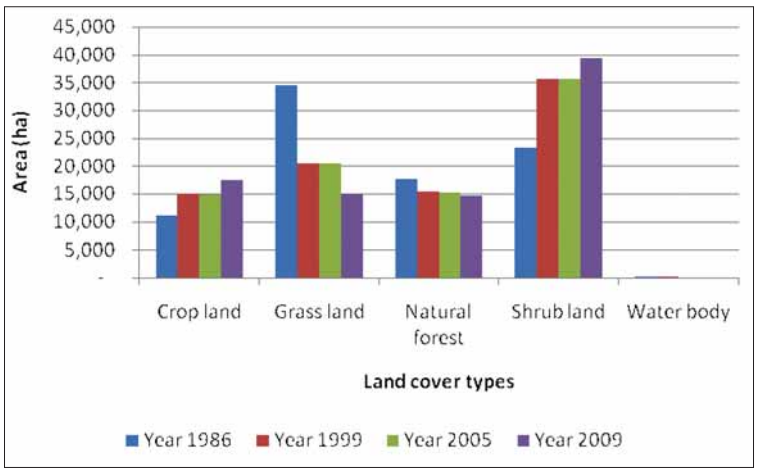


Figure 2.6.2.1 Reducing base flows for Wanjohi sub-catchment (station 2GB04) (1974-2002)

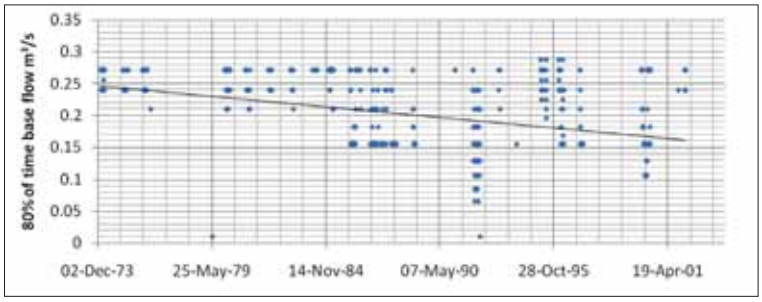
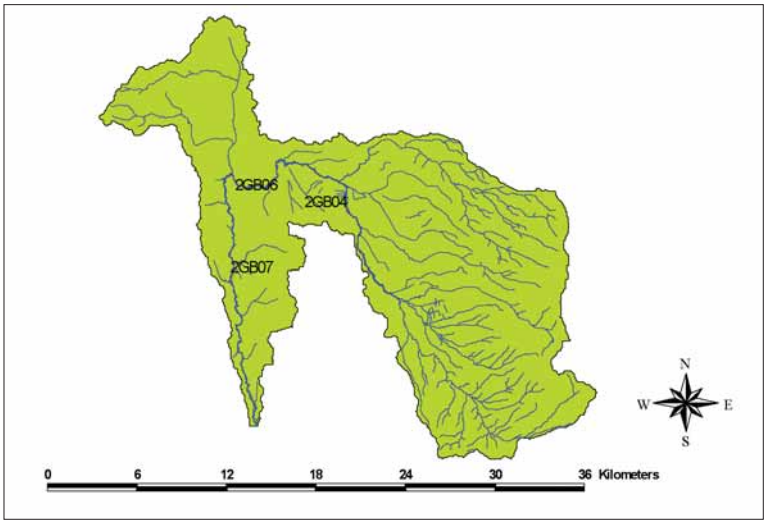


Figure 2.6.2.2 The position of 2GB04 in Wanjohi sub-catchment (near Rironi)



throughout the year, peaking in May (160mm) and dropping to its lowest in January (30mm).

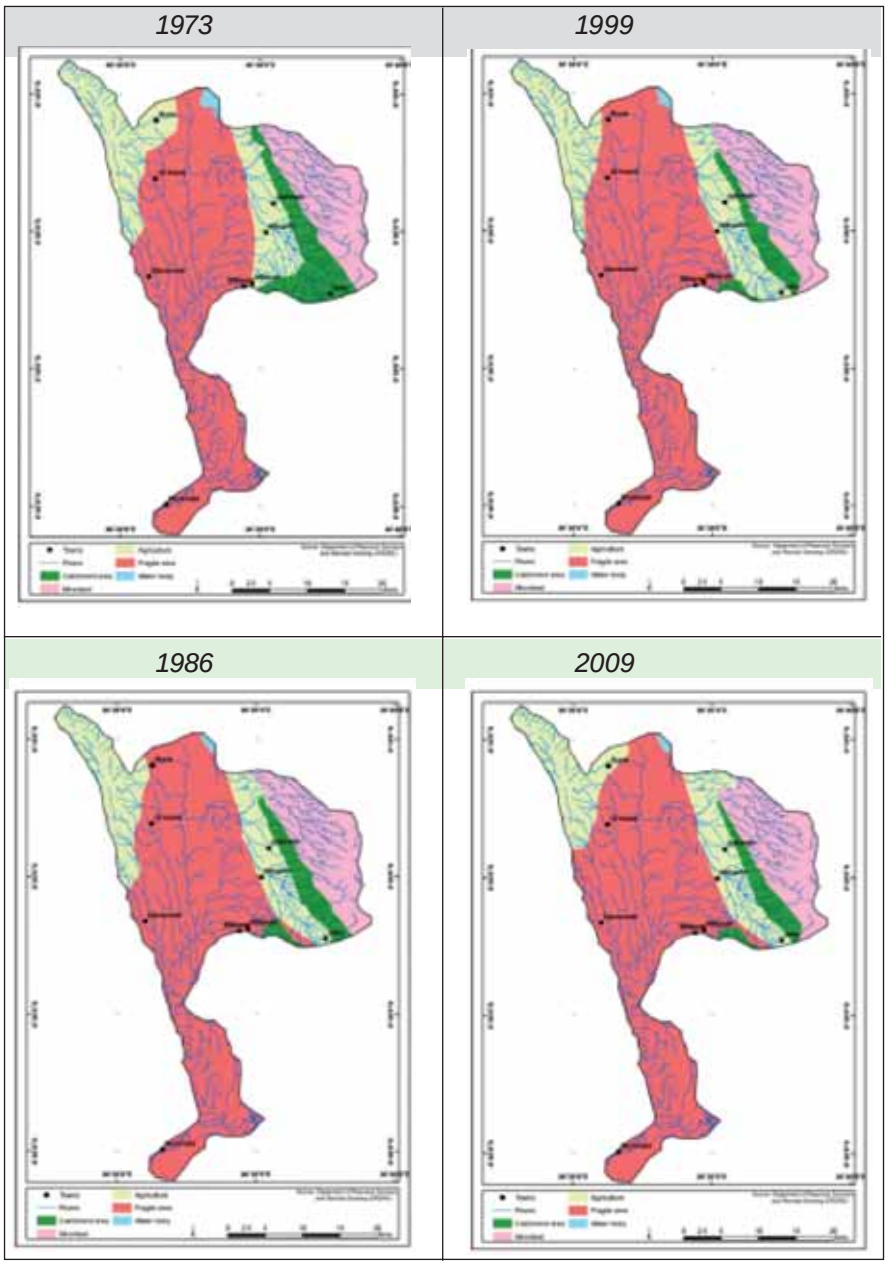
Wanjohi sub-catchment is one of the smaller areas that form Malewa, which constitutes the upper Lake Naivasha catchment. An analysis of observations made at station 2GB04, the last outlet of Wanjohi River from 1974 to 2002 are as follows: mean is 1.05m^3/s, median is 0.57m^3/s, minimum is 0.011m^3/s and maximum is 11.86m^3/s. The trend depicted for this river is one of rising for flood flow which has increased by 27% and base flows which have decreased by 44% (Figure 2.6.2.1).

The Shamata-Wanjohi catchment is largely comprised of fragile areas with low vegetation cover and is prone to sheet erosion, with the most fragile area stretching from Ruriie to Ol Kalau and down to Morendat. The catchment area, made up of vegetated slopes (closed canopy forests) of the Aberdare ranges, decreased from 8,390 Ha in 1973 to 4,370 in 2009 (Figures 2.6.2.3 and 2.6.2.4). Half of sub-catchment land cover that was previously virgin forest has been converted into agricultural land for subsistence farming, a serious threat to the sustainability of the catchment area and therefore the livelihoods of the people.

2.6.3 Tinderet Sub-Catchment

The Tinderet forest is the main catchment area for the Nyando River whose waters also drain into the River Kerio. The main land-use practices are agriculture and livestock rearing. Between 1986 and 2009, the natural forest decreased from 35,110 to

Figure 2.6.2.3 Changes in land cover types in Shamata-Wanjohi sub-catchment (1973-2009)



26,270 Ha attributable to the expansion of cropland (Figures 2.6.3.1, and 2.6.3.2).

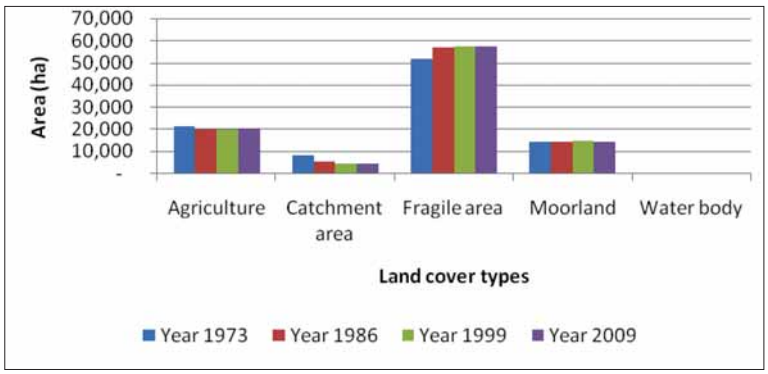
The situation for Nyando River which has some of its catchments in Tinderet has been a steady one over the decades shown by the shape of the flow duration curves (FDC) in Figure 2.6.3.3, which may imply that the catchment is resilient to the changing land uses including conversion of forests into agricultural land. A justification for this may be the fact that the forests were mainly cleared to create tea farms whose water

catchment conservation capacity may be equal to that of forests.

2.6.4 Kinale Catchment Area

Kinale sub-catchment derives its waters from the Kikuyu escarpment and predominantly supports agriculture – 75% of the land use activities. The natural forest, which has an area of less than 30% of the total catchment area, is under threat from the ongoing rapid urbanisation. The changes in the land cover are indicated in Figures 2.6.4.1 and 2.6.4.2 for the period 1986 to 2009.

Figure 2.6.2.4 Changes in land cover types in Wanjohi sub-catchment (1973-2009)



The sub-catchment and those in the surroundings – majority of which constitute upper Athi and Tana Rivers – have had their indigenous forest and wetland vegetation replaced with tea plantations and rainfed subsistence food crops. In addition, the downstream water use for irrigation, domestic and industry has steadily increased consistent with Kenya's population growth. A historical analysis shows that in 1940, about 50% of the watershed area was under natural forest cover but this decreased to 43% by 1948 and 30% by 1965. From 1940 to 1947, deforestation was undertaken mainly for agricultural purposes including shifting cultivation, home gardens, and large-scale tea plantations. The large-scale (more than 50 ha) tea plantations by the British planters in Crown lands (i.e. lands vested in the government during British rule) prompted the migration of people from the downstream areas to supply labour.

Between 1948 and 1964, tea smallholdings (varying from less than 1 to 5 ha) had mainly replaced the forest, particularly at steep headwater areas, and tea production supplanted other land uses such as shifting cultivation. The major factors for the expansion of tea smallholdings were population pressure resulting mainly from migratory labour, the tea subsidy scheme made available to smallholders, the introduction of high yielding clonal tea, and the allocation of smallholdings to farmers by the Government. Indeed, the suitability of the existing climate for tea assured farmers of a year-round income exceeding that of other agricultural crops. The changes associated with these land use transformations coupled with the reduction in forest cover from 50 to 30% between 1940 and 1964 was the generation of increased runoff.

An analysis of daily stream flow data from the Ndarugu River, located in the Kinale sub-catchments, from 1943 to 2002 shows that mean flow has been 1.79m^3/s and the median 1.02m^3/s. The decreasing linear trend for baseflows is noticeable, having reduced by 14%, while flood flow has increased by 23%. (Figure 2.6.4.3) Though the conversion of forestland into urban areas seems not have had significant impacts on mean flows, it has nevertheless had a significant impact on both minimal and maximal flows.

The effects of the intensification of extreme events (drought and flooding) in the country due to land cover degradation are well documented (e.g. Mogaka et al., 2006), for example the 1997/98 El Niño event is estimated to have cost Kes. 70 billion while the following La Niña drought is said to have cost at least Kes. 220 billion.

2.6.5 The Cherangany Catchment

The western slopes of the Cherangany support tributaries that feed into the River Nzoia; here the

Figure 2.6.3.1 Changes in land cover types in Tinderet sub-catchment (1986-2009)

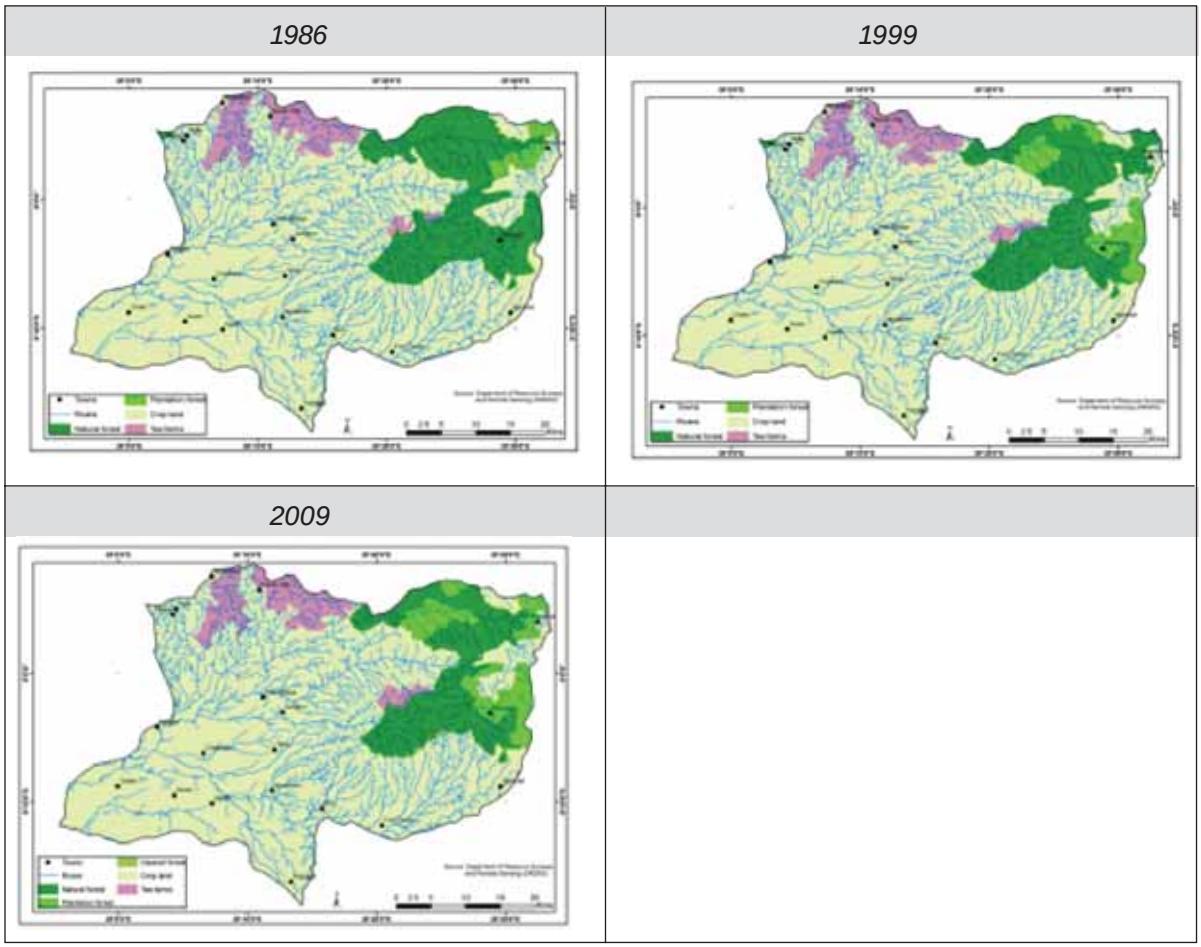


Figure 2.6.3.2 Changes in land cover types in Tinderet sub-catchment (1986-2009)

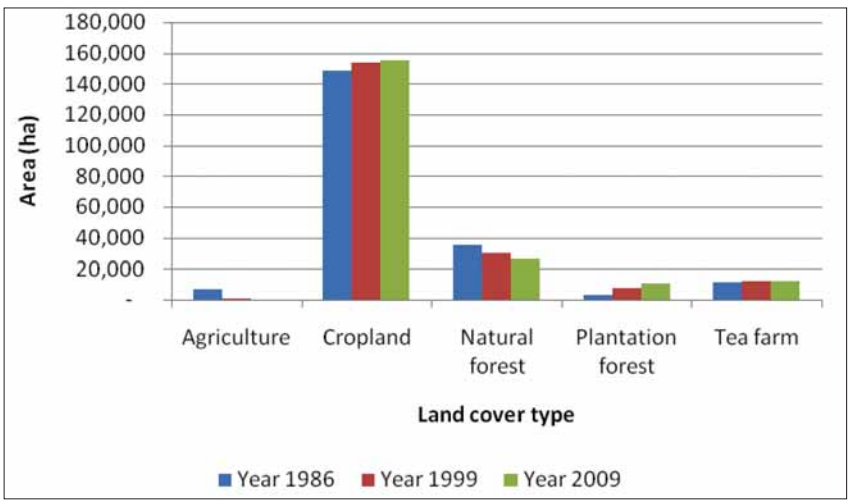


Figure 2.6.3.3 Decadal flow duration curves for river Nyando compared for 60s to 90s

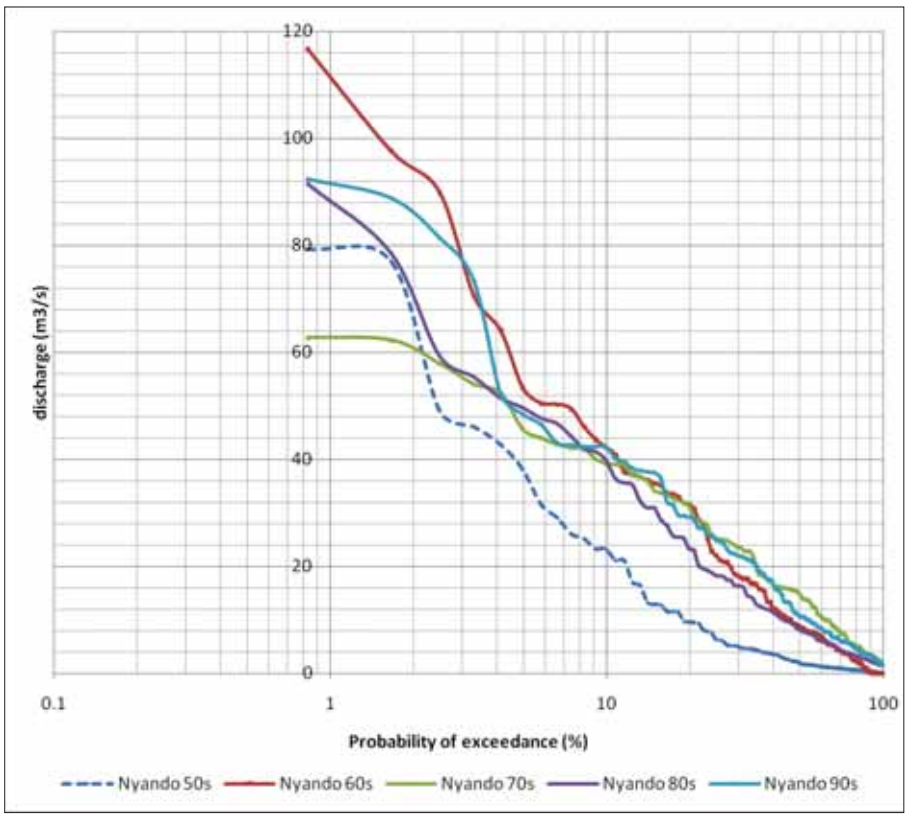


Figure 2.6.4.1 Changes in land cover types in Kinale sub-catchment (1986-2009)

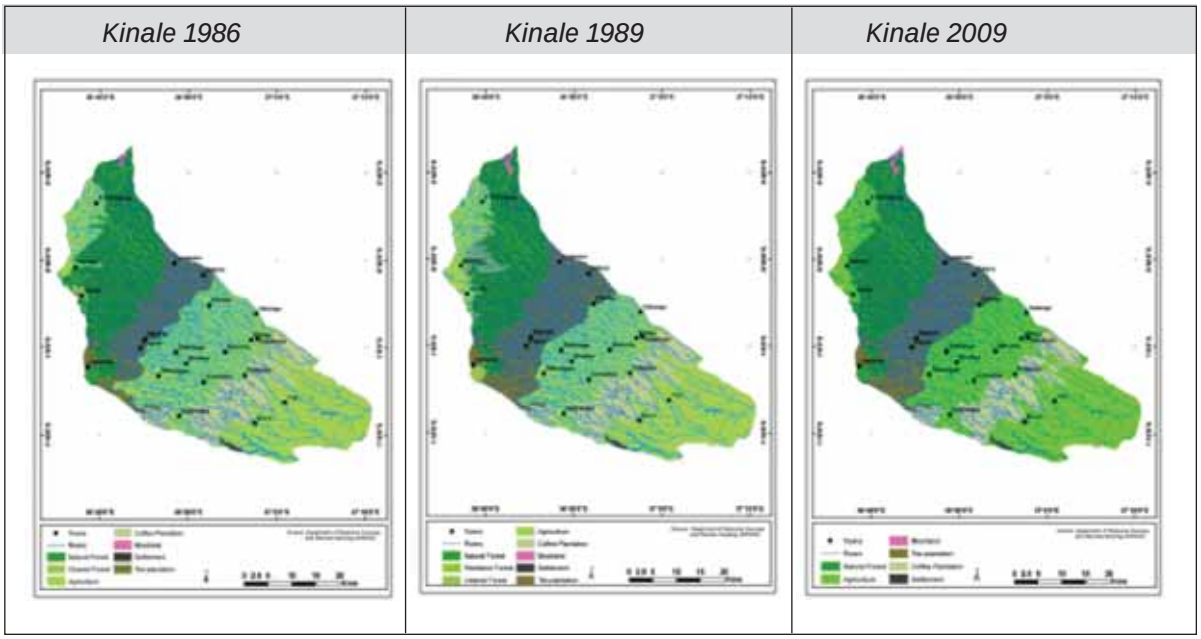


Figure 2.6.4.2 Changes in land cover types in Kinale sub-catchment (1986-2009)

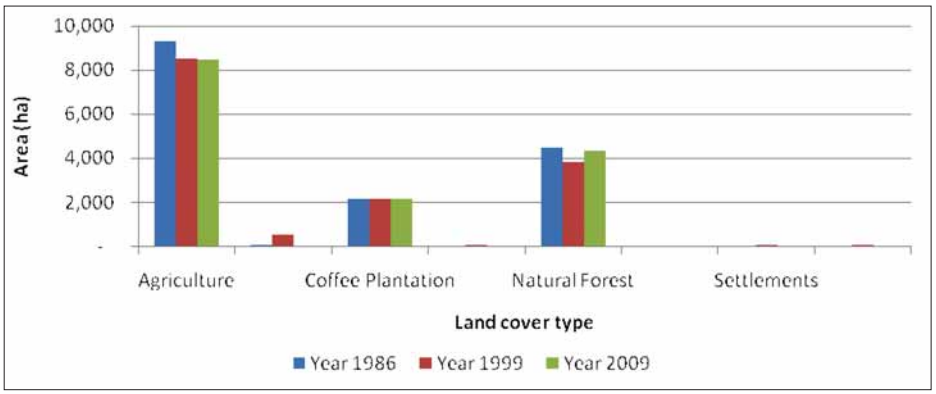
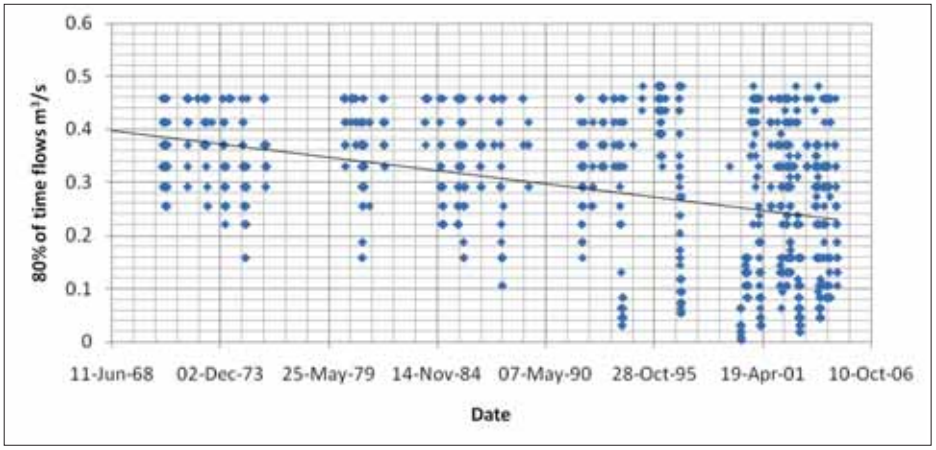


Figure 2.6.4.3 Trends in base flow (80% probability of exceedance) of Ndarugu River



land-use practices include intensive and subsistence agriculture and livestock farming but in the Upper part of West Pokot and Kerio Valley nomadic pastoralism thrives. The threats to the catchment include encroachment, high water use, illegal logging, charcoal burning, firewood collection, illegal grazing, cultivation and climate change effects. Figures 2.6.5.1 and 2.6.5.2 illustrate that from 1973 to 2009, cropland nearly doubled, increasing from 49,950 to 99,800 Ha at the expense of the natural forest, which reduced from 46,450 to 23,850 Ha.

The Frequency Duration Curve for River Nzoia did not show any significant variation over decades: maximal flows in the 50s were a few hundred m^3s-1 less than in the later decades particularly the 70s. The decay in flow from maxima to minima was steady and more towards linearity than those occurring in later decades. Those from the 70s to the 90s were of logarithmic decay, which reflects a condition of the catchment in which flows cannot retain water for slow release as was the case in the 50s and 60s. However, Githui (2008) has shown that the land use and land cover changes during 1973–2001 have contributed to a considerable increase in runoff and this is further supported by Khan et al, (2011) who show that there

were more years with high peak discharges after the 90s even with relatively less precipitation.

Wuoroya sub-catchment traversing Butere and Siaya counties and measuring 300 km^2 constitutes part of the 8-10 sub-catchments on the lower Nzoia Catchment. Data observed at station 1EG03 (Figure 2.6.5.3) from 1974 to 2000 showed base flow to have decreased by 6% and flood flow increased by 21% (Figure 2.6.5.4). The observation that base flow change is less significant than flood flow may be explained by the activities that have occurred in the sub-catchment. Though the area's population growth is one of the fastest in the country and therefore

Figure 2.6.5.1 Changes detected in land cover types in western slopes of Cherangany (1973-2009)

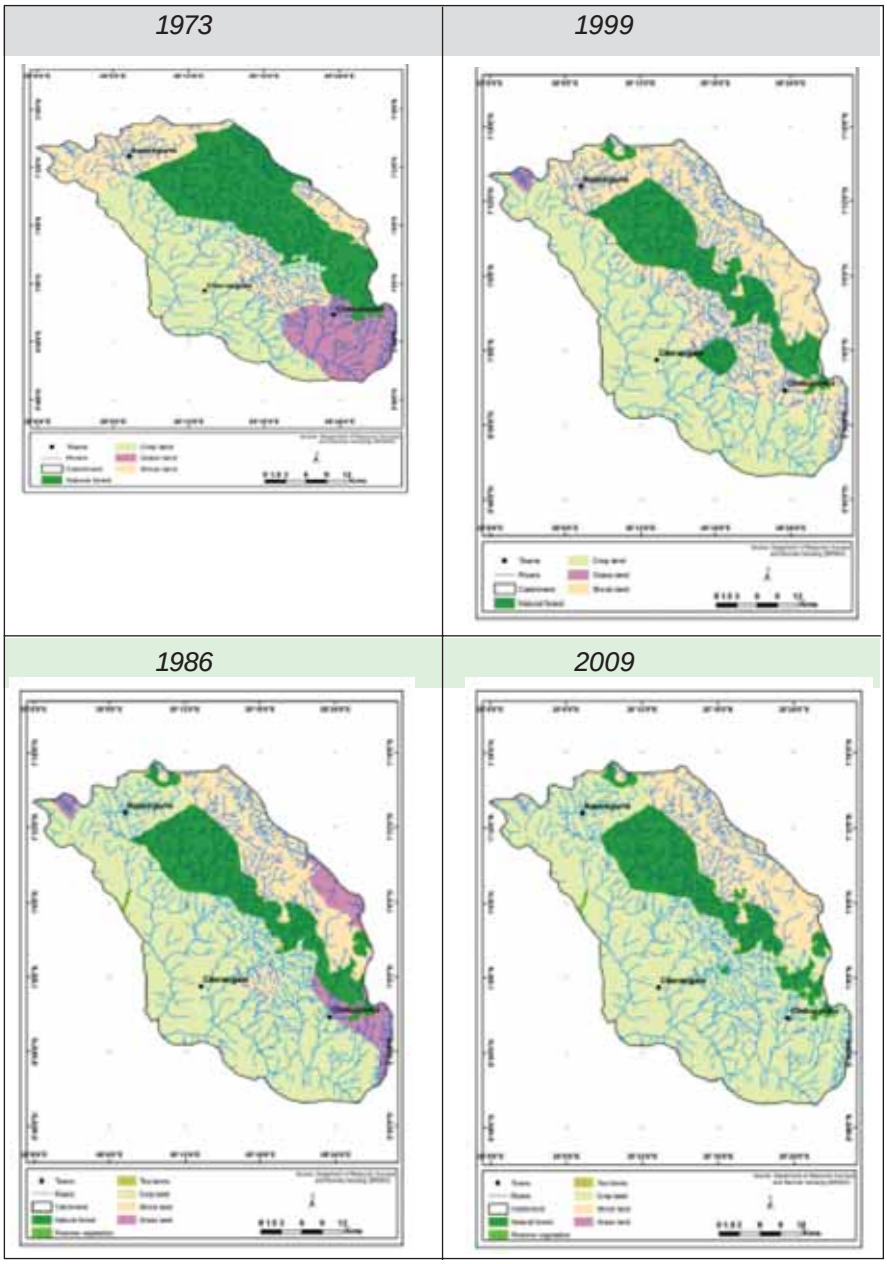
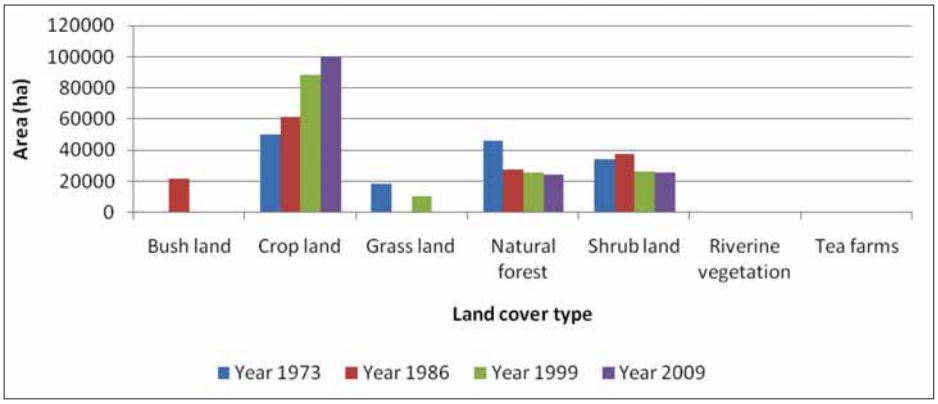


Figure 2.6.5.2 Changes in land cover types in Cherangany (1973-2009)



water abstraction should have grown at the same rate, the extent to which base flow abstraction has decreased is the least amongst all sub-catchments used in this case studies. The area enjoys good rainfall well distributed throughout the year and the area's geology favours the occurrence of springs but with the hardening of the surface for multiple roads used to ferry sugar cane - the predominant crop in the region – and construction of dwelling structures, the flood flow has increased steeply. Consequently, there has been an increase in the runoff coefficient, which means any storm translates into peak discharges in a short time.

2.6.6 Njoro Sub-Catchment

The changes in land cover and flows recorded in the Njoro sub-catchment – the main source of water for Lake Nakuru – are indicated in Figures 2.6.6.1, 2.6.6.2, 2.6.6.3 and 2.6.6.4. There has been a decline in forest cover against a rise in agricultural area from 1973 to 2009, partly due to the excision of about 35,000 Ha off East Mau Forest block for conversion into a settlement area in 2001. Okelo and Ussenge (2009) note that the catchment's once forested areas have been replaced by fragmented landscape composed of remnant forest patches, advanced and emerging secondary vegetation, grassland, tree plantations and highly compacted surfaces including roads, paths and housing units. Apart from reducing forest area, Kinyanjui (2011) further demonstrated that there has been a decline in vegetation health and density in the last decade. Using the Normalised Difference Vegetation Index (NDVI) data recorded at 10 days interval from 1999 to 2009 (Figure 2.34), it was discovered that the vegetation health and density of the East Mau Forest was decreasing gradually.

The consequence of forest clearance has been that surface runoff is highest on open land and least on indigenous forestland. The reduction in dry season streams is attributed to increased water use upstream of Njoro town and the upcoming evergreen eucalyptus plantations in which soil evaporation and stream flow have been modelled to be lower than in existing natural vegetation (Alavi and Ong, 2004). Dry season stream flow in this sub-catchment showed a reduction of 11% over the period 1943-1998 (Figure 2.35). Like sub-catchments across the floor of the Rift valley and in the west of the Aberdares, the sub-catchment has similar rainfall amounts. Geta Forest Station in the Aberdares (1,195mm) is similar to the Nessuit Forest Station in Mau (1,025mm).

2.6.7 Mt. Kenya North Water Catchment

Mt. Kenya catchment area has a radial drainage system which illustrates its richness as a catchment area for the Tana and Ewaso Ng'iro drainage systems. The main land-use practices in the area are intensive agriculture and tourism – there is a National Park and several tourist hotels and lodges within the catchment area, which are significant sources of revenue. The threats to the catchment include

Figure 2.6.5.3 Trendline for base flow for Wuoroya catchment (station 1EG03) (1974-2000)

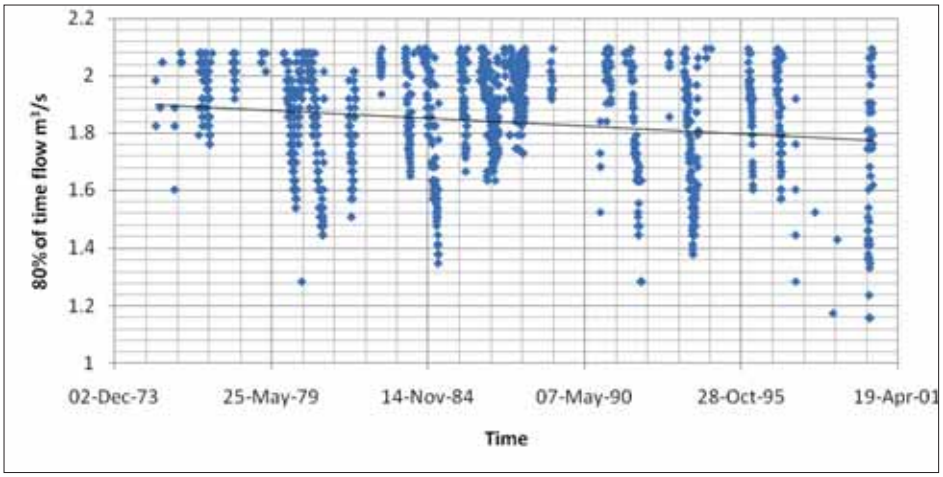


Figure 2.6.5.4 Trendline for flood flow for Wuoroya catchment (Station 1EG03) (1974-2000)

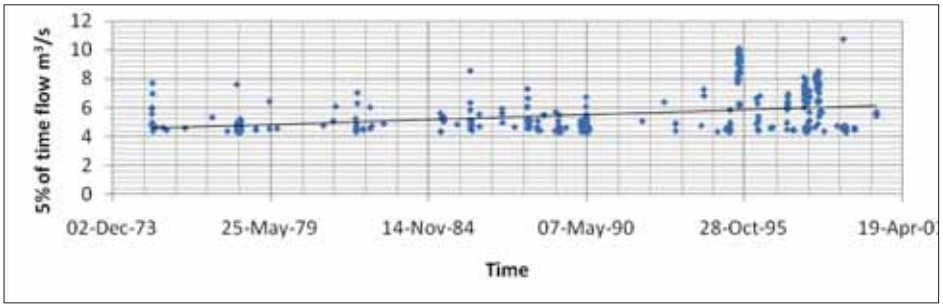
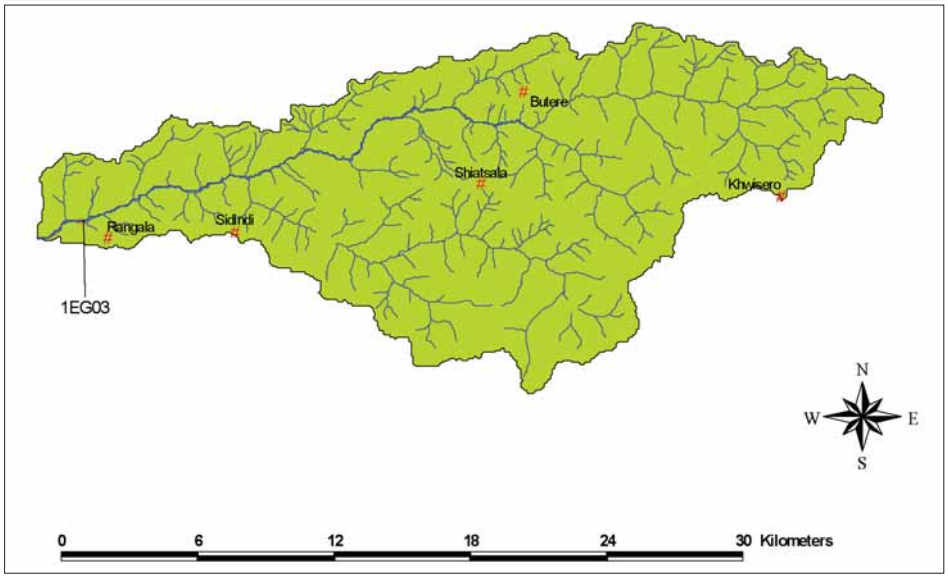


Figure 2.6.5.5 Position of 1EG03 in Wuoroya sub-catchment in Butere and Siaya counties



encroachment of the forest, illegal logging, charcoal burning, collection of firewood, illegal grazing and cultivation, and excessive use of water for irrigation, flower farming and fish farming activities.

The analysis of land cover change showed evidence of decreasing forest cover on Mt. Kenya over the last 3 decades since 1973, as the Mt. Kenya North catchment area continues to be dominated by agricultural areas (Figure 2.6.7.1).

Figure 2.6.6.1 Changes in land use in Njoro sub-catchment (1973-2009)

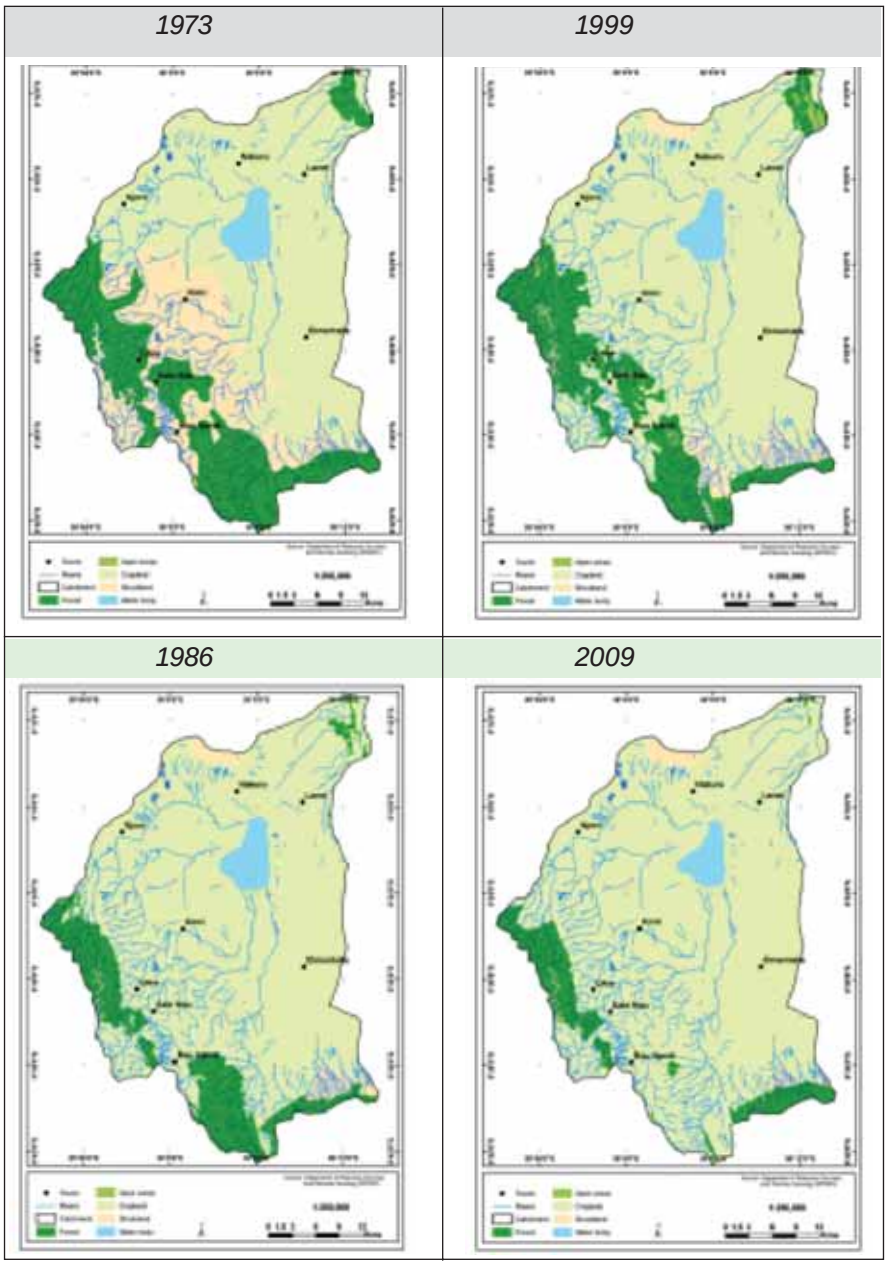


Figure 2.6.6.2 Changes in land cover types in Njoro sub-catchment (1973-2009)

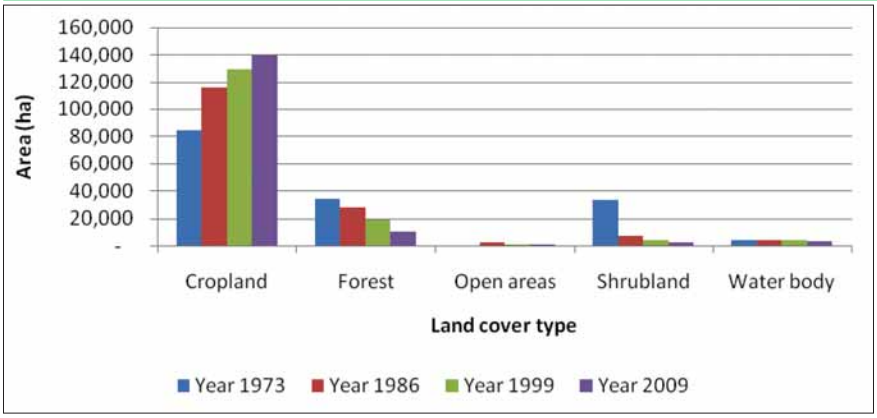
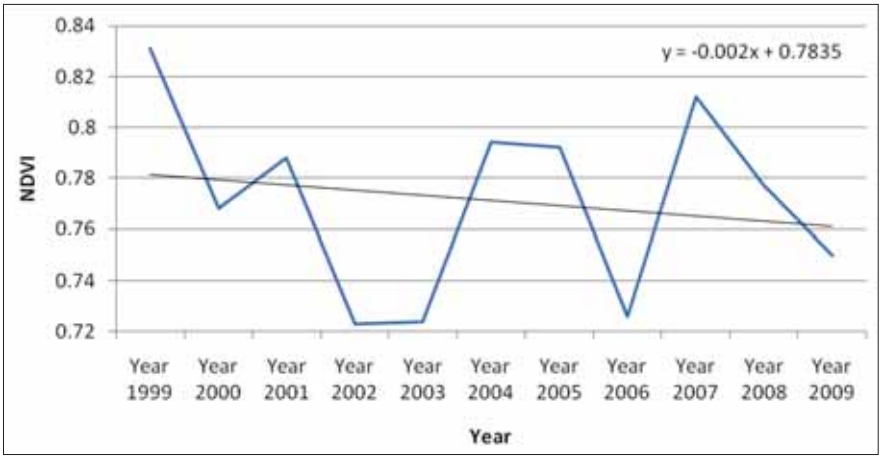
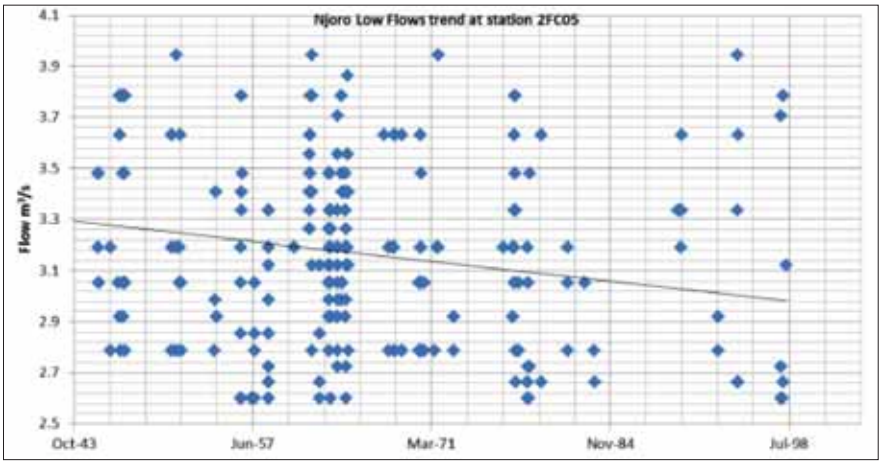


Figure 2.6.6.3 A decadal trend of vegetation health and density in East Mau



(Source: DRSRS)

Figure 2.6.5.4 Trendline for flood flow for Wuoroya catchment (Station 1EG03) (1974-2000)



Analyses of stream flow at station 5BE21 of the Likii sub-catchment – which mostly falls under the heavily degraded gazetted forest (KWS, 1999) in Mt. Kenya North – showed that overall flows were steady over the 5 decades of observations (Figure 2.6.7.3): baseflows fell by 49% and flood flow decreased by 23%. Ngigi et al., (2008) noted a reduction in baseflows at Archer's Post and related this to the semi-arid savannah grasslands downstream. In an effort to improve land production, agroforestry has been applied to lands previously under shrubs with the growth of evergreen Grevillea spp (Muthuri et al., 2004). This has improved water use efficiency by reducing the unproductive components of the water balance, specifically runoff, soil evaporation and drainage, but it also said to have reduced stream flow.

In this catchment, it has been demonstrated that forest plantations characterised by evergeen canopies and deep root systems have high potential for reducing stream flow in catchments relative to the short seasonal indigenous vegetation (Dye and Bosch, 2000). However, Scott and Lesch, (1997) observed stream flow to have completely dried up by the ninth year after planting with Eucalyptus grandis in catchments previously under savannah vegetation. Irrigated and rainfed crop production is rapidly expanding with most of the irrigation supplies being obtained illegally. Indeed, the abstraction of Likii waters is estimated to be 70% at the upper catchment and about 60% on the lower mountain slopes and adjoining savannah areas (Gikonyo, 1998; Gichuki et al., 1998). Based on water flow data from the neighbouring Naro Moru River, it has been demonstrated that the over-abstraction is mainly to

Figure 2.6.7.1 Changes in land cover in Mt. Kenya North catchment area (1976-2009)

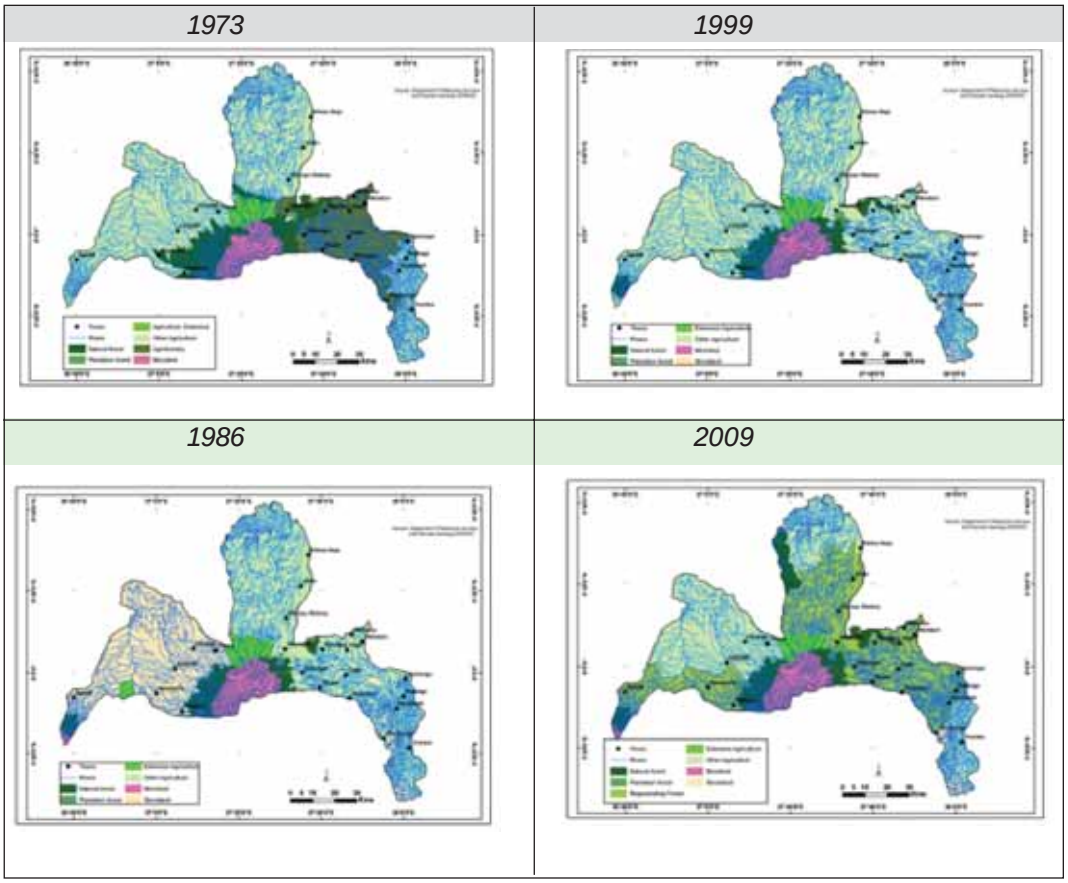
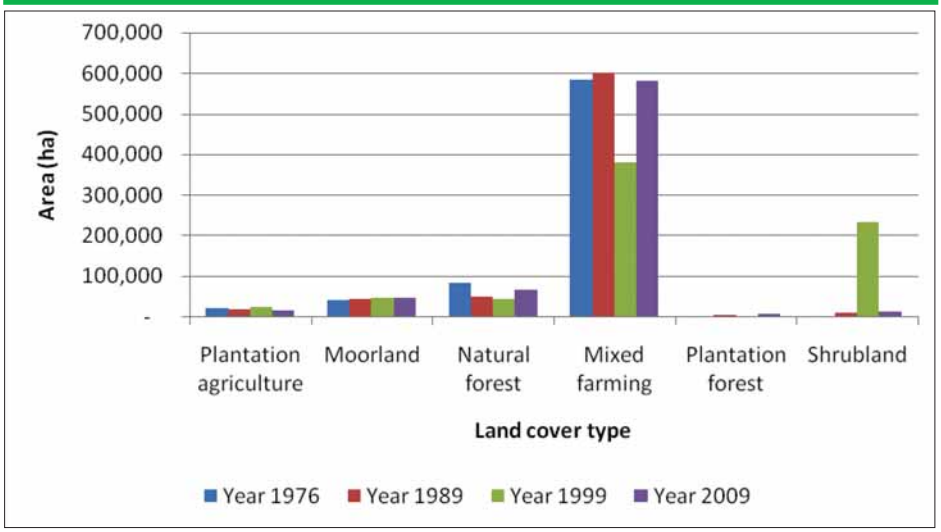


Figure 2.6.7.2 Changes in land cover in Mt. Kenya North catchment area (1976-2009)



irrigate horticultural crops, and that the number of abstractors increased fourfold in a period of 10 years (Ngigi et al., 2008).

2.6.8 Mt. Kenya South Catchment Area

Mt. Kenya South Catchment area is the main source of water for River Tana, and has important rivers including River Thiba, which is one of the largest rivers supplying flows to Masinga Dam. With the catchment dominated by agricultural lands (Figure 2.6.8.1), the forest cover has gradually decreased since the 70s. The mean flows observed from station 4DA01 along River Thiba have been decreasing since 1950s (Figure 2.6.8.3). Statistical summaries for this river include a mean flow of 6.15m^3/s, a median flow of 3.38m^3/s, a minimum flow of 0.002m3/s, and maximal flow of 84.29m^3/s.

2.6.9 Taita Sub-Catchment

The Taita Hills in Southwest Kenya are Precambrian mountain ranges made up of three massifs namely Dabida northwest of Voi, Sagalla directly south of Voi and separated from the rest of the hills by the Voi River, and Kasigau to the northeast of this range and near the Tanzanian border. The Dabida massif, the main body of the hills, is the largest and tallest of the three with an altitude of 2,228m a.s.l. at its highest peak, Vuria; other peaks include Iyale, Wesu, and Susu. The Hills, which cover an area of 1,000km^2, form the northernmost part of the Eastern Arc Mountains of Tanzania and Malawi, and are isolated from other mountainous areas by the vast Tsavo plains. These mountainous areas are Shimba Hills to the southeast, Pare and Usambara Mountains to the south, Mt. Kilimanjaro to the southwest, Ngulia and Chyulu Hills to the west and the Kenyan highlands to northwest.

The hills are known for their moist forests with a unique fauna and flora: more than 20 endemic species of African violets such as *Saintpaulia teitensis* occur exclusively in this region, which is known for its endemic bird species including the Taita Thrush *(Turdus helleri)* and Taita Apalis *(Apalis fascigularis)*. First discovered in the Taita Hills, the Taita Falcon *(Falco fasciinucha)* and the Taita Fiscal *(Lanius dorsalis)* are known to occur elsewhere while the amphibian genus Boulengerula can only be found in these hills, which are also a habitat for the critically endangered worm-like amphibian, Sagala Caecilian (Boulengerula niedeni). In order to protect the region from severe logging, as has been the case in the past, the remaining indigenous forest is now part of a nature reserve where consumptive use is prohibited.

Figure 2.6.7.3 A decreasing base flow for Likii sub-catchment (1968-2006)

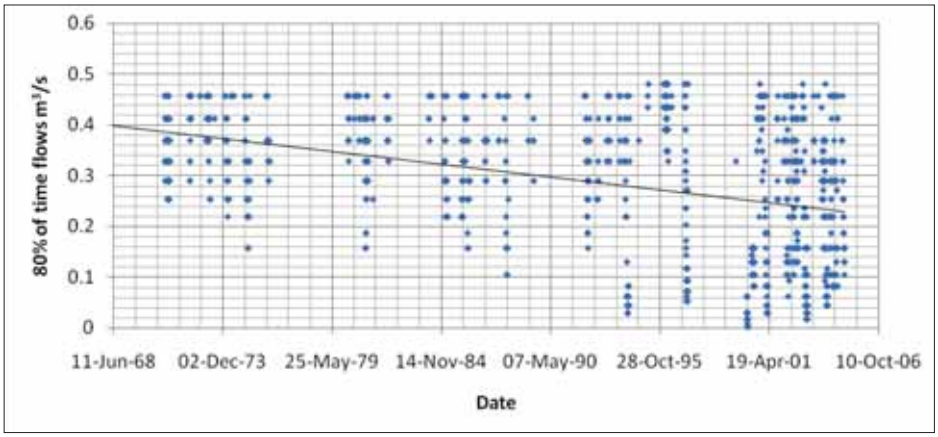
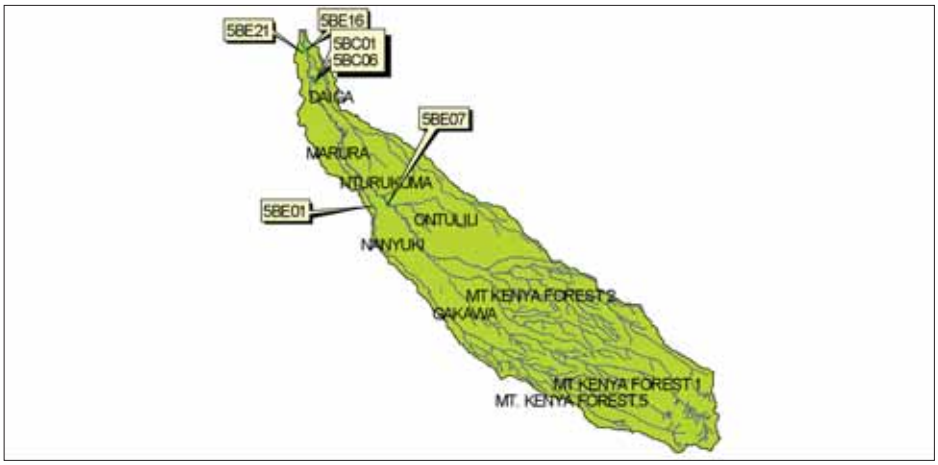


Figure 2.6.7.4 Position of stream flow determination (5BE21) in Likii sub-catchment



There are two rainy seasons in the area (March-May/June and October-December) recording a mean annual rainfall ranging from 500mm in the lowlands to over 1,500mm in the upper mountain zone. The population of Taita-Taveta district has increased, as has the land use in Taita Hills (in favour of intensive agriculture) and on the foothills and plains surrounding the hills (in favour of extensive agriculture and grazing). The growing population and resultant scarcity of available land have contributed to growing pressure in the lowlands and urban centres and caused dynamic changes in the land use patterns, leading to serious land degradation from deforestation, soil erosion, lowered water tables. Figures 2.6.9.1 and 2.6.9.2 show an analysis of the vegetation changes, which indicate that grasslands occupy the largest area.

2.6.10 Mt. Kulal Sub-Catchment

Mount Kulal (2,285m a.s.l.) is an extinct volcano – located in northern Kenya, east of Lake Turkana and the town of Loiyangalani – that has a deep crater, covered with rain and mist forest at its summit. The mountain, one of Kenya's six Man and the Biosphere (MAB) reserves having been designated thus in 1979,

Figure 2.6.8.1 Changes in land use in Mt. Kenya South catchment area (1976-2009)

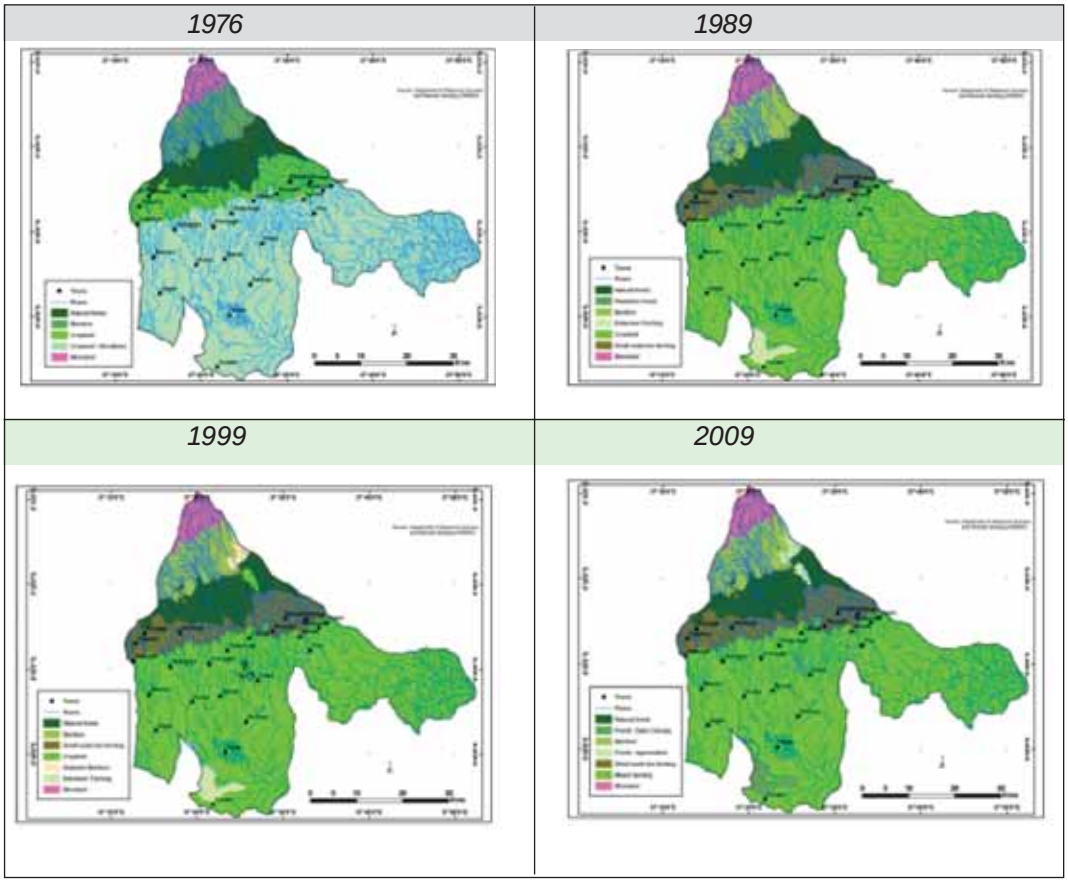


Figure 2.6.8.2 Changes in land cover in Mt. Kenya South catchment area (1976-2009)

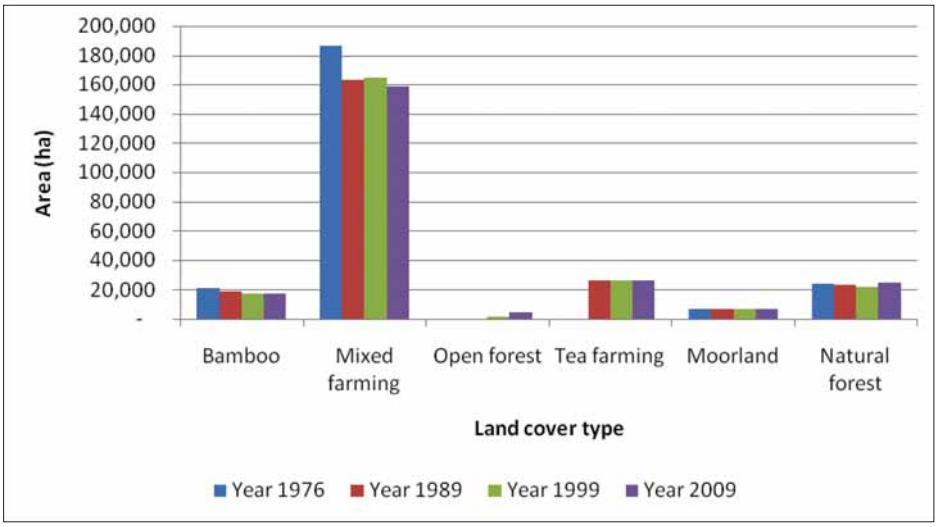


Figure 2.6.8.3 The position of 4DA01 in Thiba sub-catchment (near Koroma)

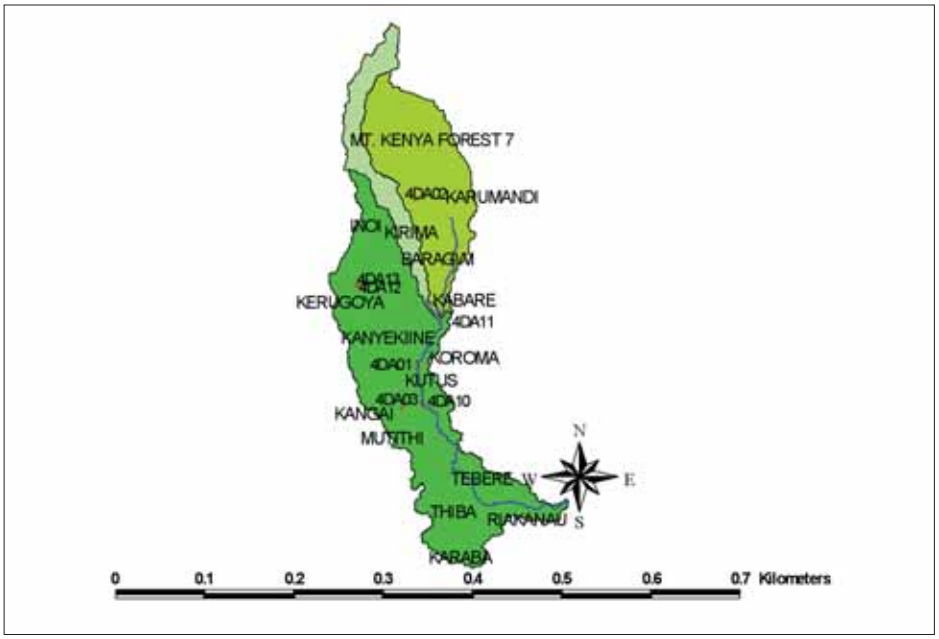


Figure 2.6.8.4 Flow trend line for Thiba River (station 4DA01) (1950-1996)

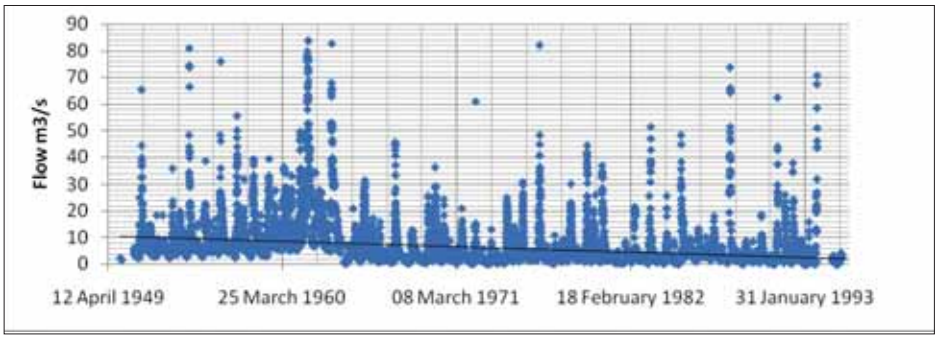


Plate 2.6.8.1 Farming in the steep hills of Murang'a (Source: DRSRS)

is inhabited by the Turkana, Samburu, Rendille, El Molo and Gabbra people who are predominantly pastoralists. Apart from livestock rearing and fishing, the main human livelihoods are dependent on the montane and sub-montane forests of Mount Kulal for fuelwood, building materials and the construction of livestock enclosures. Forest regeneration is hampered by the removal of the understory in several areas while grass fires, lit by pastoralists, erode the forest edge.

Figure 2.6.9.1 Changes in land cover types in Taita sub-catchment (1975-2009)

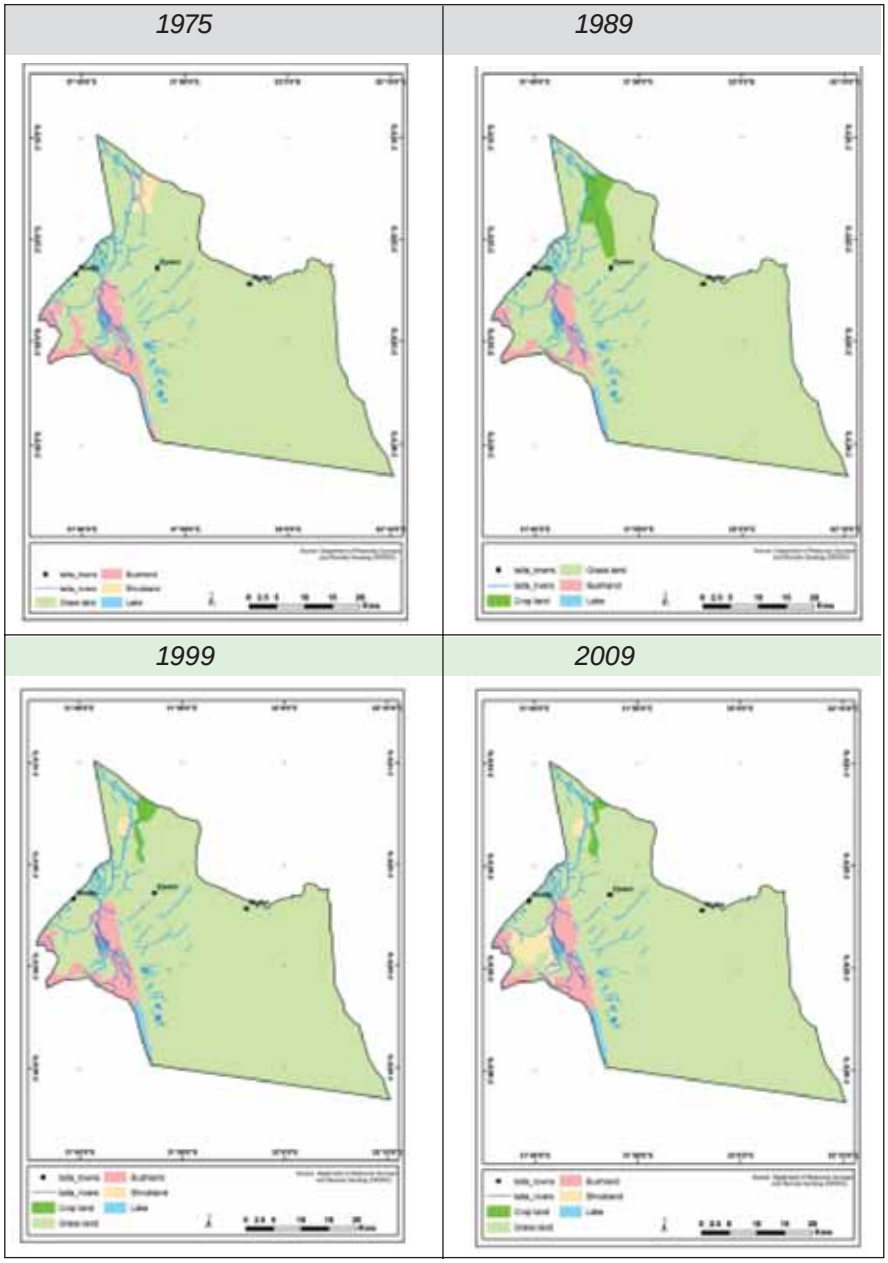
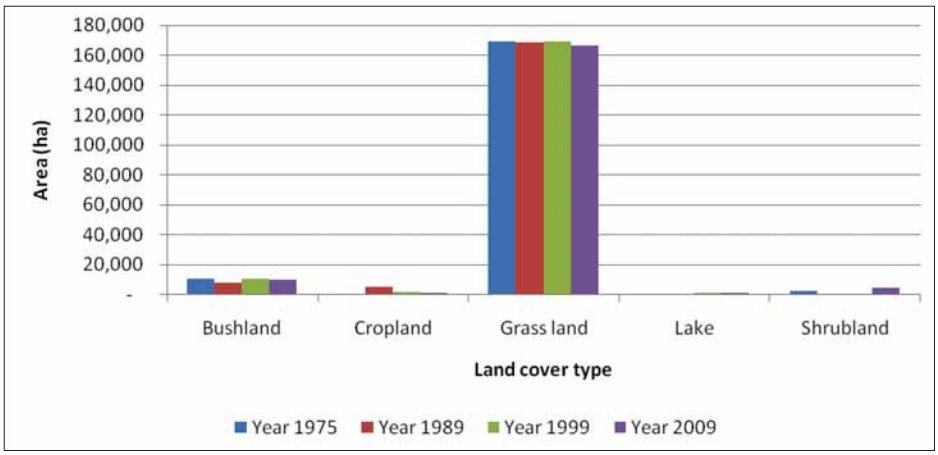


Figure 2.6.9.2 Changes in land cover types in Taita sub-catchment (1975-2009)



The vegetation is made up of montane forest, desert, montane zone with rainforest, mist forest, and grassland. A sub-montane zone exists and is composed of dry evergreen forest of *Olea africana* and *Juniperus procera* with a shrub layer of *Euclea spp.* and *Carissa spp.* and some grassland. The sub-humid/semi-arid zone is composed of *Combretum spp.* woodland with *Euphorbia spp.* and *Acacia drepanolobium* with an understory of *Duosperma eremophilum*, while the semi-arid zone is composed of Acacia mellifera and Commiphora spp. An analysis of vegetation changes indicated that the forest area decreased while the arid area increased in between 1986 and 2009 (Figures 2.6.10.1 and 2.6.10.2).

Figure 2.6.10.1 Change detection in land cover types in Mt. Kulal (1986-2009)

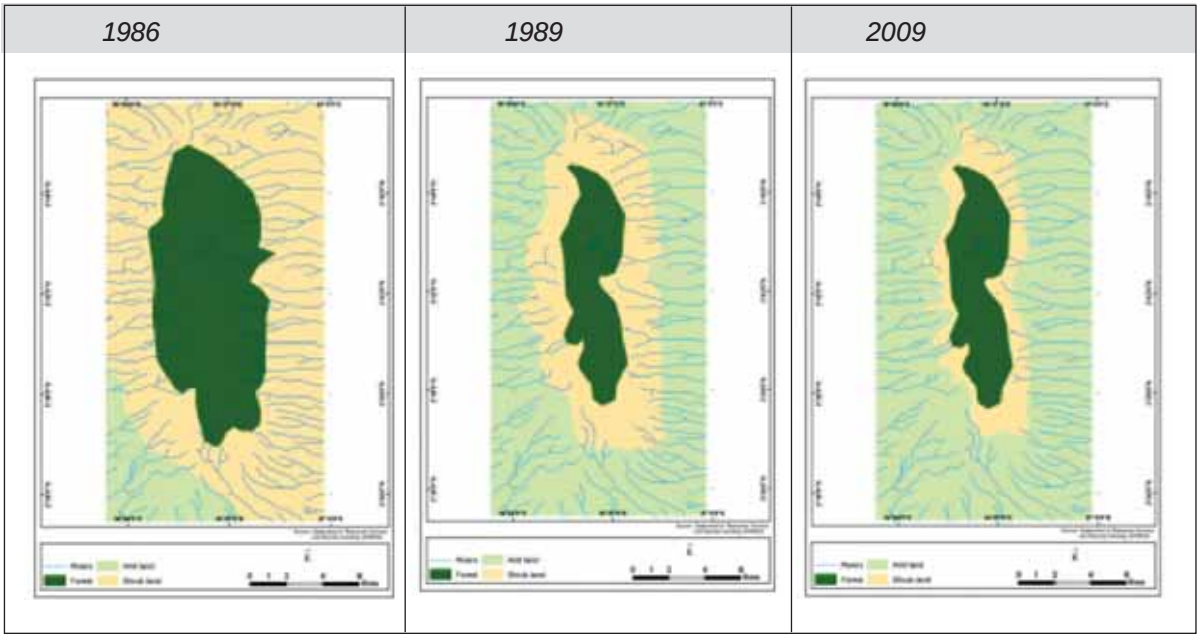
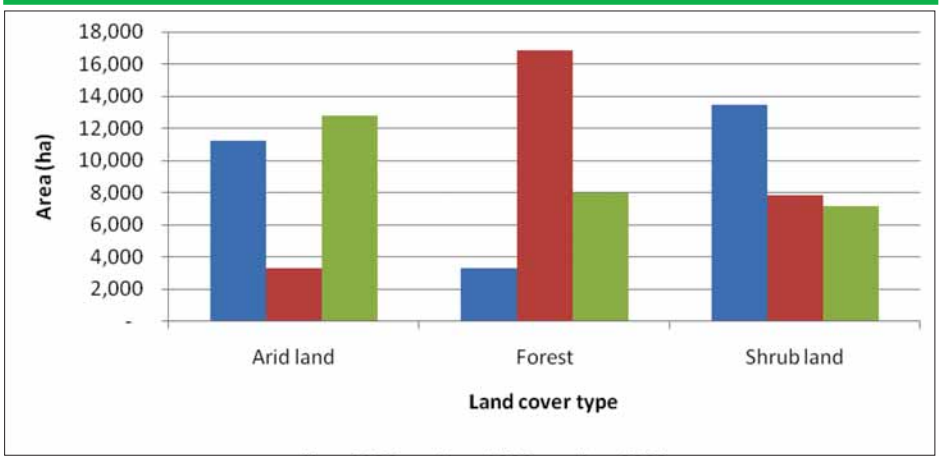


Figure 2.6.10.2 Changes in vegetation in Mt. Kulal (1986-2009)



2.6.11 Shella Sand Dunes Water Catchment Area

The Shella Sand Dunes Catchment in Lamu Island forms a unique oasis of fresh water catchment surrounded by salty waters (Plates 2.6.11.1).

The Lamu/Shella sand dunes are located on the southern end of Lamu Island, running from Kizingoni in the southwestern tip of Ras Singue Island to the southeastern tip just outside the Shella village. They stretch for 12km, cover an approximate area of 958 Ha and rise to a height of approximately 60m a.s.l. forming a continuous ridge along the Lamu bay that acts as protection against the strong open sea winds. This was evident during the Tsunami episode of 2006 that substantially affected the East African coastline with the exception of the Lamu harbour. Since the 1960's the National Museums of Kenya has been actively involved in the development of the Lamu Old Town as a cultural heritage site owing to its century's old urban landscape, its unique vernacular architecture and an unperturbed traditional way of life.

Two of the complimentary buffer zone areas which are part of the natural landscape and from which the town draws both its water resource and its beauty are the Lamu water catchment (Lamu/Shella sand dunes) and the Ras Kitau-Manda skyline. The dunes, gazetted (Gazette Notice No. 1933 of March 2002) as a protected site under the Antiquities and Monuments Act (Cap 215), continue to maintain that status under the provisions of the National Museums and Heritage Act 2006. The Ras Kitau-Manda skyline were gazetted as complimentary areas to the buffer zone of the Lamu World Heritage Site by the National Museums of Kenya (Gazette Notice No. 3499 of April 2008).

One of the major reasons for Lamu's 700 years of continuous habitation lies in its relatively vast resources of potable water, the most prominent of which is the Shella sand dune regime that acts as a giant sponge capable of absorbing and retaining rainwater, and as a membrane preventing seawater from mixing with underground water aquifers. These established facts are expounded in a report *Ground Water Resources Assessment of Lamu Island and the Hindi–Mokowe Areas of Lamu District* (1991) prepared by Coast ASAL Development Project that was under then Ministry of Reclamation and Development of Arid and Semi-Arid Areas and Wastelands.

Between 1983 and 2000, several technical and scientific studies were conducted in the sand dune area to assess the quality and quantity of the water aquifers located within the sand dune

Degraded Shella catchment and associated human encroachment

A few containers of precious fresh water ferried on a mass of salty water from Lamu to Mada Island (Source: NMK)

Plate 2.6.11.1 Shella Dunes catchment

regime. Inhabitants of Lamu Island solely depend on Shella catchment for domestic water, as do those from Mada Island, who 'import' fresh water from Lamu as illustrated on Plate 2.6.11.1. Despite the significance as a water catchment area, the state of conservation of the Shella sand dune regime is under threat from human activities that go contrary to the area's established conservation policy. Continued degradation of the catchment largely stems from the fact that inhabitants of the Shella catchment are wealthy individuals who can afford to desalinise water, a privilege not shared with the downstream inhabitants of Lamu town. In recognition of the fact that the sand dune holds the key to Lamu's future as a habitable island, local communities consulted during field visits relating to the development of this Plan strongly supported the need to protect and conserve Shella Water Catchment.

In order to improve the conservation and management of sand dunes, an assessment of the quantity and quality of water aquifers located within the sand dune regime needs to be conducted to document the significance of the sand dunes as water catchment areas and identify vulnerable dunes for special attention. It is imperative that a community-based approach be employed in the management and reclamation of all degraded sand dunes, and innovative approaches be replicated from other countries that have successfully managed their dunes.

2.7 ENVIRONMENTAL STATUS OF TRANSBOUNDARY WATER CATCHMENTS

One of the complex water resource crises that Kenya faces stems from the fact that more than half of her rivers, lakes and aquifers – including Lakes Victoria and Jipe and Rivers Mara, Daua, Malaba, Malakisi, Sio and Lumi – are shared with neighbouring countries. The environmental status of Lake Victoria may be described by the water level and quality, land use and vegetation cover in the catchment, of which the water level is dependent on seasonal inflows and decadal trends in interannual precipitation over the lake. The water level rose by 0.98m during the 1950-2000 period (LVEMP, 2001) but the surface inflows declined during the 2004-2006 period as the lake witnessed consecutive periods of drought and increasing the evaporation rate (Kyosingira et al., 2011). In terms of water quality, evidence has been presented of increasing algal blooms (Ochumba and Kibaara, 1989, Mugidde, 1993), massive fish kills (Ochumba and Kibaara (1989) and declining oxygen concentrations in the deeper water of the lake (Hecky and Bugenyi, 1992).

Land surrounding the lake includes that of transboundary Mara in which agricultural land has increased by 55% between 1986 and 2000 through the combined encroachment of forests and savannah grasslands – these have reduced by 23% and 24%

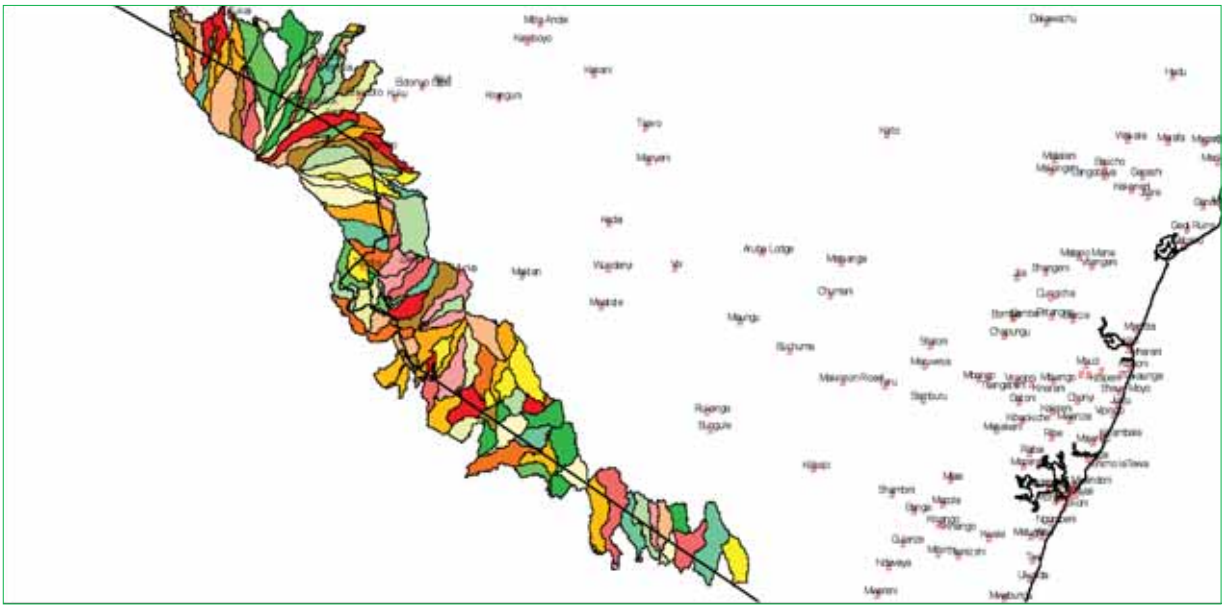
respectively (Mati et al., 2005). In the Sio Malaba Malakisi catchment, there is evidence of continuing land degradation and loss of soil fertility (Barasa et al., 2010), deforestation and absence of reforestation activities (Ogutu et al, 2005) and the use of biomass as the main source of energy (Scheren, 1995). Other evidence showing the environmental status of Lake Victoria transboundary sub-catchment include the lack of clean water for household use, insufficient water for grazing, exploitation and degradation of wetlands based on the perception that they are public property available to all.

2.8 WATER CATCHMENT CONSERVATION AND CLIMATE CHANGE

There is growing scientific consensus and evidence that global climate change is taking place and will influence the future of the global economy, ecosystems and livelihoods of the rich and poor (IPCC, 2007). Temperatures in East Africa 30,000 to 21,000 years ago are reported to have been 2 to 4.1°C lower than present, which is an indication that global temperatures have been rising. Several theories provide evidence of climate change and variability in East Africa: one associates the rise in Lake Victoria water level in the 20th century with peaks in the 11,000-year sunspot cycle (Stager et al, 2007). Another documented an 11,700-year record of Holocene climate and environmental variability showing that the greatest historically recorded drought occurred 4,000 years ago (Thompson et al., 2002). The studies proposed that if climatological conditions persisted, the remaining ice fields were likely to disappear between 2015 and 2020.

The National Climate Change Response Strategy (GOK, 2010) has presented evidence of climate change in Kenya including increases in minimum temperature by 0.5ºC to 1.0ºC since 1960 for the Western, Northern and Northeastern, Central and Southeastern Districts of Kenya. In addition, there has

Figure 2.7.1 Some transboundary water catchments shared by Kenya and Tanzania



been a notable increase in maximum temperature by 0.5ºC to 1.3ºC since 1960 in the same regions, with the coastal strip experiencing the highest increase by a maximum of 2ºC. These changing temperatures and rainfall will continue to have profound effects on water catchments; Figure 2.7.1 illustrates temperature trends for Mombasa.

2.8.1 Rainfall Variability and its Impact

An analysis of daily and monthly rainfall for the December-February, March-May, June-August, and September-November seasons since 1960 showed factors that influence rainfall in Kenya (GOK, 2010: National Climate Response Strategy). The analysis indicated that neutral to slightly decreasing trends are manifested in the annual rainfall series over most areas, mainly due to an associated general decline with time of rainfall in the main rainfall season of March-May (the 'Long Rains') over most areas.

Further, the analysis revealed a general positive trend (increase) in rainfall events of the September to February season, suggesting a tendency for the 'Short Rains' (October-December) season to be extending into what is normally the hot and dry period of January and February over most areas. This may possibly be attributed to more frequent occurrences of El-Niño events occasionally coupled with relatively warmer sea surface temperatures (SSTs) over the western Indian ocean (along the coast of east Africa) and relatively cooler-than-average sea surface temperatures to the east of the Indian Ocean. This sea surface temperature pattern over the Indian Ocean is conducive for enhancing rainfall over the country even in the absence of El-Niño conditions, resulting in heavy rainfall during the 'Short Rains' season as was the case in 1961-62 and recently in 2006-07.

Rainfall variability, and extremes such as those of 1961, 1997 and 2009 (GOK, 2010: National Climate Change Response Strategy) have caused extensive loss of life, socioeconomic disruption, damage to infrastructure and 'shocks' to livelihood systems (Conway et al., 2005). Indeed, the 1997/98 El Niño floods are estimated to have destroyed and damaged infrastructure with a replacement cost of approximately Kes. 64 billion (Mogaka et al., 2006).

Figure 2.8.1 Temperature trends for Mombasa (1960-2005) *(Source: NCCRS)*

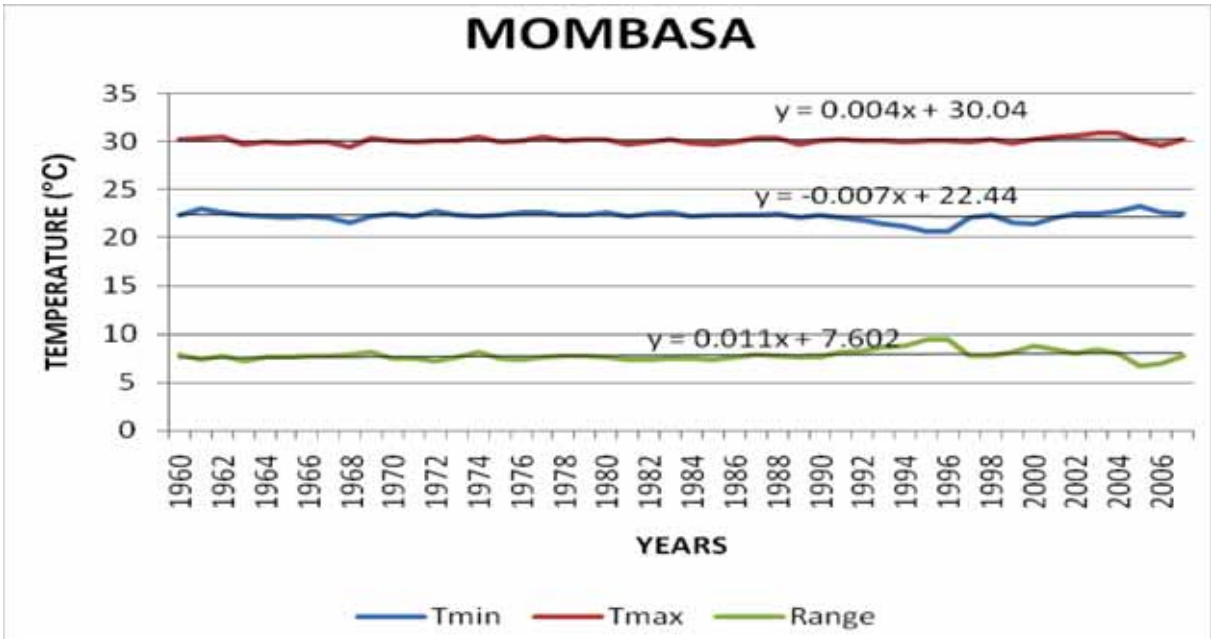
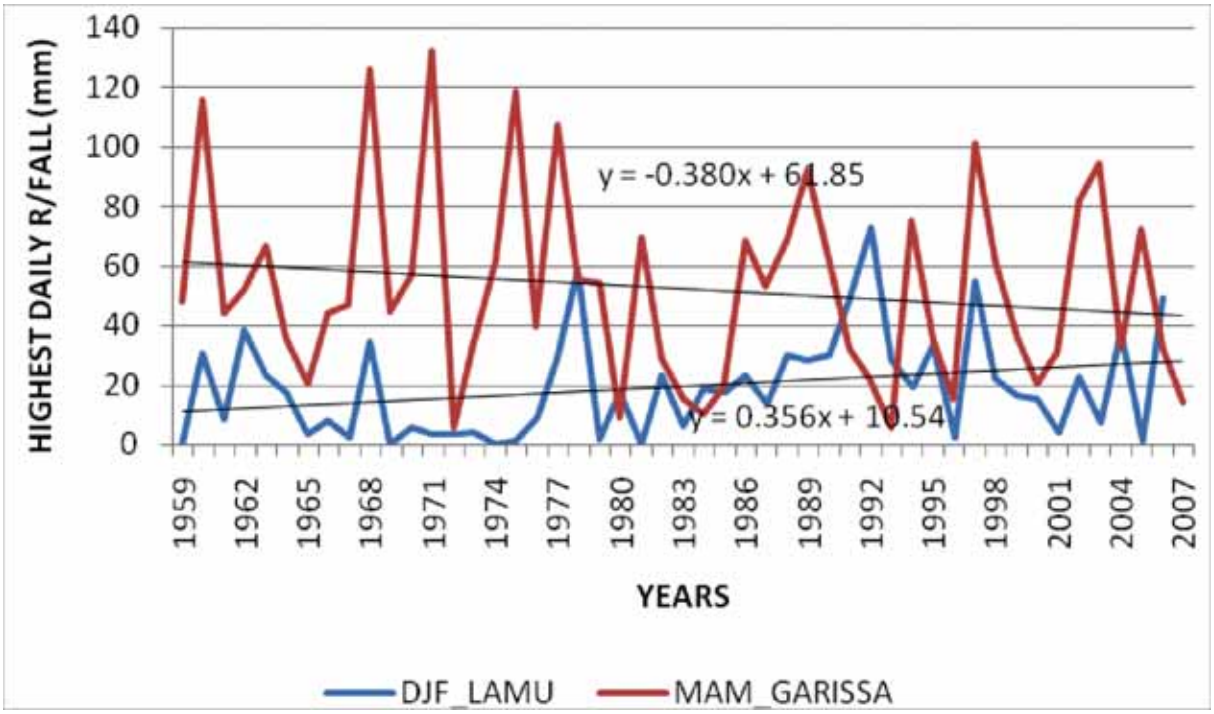


Figure 2.8.1.1 Rainfall trend in Lamu and Garissa over the period 1959-2007 *(Source: NCCRS)*



2.9 SUMMARY

The status of water catchments discussed in this Chapter gives evidence that the catchments of Kenya have been undergoing degradation in terms of water quantity, quality, availability, hydrological regimes, and biodiversity and ecosystem health. These changes have been exacerbated by increasing human, livestock and wildlife populations in the catchments and the associated increase in demand for developmental resources. Due to their critical significance, the ongoing discussion emphasises the need for conservation and sustainable management to prevent the complete loss of water catchment areas.

In particular, it has been noted that the following problems exist:

a. degraded water catchment areas
b. land degradation and soil erosion in water catchment areas
c. poor management of water resources
d. water insecurity
e. poor waste management
f. livelihood insecurity stemming from the degradation of water catchment areas
g. overdependence on biomass energy
h. limited involvement of women and youth in water catchment conservation, which may be a cause for their degradation

3.0 CHAPTER THREE

GOVERNANCE FRAMEWORK FOR WATER CATCHMENT AREAS

3

GOVERNANCE FRAMEWORK FOR WATER CATCHMENT AREAS

3.1 INTRODUCTION

Effective environmental governance at all levels is critical for finding lasting solutions to environmental challenges facing society. The term governance has been defined in many different ways that vary according to the scope and locus of decision-making power (ECOSOC, 2006). The World Bank, initially defined governance as the exercise of political power to manage a nation's affairs (World Bank, 1991) but recent developments have shown that governance is much wider than the political realm, and many governance functions in society are beyond the exclusive remit of Governments.

In recent times, the term governance has been used in reference to a set of rules and the institutional arrangements for their implementation and enforcement. According to Ruggie (2004), governance may therefore refer to conducting the public's business constellation of authoritative rules, institutions and practices for the collective management of affairs. Environmental governance therefore comprises policies, legislations and institutions that shape how humans interact with the environment (Nagai, 2009). Effective environmental governance based on targeted resource efficiency measures is therefore an important aspect of conservation of water catchment areas at various levels. This Chapter highlights the framework for environmental (and in effect water catchment) governance in Kenya.

3.2 INTERNATIONAL AND REGIONAL FRAMEWORKS FOR GOVERNING CATCHMENT AREAS

With Kenya as part of the global community, her framework for governing water catchment areas is influenced by international and regional agreements and treaties, to which she is party. The programme of action for achieving sustainable development, adopted at the United Nations Conference on Environment and Development in Rio in 1992 (Agenda 21, 1992) remains the most comprehensive international policy document on environmental issues. It identifies degradation of water catchment areas as one of the challenges facing the global community and recognises the importance of catchment areas to the availability of freshwater resources.

In addition, it recognises that the long-term development of global freshwater requires holistic management of resources and an appreciation of the interconnectedness of the elements related to freshwater and freshwater quality. To address the problem of availability of quality freshwater resources, the Agenda calls for the rehabilitation, protection and conservation of important water catchment areas. As part of this process, States are required to strengthen administrative and legislative measures to prevent encroachment on existing and potentially usable catchment areas.

In appreciation of the fact that forests are essential water catchment areas, several international conventions address forest governance including two conventions adopted in Rio in 1992 – the Convention on Biological Diversity (CBD) and United Nations Framework Convention on Climate

Change (UNFCCC). The objective of the CBD is the conservation of biological diversity, sustainable use of its components, and fair and equitable sharing of the benefits arising from the utilisation of genetic resources. Through its provisions and required action, the Convention seeks to conserve forests and ensure their existence as water catchment areas.

The UNFCCC and the Kyoto Protocol recognise the importance of conserving forests as carbon sinks that mitigate the effects of pollutants that contribute to climate change. Further, the United Nations Convention to Combat Desertification (UNCCD) recognises the importance of forests in combating desertification and drought, and calls for their conservation. In addition, other Conventions like the Ramsar Convention on Wetlands, the World Heritage Convention and the Convention on International Trade in Endangered Species of Wild Fauna and Flora also address the protection and conservation of forests.

Kenya is a member of the African Union and the East African Community (EAC), both of which have agreements relevant to environmental governance that provide a regional framework for governing national and transboundary water catchment areas. In 2003, Members of the African Union adopted the *Revised African Convention on the Conservation of Nature and Natural Resources* to replace the 1968 Algiers Convention. The Convention addresses the needs for the conservation and sustainable utilisation of water resources and urges states to ensure integrated management of water resources and the conservation of forests and other catchment areas.

Similarly, Chapter 19 of the EAC Treaty addresses environment and natural resources, in recognition of the fact that environmental degradation and the depletion of natural resources negatively affect access to a clean and healthy environment, which is a prerequisite for sustainable development. Under the Treaty, Partner States commit to undertake action to address environmental degradation through environmental management, conservation of water resources, sustainable utilisation of natural resources and protection of critical ecosystems. In addition, the EAC has developed a Protocol on Environment and Natural Resource Management, which calls for the protection of mountain ecosystems as critical water catchment areas. Further, the EAC has developed guidelines for undertaking transboundary environmental assessment of shared ecosystems including water catchment areas. These provide international and regional legal and policy frameworks for managing water catchment areas in Kenya.

3.3 THE IMPERATIVES OF THE CONSTITUTION OF KENYA 2010

The Constitution of Kenya recognises and addresses issues of environmental governance, giving the environment and its management due prominence in the preamble, which as a rule provides the background within which the specific constitutional provisions are to be interpreted and applied. The preamble to the Constitution notes that Kenya's environment – and by implication her water catchment areas – is her heritage and should be sustained for the benefit of future generations. As catchment areas serve critical functions in maintaining the country's water supply, it is important that they are conserved to guarantee the availability of quality water for both present and future generations.

This imperative is underscored by the provisions of Article 10 on national values and principles of governance that are expected to guide the process of implementing the Constitution, laws and public policies. As this Master Plan now forms part of Kenya's public environmental policies, its development and implementation must help the country to meet the requirements of the national values and principles of governance. In the efforts to conserve and sustainably manage Kenya's water catchment areas, the prerequisites of sustainable development must be adhered to and delivered on. Appreciating the key role played by water in the country's development,

this Master Plan provides a framework for sustainably conserving water catchment areas thereby meeting the requirements of sustainable development.

The conservation of water catchment areas focuses not only on water resources but also on the larger ecosystem within which the water exists, and similarly the specific focus of water catchment governance is on water and the context within which it exists including the frameworks for land, forests and biodiversity management. The Constitution addresses each of these issues, and these provisions have a bearing on the governance of water catchment areas. The Bill of Rights in the Constitution recognises the environment as a fundamental right, an inextricable part of the country's democratic framework with a bearing on socioeconomic and cultural policies.

Indeed, Article 42 of the Constitution guarantees all people the right to a clean and healthy environment, a right that places an obligation on the State and all Kenyan citizens to protect the environment for the benefit of current and future generations. In addition, it is the duty of all citizens to cooperate with all organs of the State and with other persons to protect and conserve the environment and ensure sustainable development and use of natural resources. This brings to the fore the need for enhancing public participation in the conservation of water catchment areas, a task that the State is constitutionally obligated to undertake. Accordingly, this Master Plan proposes deliberate measures to be undertaken by the State to improve the levels of citizen participation in the protection and conservation of water catchment areas.

Other constitutional obligations placed on the State – and for which this Master Plan provides a policy and action framework – in delivering the right to a clean and healthy environment include:

a. ensuring sustainable exploitation, utilisation, management and conservation of the environment and natural resources, and equitable sharing of benefits that arise thereof
b. protecting genetic resources and biological diversity
c. promoting the achievement and maintenance of a tree cover of at least 10% of Kenya's land area
d. utilising the environment and natural resources for the benefit of the people of Kenya
e. establishing systems of environmental impact assessment, audit and monitoring of the environment
f. protecting and enhancing intellectual property in, and indigenous knowledge of, biodiversity and the genetic resources of communities
g. eliminate processes and activities that endanger and degrade the environment.

The Constitution has changed the nature of governance in Kenya to a devolved government, and this means that policies will be implemented at the national and county level. Devolution is geared towards promoting democracy and accountability, promoting the involvement of people in their governance, enhancing equitable sharing of resources, and facilitating decentralisation of state organs and their functions and services. In accordance with the division of functions between national and county governments, as detailed in the Fourth Schedule of the Constitution, this Master Plan proposes avenues for the conservation of water catchment areas at national and county levels. These focus on enhancing conservation through proximate and accessible institutions and with the active participation of citizens at local levels.

A critical consideration in the conservation and sustainable management of water catchment areas is land and the laws regulating its ownership and use, in appreciation of the principal role of land in the livelihoods of most Kenyans, its nexus to the conservation of all natural resources and its impact on the availability and supply of water. Nevertheless, a key hindrance to the conservation of water catchment areas has been laws on land tenure and use, a conclusion that is supported by the findings of a Government-appointed taskforce on the conservation of the Mau Forest. Therefore, the constitutional provisions on land, the National Land Policy and the enactment of laws on land

management will greatly influence the processes of conserving water catchment areas and the successful implementation of this Master Plan.

The Constitution recognises three tenurial modes of holding land (community, private and public land holdings) but regardless of the tenure regime, it requires that the land be held, used and managed equitably, efficiently, productively and sustainably, and that ecologically-sensitive areas be conserved and protected. In its definition of public land, the Constitution includes rivers, lakes, the territorial sea and other water bodies, exclusive economic zone, sea bed, continental shelf and land between the high and low water marks. To enhance sustainable management of water catchment areas, the Government can compulsorily acquire public land that may have been irregularly acquired by private entities, without compensation. With this power, the State can reclaim any water catchment areas that may have fallen into private hands without due regard for the law, in order to restore and conserve them. In contrast, the State can compensate those who own such land legally even in the absence of a title to the land, provided such occupation is in good faith.

By recognising the right to water, the Bill of Rights puts an obligation on the State to ensure that water is conserved and available, and that every person has access to sufficient clean and safe water. In view of the role played by water catchment areas in ensuring availability of water, it is undeniable that they are instrumental in guaranteeing the right to clean and safe water, and therefore need to be protected.

3.4 LEGAL AND POLICY FRAMEWORKS FOR THE CONSERVATION OF WATER CATCHMENT AREAS

No legislation or policy in Kenya comprehensively addresses the governance of water catchment areas, primarily due to fact that this issue straddles several sectors ranging from water to wetlands to land. Recognizing this challenge, the Master Plan seeks to provide a harmonious framework for the governance of water catchment areas in the country. The analysis of the legal and policy framework therefore needs to examine laws and policies governing resources relevant to water catchment areas viz. the environment, water, wetlands, forests and land, in addition to those governing wildlife, agriculture and physical planning. Vision 2030 as the overall national development plan until 2030 provides the overriding policy anchorage for the Master Plan.

3.4.1 The Environment

In 1999, Parliament enacted the Environmental Management and Coordination Act (EMCA) to provide an overarching legal and institutional framework for the management of the environment. Hitherto environmental issues were dealt with in a sectoral and uncoordinated manner. Although enacted before the adoption of the Constitution of Kenya 2010, which has an expansive Bill of Rights, the EMCA establishes and guarantees every Kenyan the right to a clean and healthy environment and obligates them to conserve the environment.

The Act, which contains principles to govern the management of the environment for purposes of promoting sustainable development, provides a framework for the implementation and enforcement of its provisions. It establishes the National Environmental Management authority (NEMA) as the principal body for supervising and coordinating environmental management and implementing government policies on the environment. The Act as the framework law in environmental matters is relevant to the governance of water catchment areas, addressing the conservation of wetlands in Section 42, and the protection of hilltops, hillsides, mountain areas and forests in Section 44. The latter Section requires NEMA, in consultation with lead agencies, to develop, issue and implement regulations, procedures, guidelines and measures for the sustainable use of hillsides, hilltops, mountain areas and forests.

The Act requires the conduct of Environmental Impact Assessment (EIA) in situations where an activity being

undertaken is out of character with its surroundings, or involves the construction of any structure of a scale not in keeping with its surrounding and major changes in land use. The principal objective of EIA is to ensure that environmental considerations are incorporated into the planning, decision-making and implementation processes of development activities. It assists in preventing, or where that is not possible, minimizing adverse impacts and maximizing the positive effects of any given activity, essentially evaluating the economic costs and benefits of individual environmental projects. By demanding the conduct of EIA, the Act seeks to ensure that water catchment areas are protected and activities of the nature described can only be carried out once it has been determined that they will not have adverse effects on the water catchment area, and after sufficient corrective measures have been undertaken.

3.4.2 Water Resources

The governance of water catchment areas is undertaken principally to guarantee the availability and supply of water. The legal and policy framework for the water sector has undergone fundamental reforms over the last decade, first in Sessional Paper No. 1 of 1999 on Water Resource Management and Development (Water Policy, 1999). The Policy's main goal is to enhance sustainable and integrated development and management of the water sector through the:

i. preservation, conservation, and protection of water resources and their sustainable, rational and economical allocation
ii. supply of sufficient quantities of good quality water to meet various needs including poverty alleviation while ensuring safe disposal of wastewater and environmental protection
iii. establishment of an efficient and effective institutional framework and
iv. development of a sound and sustainable financing system for effective water resources management, water supply and sanitation development.

The Policy also incorporates the principles of Integrated Water Resource Management (IWRM) as fundamental to the sustainable management of water resources in Kenya.

The Policy set the stage for reforms geared towards enhancing institutional responsibility and coordination, efficiency, sustainability and public participation, and provided the basis for the enactment of the Water Act (Cap 372) of 2002, which made several reforms to the water sector revolving around four themes namely:

i. separation of management of water resources from the provision of water services
ii. separation of policy making from day to day administration and regulation
iii. decentralisation of functions to local institutions and
iv. the involvement of nongovernment entities in the management of water resources and in the provision of water services (Mumma, 2006).

The Act lays out mechanisms for the management, conservation, use and control of water resources and for the regulation of rights to use water and of water supply and sewerage services, setting detailed rules and institutional infrastructure to realize its objectives. It gives the Minister the power to formulate a national Water Resource Management Strategy to set the framework for the management, protection, use, development, conservation and control of water resources in Kenya. Pursuant to the provision of the Water Act, the Minister for Water and Irrigation published the first National Water Resources Management Strategy for the 2007 to 2009 period. Following its expiry, a new strategy has been developed for the 2010 to 2016 period, with key highlights including the recognition of water as a finite and scarce resources, the need for public participation in the management of water resources, and the application of IWRM principles in the management of water resources.

The Strategy reinforces the fact that water resource management in Kenya is undertaken along catchment

or basin boundaries thus justifying the conservation of catchment areas. The Strategy, finalised based on the provisions of the Constitution, points out that water catchment areas are to be held by the national government in trust for the people of Kenya and administered by the National Land Commission. The Strategy seeks to promote integrated approaches to water resources and catchment management using tools such as the Catchment Management Strategies (CMS) that the Act requires to be developed for every catchment area.

The Water Resource Management Authority (WRMA), the principal institution responsible for water resource management, is empowered to gazette a defined area within which rainwater flows into a watercourse as a catchment area. In exercise of this power, WRMA has classified Kenya into six catchment areas namely Lake Victoria North, Lake Victoria South, Athi, Tana, Ewaso Ng'iro and Rift Valley. Section 15 of the Water Act empowers WRMA to develop a CMS for the management, use, development, conservation, protection and control of water resources within each catchment area. Further, WRMA is required to review every CMS from time to time to ensure that each:

i. takes into account the class of the water resource and resource quality objectives of the water
ii. is consistent with the national water resources strategy
iii. prescribes principles, objectives, procedures and institutional arrangements for management within each catchment area
iv. contains water allocation plans
v. provides mechanisms and facilities for public participation in water resource management.

The Water Act prohibits the pollution of water resources and controls the discharge of industrial and municipal effluents into rivers and oceans, and pursuant to these provisions, the Ministry has established technical mechanisms (including laboratory facilities) for monitoring the quality of various water resources in Kenya. As provided for in the Act, the Minister for Water and Irrigation, upon the recommendation of WRMA, gazetted Water Resource Management Rules 2007, which addresses several issues including water quality and catchment management strategies and rules that give guidelines on water permit acquisition and adherence to conditions and enforcement of the user fee charges. Other water related Acts that impact on the management of water catchment areas are the Fisheries Act, the Irrigation Act, the Continental Shelf Act and the Maritime Zones Act.

3.4.3 Wetlands

Wetlands are amongst the most important ecosystems on earth (Kusler, 1990), making ecological contributions to the global environment by improving water quality, recharging aquifers, and functioning as storm buffers (Kruchek, 2003). In addition, wetlands control soil erosion and climate stability, and serve as a habitat for a variety of biological diversity thereby providing an important reservoir of genetic material. Therefore, wetlands significantly affect the national economy, in terms of supporting both direct livelihoods and vital ecological functions such as water provision and maintenance of hydrological cycles (Odote, 2010). Sadly, wetlands have not always been accorded the recognition and protection they warrant considering that in the past they have been converted for agricultural and development purposes irrespective of the fragility of the ecosystem.

The adoption in 1971 of the Convention on Wetlands of International Importance, especially as Waterfowl Habitat (Ramsar Convention) marked a turning point in the conservation of wetlands. The Convention, which Kenya acceded to on 05 June 1990, requires contracting parties to conserve and wisely use wetlands, and designate suitable wetlands within the country for inclusion into the list of wetlands of international importance. Further, the parties are required to include wetland conservation considerations into their natural resource planning processes, and this requires a supportive and effective legal and policy framework.

Kenya does not have a national policy on wetlands but a final Draft Wetlands Policy produced in

2008 following stakeholder consultations that commenced in the early 90s, and which aims to enhance the conservation and wise use of wetlands as well as promote recognition of wetlands as an integral component of the environment. The Policy seeks to strengthen the contribution of wetlands to sustainable development and the improvement of the livelihoods of the Kenyan people at the local and national level. The objectives of the Wetlands Policy are to:

i. establish an effective and efficient institutional and legal framework for integrated management and wise use of wetlands which will provide an enabling environment for the participation of all stakeholders
ii. enhance and maintain functions and values derived from wetlands in order to protect biological diversity and improve livelihood of Kenyans
iii. promote communication, education and public awareness among stakeholders to enhance their appreciation and participation in wetland conservation
iv. carry out demand-driven research on and monitor wetlands to improve scientific information and knowledge base
v. enhance capacity building within relevant institutions and for personnel involved in conservation and management of wetlands
vi. establish a national wetlands information management system and database including tools and packages to targeted groups
vii. promote innovative planning and integrated management approaches towards wetlands conservation and management in Kenya
viii. promote partnership and cooperation at regional and international levels for the management of transboundary wetlands and migratory species.

The Policy identifies the challenges facing wetlands in Kenyan and proposes measures to address those challenges including establishing wetland conservation areas, restoring and rehabilitating degraded wetlands, education and public awareness, and recognizing, protecting and promoting the user rights of communities living adjacent to wetland resources. Despite the importance of conserving wetlands as water catchment areas, this Policy is yet to be adopted.

Not unlike water catchment areas, no legislation or policy in Kenya comprehensively addresses the governance of wetlands, which is essentially dealt with piecemeal in the EMCA, Physical Planning and the Water Acts (Odote, 2008). Section 42 of the EMCA contains provisions for the protection of wetlands, and empowers the Director General of NEMA to regulate certain activities that cannot be undertaken within a wetland except with the approval of the Director General following an EIA. These activities include:

i. erecting, reconstructing, placing, altering, extending, removing or demolishing any structure or part of any structure in or under a wetland
ii. excavating, drilling, tunnelling or disturbing a wetland
iii. introducing any animal whether alien or indigenous into a wetland
iv. introducing any plant or part of a plant specimen, whether alien or indigenous, dead or alive, into any wetland
v. depositing any substance in a wetland if that substance would or is likely to have adverse environmental effects on the wetland
vi. directing or blocking any wetland from its natural and normal course and
vii. draining of a wetland

In addition, Section 42 gives the Minister for Environment, the powers to declare a wetland as a protected area and impose such restrictions as are necessary to protect a wetland from environmental degradation. In keeping with the powers accorded the Minister to issue orders, regulations and standards for the management of wetlands, the Minister for Environment and Mineral Resources gazetted the Environmental Management and Coordination (Wetlands, River Banks, Lake Shores and Sea Shore Management) Regulations. These Regulations, whose primary objective is to conserve water

catchments and control floods, detail the procedure for declaring a wetland as a protected area and require NEMA, in consultation with lead agencies, to prepare an inventory of wetlands together with the uses permitted in wetlands and the procedures for obtaining permits for such uses. Further, they specifically place a duty on every landowner, occupier or user of land adjacent or contiguous to a wetland to maintain the ecological integrity of a wetland.

3.4.4 Forests

Forests have numerous economic, social, cultural and ecological values, as they provide essential goods and services including timber, poles, fuel-wood, medicine and a variety of non-wood products. In addition to playing a critical role in supporting the livelihoods of Kenyans and the national economy, forests serve as habitat for flora and fauna and as water catchment areas. In view of the fact that they support the five water main water towers in Kenya (the Aberdares, Mau Complex, Mt. Elgon, Mount Kenya and Cherangany hills), their conservation and sustenance is critical to the availability of quality water.

The Forest Act was enacted in 2005 following past failures of forest legislation to sustainably manage forest and related products, and upon the realisation that forests play a vital role in the stabilisation of soils and ground water. Naturally, they support agriculture, play a crucial role in protecting water catchments and moderate climate by absorbing greenhouse gases. The Act governs all types of forests whether on publicly (state and local authority) or privately owned land but only public forests – with the exception of community forests – are vested in the State (Section 21). On its part, the Constitution classifies government forests and water catchment areas as public land to be managed by the National Land Commission.

The Forest Act gives the Minister in charge of Forests the authority to declare any land under the jurisdiction of a local authority to be a local authority forest where such land is an important catchment area, a source of water springs, or a fragile environment. However, this authority is conferred upon the recommendation of the forest conservation committee for the area within which a forest is situated, the local authority and the Board – essentially advocating for the collaborative and participatory management of forests. Indeed, even as the principal responsibility for the management of forests is vested in the Kenya Forest Service, the Act allows the communities adjacent to the forest to participate in their management. To this end, the Act provides for the creation of Community Forest Associations by persons living adjacent to the forest who can then apply to the Director of KFS to participate in the conservation and management of a forest.

In recognition of the importance of forests for sustainable development, the Constitution in Article 69 provides for the State to work towards increasing the country's forest cover to 10% of the land area of Kenya.

3.4.5 Land

Although land forms the basis of livelihoods for the majority of the people of Kenya, until 2009, the country did not have a comprehensive and clearly defined National Land Policy. Coupled with numerous, and in certain instances contradictory land laws, the result was a complex yet inadequate land management and administration system that gave rise to low levels of productivity, poverty and conflicts over land and related resources. Specifically it has occasioned the:

i. severe land pressure and fragmentation of landholdings into uneconomic units
ii. deterioration in land quality due to poor land-use practices
iii. unproductive and speculative land hoarding
iv. underutilisation and abandonment of agricultural land
v. severe tenure insecurity due to overlapping rights
vi. disinheritance of women and vulnerable members of society and biased decisions by land management and dispute resolution institutions
vii. landlessness and the squatter phenomenon

viii. uncontrolled development, urban squalor and environmental pollution
ix. wanton destruction of forests, catchment areas and areas of unique biodiversity
x. desertification in the arid and semi-arid lands
xi. growth of extralegal land administration processes (National Land Policy, 2009)

In order to provide a policy framework for addressing the above issues, Parliament adopted the Sessional Paper No. 3 on National Land Policy in 2009 to "guide the country towards efficient, sustainable and equitable use of land for prosperity and posterity." The Policy's overall objective is to secure rights over land and provide for sustainable growth, investment and reduction of poverty in line with the Government's overall development objectives. The Policy seeks to provide a legal and policy framework for the maintenance of sound and effective land administration and management in order to provide:

i. all citizens with the opportunity to access and beneficially occupy land
ii. economically viable, socially equitable and environmentally sustainable allocation and use of land;
iii. efficient, effective and economical operation of land markets
iv. efficient and effective utilisation of land and land-based resources, and
v. efficient and transparent land dispute resolution mechanisms.

The National Land Policy recognises that land has numerous values including economic, cultural, social and environmental, and therefore makes proposals for regulating land to ensure the realisation of these multiple values. It recognises that tenure, being the terms and conditions under which land and related resources are acquired, held, managed and disposed of is at the heart of the past land problems in the country. It thus, in similar terms as the Constitution, recognises that land belongs to the people of Kenya and is to be held by these nationally as public land, individually as private land or as communities as community land. These three land tenure categories will receive equal recognition and protection in both law and policy, a move away from the previous view where private landholding was viewed as superior.

The Policy reinforces the role of government in regulating property rights in land through the exercise of its powers of compulsory acquisition and development control over all land in the public interest. The Policy, however, recognises that this power has in the past been used in a manner that is inimical to the security of land rights and against public interest including not promoting conservation or natural resources and sustainable management of the environment. To ensure that the powers of the State in regulating property rights serve their intended functions, the Policy recommends the review and democratisation of the process of their exercise, their effective enforcement and the harmonisation of the institutional framework for their exercise. The Policy also calls for the review and consolidation of the laws relating to land and proposes the development of a comprehensive land law, an issue that needs to be undertaken within eighteen months of the date when the Constitution was adopted.

Aside tenure, the Constitution and the National Land Policy provide rules for the regulation of the use of land and other natural resources, given as the manner of use has implications on sustainability. The National Land Policy requires land-use planning, reviews of the policy and legal framework for land-use planning, and the participation of the public in the planning process be recognised and improved. The Physical Planning Act (Cap 286) of 1996 regulates the preparation and implementation of physical development plans in all parts of the country, and as such, it is critical to the regulation of land use. It details the procedures for development control and requires that proponents apply to the relevant authority to obtain approvals before a development is undertaken.

The Act requires the balancing of various interests in the process of designing and approving physical

plans and specifically calls for the conduct of EIA in cases where the local authority is of the view that proposals for industrial development activities will have injurious impact on the environmental. As the EIA provides an opportunity for development projects to be weighed against the environmental imperatives of the ecosystem, it effectively ensures the conservation of water catchment areas.

3.4.6 Wildlife

Although still relevant, the policy framework for the management of wildlife resources is very old, having first been developed in 1975 through Sessional Paper No. 3 of 1975, *A Statement on Future Wildlife Management Policy in Kenya.* Thereafter, the Wildlife (Conservation and Management) Act of 1976 was enacted to provide a legal and institutional framework for the implementation of the Policy. Through an amendment in 1989, the Act established the Kenya Wildlife Services (KWS) as the principal body for overseeing the development and implementation of policies and strategies on wildlife conservation and management. The KWS has the duty of advising the Government on the establishment of protected areas namely, national parks, game reserves or protected wildlife sanctuaries, and for managing the majority of the protected areas.

On occasion, water catchment areas fall within the purview of the Act if they are protected areas that are habitat for wildlife – a factor that raises the issue of institutional responsibility for the management of WCA and the relevant legal framework. The decision by the Government to designate KWS as the focal point for the implementation of the Ramsar Convention on Wetlands in Kenya makes the Act relevant to the conservation and management of wetlands – critical water catchment areas.

In 2008, efforts to revise the Act culminated in the development of the draft Wildlife Policy, which provides a framework for the protection, conservation and management of wildlife, habitats and ecosystems in Kenya for the present and future generations. The proposed changes to the Act aim to address existing inadequacies that have contributed to the current threats and challenges facing wildlife conservation in Kenya including human-wildlife conflict and the disjointed approach to wildlife conservation.

3.4.7 Agriculture

The agricultural sector, which constitutes the greatest use of land in Kenya, significantly affects livelihoods and sustainability considering that it is the single largest employer of the country's labour force and user of freshwater resources. The Agriculture Act (Cap 318), the principal legislation governing agricultural activities, is geared towards promoting agricultural development in Kenya. The long-term objective of the Act is to ensure the development of arable land in accordance with sound land management and husbandry practices, hence the emphasis on the need for the conservation of soil and its fertility.

The Act empowers the Minister for Agriculture to make regulations to, inter alia, prevent soil erosion and thus preserve the soil. To this end, the Minister for Agriculture gazetted the Agriculture Farm Forestry Rules on 27 October 2009, with the aim of "promoting and maintaining farm forest cover of at least 10% of every agricultural landholding and to preserve and sustain the environment in combating climate change and global warming." The Rules are geared towards the establishment and maintenance of sustainable forests for purposes of water, soil and biodiversity conservation, and the protection of riverbanks, shorelines, riparian and wetland areas.

As stipulated in Section 48 of the Act, such regulations will prevent the clearing of certain parcels of land for cultivation and the drainage of land, as well as protect slopes and catchment areas, and preserve soil on ridges, slopes or valleys. The powers of the Minister and the Director of Agriculture relevant to the conservation of water catchment areas include imposing penalties on those violating the stipulated regulations. By regulating the utilisation of different categories of land in Kenya for various agricultural purposes, the Act strives towards sustainable utilisation of land resources.

The Agricultural Sector Development Strategy 2010-2020 was adopted to guide the sector in addressing the challenges facing it and enhance its development

and expansion. The Strategy acknowledges the importance of forests as water catchment areas, and appropriately prioritises the rehabilitation of degraded water catchment areas. In addition, the Strategy identifies wetlands conservation and the implementation of the National Climate Change Response Strategy as key to the development and conservation of catchment areas.

3.4.8 Legislation on Regional Authorities

Since the 1970s, the GOK has created six Regional Development Authorities (RDAs) with the mandate to plan and coordinate the implementation of rural development activities to ensure equitable resource development and promote regional socioeconomic development through integrated planning and management. The RDAs are the Tana and Athi Rivers Development Authority (TARDA), Kerio Valley Development Authority (KVDA), Lake Basin Development Authority (LBDA), Ewaso Ng'iro North Development Authority (ENNDA), Ewaso Ng'iro South Development Authority (ENSDA), and Coast Development Authority (CDA). These development authorities were established through various Acts of Parliament namely the:

i. Tana and Athi Rivers Development Authority (TARDA) Cap 443 of 1974
ii. Kerio Valley Development Authority (KVDA) Cap 441 of 1979
iii. Lake Basin Development Authority (LBDA) Cap 442 of 1979
iv. Ewaso Ng'iro North Development Authority (ENNDA) Cap 448 of 1989
v. Ewaso Ng'iro South Development Authority (ENSDA) Cap 447 of 1989
vi. Coast Development Authority (CDA) Cap 449 of 1990.

The effective planning, development and implementation of integrated and multipurpose programmes and projects in these RDAs contributes to the achievement of balanced regional development through employment creation, equitable distribution of resources and rural-urban balance. The RDAs are mandated to promote integrated development within their areas of jurisdiction through the implementation of integrated programmes and projects including the provision of hydropower, flood control, water for irrigation, domestic and industrial use as well as environmental conservation.

The jurisdiction of the RDAs covers the following areas:

i. TARDA covers about 138,000km^2 of the area bounded by and drained by the Tana and Athi River catchments
ii. KVDA covers about 96,285km^2 the area drained and bounded by watersheds of Kerio, Turkwell, Arror, Perkera, Embobut, Weseges, Wei-Wei, Muruny rivers and their tributaries
iii. LBDA covers about 39,000km^2 of areas in the Lake Victoria catchments
iv. ENNDA covers about 209,576km^2 of the area drained and bounded by Ewaso Ng'iro North River Basin
v. ENSDA covers about 47,000km^2 of the area drained and bounded by Ewaso Ng'iro South River Basin
vi. CDA covers about 83,681km^2 and the Exclusive Economic Zone (EEZ) of 200 nautical miles, the immediate coastal hinterland.

3.4.9 Land Reclamation

Kenya has not had a land reclamation policy, hence the significance of the recent formulation of the draft National Land Reclamation Policy whose aim is to transform Kenya's arid and semi-arid areas into vibrant economic development areas, and sustainably exploit their potential for economic development. The ASALs, which cover 80% (467,200km^2) of the country's landmass of 584,000km^2, have been expanding due to land degradation and increased settlements stemming from migration. The draft policy intends to promote the reclamation of degraded lands, wastelands, wetlands and restoration of fragile eco-systems, promoting rehabilitation and construction of water harvesting structures including water development technologies. In addition, it will follow up on environment and development issues in ASAL and rural areas, and reclaim, rehabilitate

and restore degraded ASAL areas through de-silting pans, dams and other water bodies, soil and water conservation, and reforestation.

3.5 INSTITUTIONAL ARRANGEMENTS

The governance of catchment areas is scattered across several sectors and legislations, as is evident from the Acts – discussed previously in this Chapter – which establish diverse institutions all charged with certain aspects of water resource management. In practice, these Acts have rarely coordinated their activities and fully implemented their mandates over water catchment areas, due to the lack of clarity on which institution has overall responsibility for the governance of these areas. Multiple agencies have a mandate over the determination and utilisation of riparian land, which provides an opportunity for collaborative enforcement mechanisms on the extent of river and lake riparian reserve (environment, water, agriculture, local authorities), and formulating regulations concerning the development of riparian land (environment, agriculture).

3.5.1 Ministries

There are several Ministries responsible for various aspects of water catchments, namely those responsible for agriculture, water and irrigation, local government, land, fisheries, forestry and wildlife. With the main aim of these Ministries being policy formulation, each has a role in the governance of water catchment areas. However, given that the governance of water catchment areas transcends the mandate of any one particular ministry, inter-ministerial collaboration is imperative. In appreciation of the multi-ministerial nature of various issues, collaborative efforts have been undertaken including the establishment of the Agricultural Sector Coordination Unit (ASCU) to ensure coordinated development and implementation of policies and strategies for improving the agricultural sector, and the coordinated of the rehabilitation of the Mau Forest Complex under the Prime Minister's Office.

The constitutional provisions governing the various Ministries afford them with the opportunity for collaboration in the management of water catchment areas, with the Ministry of Environment and Mineral Resources playing an important role including:

i. monitoring and coordination of environmental activities and enforcing compliance with environmental regulations and guidelines
ii. formulating environment and natural resources policy, and related analyses
iii. reviewing continuous development of the geodatabase for integrated natural resource and environmental management systems, conducting applied research and dissemination of research findings in forestry, land resources and geology
iv. carrying out geological surveys, mineral explorations and regulations of mining and the use of commercial explosives.

3.5.2 National Environmental Management Authority

The Environmental Management and Coordination Act creates the National Environmental Management Authority (NEMA) as the principal instrument of government for implementing policies relating to the environment, and supervising and coordinating all matters relating to the environment. In discharging its mandate, NEMA coordinates lead agencies, recognising that whereas it has the overall coordinating and supervisory responsibility, the lead agencies have the legislative or administrative responsibility for the management of certain elements of the environment. However, as regards water catchment areas, the lack of clarity on the lead institution results in duplication and institutional rivalry between NEMA and sectoral institutions mandated to manage certain aspects of water catchment areas. Although NEMA is responsible for the management, protection and conservation of the water bodies and water sources, and the development of appropriate environmental plans, the implementation of these provisions has not resulted in effective protection of water catchment areas.

At the lower levels, the EMCA creates Provincial and District Environmental Committees charged with the responsibility of coordinating environmental management within their respective areas of jurisdiction. With the adoption of the Constitution, the structures and membership of these Committees will need to be aligned with the devolved system of government.

3.5.3 Water Resource Management Authority and Other Water Institutions

The Water Act creates a comprehensive institutional structure for the management of water resources in Kenya, with the Water Resource Management Authority (WRMA) being the apex body responsible for the day-to-day management of water resources. Its functions include:

i. developing principles, guidelines, and procedures for allocation of water resources
ii. monitoring and periodically reassessing the national water strategy
iii. receiving and determining applications for water use
iv. monitoring an enforcing conditions attached to permits for water use
v. regulating and protecting water resource quality from adverse impacts
vi. managing and protecting water catchments
vii. determining charges to be imposed for the use of water from any water resource and
viii. gathering and maintaining information on water resources and periodically publishing forecasts, projections and information on water resources.

In discharging its functions of managing and protecting water catchment, WRMA has divided the country into six catchment areas, and in accordance with the requirements of Section 15 of the Water Act facilitated the development of Catchment Management Strategies (CMS) to enable the management of water resources and related land use within the catchment area. The Act provides for the establishment of two institutions to enhance the participation of local communities in water management: Catchment Area Advisory Committees (CAAC) and Water Resources Users Associations (WRUAs). The Act requires that WRMA, in consultation of the Minister, appoint a CAAC for every catchment area to advise it in water resource conservation, use and apportionment. The membership of every CAAC comprises 15 members drawn from representatives of RDAs and local authorities whose jurisdiction falls within the catchment, representatives of farmers/pastoralists, representatives of the business community, representatives of NGOs engaged in water resource management, and other persons of demonstrated competence all within the catchment.

In addition, every catchment management area shall have, within the context of the implementation of the CMS, WRUAs to provide fora for the resolution of conflicts and cooperative management of water resources in catchment areas. The inclusion of these institutions in the Water Act was to fulfil the policy objective that the community should be involved in all stages of the water projects. However, modalities for ensuring the full operation of these bodies are still not in place, with WRMA neither fully appreciating nor implementing recommendations from CAACs.

3.5.4 Kenya Forest Service

The Forest Act establishes the Kenya Forest Services and vests it with the overall responsibility of:

i. formulating policies and guidelines for the management, conservation and utilisation of all types of forests
ii. managing all state forests
iii. managing all provisional forests in consultation with forest owners
iv. protecting forests in Kenya
v. promoting forestry education and training
vi. collaborating with individuals and private and public research institutions in identifying research needs and applying research findings
vii. drawing or assisting in drawing up of management plans for all indigenous and plantation estates, local authority, provisional and private forests

viii. collaborating with other organisations and communities in the management and conservation of forests and

ix. managing forests in water catchment areas primarily for water and soil conservation, carbon sequestration and other environmental services.

KFS, which is managed by a board that exercises policy oversight over the operations of the Service, is empowered to establish forest conservancy areas for the proper and efficient management of forests. This considered, it is evident that the KFS has a role to play in the management of forests in water catchment areas.

3.5.5 Kenya Wildlife Services

The Kenya Wildlife Service was established under the provisions of the Wildlife (Conservation and Management) Act to formulate and implement policies for the conservation, management and utilisation of wildlife resources, manage national parks and reserves, prevent the destruction by wildlife of agricultural and animal husbandry activities of ranching communities. In addition, KWS is empowered to administer and coordinate international treaties relating to wildlife conservation, and protect ecologically vulnerable ecosystems and wetlands including those designated as Ramsar sites. In Kenya, the water bodies that are designated as Ramsar sites are Lakes Nakuru, Elementaita, Naivasha, Baringo and Bogoria.

3.6 CHALLENGES WITH CURRENT GOVERNANCE ARRANGEMENTS

With the existence of the wide array of laws, policies and institutions related to the governance of water catchment areas, there are several challenges plaguing the current governance framework including:

a. Multiplicity and Conflicts within Laws: There are numerous laws governing the management of water catchment areas but none of these comprehensively address water catchment management. Instead, the provisions have to be gleaned from numerous laws, some of which contradict each other, for example the powers to regulate water quality under the Water Act and The Environmental Management and Coordination Act. Based on both Acts, the respective authorities have developed regulations, which both set water quality standards and the need for payment for permits for effluent discharge: Rule 87 and 104 of the Water Resource Regulations and sections 74 and 75 of EMCA. Such duplicity and conflicting legislations have led to difficulty in their implementation thereby reducing effectiveness in governance.

b. Weak Institutional Linkages and Synergies: Despite the existence of a wide array of institutions relevant to the management of water catchment areas, there are very few linkages and synergies between these institutions. The lack of an integrated approach in the management of water catchment areas has resulted in their encroachment as well as massive deforestation. Evidence of the institutional disharmony is clearly demonstrated by the controversies between KFS and KWS on the management of Mount Kenya and the controversies between KFS and NEMA over the powers to cut down trees within a forest. What these demonstrate is the lack of clarity on the overall institutional responsibility for the conservation of water catchment areas or a proper framework for harmonisation and coordination of mandates. The provisions within EMCA, though useful, are not adequate to fully deliver the required harmonisation and coordination.

c. Lack of a Comprehensive Policy Framework: Despite the existence of several policies, the lack of an overall policy framework for the environment sector hampers effective governance of water catchment areas. The Draft Environmental Policy developed in 2008 has never been finalised and adopted, and there is no single government policy framework specific to

water catchment areas despite the recognition by Vision 2030 of the importance of conserving water catchment areas. The development of this Master Plan is a response to this policy gap.

d. Non-Alignment to the Constitutional Directives: As the current legal and policy framework relevant to the governance of water catchment areas was put in place before the adoption of the Constitution, several of its provisions contradict the Constitution. The institutional arrangement for example, refers to Provinces and Local authorities, aspects that have been reconfigured within the context of the current constitutional dispensation. The imperatives of a devolved system of government also calls for realignment of the arrangements for governing water catchment areas to sui devolved system of government.

4.0 CHAPTER FOUR

CONSERVATION AND SUSTAINABLE MANAGEMENT OF WATER CATCHMENT AREAS

4

CONSERVATION AND SUSTAINABLE MANAGEMENT OF WATER CATCHMENT AREAS

This Chapter identifies programmes to maintain and enhance the sustainability of natural resources, and that will have knock-on effects on other environmental restoration and conservation efforts. The Plan, which addresses key areas that need immediate attention, aspires to embrace collaborative natural resource management practices through partnerships and participation. This section includes a summary that takes into account the continued biodiversity loss, current conservation practices, unplanned settlements, and natural resources-use conflicts. It identifies the areas that need fast tracking as the development and implementation of tree planting programmes, rehabilitation of silted dams and pans, waste management and construction of contours, and estimates the required resources.

These estimates are apportioned to the 14 target outputs and 189 activities, which are clustered under the respective sector working groups and Ministries: 6 sector working groups organized according to the 2012-2015 grouping of MTEF sectors, and 25 lead agencies assigned specific activities based on their respective mandates. The financial projections, estimated at Kes. 942 billion, are segmented into various medium-term planning periods between 2011 and 2032 – a duration of 21 years; only Kes. 31 billion will be required during the first planning period. These funds have already been provided and allocated to various sectors, as this is expected to aid resource mobilisation in line with the national planning system. The proposed management structures will accommodate the devolved governance structure envisioned in the Constitution of Kenya 2010; a monitoring and evaluation framework will be integrated into the national E-PROMIS.

4.1 PROBLEMS IDENTIFIED

The factors that have triggered – and continue to drive – the degradation of water catchment areas were identified as:

a. weak institutional linkages, synergies and limited consultation of stakeholders
b. conflicting institutional mandates a is evident from the overlapping mandates, programmes, projects, and conflicting policies and legislations
c. inadequate flow and sharing of information on WCAs
d. low levels of awareness and limited capacity of stakeholders – particularly at corporate and grassroots level – to implement conservation measures
e. expansive and severely degraded WCAs
f. continued application of inappropriate land use and management in WCAs
g. poor and inefficient water resource management
h. water insecurity
i. poor waste management including inappropriate disposal methods
j. livelihoods insecurity
k. continued high dependence on a limited range of energy sources particularly wood fuel for industrial and household use
l. inadequate involvement of gender and youth in WCAs conservation programmes and projects
m. lack of clear funding mechanisms for WCAS
n. lack of integrated WCA monitoring and evaluation systems

4.2 PROPOSED INTERVENTIONS

This document proposes remedial actions for the 14 problems identified, based on data analysis, literature review, consultations at policy level, and observations made during fieldwork in 20 sub-catchments. The actions primarily aim to enhance production and consumption efficiency, respond to climate change, support socioeconomic growth, and ensure sustainable availability of natural resources derived from WCAs.

4.2.1 Partnerships and Participation of Stakeholders

This Master Plan proposes the establishment of the National Water Catchment Management Programme (NWCMP), which will coordinate the prioritised actions and eliminate duplication of activities by various Departments and Ministries, while harmonising the conservation of WCAs. For the effective conservation of WCAs, strong partnerships and public participation at all levels will be necessary in responding to the issues of weak institutional linkages and synergies, and limited consultation of stakeholders. The proposed NWCMP will be operationalised through committees similar to the National Water Towers Management Committee that was established by the Kenya Gazette Supplement No. 47 of July 2010, and will be governed by an Inter-Ministerial Steering Committee. A multi-stakeholder National WCA Management Committee will oversee the zoning and demarcation of the boundaries by the Ministry of Lands and the Ministry of Forestry and Wildlife. WCA discussion fora will be convened biannually at national level, and quarterly at county level where an inter-departmental committee will be established to facilitate these county meetings.

Degradation of water catchment areas is a process that takes place from as low an administrative level as the village, and for this reason, strategic actions need to be steered through common interest groups in villages. It is important to establish community-level environmental conservation, planning and implementation committees to support the activities of natural resource users associations including WRUAs, Community Forest Associations (CFA) and Environment Management Committees (EMC). Such user-groups can facilitate change in attitudes towards conservation through capacity-building programmes that address practical conservation challenges derived from community-driven conservation approaches. This proposal recognises that environmental destruction is mainly due to human activities, and that conservation efforts can only succeed with the full participation of local communities.

4.2.2 Governance of Water Catchment Areas

In order to strengthen the governance of WCAs, the proposed interventions are as follows:

i. review and harmonise conflicting policies, legislations, regulations and standards governing the management of water catchment areas, including Water Policy (Sessional Paper No. 1 of 1999 on Water Resource Management and Development), Water Act 2002, Agriculture Act 1986, Wetlands Regulations 2009, Forests Act 2005 and EMCA 1999. Regarding effluent discharge, there are provisions in EMCA 1999 and Water Resource Management Rules 2007 that have been discussed previously in Chapter 3 of this Plan. The revision of these will enable the articulation of provisions of the Kenya Constitution 2010 and flagship projects in the environment sector according to Kenya Vision 2030

ii. strengthen enforcement of and compliance with relevant legislations, policies and regulations including the acquisition of water abstraction permits and compliance with water use conditions, Part V of the Environmental Management and Coordination Act (1999) that provides a rational framework for enforcing provisions of Part VII of EMCA (1999) particularly the sections on waste management standards and control of discharge of waste into the environment

iii. develop and promote the application of policy and legislative provisions that support profitable engagement in carbon credit trading and carbon offset programmes with specific objectives of enhancing the protection and conservation of

water catchment areas, poverty alleviation and employment creation

iv. harmonise institutional arrangements for the sustainable management of water catchment areas

v. develop and implement a national programme on resource efficiency.

4.2.3 Communication strategy

In order to implement the NWCMP, a communication strategy to promote access to and use of information, innovation and technologies needs to be developed. The strategy will take into account the following measures:

i. develop, upload and maintain a website, information database and information centres on WCA

ii. disseminate information through newsletters, brochures, sports, competition, media, billboards, arts, posters and in community fora

iii. develop and integrate WCA curricula at all levels in schools

iv. set up water catchment management information centres in all Wards

v. establish a conservation-reward system and promote competition on WCA activities among the communities and groups

4.2.4 Capacity Building

Capacity building interventions have been designed to respond to the lack of awareness, skills and competency shortfalls in the application of innovations and technologies relating to environmental conservation and management. The Education for Sustainable Development Initiative is one of programmes that will contribute to capacity building. The main interventions are:

i. organising regular educational and sensitisation meetings to enhance community awareness on NWCMP and water catchment conservation of rangelands, forests and wetlands

ii. strengthening the capacities of communities, corporates and other stakeholders in the conservation and management of water catchment areas

iii. establishing and operationalising community-level youth and women WCA conservation groups

iv. building capacity on water quality monitoring including training personnel to protect, conserve and sustainably manage watersheds

v. strengthening the capacity, skills and competency of WRUAs, CFAs and EMCs to establish tree nurseries through community groups (youths, women, elders groups and other groups), and empowering them to co-manage critical water catchment areas.

4.2.5 Restoration and Management of Water Catchment Areas

All water catchments areas need to be restored, conserved and sustainably managed in order to address problems related to the degradation of WCAs such as inadequate water catchment protection, unsustainable utilisation of resources, unplanned developments and settlements, non-point pollution from inflows of urban wastes, and soil erosion. The main interventions are:

i. delineating natural vegetation and degraded areas as baseline information for restoration

ii. promoting tree planting in forests and on farms, and designing and replicating existing successful programmes aimed at achieving at least 10% cover through youth, women and community groups. Based on the 2009 census data and taking into account that the economically active age-group of Kenyans ranges from 15 and 64 years (20, 684, 861 people), the 7.6 billion trees target by 2030 can be attained if each person grew 27 trees per year assuming a 60% survival rate

iii. adhering to species and site matching principles taking into account the following:

- what species were there before degradation?
- what kind of degradation is taking place and at what elevation?

- what species would be appropriate for that particular ecological zone? (see Appendix 5)
- what is the appropriate ecological restoration model to apply

iv. controlling and, where necessary, banning livestock grazing, logging and charcoal production in critical water catchment areas in order to allow for aquifer recharge

v. surveying, demarcating and mapping out critical water catchment forest areas where the non-destructive use of forests should not be allowed

vi. assisting communities living adjacent to indigenous forests to establish their own wood lots on their private land, and engage in non-forest-destructive bio-enterprises

4.2.6 Land Use and Management Practices

Soil conservation and land use management interventions are proposed to address some of the problems related to inadequate water catchment protection and unsustainable utilisation of water resources. The main interventions are:

i. establishing a baseline on biodiversity endowment, vegetation and land cover

ii. introducing and promoting sustainable land managed technologies – including minimum tillage, organic agriculture, controlled grazing, construction of terraces, contour farming, mulching – and other conservation measures that will enable recovery of areas that have ceased to be water catchments

iii. gazetting water catchments as environmentally significant areas

iv. enforcing the Agriculture (Farm Forestry) Rules 2009

v. constructing waterways and gabions within farms to manage on-farm runoff

vi. mapping fragile ecosystems in critical catchment areas and updating the soil and geology maps of all catchment areas

vii. promoting drip irrigation

4.2.7 Water Resource Conservation and Management

Water resource conservation and management interventions have been prepared to promote landscape-wide conservation of catchments. The main interventions are:

i. implementing inter-basin and intra-basin water transfers to channel water from areas with excess water to areas with water deficit,

ii. conducting a detailed water-use survey and water resources assessment to establish water balance

iii. implementing Sub-Catchment Management Plans (SCMPs)

iv. demarcating and constructing designated livestock water consumption points

4.2.8 Water Storage Infrastructure

Water storage infrastructure interventions have been designed to promote rainwater and storm runoff harvesting. The main interventions are to:

i. promoting rainwater and storm runoff harvesting through establishment of on-farm ponds for water harvesting and installation of water tanks

ii. increasing capture and retention of rainwater through the construction of waterways, strategically located boreholes and other water harvesting structures to ensure water availability during dry seasons

iii. rehabilitating silted and degraded pans and dams, which can result in harvesting 5 billion cubic metres of rainwater that can support extensive crop irrigation and livestock production including rearing fish in ponds. Overall, all degraded water infrastructure including dams, water pans, water supply and distribution lines need to be rehabilitated or constructed at the lowest level of administration to ensure that consumers exert less pressure on water resources. Given that water in dams and pans may not be consumable, consumers and water resource managers should therefore be equipped with skills for monitoring water quality.

At household and community level, small-scale water purification and quality management methods will need to be promoted

iv. increasing water storage and harvesting through development of infrastructure such as pans, gabions, dams, canals, ponds

v. building capacity on water quality monitoring including training personnel to protect watersheds and monitor water quality

vi. constructing watering infrastructure (ramps, troughs) to prevent destruction of water pans and boreholes by livestock.

4.2.9 Management of Urban, Rural and Industrial Waste

Proper waste management can contribute significantly to the conservation of WCAs by promoting resource-use efficiency, thereby minimising harmful discharge into the environment and increasing resource productivity. In order to enable the country improve and manage urban and industrial waste and sanitation, the following interventions have been identified:

i. developing and implementing waste management strategies for all major urban areas

ii. promoting sorting of waste at source in all types of establishments, and on a large scale not only to enable the country dispose of solid waste appropriately through gasification and bio-methanisation, but also generate revenue through the Clean Development Mechanism initiatives

iii. managing urban and industrial waste as is the case with domestic waste to generate revenue through the application of resource-efficient technologies and innovations, for instance, efficient water-use technologies can save up to 20% of production costs

iv. upgrading sanitation and sewerage systems to reduce pollution

v. increasing national coverage of water supply and sanitation according to the Millennium Development Goals (MDG) while developing longer-term targets

vi. promoting the use of cleaner production technologies including recycling and re-use of water in all types of establishments.

4.2.10 Alternative Livelihoods

Alternative livelihood interventions have been prepared to reduce pressure on natural resource utilisation, enhance conservation and promote livelihoods sustenance. The main interventions are to:

i. diversify livelihoods to facilitate the sustainable natural resource use in water catchment areas, which are important resources upon which a large percentage of communities neighbouring them depend for their livelihoods. Creating livelihood options is one of the most viable WCA conservation strategies that will reduce pressure on dependence on natural forests. Options like bee-keeping, butterfly farming, mushroom farming, establishment and management of small-scale tree nurseries, on-farm woodlots, community-based production and marketing of handcrafts, operating local eco-tourism groups and other income-generating activities (IGAs) need to be promoted

ii. establish a contract-based production and market through nature-based conservation programmes to address the persistent drawback of lack of markets

iii. increase area under irrigation to improve efficiency and food security

iv. promote the use of non-wood forest products especially gums and resins in the drylands

v. develop appropriate livestock management strategies for the drylands

4.2.11 Renewable Energy Consumption and Catchment Conservation

Kenya, like other African countries heavily depends on biomass energy, and this will continue to be the case for many decades to come unless drastically heavy investments are made to develop and promote renewable energy. Biomass energy contributes 67% of the country's energy requirements (Mugo and

Gathui, 2010), and it is this high dependence on biomass energy (crop residues and dung) that is driving the degradation of water catchment areas. The indiscriminate harvesting of woodlands and trees in natural forests results in bare hilltops and aggravates land degradation by accelerating soil erosion, the formation of gulleys and high sediment loads in rivers and lakes.

The following actions are proposed:

i. support the use of alternative energy sources such as solar, biogas, offshore wave energy harvesting and wind energy to meet the energy demands especially of rural populations
ii. support tree planting on farms, protect natural forests, promote regeneration of natural woodlands
iii. promote the use of energy-saving appliances
iv. develop and promote bio-energy technologies.

4.2.12 Mainstreaming Gender, Youth and Vulnerable Groups

Women and youth are numerically the most significant part of Kenya's population, and owing to its vibrancy, the youth is a particularly valuable asset to national development – social, political and economic growth. The majority of the population in this category has formal education but no vocational skills but their engagement in environmental conservation programmes can produce positive multiplier effects on economic growth. The following interventions have been designed to close this gap:

i. developing a gender mainstreaming strategy to address the low involvement of the gender and the youth in activities like tree planting, waste management, promotion of indigenous and current forms of soil conservation and alternative sources of energy and livelihood activities
ii. developing a strategy for the youth, physically-challenged and other vulnerable groups
iii. building the capacity of women, youth and special interest groups to enable them effectively participate in catchment conservation activities

4.2.13 Funding Mechanisms

The restoration of water catchment areas will require a substantial amount of funds estimated at Kes. 942 billion for technical support, capacity building and

Plate 4.2.11 Renewable wind energy on Ngong Hills
(Source: Ministry of Energy 2011)

other institutional arrangements. This intervention has been prepared to enable the proposed NWCMP secure funds for the implementation of activities proposed in this Master Plan. The main interventions are:

i. identifying current and potential sources of funding
ii. reviewing and evaluating the current funding mechanisms and streamline their operations
iii. developing a financial, procurement and management handbook for WCA at all levels
iv. introducing conservancy levy and payment for ecosystem services
v. establishing a WCA fund coordinating body
vi. facilitating carbon credit trading and carbon offset programmes
vii. putting in place an auditing mechanism to strengthen the management of WCA funds committees at district and county levels
viii. reviewing, evaluating, developing and streamlining WCA funding mechanisms at all levels

4.2.14 Monitoring and Evaluation Systems in Water Catchment Areas

A rapid survey conducted by the Taskforce showed that the ongoing interventions have a unique monitoring, evaluation and reporting component that is mainly a prescription of the sponsoring/funding agency. A strategic communication intervention – one of the key means through which access to and application of knowledge and information are facilitated – helps establish a common understanding among all participants of a development initiative, creating a base for common action (Mozammel and Schechter 2005). Under this component, the following activities will be undertaken:

i. developing and operationalising a monitoring and evaluation (M&E) framework and an M&E manual for Natural Resource Users Association (NRUAs)
ii. supporting publication and dissemination of a WCA annual report
iii. installing water catchment M&E systems in all catchments
iv. building the capacity of NRUAs and other legally constituted organisations in monitoring and equip all NRUAs and other legally constituted organisations with monitoring tools
v. sensitising and training stakeholders on M&E
vi. mid-term review of the Master Plan after 10 years
vii. end term review of the Master Plan

4.3 RESOURCE MOBILISATION

The restoration of water catchment areas requires a substantial amount of financial, technical and human resources. Funding will be required to undertake thorough surveys of all water catchment areas countrywide, take inventory of the biodiversity in all water catchment areas, and acquire the appropriate tree species seedlings for rehabilitation. A qualified workforce will be required to undertake the restoration, so will guides to ensure that the appropriate tree species are planted. Considering that the annual budget allocation is approximately Kes. 100 billion, the Master Plan has a funding deficit of over Kes. 800 billion that is required over the remaining period of Vision 2030. The Government will lead the process of funding the Master Plan, and development partners (both bilateral and multilateral), NGOs/CBOs, the civil society, private sector, and public private partnerships will contribute significantly to close the funding gap. Other innovative financing mechanisms, including tapping resources to be allocated to the 47 Counties, will be explored. It is envisaged that the resources will be allocated according to the identified priority interventions in Section 5.3 of the NWCCP, commensurate with Kenya's Vision 2030 Medium Term Plans. A resource mobilisation strategy will also be developed in the first phase of the implementation of the Master Plan.

Table 4.3.1 Total 2011/12 Budgetary Allocations

MINISTRY	RECURRENT	DEVELOPMENT	TOTAL
Ministry of Water and irrigation	6,060,124,046.00	36,931,463,944.00	42,991,587,990.00
Ministry of environment and Mineral resources	2,602,169,150.00	4,105,750,532.00	6,707,919,682.00
Ministry of Forestry and Wildlife	5,174,231,210.00	3,488,912,000.00	8,663,143,210.00
Other Ministries (Funds, Agriculture, Livestock development, Communities, CBOs, NGOs etc)			42,0000000000.00
			100,000,000,000,000.00
Financing Deficit			800,000,000,000,000.00

a. Ministry of Water and Irrigation

FUND	RECURRENT	DEVELOPMENT	TOTAL
Water Services Trust Fund	20,000,000.00	995,783,175.00	1,015,783,175.00

b. Ministry of Environment and Mineral Resources

FUND	RECURRENT	DEVELOPMENT	TOTAL
The National Environmental Trust Fund	50,000,000.00	Nil	50,000,000.00
National Restoration Fund	N/A	N/A	N/A

c. Ministry of Forestry and Wildlife

FUND	RECURRENT	DEVELOPMENT	TOTAL
Water Tower Conservation Fund	N/A	50,000,000	50,000,000.00
Forest Management and Conservation Fund	N/A	N/A	N/A
The Wildlife Service Fund	N/A	N/A	N/A

4.3.1 Funding Restoration from the Government-Established Funds

Various funds have been established to support conservation of water catchment areas, and there are other funds established for other purposes but which can still be used for the protection of water catchment areas. Some of these potential sources of funds for restoration include the:

i. Water Towers Conservation Fund, established on 23 July 2010, is part of the Mau Complex Forest Interim Coordinating Secretariat's mandate "to develop the framework for long-term measures to restore and sustainably manage the Mau Forest Complex and other water towers". This fund is managed by a National Water Towers Management Committee that comprises eight members
ii. Forest Management and Conservation Fund, established under the Forests Act 2005, is managed by a Finance Committee appointed and empowered by the Kenya Forest Service (KFS) Board. Some of the functions of the Board include the maintenance and conservation of indigenous forests, rehabilitation of forests, management of unique forests for biodiversity conservation, and establishment of nurseries and production of seedlings
iii. Water Services Trust Fund, established under the Water Act 2002, whose objective is to assist in financing the provision of water to areas of Kenya with inadequate water supply
iv. National Environment Trust Fund established under EMCA 1999 and managed by a Board of Trustees
v. National Restoration Fund vested in NEMA with the objective of supplementing insurance for the mitigation and control of environmental degradation
vi. Kenya Wildlife Service Fund established under the Wildlife (Conservation and Management) Act and managed by the KWS Board of Trustees
vii. National Consolidated Fund and the County Government Revenue Fund established by the Constitution of Kenya 2010
viii. Constituency Development Fund (CDF) established by the CDF Act
ix. Local Authorities Transfer Fund (LATF) established by the Local Authorities Act

4.4 MONITORING AND EVALUATION FRAMEWORK

The purpose of monitoring and evaluation is to measure and assess performance, in order to manage the outcomes of the restoration/rehabilitation process more effectively, and as such it will be an essential part of planning and management. Monitoring will be a continuous, systematic and critical review of a process with the aim of assessing progress, and it will be done in a participatory manner through a logical framework.

The objective for applying a monitoring and evaluation framework is to help empower the primary stakeholders by creating opportunities for them to reflect critically on the direction of the management interventions. For this reason, stakeholders should hold regular meetings to share experiences or lessons and evaluate potential impacts arising from any interventions on water catchments. Short study tours, particularly for the leaders, could be organised for capacity building and to facilitate sharing of experiences on what others are doing in water catchment restoration and management. Relevant government institutions (e.g. WRMA, KFS, KWS) should be mandated to conduct and evaluate the status of water catchments on annual basis, ensuring that findings, recommendations/remedial actions are communicated promptly and regularly to the relevant parties.

The initiative should be aimed at promoting learning, and information sharing of results and lessons learned among the stakeholders as a basis for decision-making on various strategies and to improve knowledge and performance on water catchment restoration and management. Appendix 11 shows the logical framework on priority activities needed for the protection and conservation of water catchment areas, Appendix 12 shows the work plan and activity based budget, while Appendix 8

indicates the detailed budget for each output to be implemented in the Master Plan over the 2011 to 2030 period.

4.5 COMMUNICATION AND PUBLIC PARTICIPATION

The Government and nongovernmental organisations need to aggressively undertake initiatives to educate the public, particularly communities living adjacent to WCAs, on the importance of water catchment conservation. It is imperative for these communities to be involved in all plans for the restoration and management programmes of the water catchments in order to see and get direct benefits from their initiatives. These local communities, which sometimes possess untapped indigenous knowledge on restoration, have not been consulted resulting in the adoption of counterproductive interventions including planting unsuitable species in water catchment areas.

In order to assure the effective implementation of the restoration programme, multi-stakeholder consultation and participation will be critical, especially given that water catchment areas are a direct source of livelihood for millions of people in Kenya. Therefore, consultations need to be held for the following reasons:

a. improve the quality of decision-making processes by capturing the experience of specialised governmental and nongovernmental organisations and local community groupings
b. tap the knowledge of other CSOs working at community level
c. promote the sustainability of the proposed forest restoration programme
d. appreciate the diverse needs of different population groups based on gender, ethnic, socio-economic or geographical variations
e. set the foundation for broad-based participation in the ensuing design and implementation of restoration interventions and
f. assist governments in increasing transparency, public understanding and citizen involvement in restoration decision-making.

4.6 ORGANISATION STRUCTURE FOR THE RESTORATION

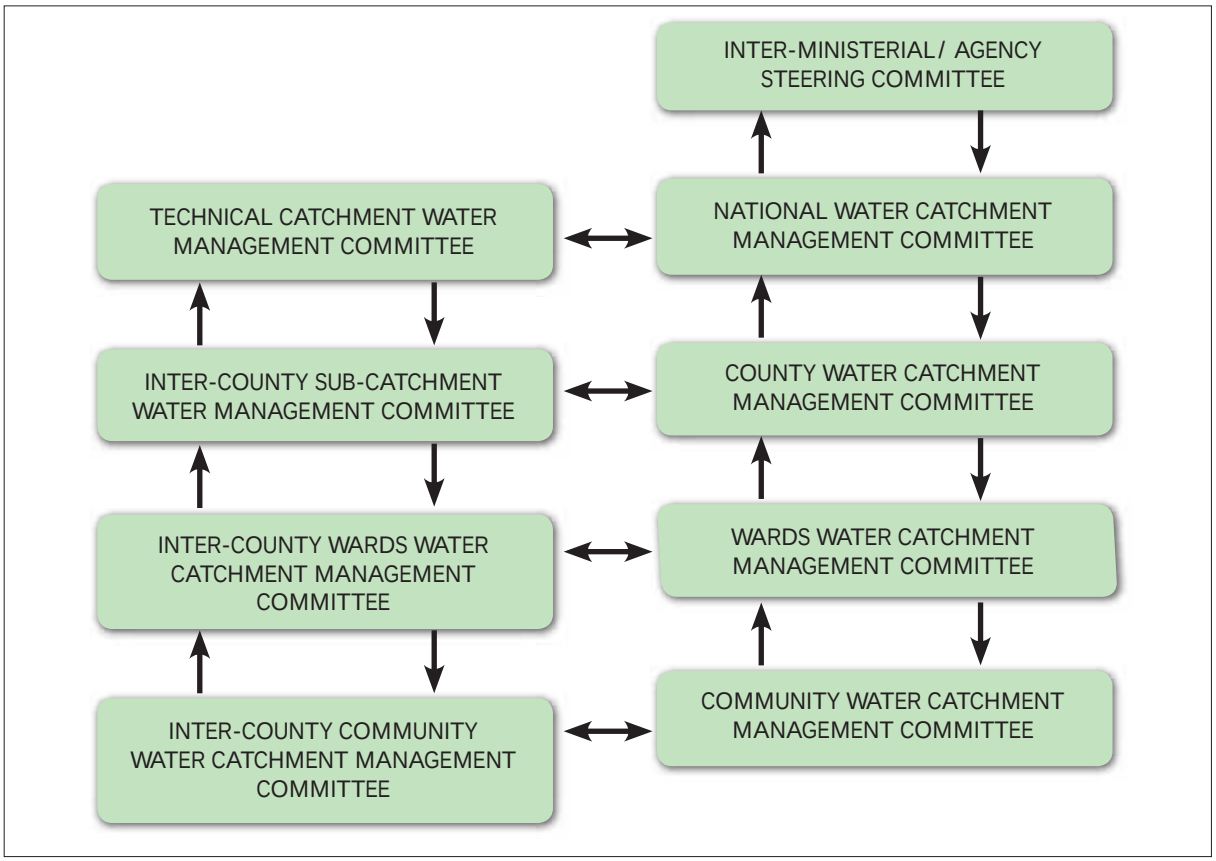
It is important for all stakeholders to agree on the conduct of the restoration programme. For this reason, all relevant Government Ministries, county governments, NGOs, donors and other stakeholders including local community organisations (WRUAs, CFAs CBOs etc.), need to be involved in the joint development of a common blueprint acceptable to all. The involvement of the youth in water catchment conservation activities can be assured by local schools and the *Kazi Kwa Vijana* and other youth programmes. The blueprint needs to clearly provide for the organisational structure, taking into consideration provisions of relevant laws and policies. Indeed, during the development of the Master Plan, a Management Structure was developed, clarifying how the programme will be effectively managed, and setting out the planning, organising, directing, controlling, supervision, monitoring and evaluation of water catchment conservation activities.

These activities will provide a framework that gives confidence that the programme is operating as planned. It will also ensure cost effective and durable sustainable water reservation and restorations outputs. The programme will be managed at various levels, with the two main levels being the National and County levels, which will have supervisory and oversight roles, while the other two will be the wards and community levels. Figure 4.1 provides the organisational structure envisaged for restoration of the programme.

4.6.1 National Water Catchment Management Steering Committee

The Water Catchment Master Plan Programme will be implemented under the overall supervision and guidance of the National Steering Committee, which will be set up in the Ministry of Environment

Figure 4.1 Organisational Structure for Restoration



and Mineral Resources and chaired by the Cabinet Secretary in the MEMR. Other representatives that will be involved in the implementation of the Master Plan are the Principal Secretaries of relevant Ministries – including Forestry and Wildlife, Energy, Youth and Sports Affairs, Local Government, Water, Agriculture and Livestock, Trade and Industrialisation, Lands, and Gender, Children and Social Development – and selected representatives of development partners involved in the water sector. The functions of the Steering Committee will be to give policy direction, set national agenda, approve budgets, programme activities and workplans, and participate in national monitoring and evaluation.

4.6.2 National Water Catchment Management Committee

Below the steering committee will be the National Water Catchment Management Committee to be chaired by the Principal Secretary of the Ministry of Environment and Mineral resources, which provides the Secretariat. This Committee will comprise of designated officers as reflected in the National Steering Committee and other representatives from the relevant organisations. Specifically, the membership will comprise the Principal Secretaries of the Ministries of Forestry and Wildlife, Energy, Youth and Sports Affairs, Local Government, Water, Agriculture and Livestock, Trade and Industrialisation, Lands, and Gender, Children and Social Development. Other members will be representatives of development partners, KEPSA, WRMA, KEFRI, KFS, and NMK for biodiversity monitoring purposes.

The functions of this Management Committee will be to:

i. coordinate the Water Catchment Master Plan activities at national level
ii. make appropriate recommendations to the Steering Committee for consideration and approval
iii. undertake overall monitoring and evaluate – 5%
iv. develop the programme design
v. develop the Water Catchment Strategic Plan
vi. provide technical assistance to the counties
vii. provide quarterly returns and reporting

4.6.3 Trans-County Water Catchment Management Committee

This multi-county water catchment forum, equivalent to the county management committee, will be composed of various counties that fall within the sub-catchment areas. Table 4.6.3.1 below gives a sample of the extent of the water catchments in terms of county and inter-county units of implementation.

The membership of this Committee will comprise Governors of the respective counties, and Heads of technical officers from the line Ministries mentioned in section 4.6.2 above. Its functions will be to:

i. implement water catchment programme activities at inter-county level
ii. manage the transboundary catchments
iii. provide technical assistance at ward level
iv. provide quarterly returns

4.6.4 County Water Catchment Management Committee

The second level of management, the County Level Management Committee, will be charged with the implementation of policies and programmes of WCA activities; the Ministry of Environment and Mineral Resources will provide the Secretariat. In addition to the County Governor who will chair the Committee, its membership will comprise 3 members of the County Executive Committee appointed by the Governor as provided for in Article 179 of the Constitution, heads of the technical Ministries mentioned in section 4.6.2 above, and 2 other members drawn from civil society organisations. Its functions will be to:

i. coordinate the activities of the Water Catchment Master Plan at county level
ii. carry out planning at county level
iii. undertake monitoring and evaluation – 25% programme activities in the county
iv. implement water catchment activities at county level
v. provide technical assistance to the wards.

Table 4.6.3.1 Extent of selected water catchments

Sub-Catchment	Size	Extent	Percentage in county
Wuoroya	300	Trans-county	65% Kakamega, 35% Siaya
Hibwein Kuria	150	Intra-county	100% Migori
Bathi	136	Intra-county	100% Kiambu
Nyando	3,625	Trans-county	44% Kericho, 25% Kisumu, 22% Nandi, 4% Uasin Gishu, 4% Nakuru, and 2% Baringo
Nzoia	12,710	Trans-county	22% Uasin Gishu, 20% Kakamega, 18% Trans Nzoia, 15% Bungoma, 11% Keiyo/Marakwet, 6% Siaya, 4% Nandi, 3% West Pokot, 2% Busia

4.6.5 Ward Water Catchment Management Committee

The third level of management, the Ward Management Committee, will be chaired by the County Assembly member elected to represent the ward. Its membership will comprise the chair, heads of relevant technical Ministries represented at the ward level, and 2 other members from CBOs. Its functions will be to:

i. coordinate the activities of the Water Catchment Master Plan at ward level
ii. carry out planning at ward level
iii. undertake monitoring and evaluation – 50% programme activities in the county
iv. implement water catchment activities at ward level
v. provide technical assistance to the communities.

4.6.6 Community Water Catchment Management Committee

The lowest level of management, the Community Water Catchment Management Committee, will be reporting to the Ward Management Committee or the Project Management Committee, by the Project Coordinator appointed by the line Ministry responsible for the particular project. It will comprise representatives of other concerned line Ministries, community and local leaders and youth and women leaders. Its membership will comprise the chair elected from either WRUAs or CFAs, a representative of the youth, and a representative of the women.

In the memberships of all the management committees discussed above, no more than two thirds of the membership will be from the same gender.

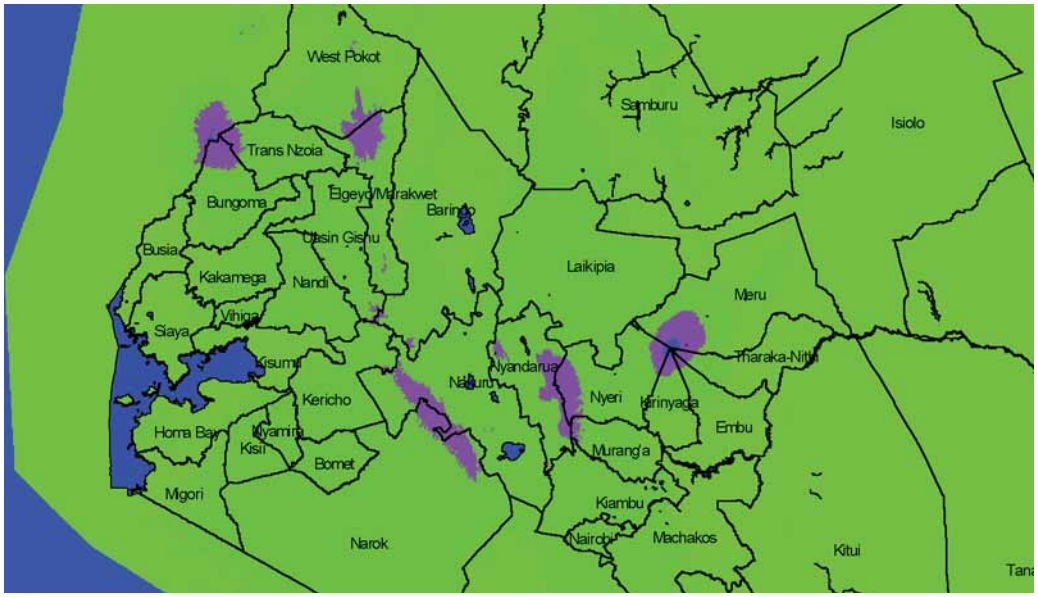
4.7 INTERVENTION MEASURES FOR TRANSBOUNDARY WATER CATCHMENTS

a. Conducting assessments of water resources and water demand on entire river basins, for the purpose of computing the water balance, will result in knowledge of water distribution against surface, groundwater, precipitation, rainfall, runoff and water quality, and facilitate the development of a water allocation plan
b. Development of a water allocation plan taking full account of all users and uses across the political boundary; the Plan should consider priority water needs agreeable as per National Water Acts, including human and ecosystems needs, agriculture, power and industrial in that sequence.
c. Development of a monitoring system for natural resource (particularly water) use, agreeable across the political boundary in terms of equipment, sampling protocol and reporting; this mainly involves hydrological, hydrogeological and water quality practices.
d. Development and implementation of a common funding mechanism for catchment restoration activities that takes into account each country's revenue statutes.
e. Development and implementation of a common land management and water infrastructure development plan.

There are transboundary water catchment areas that require cross-border collaboration in their restoration and management and these include the Mt. Elgon, Lakes Victoria and Jipe, Mara ecosystem, Sio Malakisi, River Dawa, and the Moyale and Namanga Hills. It is important to develop harmonised and well coordinated joint management work plan to guide the management of these cross-border water catchment areas. This may be achieved through intergovernmental committees on water catchment areas aimed at ensuring sustained water resource production.

The East African Community (EAC) Protocol on Environment and Natural Resource Management, which applies to among others, all activities, matters and areas of management of the environment and natural resources of the Partner States provides an opportunity to address the cross-border issue. Article

Figure 4.3. Position of Kenya's water towers traversing counties



11 on the management of forest and tree resources states that Partner States shall cooperate in all activities relating to the development, conservation, sustainable management and utilisation of all types of forests, trees, and trade in forest products throughout the Community. The Protocol was signed in 2005 but it is only recently that governments have come together and agreed to ensure its adequate implementation.

4.8 COST BENEFIT ANALYSIS OF THE RESTORATION PROGRAMME

Restoring 1 Ha with 1,000 tree seedlings is estimated to cost between Kes. 35,000 to 40,000, dependent on whether the seedlings are raised in a nursery or purchased, or on the type of seedlings, sizes, sites and other local factors like transport and labour. In case of raising seedlings in a nursery, the cost will include costs of nursery management (soil collection, wildings collection and purchasing of potting bags), costs of nursery management practices (root pruning, pest control, weeding etc), costs of field operations (pitting and planting) and post-planting care. On seedling purchases, the main costs are related to the cost of the seedlings, pitting, planting and post-planting care.

Some of the un-quantified benefits of restoring water catchment areas include:

a) Biodiversity: increasing the plant and animal variety and improving their habitat
b) Water retention capacity: increasing the water retention capacity of soils
c) Products: availability of fuelwood and fodder for animals. It has been noted that in some young/new restoration sites, quantity and quality of some fodder particularly the grass has improved
d) Medicinal trees: Most of the tree parts used by community for medicine include Prunus Africana and Zanthoxylum gilettii
e) Culture: many communities attach cultural values to some of the trees e.g. the fig trees are considered sacred by many communities

f) Aesthetics: trees are beautiful and used for ornamental purposes

g) Educational: most indigenous trees are important for educational and scientific research

h) Pollination: restored catchments increases pollinators, thereby enhancing the reproductive biology of most species

i) Tourism: restored catchments increase the touristic value

j) Ownership and community participation in conservation: tree-planting and restoration activities bring peri-forest communities closer to the forest, which allows for ownership and community stewardship in the management of natural resources.

Planting eucalyptus trees is not encouraged in water catchment areas but these can be grown in appropriate areas outside the water catchment areas. The KFS guide shows that a hectare of firewood and poles could generate a net surplus of Kes. 540,000 and Kes. 1, 000,000 respectively over a period of 8 years. This is a high return compared with Kes. 88 000 for low to medium production maize, Kes. 96,000 for medium production maize, Kes. 376,000 for high production maize and Kes. 630,000 for tea over the same period.

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APPENDICES

APPENDIX 1.

GAZETTED MEMBERS OF THE TASKFORCE

Name	Institution
Hassan Noor Hassan (Chairperson)	Office of the Deputy Prime Minister and Ministry of Local Government
Prof. Joy Obando (Vice-Chairperson)	Kenyatta University
Esther N. Ndirangu	Ministry of Gender, Children and Social Services
Henry Njuguna	Water Resources Management Authority
Beatrice Manyonge	Ministry of State for Planning, National Development and Vision 2030
Lorna Akoth Odero	Ministry of State for Provincial Administration and Internal Security
Zaverio N. Njeru	Ministry of Youth Affairs and Sports
Erastus M. Wahome	Office of The Deputy Prime Minister and Ministry of Finance
Michael Gachanja	East African Wildlife Society
Prof. Moses Imo	Moi University
Dr. Helida Oyieke	National Museums of Kenya
Anne Nyakihu Mukoma	Ministry of Youth Affairs and Sports
Esther Muiruri	Equity Bank
Dr. Alice Kaudia (Secretary)	Ministry of Environment and Mineral Resources
Esther Kathure Magambo	Ministry of Agriculture
Raphael Mwatha	Ministry of Fisheries Development
William Ogolla	Ministry of Regional Development Authorities
Francisca Wamboi	Kenya Wildlife Service
Francis N. Gachathi	Kenya Forestry Research Institute
Peter Mule Makau	Eco Bank
Esau Omolo	Kenya Forest Service

SECRETARIAT WATER CATCHMENT AREA

Name	Institution
Paul Kere	Ministry of Environment and Mineral Resources
Isabella A. Masinde	Technical Advisor Environmental Policy, Natural Resources Management Programme
Dr. Mwangi Kinyanjui	Department of Resource Survey and Remote Sensing
Kimani J. N.	Coordinator Natural Resources Management Programme
Wilfred Amollo	Ministry of Environment and Mineral Resources
King'uru Wahome	Ministry of Environment and Mineral Resources
Faith T. Pesa	Ministry of Environment and Mineral Resources
Ernest Mwangi Maina	National Environmental Management Authority
Aristarico Onyango	Department of Mines and Geology
Philip Munah	Kenya Meteorological Department
Veronica Kioko	Ministry of Environment and Mineral Resources
Mary S. Tiges	Ministry of Environment and Mineral Resources
Lorraine Kojwang'	Ministry of Environment and Mineral Resources

CHAPTER DRAFTERS AND REVIEWERS

Name	Institution
Hassan Noor Hassan, EBS	Office of the Deputy Prime Minister and Ministry of Local Government
Prof. Joy Obando	Kenyatta University
Henry Njuguna	Water Resources Management Authority
Beatrice Manyonge	Ministry of State for Planning, National Development and Vision 2030
Lorna Akoth Odero, OGW	Ministry of State for Provincial Administration and Internal Security
Zaverio N. Njeru	Ministry of Youth Affairs and Sports

Erastus M. Wahome	Office of The Deputy Prime Minister and Ministry of Finance
Michael Gachanja	East African Wildlife Society
Dr. Helida Oyieke	National Museums of Kenya
Dr. Alice Kaudia, HSC	Ministry of Environment and Mineral Resources
Raphael Mwatha	Ministry of Fisheries Development
Francis N. Gachathi	Kenya Forestry Research Institute
Paul Kere	Ministry of Environment and Mineral Resources
Isabella A. Masinde	Technical Advisor Environmental Policy, Natural Resources Management Programme
Dr. Mwangi Kinyanjui	Department of Resource Survey and Remote Sensing
Faith T. Pesa	Ministry of Environment and Mineral Resources
Lorraine Kojwang'	Ministry of Environment and Mineral Resources

APPENDIX 2.

TERMS OF REFERENCE OF TASKFORCE

1. Prepare a work plan for the taskforce activities
2. Study existing legislation, policies and other relevant documents regarding the management of water catchment areas and identify any gaps in the existing legislation, policies and other relevant documents
3. Identify, map and document water catchment areas in the country including areas that have ceased to be catchment areas for reasons to be identified by the taskforce
4. Document the environmental status of each water catchment area
5. Recommend appropriate intervention measures for each water catchment area
6. Prepare an action plan for the implementation of the recommendations
7. Draft a Master Plan for the Sustainable Management of Water Catchment Areas
8. Identify potential sources of resources, both financial and human for undertaking the recommended interventions
9. Elect its chairperson
10. Identify and co-opt other members or any other resource provided that the co-opted members do not exceed one third of the taskforce

APPENDIX 3.

POPULATION BY COUNTY, GENDER AND YOUTH (2009)

S/NO.	County	Males	Females	Total	Youth Population
1.	Nairobi	1,605,230	1,533,139	3,138,369	1,171,901
2.	Mombasa	486,924	452,446	939,370	328,712
3.	Kwale	315,997	333,934	649,931	184,374
4.	Kilifi	535,526	574,209	1,109,735	244,375
5.	Tana River	119,853	120,222	240,075	59,252
6.	Lamu	53,045	48,494	101,539	21,572
7.	Taita Taveta	145,334	139,323	284,657	77,496
8.	Garissa	334,939	288,121	623,060	96,931
9.	Wajir	363,766	298,175	661,941	74,534
10.	Mandera	559,943	465,813	1,025,756	71,393
11.	Marsabit	151,112	140,054	291,166	50,849
12.	Isiolo	73,694	69,600	143,294	28,773
13.	Meru	671	685,645	1,356,301	473,770
14.	Tharaka	178,451	186,879	365,330	31,244
15.	Embu	254,303	261,909	516,212	192,164
16.	Kitui	481,282	531,427	1,012,709	260,298
17.	Machakos	543,139	555,445	1,098,584	317,396
18.	Makueni	430,710	453,817	844,527	255,894
19.	Nyandarua	292,155	304,113	596,268	159,283
20.	Nyeri	339,725	353,833	693,558	214,560
21.	Kirinyaga	260,630	267,424	528,054	185,878
22.	Murang'a	457,864	484,717	942,581	221,591
23.	Kiambu	802,809	820,673	1,623,282	487,877
24.	Turkana	445,089	410,330	855,399	162,334
25.	West Pokot	254,827	257,883	512,690	89,137
26.	Samburu	112,007	111,940	223,947	42,060
27.	Trans Nzoia	407,172	411,585	818,757	255,197

28.	Uasin Gishu	448,994	445,185	894,179	288,688
29.	Elgeyo Marakwet	183,738	186,280	369,998	106,171
30.	Nandi	378,488	376,477	752,965	198,600
31.	Baringo	279,081	276,480	555,581	150,803
32.	Laikipia	198,625	200,602	399,227	129,987
33.	Nakuru	804,582	798,743	1,603,325	433,885
34.	Narok	429,026	421,894	850,920	159,759
35.	Kajiado	345,146	342,166	687,312	166,285
36.	Bomet	359,727	364,459	724,186	127,102
37.	Kericho	381,980	376,359	758,339	291,560
38.	Kakamega	800,989	859,662	1,660,651	367,456
39.	Vihiga	262,716	291,906	554,622	161,827
40.	Bungoma	795,595	835,339	1,630,934	370,149
41.	Busia	232,075	256,000	488,075	179,041
42.	Siaya	398,652	443,652	842,304	208,148
43.	Kisumu	474,760	494,149	968,909	311,376
44.	Homa Bay	462,454	501,340	963,794	224,325
45.	Migori	444,356	472,814	917,170	208,855
46.	Kisii	550,464	601,818	1,152,282	171,941
47.	Nyamira	287,048	311,204	598,252	325,777
	Kenya(Total)	19,192,458	19,417,639	38,610,097	10,340,580

APPENDIX 4.

LOCATION AND STATUS OF THE MAIN WATER CATCHMENT AND SUB-CATCHMENT AREAS

Catchment Area	Location/County	Main Catchment/Major Rivers	Threats
Aberdare Ranges Mountain ranges (3,994m), natural montane forests and plantations, 2,000 – 3,000m a.s.l.	Central Kenya. Nyeri, Laikipia, Nyandarua, Murang'a, Kiambu	Tana River, Ewaso Ng'iro and Athi River systems Chania, Thika, Kimakia, Gatamaiyu, Gura, Thiririka, Zuti, Zaina, Thengeraini, Komothai, Theta, Kariminu, Sasumua, Maela, Bathi, Kiburu	Encroachment, high water use, illegal logging, charcoal burning, firewood collection, illegal grazing, cultivation, climate change effect
Mt. Kenya Mountain (5,199m.), natural montane forests and plantations, 2,000 – 3,000m a.s.l.	Central Kenya. Nyeri, Meru, Kirinyaga, Embu	Tana River and Ewaso Ng'iro River systems. Chehe, Ragati, Hombe, Muhohi, Mathira, Kamuya, Nairobi, Sagana, Naromoru and Gathiuru, Liki, Ontulili, Timau, Nanyuki, Ngara-Ndare, Ethi, Marania, Kathita, Kanyaritha, Gachiuma, Gatobora, Mutonga, Mara and Nithi, Nyamindi, Rumido, Karinga, Thiba, Kamweti and Nyaga, Thuchi, Thambana, Kie and Rupingazi	Encroachment, high water use, illegal logging, charcoal burning, firewood collection, illegal grazing, cultivation, loss of mountain glaciers, climate change effect
Mt. Elgon Mountain (4,321m.), natural montane forests and plantations, 1900 – 3,000m a.s.l.	Western Kenya (cross-border with Uganda). Trans Nzoia, Bungoma, Mt. Elgon	Suam/Turkwell (Lake Turkana), Nzoia and Malakisi (Lake Victoria) River systems Suam, Kaibei, Kimothon, Mubere, Kiptogot, Suam, Kapteka,Kamjong, Chepchoinor, Labaa, Kibisi, Kimilili, Kapkateny, Kitamani, Chepkungwi, Kikuk and Chepbirbey	Encroachment, high water use, illegal logging, charcoal burning, firewood collection, illegal grazing, cultivation.
Cherangany Hills Series of hills with natural forests and plantations, forms the western escarpment of Kerio Valley 1,900 – 3,000m a.s.l.	Rift Valley West Pokot, Elgeyo Marakwet, Trans Nzoia	Lake Victoria, Turkana and Baringo Nzoia, Turkwel (source of Turkwel Gorge dam), Chebiemit (source of Chebara dam for Eldoret Municipality), Sosian, Chepkoilel, Kapteret, Suguta, Kerio and others	Encroachment, high water use, illegal logging, charcoal burning, firewood collection, illegal grazing, cultivation.

Catchment Area	Location/County	Main Catchment/Major Rivers	Threats
Mau Forest Natural montane forests and plantations, 1,900 – 3,000m a.s.l.	Rift Valley Kericho, Nakuru, Narok	Lake Victoria, Nakuru and Baringo Mara, Ewaso Ng'iro South, Molo, Kedowa, Rongai, Mau, Eldama Ravine, Perkera, Narosura, Arama, Keringet, Baraget, Chania, Ruiru, Baruk, Wanyororo, Kiamunyeki, Nabkoi, Kipkaren, Kerio and Nyando.	Encroachment, high water use, illegal logging, charcoal burning, firewood collection, illegal grazing, cultivation.
Nandi Forest Natural tropical rain forests and plantations, 1,700-1,850m a.s.l.	Western Kenya Kakamega Rift Valley Nandi County	River Yala system for Lake Victoria Isiukhu, Ikunywa, Lugusisi, Shitiya, Musimi, Sirwa and Mitobi River Yala and tributaries of Nyando River system, for Lake Victoria	Encroachment, high water use, illegal logging, charcoal burning, firewood collection, illegal grazing, cultivation. Encroachment, high water use, illegal logging, charcoal burning, firewood collection, illegal grazing, cultivation.
Marmanet/Ol Arabel Forest Upland Dry Forest and plantations, 1,550-1,650m a.s.l.	Rift Valley Laikipia	Ewaso Ng'iro North River system	Encroachment, high water use, illegal logging, charcoal burning, firewood collection, illegal grazing, cultivation
Bahati Forest Natural Upland Dry Forest and plantations, 2,100-2,800m a.s.l.	Rift Valley Nakuru	Lake Nakuru, Lake Bogoria	Encroachment, high water use, illegal logging, charcoal burning, firewood collection, illegal grazing, cultivation .
Tugen Hills Hilltop Forests, 1,800-2,500m a.s.l.	Rift Valley Baringo	Lake Baringo, Perkerra, Kerio, and Suguta River systems	Encroachment, high water use, illegal logging, charcoal burning, firewood collection, illegal grazing, cultivation
Karasuk/Loima Hills Hilltop Forests, 2,100-2,700m a.s.l.	Rift Valley Turkana	Turkwell River system	Encroachment, high water use, charcoal burning, firewood collection, grazing.
Elgeyo-Marakwet Escarpment Escarpment, Dry Forests, 1,900-3,000m. a.s.l.	Rift Valley Elgeyo-Markwet	Kerio River system	Encroachment, high water use, illegal logging, charcoal burning, firewood collection.

Catchment Area	Location/County	Main Catchment/Major Rivers	Threats
Kikuyu Escarpment Escarpment Dry Forest and plantations, 1,800-2,250m. a.s.l.	Central Kenya Kiambu	Kedong river system	Encroachment, high water use, illegal logging, charcoal burning, firewood collection, illegal grazing, cultivation.
Kiganjo Upland Dry Forest, 1,650-1,800m. a.s.l.	Central Kenya Nyeri	Ewaso Ng'iro river system	Encroachment, high water use, illegal logging, charcoal burning, firewood collection, illegal grazing, cultivation
Kirisia (Leroghi) Hills Hilltop Dry Forest, 2,000-2,500m. a.s.l.	Rift Valley Samburu	Ewaso Ng'iro North system, seasonal for Milgis River	Encroachment, high water use, illegal logging, charcoal burning, firewood collection
Loita Hills Hills, Dry Forest 2,300-2,500m. a.s.l.	Rift Valley Narok	Local catchment	Encroachment, high water use, illegal logging, charcoal burning, firewood collection
Siria Plateau Forest 1,600-1,800m. a.s.l.	Rift Valley Narok	Migori and Mara River systems	Encroachment, high water use, illegal logging, charcoal burning, firewood collection
Mathews Range (Ol Doinyo Lenkiyo) Mountain ranges about 150km long. (2,375m a.s.l.), natural montane forest	Northern Kenya Samburu	Ewaso Ng'iro and Milgis River systems Ngeng river	High water use, over grazing
Mt. Marsabit Low Mountain, dry forests, 1,165-1,500m a.s.l.	Northern Kenya Marsabit	Local catchment	High water use, over grazing
Maungu Hills Hilltop forest, 900-1,000m a.s.l.	Coastal Taita-Taveta	Local catchment	Encroachment, high water use, charcoal burning, firewood collection, grazing
Ndoto Mountains Low Mountain dry forests, 1,400-2,600m a.s.l.	Northern Kenya Samburu	Local catchment and seasonal for the Milgis lugga	High water use, over grazing

Catchment Area	Location/County	Main Catchment/Major Rivers	Threats
Ngong Hills Hill forest, 2,200-2,400m a.s.l.	Rift Valley Kajiado	Local catchmemt	Encroachment, high water use, charcoal burning, firewood collection, grazing
Kiang'ombe Hill Low Mountain forest, 1,800m a.s.l.	Central Kenya Embu	Tana River system	Encroachment, high water use, charcoal burning, firewood collection, grazing
Nyambene Hills Low Mountain forest, 1,850-2,500m a.s.l.	Central Kenya Meru	Tana River system	Encroachment, high water use, charcoal burning, firewood collection, grazing
Tinderet Moist forests, 2,100-2,600m a.s.l.	Rift Valley Uasin Gishu, Kericho, Baringo	Nyando River system	Encroachment, high water use, charcoal burning, firewood collection, grazing
Nguruman Escarpment Escarpment forests, 1,500-2,300m a.s.l.	Rift Valley Narok	Ewaso Ng'iro River system	Encroachment, high water use, charcoal burning, firewood collection, grazing
Nyiru Mountains Low Mountain forest, 1,600-2,500m a.s.l.	Northern Kenya Samburu	Local catchment	High water use, over grazing
Mount. Kulal Low Mountain forest, 1,300-1,900m a.s.l.	Northern Kenya Marsabit	Local catchment	High water use, over grazing
Ol Doinyo Orok (Namanga) Hill Hill forest, 2,200-2,400m a.s.l.	Rift Valley Kajiado	Local catchment, (cross-border)	Encroachment, high water use, charcoal burning, firewood collection, grazing
Ol Doinyo Sabuk(Kilimambogo) Hill Hill forest, 1,950-2,100m a.s.l.	Machakos	Athi River system	Encroachment, high water use, charcoal burning, firewood collection, grazing
Shimba Hills Coastal forest and plantations, 150-450m. a.s.l.	Coastal Kwale	Cha shimba and Ramisi River systems	Encroachment, high water use, charcoal burning, firewood collection, grazing

Catchment Area	Location/County	Main Catchment/Major Rivers	Threats
Taita Hills Various hills including Mbololo, Ngangao, Chawia, Sagala, Vuria 1,350-2,270m. a.s.l.	Coastal Taita-Taveta	Voi River systems	Encroachment, high water use, charcoal burning, firewood collection, grazing
Taveta (Kitovo) Lumi Ground water forest	Coastal Taita-Taveta	Lumi River system	Encroachment, high water use, charcoal burning, firewood collection, grazing
Mount. Kasigau Low mountain with forest, 1,400-1,550m. a.s.l.	Coastal Taita-Taveta	Local catchment	Encroachment, high water use, charcoal burning, firewood collection, grazing
Mangea Coastal forest	Coastal Kilifi	Local catchment	Encroachment, high water use, charcoal burning, firewood collection, grazing
Kitui Hills Various hills including: Endau, Mutha, Mutitu, Makongo, Nuu, Nthoani, Kabonge, Kyawea etc.	Kitui	Local catchments	Encroachment, high water use, charcoal burning, firewood collection, grazing
Machakos Hills Various hilltop forests generally below 1,800m. a.s.l. e.g. Nzaui, Kibauni	Machakos	Local and general catchment for Athi River system	Encroachment, high water use, charcoal burning, firewood collection, grazing
Chyulu Hills Various ridges, 1,400-1,750m a.s.l. hilltop forests	Makueni, Kajiado, Taita Taveta	Mzima springs, Tsavo and Athi/Galana river systems	Encroachment, high water use, charcoal burning, firewood collection, grazing

APPENDIX 5.

KEY TREE SPECIES FOR THE MAIN WATER CATCHMENT AND SUB-CATCHMENT AREAS

Water Catchment	Natural Vegetation Type	Elevation (m)	Appropriate Tree Species
Aberdare Ranges	Montane forests Bamboo zone	2,000 - 3,000	*Yushania alpina, Afrocrania volkensii, Podocarpus latifolius, Hagenia abyssinica, Rapanea melanophloeos, Dombeya torrida, Dracaena afromontana, Nuxia congesta.*
	Moist forest (E. slopes)	1,800 - 2,450	*Ocotea usambarensis, Pouteria adolfi-friederici, Albizia gummifera, Newtonia buchananii, Prunus africana, Casaeria battiscombei, Syzygium guineense, Polyscias kikuyuensis.*
	Drier forest (W. and S. slopes)	1,800 - 2,900	*Juniperus procera, Olea europaea ssp. cuspidata, Podocarpus falcatus, Nuxia congesta, Cassipourea malosana, Apodytes dimidiata, Ekebergia capensis, Olinia rochetiana, Teclea nobilis, Croton megalocarpus, Calodendrum capense.*
Mt. Kenya	Bamboo zone	2,100 - 3,300	*Yushania alpina, Afrocrania volkensii, Podocarpus latifolius, Hagenia abyssinica, Rapanea melanophloeos, Dombeya torrida, Dracaena afromontana, Nuxia congesta.*
	Moist montane forest (E. and S. slopes)	1,800 - 2,450	*Ocotea usambarensis, Pouteria adolfi-friederici, Albizia gummifera, Newtonia buchananii, Prunus africana, Casaeria battiscombei, Syzygium guineense, Polyscias kikuyuensis.*
	Dry montane forest (N.W. and W. slopes)	1,800 - 2,900	*Juniperus procera, Olea europaea ssp. cuspidata, Podocarpus falcatus, Nuxia congest, Cassipourea malosana, Apodytes dimidiata, Ekebergia capensis, Olinia rochetiana, Teclea nobilis, Croton megalocarpus, Calodendrum capense.*
Mt. Elgon (Ol Doinyo Ilgoon)	Bamboo zone	2,100 - 3,300	*Yushania alpina, Afrocrania volkensii, Podocarpus latifolius, Hagenia abyssinica, Rapanea melanophloeos, Dombeya torrida, Dracaena afromontana, Nuxia congesta.*
	Moist montane forest (S. slopes)	1,800 - 2,450	*Ocotea usambarensis, Pouteria adolfi-friederici, Albizia gummifera, Newtonia buchananii, Prunus africana, Casaeria battiscombei, Syzygium guineense, Polyscias fulva.*

Water Catchment	Natural Vegetation Type	Elevation (m)	Appropriate Tree Species
	Dry montane forest (N. and E. slopes)	1,800 - 2,900	*Juniperus procera, Olea europaea ssp. cuspidata, Podocarpus falcatus, Nuxia congest, Cassipourea malosana, Apodytes dimidiata, Ekebergia capensis, Olinia rochetiana, Teclea nobilis.*
Cherangany Hills	Bamboo woodland	2,100 - 3,300	*Yushania alpina, Afrocrania volkensii, Podocarpus latifolius, Hagenia abyssinica, Rapanea melanophloeos, Dombeya torrida, Dracaena afromontana, Nuxia congesta.*
	Moist montane forest (lower parts of Kiptaberr-Kapkanyar)	1,800 - 2,450	*Pouteria adolfi-friederici, Albizia gummifera, Prunus africana, Casaeria battiscombei, Syzygium guineense, Polyscias fulva, Dombeya torrida.*
	Dry montane forest (S. and E. slopes)	1,800 - 2,900	*Juniperus procera, Olea europaea ssp. cuspidata, Podocarpus falcatus, Nuxia congest, Cassipourea malosana, Apodytes dimidiata, Ekebergia capensis, Olinia rochetiana, Teclea nobilis, Ephorbia spp.*
Mau Forest	Bamboo woodland	2,100 - 3,300	*Yushania alpina, Afrocrania volkensii, Podocarpus latifolius, Hagenia abyssinica, Rapanea melanophloeos, Dombeya torrida, Dracaena afromontana, Nuxia congesta.*
	Moist montane forest (S.W. Mau)	1,800 - 2,450	*Pouteria adolfi-friederici, Albizia gummifera, Prunus africana,, Casaeria battiscombei, Syzygium guineense, Polyscias fulva, Dombeya torrida, Podocarpus latifolius.*
	Dry montane forest (N., N.E., S.E. higher elevation)	1,800 - 2,900	*Juniperus procera, Olea europaea ssp. cuspidata, Podocarpus falcatus, Nuxia congest, Cassipourea malosana, Apodytes dimidiata, Ekebergia capensis, Olinia rochetiana, Teclea nobilis.*
Kakamega Forest	Tropical Rain Forest	1,550 - 1,650	*Pouteria altissima, Croton megalocarpus, Antiaris toxicaria, Zanthoxylum gillettii, Celtis gomphophylla, Prunus africana, Maesopsis eminii, Albizia grandibracteata, Milicia excelsa, Polyscias fulva, Funtumia africana.*
Nandi Forest	Tropical Rain Forest (like Kakamega)	1,700 - 1,850	*Pouteria altissima, Croton megalocarpus, Antiaris toxicaria, Zanthoxylum gillettii, Celtis gomphophylla, Prunus africana, Maesopsis eminii, Albizia grandibracteata, Milicia excelsa, Polyscias fulva, Funtumia africana.*

Water Catchment	Natural Vegetation Type	Elevation (m)	Appropriate Tree Species
Marmanet/Ol Arabel Forest	Upland Dry Forest	1,550 - 1,650	*Juniperus procera, Olea europaea ssp. cuspidata, Nuxia congesta, Podocarpus falcatus, Croton megalocarpus, Calodendrum capense, Olinia rochetiana, Zanthoxylum usambarense, Ekebergia capensis, Pistacia aethiopica, Schrebera alata, Teclea simplicifolia.*
Bahati Forest	Upland Dry Forest	2,100 - 2,800	*Warburgia ugandensis, Olinia rochetiana, Syzygium cordatum, Sapium ellipticum, Prunus africana, Ficus spp. Olea europaea ssp. cuspidata, Ehretia cymosa, Juniperus procera, Podocarpus falcatus, Nuxia congesta, Ekebergia capensis, Teclea nobilis, Acokanthera schimperi, Zanthoxylum usambarense, Pittosporum viridiflorum.*
Tugen Hills	Hilltop Forests, dry type	1,800 - 2,500	*Croton megalocarpus, Podocarpus falcatus Juniperus procera, Podocarpus falcatus, Nuxia congesta, Ekebergia capensis, Teclea nobilis, Acokanthera schimperi, Zanthoxylum usambarense, Olea europaea ssp. cuspidata.*
Karasuk/Loima Hills	Hilltop Forests, dry type	2,100 - 2,700	*Croton megalocarpus, Podocarpus falcatus Juniperus procera, Podocarpus falcatus, Nuxia congesta, Ekebergia capensis, Teclea nobilis, Acokanthera schimperi, Zanthoxylum usambarense, Olea europaea ssp. cuspidata.*
Elgeyo-Marakwet Escarpment	Escarpment, Dry Forest	1,900 - 3,000	*Warburgia ugandensis, Olinia rochetiana, Sapium ellipticum, Prunus africana, Olea europaea ssp. cuspidata, Juniperus procera, Podocarpus falcatus, P. latifolius, Nuxia congesta, Ekebergia capensis, Teclea nobilis, Acokanthera schimperi, Zanthoxylum usambarense.*
Kikuyu Escarpment	Escarpment Dry Forest	1,800 - 2,250	*Olea europaea ssp. cuspidata, Juniperus procera, Elaeodendron buchananii, Albizia gummifera, Syzygium cordatum, Prunus africana, Nuxia congesta, Ekebergia capensis, Zanthoxylum usambarense, Pittosporum viridiflorum, Warburgia ugandensis, Celtis africana, Croton megalocarpus, Acokanthera schimperi,Cussonia holstii, Calodendrum capense, Teclea simplicifolia*
Kiganjo	Upland Dry Forest	1,650 - 1,800	*Olea europaea ssp. cuspidata, Nuxia congesta, Ekebergia capensis, Zanthoxylum usambarense, Pittosporum viridiflorum, Warburgia ugandensis, Croton megalocarpus, Acokanthera schimperi,Cussonia holstii, Calodendrum capense, Teclea simplicifolia, Brachylaena huillensis.*

Water Catchment	Natural Vegetation Type	Elevation (m)	Appropriate Tree Species
Kirisia (Leroghi) Hills	Hilltop forests, Dry Forest	2,000 - 2,500	*Croton megalocarpus, Podocarpus falcatus Juniperus procera, Podocarpus falcatus, Nuxia congesta, Ekebergia capensis, Teclea nobilis, Acokanthera schimperi, Zanthoxylum usambarense, Olea europaea ssp. cuspidata, Olea capensis*
Loita Hills	Dry Upland Forest	2,300 - 2,500	*Warburgia ugandensis, Olinia rochetiana, Syzygium cordatum, Sapium ellipticum, Prunus africana, Ficus spp. Olea europaea ssp. cuspidata, Ehretia cymosa, Juniperus procera, Podocarpus falcatus, Nuxia congesta, Ekebergia capensis, Teclea nobilis, Acokanthera schimperi, Zanthoxylum usambarense, Cassipourea malosana.*
Siria	Plateau Forest	1,600 - 1,800	*Warburgia ugandensis, Olinia rochetiana, Prunus africana, Olea europaea ssp. cuspidata, Juniperus procera, Podocarpus falcatus, Nuxia congesta, Ekebergia capensis, Acokanthera schimperi.*
Mathews Range (Ol Doinyo Lenkiyo)	Dry montane forest type	1,200 - 2,600	*Juniperus procera, Olea europaea ssp. cuspidata, Podocarpus latifolius, Nuxia congest, Cassipourea malosana, Apodytes dimidiata, Ekebergia capensis, Teclea simplicifolia, Croton megalocarpus, Calodendrum capense, Encephalartos tegulaneus (endemic).*
Mt. Marsabit	Low Mountain forest, dry type	1,165 - 1,500	*Olea europaea ssp. cuspidata, Olea capensis, Podocarpus latifolius, Nuxia congest, Cassipourea malosana, Apodytes dimidiata, Ekebergia capensis, Teclea simplicifolia, Croton megalocarpus, Calodendrum capense, Strychnos spp.*
Maungu Hills	Hilltop forest	900 - 1,000	*Craibia brownii, Diospyros gerrardii, Syzygium sclerophyllum, Cola greenwayi, Encephalartos kisambo*
Ndoto Mountains	Low Mountain forest	1,400 - 2,600	*Olea europaea ssp. cuspidata, Olea capensis, Podocarpus latifolius, Nuxia congest, Ekebergia capensis, Teclea simplicifolia, Croton megalocarpus, Calodendrum capense, Strychnos mitis.*
Ngong Hills	Dry upland forest	2,200 - 2,400	*Olea europaea ssp. cuspidata, Olea capensis, Nuxia congest, Cassipourea malosana, Ekebergia capensis, Teclea simplicifolia, T. nobilis, Croton megalocarpus, Calodendrum capense, Strychnos spp., Maesa laneolata, Dombeya torrida.*

Water Catchment	Natural Vegetation Type	Elevation (m)	Appropriate Tree Species
Kiang'ombe Hill	Low Mountain forest	1,500 - 1,800	*Ocotea usambarensis, Pouteria adolfi-friederici, Albizia gummifera, Newtonia buchananii, Prunus africana,, Casaeria battiscombei, Syzygium guineense, Polyscias kikuyuensis, Cylicomorpha parviflora.*
Nyambene Hills	Low Mountain forest	1,850 - 2,500	*Ocotea usambarensis, Pouteria adolfi-friederici, Albizia gummifera, Newtonia buchananii, Prunus africana,, Casaeria battiscombei, Syzygium guineense, Polyscias kikuyuensis.*
Tinderet	Moist forests	2,100 - 2,600	*Polyscias fulva, Croton macrostachyus, Albizia gummifera, Syzygium cordatum, Tabernaemontana stapfiana, Prunus africana, Sapium ellipticum, Casaeria battiscombei, Zanthoxylum gillettii, Bridelia micrantha, Celtis africana, Dombeya torrida, Pouteria adolfi-friederici, Nuxia congesta.*
Nguruman Escarpment	Escarpment forests, drier type	1,500 - 2,300	*Tabernaemontana stapfiana, Olea europaea ssp. cuspidata, Olea capensis, Nuxia congesta, Podocarpus falcatus, Ekebergia capensis, Teclea simplicifolia, T. nobilis, Croton megalocarpus, Calodendrum capense, Strychnos spp., Maesa laneolata, Diospyros abyssinica.*
Nyiru Mountains	Low Mountain forest	1,600 - 2,500	*Juniperus procera, Olea europaea ssp. cuspidata, Podocarpus latifolius, Nuxia congest, Ekebergia capensis, Teclea simplicifolia, Croton megalocarpus, Strychnos mitis.*
Mount. Kulal	Low Mountain forest	1,300 - 1,900	*Juniperus procera, Olea europaea ssp. cuspidata, Podocarpus latifolius, Nuxia congest, Ekebergia capensis, Teclea simplicifolia, Croton megalocarpus, Strychnos mitis.*
Ol Doinyo Orok (Namanga) Hill	Dry montane forest	2,200 - 2,400	*Olea capensis, Nuxia congest, Cassipourea malosana, Ekebergia capensis, Teclea simplicifolia, T. nobilis, Croton megalocarpus, Calodendrum capense, Maesa laneolata, Drypetes gerrardii.*
Ol Doinyo Sabuk (Kilimambogo) Hill	Hill forest	1,950 - 2,100	*Drypetes gerrardii, Diospyros abyssinina, Croton macrostachyus, Cassipourea malosana, Cola greenwayi, Pouteria adolfi-friedericii, Strombosia scheffleri.*
Shimba Hills	Coastal moist forest	150 - 450	*Afzelia quanzensis,Hymenaea verrucosa, Combretum schumannii, Syzygium sclerophyllum, Breonadia microcephala.*

Water Catchment	Natural Vegetation Type	Elevation (m)	Appropriate Tree Species
Taita Hills including Mbololo, Ngangao, Chawia, Sagala, Vuria	Coastal moist and dry forests	1,350 - 2,270	*Ocotea kenyensis, Cola greenwayi, Craibia brevicaudata, Maesa lanceolata, Erica mannii, Syzygium sclerophyllum.*
Taveta (Kitovo) Lumi	Ground water forest	700 - 850	*Diospyros mespiliformis, Albizia glaberrima, A. gummifera, Celtis africana, Newtonia buchananii, Trichilia emetica, Cordyla africana, Milicia excelsa.*
Mount. Kasigau	Low mountain, Coastal/upland forest type	1,400 - 1,550	*Newtonia buchananii, Albizia gummifera, Ficus sycomorus, Maesa lanceolata, Rapanea melanophloeos, Syzygium guineense, Strombosia scheffleri, Olea europaea ssp. cuspidata, Chrysophyllum viridifolium, Encephalartos kisambo, Polyscias fulva.*
Mangea	Coastal dry forests	300 - 500	*Brachylaena huillensis, Cynometra webberi, Diospyros kabuyeana, Manilkara sansibarensis, Pteleopsis tetraptera, Julbernardia magnistipulata, Inhambanella henriquesii, Manilkara sansibarensis, Pteleopsis tetraptera.*
Kitui Hills Endau, Mutha, Mutitu, Makongo, Nuu, Nthoani, Kabonge, Kyawea etc.	Dry hilltop forests	1,400 - 1,800	*Podocarpus falcatus, Newtonia hildebrandtii, Albizia gummifera, Calodendrum capense, Olea capensis, Olea europaeae ssp. cuspidata, Zanthoxtylum usambarense, Cassipourea celastroides, Terminalia brownii, Hunteria zeylanica.*
Machakos Hills Various hills, e.g. Nzaui, Kibauni	Dry hilltop forests	1,400 - 1,800	*Craibia brevicaudata, Podocarpus falcatus, Newtonia hildebrandtii, Albizia gummifera, Calodendrum capense, Olea capensis, Olea europaea ssp. cuspidata, Zanthoxtylum usambarense, Cassipourea celastroides, Terminalia brownii.*
Chyulu Hills	Dry hilltop forests	1,400 - 1,750	*Olea capensis, Prunus africana, Rapanea melanophloeos, Pistacia aethiopica, Alangium chineense, Ilex mitis, Ficus sycomorus, Catha edulis, Olea europaea ssp. cuspidata, Commiphora eminii, Juniperus procera, Xymalos monospora.*

APPENDIX 6.

EXTENT OF DEGRADATION OF WATER CATCHMENTS IN KENYA

Water Catchment Area	Sub-Catchments	Counties	Extent Of Degradation (Very Good, Good, Normal, Poor, Very Poor)
Athi-River Basin	Athi Kibwezi	Kajiado	Normal
	Athi River	Kajiado	Normal
	Athi River	Machakos	Good
	Athi Wamunyu	Machakos	Good
	Chania	Kiambu	Good
	Kalundu	Kitui	Normal
	Kalundu	Kitui	Good
	Kiu	Kiambu	Very good
	L. Naivasha	Nakuru	Poor
	Lake Jilore	Kilifi	Good
	Little Kedong	Kajiado	Poor
	Lumi	Taita Taveta	Normal
	Mtito Andei	Makueni	Good
	Mtito Andei	Makueni	Good
	Mukurumuji	Kwale	Good
	Mwachi	Taita Taveta	Good
	Ndarugu	Nakuru	Very good
	Ndsovuni	Kilifi	Good
	Ruiru	Kiambu	Very good
	Sabaki	Taita Taveta	Normal
	Stoney Athi	Makueni	Normal
	Thika	Thika	Very good
	Thiririka	Kiambu	Very good
	Thwake	Machakos	Good
	Tsavo	Taita Taveta	Normal
Ewaso Ng'iro Basin	Voi	Taita Taveta	Normal

Water Catchment Area	Sub-Catchments	Counties	Extent Of Degradation (Very Good, Good, Normal, Poor, Very Poor)
	Amboni	Nyeri	Very good
	Burguret	Laikipia	Good
	Ewaso Ng'iro	Samburu	Normal
	Kathita	Meru	Very good
	Lemisigio	Laikipia	Normal
	Maji matamu	Meru	Very good
	Malewa	Nyandarua	Very good
	Moyok	Laikipia	Good
	Mutara	Laikipia	Normal
	Ngare Ndare	Samburu	Poor
	Nithi	Tharaka Nithi	Good
	Nithi	Meru	Very good
	Pesi	Nyandarua	Good
	Rupingazi	Embu	Very good
	Suguroi	Laikipia	Good
	Suguta	Samburu	Poor
	Tana Garissa	Garissa	Poor
	Timau	Meru	Good
Lake Victoria Basin	Ainamotwa	Nandi	Very good
	Ainopsiwa	Nandi	Very Good
	Alupe	Busia	Normal
	Amala	Busia	Good
	Awach	Kisumu	Good
	Awach Tende	Homa bay	Good
	Chwele	Bungoma	Good
	Edzaba	Nandi	Good
	Gaula	Busia	Good
	Gembe Hills	Homa bay	Good
	Gucha	Kisii	Very good

Water Catchment Area	Sub-Catchments	Counties	Extent Of Degradation (Very Good, Good, Normal, Poor, Very Poor)
	Isiukhu	Kakamega	Good
	Itare	Bomet	Very good
	Kamakoiwa	Trans nzoia	Very good
	Keringet	Nakuru	Very good
	Kerio	Elgeyo marakwet	Good
	Khalaba	Busia	Good
	Kibabet	Nandi	Very good
	Kibos	Siaya	Good
	Kimondi	Nandi	Very good
	Kipkarren	Bungoma	Good
	Kipsonoi	Bomet	Very good
	Koitobos	Trans nzoia	Good
	Kuywa	Bungoma	Good
	Lelgel	Nandi	Very good
	Little Nzoia	Uasin Gishu	Good
	Luandeti	Bungoma	Good
	Lusumu	Kakamega	Good
	Malaba	Busia	Normal
	Malakisi	Bungoma	Good
	Maramara	Bomet	Good
	Maseno	Kisumu	Good
	Migori	Migori	Good
	Moiben	Trans Nzoia	Good
	Molo	Nakuru	Good
	Nyando	Kericho	Very good
	Nyangores	Bomet	Good
	Nzoia	Trans nzoia	Good
	Riana	Homa bay	Very good
	Rusinga	Homa bay	Good

Water Catchment Area	Sub-Catchments	Counties	Extent Of Degradation (Very Good, Good, Normal, Poor, Very Poor)
	Sergoit	Bungoma	Good
	Sio	Busia	Good
	Sondu	Kisumu	Good
	Sosiani	Uasin gishu	Good
	Suguta	Turkana	Very poor
	Tambach	Elgeyo marakwet	Good
	Timbilil	Kericho	Very good
	Tugenon	Kericho	Good
	Wuroya	Siaya	Good
	Yala	Siaya	Good
	Yurith	Kericho	Very good
Rift Valley Basin	Crater stream	Nakuru	Good
	Endao	Baringo	Good
	Engare Narok	Narok	Very good
	Engare Narok	Narok	Normal
	Esageri	Baringo	Good
	Ewaso Narok	Laikipia	Good
	Ewaso Narok	Narok	Good
	Ewaso Ng'iro	Narok	Very good
	Gilgil	Nakuru	Good
	Itare	Bomet	Very good
	Kipsonoi	Bomet	Very good
	Koitobos	Uasin Gishu	Good
	L. Naivasha	Nakuru	Good
	Lelgel	Baringo	Good
	Little Kedong	Nakuru	Good
	Maji matamu	Nakuru	Good
	Malewa	Nyandarua	Good
	Mariashoni	Nakuru	Good

Water Catchment Area	Sub-Catchments	Counties	Extent of Degradation (Very Good, Good, Normal, Poor, Very Poor)
	Mereroni	Nakuru	Good
	Moiben	Elgeyo Marakwet	Normal
	Molo	Nakuru	Good
	Mutonga	Meru	Very good
	Njoro	Nakuru	Good
	Nyangores	Bomet	Very good
	Ol arabel	Laikipia	Good
	Onyokie	Uasin Gishu	Good
	Perkerra	Baringo	Good
	Pesi	Nyandarua	Good
	Sergoit	Uasin Gishu	Good
	Siyoi	Turkana	Very poor
	Sosiani	Uasin Gishu	Good
	Suam	Trans Nzoia	Normal
	Subukia	Nakuru	Good
	Tugenon	Kericho	Good
	Turasha	Nyandarua	Good
	Turasha	Nyandarua	Good
	Turkwel	Turkana	Very poor
	Turkwel	West Pokot	Normal
Tana River Basin	Chania	Nyeri	Very good
	Ena	Nyeri	Very good
	Gura	Nyeri	Very good
	Kathita	Meru	Very good
	Lake Kenyatta	Garissa	Good
	Maragua	Murang'a	Very good
	Mathioya	Murang'a	Very good
	Mkondo Wawitu	Garissa	Good
	Ragati	Nyeri	Good

Water Catchment Area	Sub-Catchments	Counties	Extent Of Degradation (Very Good, Good, Normal, Poor, Very Poor)
	Rwathambi	Kirinyaga	Good
	Saba Saba	Murang'a	Good
	Sagana	Nyeri	Good
	Sagana	Murang'a	Very good
	Tana	Murang'a	Good
	Tana Garissa	Tana River	Normal
	Tana Kamburu	Kitui	Good
	Thiba	Kirinyaga	Very good
	Thika	Murang'a	Very good

APPENDIX 7.

POLICIES, LEGAL INSTRUMENTS AND INSTITUTIONS APPLICABLE TO GOVERNANCE OF WATER CATCHMENT AREAS

Policy	Legal Framework	Functional Relationship to Governance on Water Catchment Areas, Relevant Sections	Institution
	The Constitution of Kenya 2010	The preamble provides obligations of Kenyans to be respectful of the environment. Article 2(6) treaties that Kenya has signed are part of the laws of Kenya, article 42, right to clean environment, article 69-72, provisions on environment and natural resources.	GOK
Forest Policy 1968 (draft forest policy is in formulation)	The Forest Act 2005	The main objective is to achieve conservation and maintenance of vegetative cover and water catchment areas. Section 40 provides for sustainable management of forests and woodlands for the purpose of conservation of water. Part 4(45-46) provides for community participation in conservation and management.	KFS
Water Policy Session Paper I of 1999	Water Act 2002	Formulation of National Water Resource Management Strategy. The Water Act provides for conservation and controlled use of water uses in Kenya. Section 14 and 15 deals with catchment management.	Ministry of Water and Irrigation
Water Policy Session Paper I of 1999	Water Resource Management Rules 2007	These are forums for Conflict resolution. Lack of capacity to enforce compliance is missing	WRUA (WRMA) CAAC
Non-existent	Agriculture Act (Cap 318)	This emphasises on the requirement of soil conservation i.e. through prevention of erosion therefore indirectly conserving the water quality.	Ministry of Agriculture
	Wildlife Conservation and Management Act	Protection and management of watersheds	Ministry of Forestry and Wildlife
		Designates Ramsar sites as protected areas	KWS
	Continental Shelf Act (Cap 312)	Provides for management o the continental shelf situated in Kenya territorial waters.	
	Local Authority Act (Cap 265)	Provisions of enactment of by-laws which include construction of water supply and sewerage systems	Ministry of Local Government

Policy	Legal Framework	Functional Relationship to Governance on Water Catchment Areas, Relevant Sections	Institution
Draft Policy	Mining Act (Cap 306)	It has an implication on water catchment areas in that with the approval of the minister, mining can be allowed in both gazetted and non-gazetted areas	MEMR Department of Mines and Geology
Regional Development Policy	Regional Development Acts	It provides for the implementation of rural development activities to ensure equitable resource development and promote regional social economic development through integrated planning and management	TARDA ENSDA CDA ENNDA LBDA
Session Paper 6 of 1999	EMCA Act No. 8 of 1999	Guide and co-ordinates activities related to the management of natural resources.	MEMR
		This legislation governs provides for wetlands regulations and waste regulations which have a bearing on catchment governance	NEMA
Non-exist	Fisheries Act (Cap 378)	It provides for regulation of fish industry through sustainable exploitation of fisheries and protection of fish ecosystems Applies to land under customary law, namely native reserves and trust land.	Ministry of Fisheries
National Land Policy	The Registered Land Act (Cap 300) The Land Acquisition Act (Cap 295)	Provides for acquisition of land for public benefit. The Government has the powers under this Act to acquire land for projects, which are intended to benefit the general public.	Ministry of Lands
	The Lakes and River Act (Cap 409)	This Act provides for protection of river, lakes and associated flora and fauna.	

APPENDIX 8.

RESOURCE DISTRIBUTION BY MEDIUM TERM EXPENDITURE FRAMEWORK

OUTPUTS	MTP1 2008-2012	MTP2 2013-2017	MTP3 2018-2022	MTP4 2023-2027	MTP5 2028-2032	TOTAL
	Amount in Kes. Millions					
Output 1: Partnerships and participation of stakeholders in the management of water catchment areas improved	879	4,257	4,222	4,222	3,378	16,958
Output 2: Policies, legislations, regulations and standards governing management of water catchment areas reviewed, harmonised and enforced	69	459	349	349	280	1,506
Output 3: A Communication strategy for WCA programme developed and implemented	47	1,026	991	991	944	3,998
Output 4: Capacity of communities to implement WCA programmes strengthened	94	1,242	1,137	1,237	1,137	4,847
Output 5: Restoration and protection of all water catchment areas undertaken	2,780	19,275	11,430	8,130	5,170	46,785
Output 6: Adoption of soil conservation and land use management practises promoted	588	3,290	2,350	2,350	1,763	10,340
Output 7: Water Resource Conservation and management undertaken in all WCAs	2,145	115,720	74,950	72,010	67,365	332,190
Output 8: Water storage infrastructure developed and maintained in all WCA	15,000	101,000	86,000	11,000	11,000	224,000
Output 9: Improved management of urban and industrial waste and sanitation harmonised and enforced	700	64,500	64,500	2,500	1,800	134,000
Output 10: Alternative livelihoods for sustainable resource use in water catchment conservation programmes supported	75	350	350	350	280	1,405

OUTPUTS	MTP1 2008-2012	MTP2 2013-2017	MTP3 2018-2022	MTP4 2023-2027	MTP5 2028-2032	TOTAL
			Amount in Kes. Millions			
Output 11: Renewable energy technologies identified, developed and promoted	7,350	38,370	38,350	37,350	30,000	151,420
Output 12: Gender, youth and vulnerable groups mainstreamed in WCA activities	404	2,050	2,020	2,020	1,616	8,110
Output 13: Water catchment areas funding mechanisms streamlined and mainstreamed in budgets at all levels	2	689	535	535	533	2,293
Output 14: Water catchment areas monitoring and evaluation systems integrated and strengthened	189	901	917	756	621	3,383
GRAND TOTAL	30,322	353,128	288,100	143,799	125,885	941,234

APPENDIX 9.

RESOURCE DISTRIBUTION TO SECTORS AND AGENCY

Sector[1] and Agency	Sum (Million Kes.)
Agriculture and Rural Development (ARD)	74,695
KARI	1,470
KEFRI	10,090
KFS	8,000
MOA	50,135
MoLD	5,000
Education	505
KIE	5
MoEducation	500
Energy Infra and ICT (EII)	166,420
KenGen	86,720
MoEnergy	64,700
MOLG	14,000
MoRoads	1,000
Environmental Protection, Water and Housing (EWH)	588,759
MEMR	18,600
MWI	94,425
NEMA	7,005
NRUAs	231,236
WRMA	237,493
General Economic, Commercial and Labour Affairs (GECLA)	94,900
MoEAC	900
MoIndustry	94,000
Governance, Justice, Law and Order (GJLOS)	3,007
Governor	2,982
MoJCA	25

[1]These are MTEF sectors during the 2011/2012. The Ministries are as per the GoK Circular April 2008

Sector[1] and Agency	Sum (Million Kes.)
Health	6,000
MoPH	6,000
Macro Working Group	2,638
MoF	46
MoPV2030	2,592
Social Protection, Culture and Recreation (SCR)	4,310
MoGender and Social Development	3,370
MoYA	940
Grand Total	941,234

APPENDIX 10.

RESOURCE DISTRIBUTION TO OUTPUT BY LEAD AGENCY

Output		Amount (million Kes.)
Output 1.	Partnerships and participation of stakeholders in the management of water catchment areas improved	16,957.7
	Governor	306.0
	MEMR	16,463.7
	WRMA	188.0
Output 10.	Alternative livelihoods for sustainable resource use in water catchment conservation programmes supported	1,405.0
	MWI	405.0
	WRMA	1,000.0
Output 11:	Renewable energy technologies identified, developed and promoted	151,420.0
	KenGen	86,720.0
	KFS	0
	MoEnergy	64,700.0
Output 12:	Gender and youth involvement, Mainstreamed in WCA activities	8,110.0
	MoGender and Social Development	2,110.0
	NRUAs	6,000.0
Output 13.	Water catchment areas funding mechanisms streamlined and mainstreamed in budgets at all levels.	2,292.5
	Governor	100.0
	KEFRI	2,100.0
	MEMR	66.5
	MoF	21.0
	NEMA	5.0
Output 14.	Water catchment areas monitoring and evaluation systems integrated and strengthened.	3,382.8
	Governor	225.6
	MEMR	4.0
	MoPV2030	2,589.2

Output		Amount (million Kes.)
	NRUAs	564.0
	WRMA	0
Output 2.	Policies, legislations, regulations and standards governing management of water catchment areas reviewed, harmonised and enforced	1,506.2
	MEMR	481.2
	MoJCA	25.0
	NEMA	1,000.0
Output 3.	A Communication strategy for WCA programme developed and implemented	3,998.0
	Governor	0
	KIE	5.0
	MEMR	1,050.0
	MoGender and Social Development	1,260.0
	MoEducation	500.0
	MoPV2030	3.0
	MoYA	940.0
	MWI	20.0
	NRUAs	220.0
Output 4.	Capacity of communities to implement WCA programmes strengthened.	4,847.0
	Governor	1,410.0
	KFS	0
	MEMR	200.0
	NRUAs	3,232.0
	WRMA	5.0
Output 5. Restoration and protection of all water catchment areas undertaken		46,785.0
	KEFRI	7,990.0
	KFS	8,000.0
	MoA	5,000.0
	MoF	25.0
	MoLD	5,000.0

Output		Amount (million Kes.)
	NRUAs	16,520.0
	WRMA	4,250.0
Output 6:	Adoption of soil conservation and land use management practises promoted	10,340.0
	KARI	470.0
	MEMR	235.0
	MoA	4,935.0
	NRUAs	4,700.0
Output 7:	Water Resource Conservation and management undertaken in all WCAs	332,190.0
	Governor	940.0
	KARI	1,000.0
	MEMR	100.0
	MoEAC	900.0
	MoA	200.0
	MoRoads	1,000.0
	MWI	30,000.0
	NEMA	6,000.0
	NRUAs	200,000.0
	WRMA	92,050.0
Output 8:	Water storage infrastructure developed and maintained in all WCA	224,000.0
	MoA	40,000.0
	MWI	44,000.0
	WRMA	140,000.0
Output 9:	Improved management of urban and industrial waste and sanitation harmonised and enforced	134,000.0
	MoIndustry	94,000.0
	MoLG	14,000.0
	MoPH	6,000.0
	MWI	20,000.0
Grand Total		941,234.2

APPENDIX 11.

LOGICAL FRAMEWORK: 2011-2030

Vision: Well managed water catchment areas

Intervention Logic	Objectively Verifiable Indicators	Means of Verification	Important assumptions
Goal Water catchment areas are conserved and sustainably managed to enable Kenya attain global water catchment security targets for all; while supporting national development as aspired by Kenya Vision 2030 and under the principles of rights-based development and devolved governance, in the Constitution of Kenya 2010 Purpose To improve the capacities of stakeholders and institutions with mandate on water catchment areas to undertake effective and efficient management in order to sustain economic, social and ecological benefits of water catchments.	• A national multi-sectoral programme of Action is developed and implementation resources secured by May 2012 (NWCMP)	Programme document Signed agreement between financiers and the Treasury	Important assumptions Devolved Governance systems of the Constitution of Kenya 2010 is operationalised and functioning
	• Governance systems for conservation of water resources restructured and harmonised by June 2014	Reports on harmonised policies, Law and intuitional arrangements	National and Regional Governments allocated adequate resources to support large scale conservation programmes
	• Baseline reports on competency skills of communities in water catchment conservation		
	• Increased understanding and application of best practices in Water Resource Conservation and water-use efficiency	Baseline survey reports Training reports	
	• Report on inventory of Water Resource Conservation practices and water-use efficiency technologies and principles adhered to by resources users	Reports % adoption of Water Resource Conservation, water harvesting and water-use efficiency technologies at all levels	
	• Developed curricula and training materials		

Intervention Logic	Objectively Verifiable Indicators	Means of Verification	Important assumptions
Output 1: Partnerships and participation of stakeholders in the management of water catchment areas improved			
	• An inter- ministerial committee set up by 2013	Minutes of the meetings held	Master Plan is adopted
	• 30% WCA units established at all levels 2012	Minutes of meetings	
	• All partners identified roles responsibilities and intervention matrix developed by 2012	List of stakeholder members Minutes of the stakeholders meeting	
	• A National stake holder committee set up at by 2012	List of partners, Registration certificates, work plans and budgets Agreements and MOU	
	• 50% of WCA interdepartmental and stakeholder forums at the County level established by 2013	Schedule of meetings Number of WCA forums set up	
	• Key massages for sensitisation of stakeholders developed and 50% of stakeholders sensitised by 2013	Reports of the sensitisation meetings	
Output 2: Policies, legislations, regulations and standards governing management of water catchment areas reviewed, harmonised and enforced			
	• Policies legislation regulations and standards reviewed and harmonised by 2013	Report of the PLRS review	Leadership commitment
	• WCA handbook to the stakeholders developed and distributed by 2013	WCA handbook	
	• Midterm review done by 2021	Midterm review report	
	• End term evaluation conducted by 2031	End term evaluation report	

Intervention Logic	Objectively Verifiable Indicators	Means of Verification	Important assumptions
Output 3: A communication strategy for WCA programme develop and applied by 2013			
	• 80% communication unit and website on WCA set up and maintained by 2014	Communication unit and Website in place	
	• WCA Conservation programmes developed and four weekly programmes aired by 2014	Radio, TV programmes	
	• 500 billboards brochures outlining activities and achievements of WCA designed by 2013	Billboards, brochures Performances records and shows held	
	• 4 monthly youth groups, women school competitions (essay writing, painting, drawing, games) to communicate WCA running from 2014	Number of groups set up and involved No of clubs established No of resources centres established	
	• 50% of Environment and conservation Resource Centres for sharing information established by 2014		
Output 4: Capacity of communities to implement WCA programmes strengthened.			
	• 50% community groups to implement WCA programmes trained by 2014 • 50% of community based groups implementing programmes using WCA manuals by 2013 • A reward system for WCA conservation established by 2015 • 40% community groups exchange visits undertaken after every 3 years	No of people trained Reports No of offices established and equipped No of groups rewarded reward No places visited and reports of exchange visits	Availability of funds

Intervention Logic	Objectively Verifiable Indicators	Means of Verification	Important assumptions
Output 5: Restoration and protection of all water catchment areas undertaken			
	• Natural vegetation cover baseline in water catchment areas established by 2013	Land use and land cover maps	
	• Appropriate tree cover increased to 5% by 2020 and then 10% by 2030	Land use and land cover maps	
	• All water catchment areas gazetted by 2015	Gazette notices	
	• 10,000km of riparian areas restored and conserved by year 2030	Land use land cover maps	
	• Sources of Seed/propagation material available at all forest stations and other sources of quality germplasm by year 2015	Presence of marked seed stands in the forest Forest seed supply records	
	• Biodiversity endowment of at least one catchment per County studied by 2020	Published report	
	• At least 20 tree nurseries per County established by a School/community/youth/ women group by 2020	Monitoring reports	
Output 6: Promote the adoption of soil conservation and land use management practises			
	• All farms with 12 - 30% slope terraced by year 2020	Agricultural officers' records	
	• 10 urban centres per county have developed and implemented storm water management	Reports	
	• 20 % of all farming households have adopted high value and efficient production and consumption systems	Annual agricultural reports	

Intervention Logic	Objectively Verifiable Indicators	Means of Verification	Important assumptions
Output 7: Water Resource Conservation and management undertaken in all WCA			
	• Increase in renewable fresh water from the current FAO estimate of 30.2 km^3/yr by 50% by 2030 (FAO, 1995)	Baseline survey report Reports on % adoption of Water Resource Conservation, water harvesting and water use efficiency technologies at all levels	Skilled human resource will be available Funds will be made available at point of use
	• Decrease in water related conflicts from the reported incidences by 50% to 2020 and to nil by 2030		
Output 8: Water storage infrastructure developed and maintained in all WCA			
	• Increase in per capita in water availability from the current 300m^3 to 1,000m^3 by 2030	Quarterly and annual statutory reports	
	• Governance systems for conservation of water resources restructured and harmonised by June 2014		
	• Increase in per capita in water availability from the current 300m^3 to 1,000m^3 by 2030	Number of dams, pans and ponds constructed and in operation	Functioning PPP Availability of skilled man power
	• Decrease in stream/rivers bank point pollution by 65% to less than 10% by 2030	Length (km) of river banks protected from erosion Progress and annual reports	Functioning PPP Availability of skilled man power
Output 9: Improved management of urban and industrial waste and sanitation			
	• Increase in population with access to decent sanitation from the current figure of 56% urban and 43% rural, (UNICEF, 2005) to 100% by 2030	Baseline report on pollution load	There will be above 70% literacy population
	• Decrease in point source pollution loading by 50% by 2030 in all water bodies	Subsequent progress reports on % reduction in pollution load	Functioning PPP
	• Increase in number of green industries from the current by 50% by 2020 and 75% by 2030		

Intervention Logic	Objectively Verifiable Indicators	Means of Verification	Important assumptions
	• Increase in number of industries adopting resource use efficiency technologies by 50% by 2020 and 75% by 2030	Water and sanitation statistics	
Output 10: Support Alternative livelihood options for sustainable resource use in water catchment conservation programmes			
	• A contract-based marketing system for Nature Based Enterprises established by year 2015 at National and County level	The quantity of produce supplied through the established markets	
	• Natural Resource user Associations Established and operational in all catchment areas by 2015	Records from Counties and Registrar of Societies Number of Management agreements signed and implemented Annual progress reports	
Output 11: Identify develop and promote renewable energy technologies			
	• Reduce the reliance of wood fuel in Kenya from the current 80% to 30% by year 2030	Records from Kenya energy sector reports and records	
	• Access to electricity by Kenyan households improved from the current 15% to 80% by year 2030	Records from Kenya Energy sector	
Output 12: Gender and youth involvement mainstreamed in WCA activities			
	• One Sensitisation workshop youth, women and men groups on environmental conservation methods	• Reports of the sensitisation meetings • Number of groups sensitised	
	• Five Capacity building workshops for youth, women and men groups on environmental conservation methods	Reports on trainings held	Availability of funds
	• Establish 30 tree nurseries per county per year	• Number of tree nurseries	
	• Tree planting- 30,000 trees per year	• Number of trees planted	

Intervention Logic	Objectively Verifiable Indicators	Means of Verification	Important assumptions
	• Encourage youth, women and men groups to form waste management Groups	• Number of youth groups formed on waste management	
	• Develop a gender mainstreaming strategy		
Output 13: Water catchment areas funding mechanisms streamlined and mainstreamed in budgets at all levels			
	• Enhanced 2011/12 budgetary allocations to the water, forestry and Environmental sector	Actual expenditure in the MTP phases and annual estimates	
Output 14: Water catchment areas monitoring and reporting systems integrated and strengthened			
	• M&E tools developed for and Natural Resources Users Associations (NRUA's) other community development groups	• M&E tools in place and operational • Reports and documentations, including operational manuals	
	• M&E Framework developed and operational	• M&E framework in place and operational • Relevant documentations and records •	• Overall policy and institutional framework can support the system/ i.e. M&E framework.
	• Publications and dissemination of WCA supported	• Report and publications • Dissemination report/workshop/ seminars reports	• Relevant documentation/ publication is available • Resources required for this activity is adequate.
	• Number of water catchment M&E Systems installed	• Actual M&E systems installed • Installation manuals • Operation manuals	• Overall integrated system is installed and operational centrally • Resources availability
	• Data collected monthly in all WCAs	• Data files, data software and related documents in place • Reports and statistical abstracts •	• Baseline data is available • Data storage software available • Relevant human capacity available
	• Capacity built for Natural Resources Users Associations (NRUA's) and other legally instituted organizations	• Trained human resources in place • Certificates of trained persons and reports	• Resources required for training is adequate

Intervention Logic	Objectively Verifiable Indicators	Means of Verification	Important assumptions
	• NRUA's and other legally constituted organizations equipped with monitoring tools	• Institutions with monitoring tools and are operational • Operations manuals available	• NRUA's and other legally constituted organizations are receptive to the monitoring tools.
	• Number of updates made for each CA at County and district levels	• Update reports • Update programme/plans	• All updates requirements are in place
	• Number of monitoring and reporting systems identified and list	• Identification list • Report of monitoring and reporting system identified and listed	• Monitoring and reporting systems do exist at the county and district levels
	• Number of recommendations and improvements made on performance and validity of M&E tools	• Report of evaluation • Action taken based on recommendations	• Performance and validity of the M&E tools/systems is effective and efficient.
	• M&E strategy developed along with instruments, pre-testing, standards and reporting framework in place	• M&E strategy document • Pre-testing standardization and reporting guidelines, framework	• Adequate resources and proper planning is guaranteed.
	• Number of pre-monitoring midterm and end of programme M&E processes conducted.	• Reports of actual activities undertaken	• All systems are properly operational
	• Number of stakeholders sensitized and trained on M&E	• Sensitization and training reports • Certificates awarded •	• Resources required are assured.
	• Number of M&E manuals developed	• Report and manuals in place/used•	• Skills required is available
	• Number of additional data collection instruments supplied, installed and commissioned	• Actual instruments supplied • Installation manuals • Supply certificate • Commissioning report	• There is inadequate data collection equipment in place
	• M&E implemented regularly in WCA	• Implementation reports	• All necessary arrangements and resources are provided
	• Performance Contract incorporated in WCA programmes	• PC document incorporating WCA programmes • Report	• All the personnel understand PC and its application in WCA

Intervention Logic	Objectively Verifiable Indicators	Means of Verification	Important assumptions
	• Number of users applying self monitoring	• Report • List of users applying M&E	• All users are conversant with monitoring tools
	• Number of midterm reviews undertaken on Master Plan	• Review report • List of recommendation abstract	• Instruments of review of the Master Plan are in place.
	• Master Plan reviewed at the end of planed period	• Revised document • Road map/Action plan	• All factors are satisfactorily met • Review resources are available.

APPENDIX 12.

ACTIVITY BUDGET LOGFRAME

Output		Activity	Inputs	Amount (million) Kes.	MTP1 2008-2012	MTP2 2013-2017	MTP3 2018-2022	MTP4 2023-2027	MTP5 2028-2032
Output 1: Partnerships and participation of stakeholders in the management of water catchment areas improved	1.1	Set up and operationalise an inter-ministerial/agency policy steering committee	Allocate 20 million for 20 years	20	2	5	5	5	3
	1.2	Set up and operationalise WCA stakeholder standing committee at National level	Allocate 1.5 million for 20 years	30	6	6	6	6	6
	1.3	Convene bi-annual WCA discussion fora at national level	Allocate 2 million annually = 1,000,000 x 20 years	40	2	10	10	10	8
	1.4	Convene quarterly meetings for WCA discussion fora at county level	Allocate 1 million per county annually = 1,000,000 x 47 x 4 x 20 years	3,760	188	940	940	940	752
	1.5	Setup WCA desks in relevant Ministries	Allocate 5 million per Ministries = 5,000,000 x 5	25	0	25	0	0	0
	1.6	Create inter departmental committee fora in each County	Allocate 100,000 for monthly meeting of 30 persons in 47 counties for 20 years	94	5	24	24	24	19
	1.7	Develop community government Private sector Partnership in all sub-catchments	Incorporate in meetings in 1.5	0	0	0	0	0	0
	1.8	Define roles and responsibilities of stakeholders at sub-catchment level	incorporate in 1.6	0	0	0	0	0	0

Output		Activity	Inputs	Amount (million) Kes.	MTP1 2008-2012	MTP2 2013-2017	MTP3 2018-2022	MTP4 2023-2027	MTP5 2028-2032
	1.9	Hold regular educational meetings for the stakeholders	3 meetings per yr in 47 counties for 100 pax @ 100,000	282	14	71	71	71	56
	1.10	Identify key stakeholders and their main interventions in WCA	Part of 1.9	0	0	0	0	0	0
	1.11	Identification of strengths, (SWOT) and initiation of collaborative efforts	Part of 1.9	0	0	0	0	0	0
	1.12	Hold national stakeholder forum for WCA programme launch	20 million for 200 pax (Notes)	20	20	0	0	0	0
	1.13	Sensitisation of stakeholders at national levels	Allocate 3 million for 20 years for 200 people	1,200	60	300	300	300	240
	1.14	Sensitisation of stakeholders at county and community levels	Allocate 3 million quarterly to 47 counties for 20 years	11,280	564	2,820	2,820	2,820	2,256
	1.15	Identify and document the partners in WCA (Stakeholder analysis)	Consultancy at 4 million	4	4	0	0	0	0
	1.16	Build technical and managerial capacities	One month training for 50 pax @ 200,000	10	0	10	0	0	0
	1.17	Set up WCA community groups for management	Allocate 100,000 per county (x47)	5	5	0	0	0	0
	1.18	Establish and operationalise community level WCA conservation youth Groups	Allocate 200,000 per county for 20 yrs	188	9	47	47	47	38
			SUB TOTAL	16,958	879	4,257	4,222	4,222	3,378

Output		Activity	Inputs	Amount (million) Kes.	MTP1 2008-2012	MTP2 2013-2017	MTP3 2018-2022	MTP4 2023-2027	MTP5 2028-2032
Output 2: Policies, legislations, regulations and standards governing management of water catchment areas reviewed, harmonised and enforced	2.1	Review and detect conflicting policies, legislations, regulations and standards (PLRS) governing management of water catchment areas	Consultancies @ 25 million	25	0	25	0	0	0
	2.2	Establish standards for conservation of Water CA	See TOR 2.1	0	0	0	0	0	0
	2.3	Develop enforcement procedures for community groups	See TOR 2.1	0	0	0	0	0	0
	2.4	Carry out public consultation of Draft harmonised PLRS	47 county workshops for 100 people x 600,000	28	0	28	0	0	0
			National level workshop for 200 people	5	0	5	0	0	0
	2.5	Identify PLRS to be reviewed	See TOR 2.1	0	0	0	0	0	0
	2.6	Develop a simplified hand book on PLRS on WCA	Consultancy @ 5 million	5	0	5	0	0	0
	2.7	Publish distribute and dissemination the handbook	47 counties @ 1 million	47	0	47	0	0	0
	2.8	List relevant PLRS for WCA	See output 2.1	0	0	0	0	0	0
	2.9	Identify gap and overlaps that need to be changed	See output 2.1	0	0	0	0	0	0
	2.10	Establish inter-ministerial committee to coordinate and mange the proposed changes with stakeholders	See output 2.1	0	0	0	0	0	0

Output		Activity	Inputs	Amount (million) Kes.	MTP1 2008-2012	MTP2 2013-2017	MTP3 2018-2022	MTP4 2023-2027	MTP5 2028-2032
	2.11	Establish a Department on WCA within the Ministry in charge of Environment	See output 1.3	0	0	0	0	0	0
	2.12	Mainstream WCA policies in all the relevant Ministries	See output 1.3	0	0	0	0	0	0
	2.13	Publicise and create awareness for PLRS on WCA	National level @ 5 million four times in 20 yrs	20	0	5	5	5	5
			47 counties @ 2 million four times in 20 yrs	376	19	94	94	94	75
	2.14	Carry out a survey to determine compliance to PLRS	Nationwide field visits @ 10 million for 20 yrs	200	10	50	50	50	40
	2.15	Monitor compliance to existing PLRS	See output 2.15	0	0	0	0	0	0
	2.16	Strengthen Environmental compliance enforcement capacities for EMCA institutions and other regulatory agencies up to county level	Allocate 40 million x 20 years for training and related activities	800	40	200	200	200	160
			SUB TOTAL	1,506	69	459	349	349	280
Output 3: A Communication strategy for WCA programme developed and implemented	3.1	Develop, upload and maintain a website on WCA	Annual budget of 100,000 for 20 years	2	0	1	1	1	0
	3.2	Publish a newsletter	Annually @50,000 for 20 years	1	0	0	0	0	0
			Monthly Electronic	0	0	0	0	0	0

Output		Activity	Inputs	Amount (million) Kes.	MTP1 2008-2012	MTP2 2013-2017	MTP3 2018-2022	MTP4 2023-2027	MTP5 2028-2032
	3.3	Promote WC Conservation through various media(tv, radio programmes, mobile phones, ranet radio, social media)	Annual budget of 10 million of 20 years	20	1	5	5	5	4
	3.4	Produce illustrative posters on PLRS related to WCA	See output 4	0	0	0	0	0	0
	3.5	Create community dissemination programmes	See output 4	0	0	0	0	0	0
	3.6	Promote community exchange programmes, barazas and meetings	See output 1	0	0	0	0	0	0
	3.7	Design billboards outlining activities and achievements of WCA	10 million annually x 20 years	200	10	50	50	50	40
	3.8	Develop brochures to be distributed to communities and other stakeholders for sensitisation	Allocate 1 million annually for 20 yrs	20	1	5	5	5	4
	3.9	Develop public awareness tools	See output 4	0	0	0	0	0	0
	3.10	Develop curricula at primary and secondary school levels	Consultancy @ 5 million	5	0	5	0	0	0
	3.11	Integrate WCA into school curricula	Educational budget of 20 million annually x 20 years	400	20	100	100	100	80

Output		Activity	Inputs	Amount (million) Kes.	MTP1 2008-2012	MTP2 2013-2017	MTP3 2018-2022	MTP4 2023-2027	MTP5 2028-2032
	3.12	Promote WCA conservation programmes and awareness through visual and performance arts	Allocate 5 million for 20 years	100	5	25	25	25	20
	3.13	Setup communication unit on WCA at the relevant Ministry	Allocate 10 million	10	0	10	0	0	0
	3.14	Use youth groups, women, school competitions (essay writing, painting, drawing, games) to communicate WCA issues	Allocate 8 million for 20 yrs	120	10	30	30	30	20
		Use youth groups, women, school competitions (essay writing, painting, drawing, games) to communicate WCA issues	Allocate 10 million	0	0	0	0	0	0
	3.15	Establish a reward system for WCA conservation	Allocate 1 million per county for 20 years	940	0	235	235	235	235
	3.16	Develop and implement youth sports clubs for promoting WCA conservation	Allocate 1 million per county for 20 years	940	0	235	235	235	235
	3.17	Create a user friendly communication mechanism to include youth, men, women old people and the physically challenged	Allocate 10 million for 20 yrs	200	0	50	50	50	50
	3.18	Develop, install and commission information management systems - database	Budget of 100 million for database development and maintenance	100	0	40	20	20	20

Output		Activity	Inputs	Amount (million) Kes.	MTP1 2008-2012	MTP2 2013-2017	MTP3 2018-2022	MTP4 2023-2027	MTP5 2028-2032
	3.19	Establish Environment and conservation Resource Centres for sharing information	Allocate 1 million per county for 20 years	940	0	235	235	235	235
			SUB TOTAL	3,998	47	1,026	991	991	944
Output 4: Capacity of communities to implement WCA programmes strengthened	4.1	Awareness creation of community on WCA	See 1.5	0	0	0	0	0	0
	4.2	Training on technical aspects, proposals, and other aspects of WCA programme	Annual budget for training for 47 million x 20 years	940	0	235	235	235	235
	4.3	Exchange visits for community groups	Allocate 500000 per County for 20 years	470	0	118	118	118	118
	4.4	Quarterly meetings for feedback on issues arising from implementation of WCA programmes	Allocate 200,000 per County	188	0	47	47	47	47
	4.5	Special training for management staff (national level)	Annual budget of 10 million x 20 years	200	0	50	50	50	50
	4.6	Training of trainers (county level)	Annual budget of 2 million x 47 counties every 5 years	470	94	94	94	94	94
	4.7	Facilities establishment for WCA associations (offices, transport, internet)	Annual budget of 100 million twice in 47 Counties	200	0	100	0	100	0
	4.8	Training on book keeping, data collection and reporting	See 6.2	0	0	0	0	0	0

Output		Activity	Inputs	Amount (million) Kes.	MTP1 2008-2012	MTP2 2013-2017	MTP3 2018-2022	MTP4 2023-2027	MTP5 2028-2032
	4.9	Training of WCA institutions on empowerment skills	Total budget of 24 million	24	0	6	6	6	6
	4.10	Establish and strengthen management structures for WCA community organisations	See output 1	0	0	0	0	0	0
	4.11	Training of environmental management issues (Tree nursery management, terracing, energy saving technologies and water harvesting)	See output 5	0	0	0	0	0	0
	4.12	Facilitating communities to engage in IGA	Revolving fund at 10000000 per County every five years	2,350	0	588	588	588	588
	4.13	Production of awareness and communication materials	See output 3	0	0	0	0	0	0
	4.14	Train communities on development and management of nature based enterprises	See output 5	0	0	0	0	0	0
	4.15	Train communities on land management and resources use efficiency	See output 5	0	0	0	0	0	0
	4.16	Develop capacity of communities to develop and negotiate co-management agreements	See output 5	0	0	0	0	0	0
	4.17	Build capacity of communities in resources inventory and assessment	See output 5	0	0	0	0	0	0

Output		Activity	Inputs	Amount (million) Kes.	MTP1 2008-2012	MTP2 2013-2017	MTP3 2018-2022	MTP4 2023-2027	MTP5 2028-2032
	4.18	Develop a curricula and training manuals for capacity building for WCA at all levels	Consultancy @ 5 million (Increase)	5	0	5	0	0	0
		SUB TOTAL		4,847	94	1,242	1,137	1,237	1,137
Output 5: Restoration and protection of all water catchment areas undertaken	5.1	Develop and apply catchment restoration models	Allocate 10 million for each of the agro ecological zones of Kenya	60	0	20	20	10	10
	5.2	Undertake biodiversity resource assessment in water catchment areas	Allocate 10 million per catchment x 25 catchments	250	10	80	70	50	40
	5.3	Establish 400,000 tree seedling capacity nurseries per school / per community	Allocate Kes. 5 for raising each seedling x 4000 nurseries	8,000	500	3,000	2,000	1,500	1,000
	5.4	Planting and growing trees	Allocate Kes. 2 per seedling for planting labour	4,000	100	2,000	1,000	500	400
			Allocate Kes. 2 per seedling for maintaining seedlings	4,000	100	2,000	1,000	500	400
	5.5	Develop and promote water harvesting technologies	See output 8	0	0	0	0	0	0
	5.6	Establish on farm woodlots	Allocate Kes. 30 per seedling per person to plant 12 seedlings per year	11,520	520	5,000	3,000	2,000	1,000
	5.7	Rehabilitate Quarries (Establishment of Eco parks)	Allocate 10 million to rehabilitate 100 quarries	1,000	0	400	400	100	100
	5.8	Rehabilitate and protect riparian areas	Allocate 500,000 per km to rehabilitate 10,000km of riparian areas	5,000	500	2,000	1,000	1,000	500

Output		Activity	Inputs	Amount (million) Kes.	MTP1 2008-2012	MTP2 2013-2017	MTP3 2018-2022	MTP4 2023-2027	MTP5 2028-2032
			Allocate 500,000 per km to conserve 10,000km of riparian areas	5,000	500	2,000	1,000	1,000	500
	5.9	Develop and Promote community based grazing in water catchment areas	Allocate 1 million to develop grazing agreements for 25 catchment areas	25	0	25	0	0	0
	5.10	Develop and promote Hillside terracing	Allocate 10 million for terracing in fragile catchment areas	250	10	80	70	50	40
	5.11	Develop and promote Carbon credit trading and carbon offset programmes	Allocate 10 million per catchment x 40 catchments to develop carbon baselines and trading agreements	400	10	200	100	50	40
	5.12	Develop and promote point and non point Pollution control measures	Allocate 1 million per catchment for 2000 sub-catchments	2,000	50	1,000	500	250	200
	5.13	Identify and mark out indigenous tree seed stands	Allocate 10 million per catchment x 40 catchments for marking and maintaining the seed stands	400	10	200	100	50	40
	5.14	Establish tree seed and other propagation material, supply centres at Forest station level	Allocate 1 million per forest station per year x 150 stations for 20 years for	3,000	300	800	700	600	600
	5.15	Training in nursery establishment, management, outplanting, growing trees and disposal of seedling containers	Allocate 2 million per year per county for 20 years	1,880	170	470	470	470	300
		SUB TOTAL		46,785	2,780	19,275	11,430	8,130	5,170

Output		Activity	Inputs	Amount (million) Kes.	MTP1 2008-2012	MTP2 2013-2017	MTP3 2018-2022	MTP4 2023-2027	MTP5 2028-2032
Output 6: Adoption of soil conservation and land use management practises promoted	6.1	Update and document slope factors for all catchment areas	Allocate 5 million per county for 47 counties	235	0	235	0	0	0
	6.2	Update soil and geology maps for all catchment areas	Allocate 10 million per county for 47 counties	470	0	470	0	0	0
	6.3	Map out fragile ecosystems in 47 counties	Allocate 5 million per county for 47 counties	235	0	235	0	0	0
	6.4	Practical Training of farmers on terracing, gabion construction and contour farming	Allocate 5 million per county x 20 yrs	4,700	294	1,175	1,175	1,175	881
	6.5	Construct and maintain terraces and gabions	Allocate 5 million per county x 20 yrs	4,700	294	1,175	1,175	1,175	881
	6.6	Train farmers on sustainable land use management practices	See output 8.4	0	0	0	0	0	0
		SUB TOTAL		10,340	588	3,290	2,350	2,350	1,763
Output 7: Water Resource Conservation and management undertaken in all WCAs	7.1	Enforcement of water abstraction permits conditions, e.g. installation of measuring and control device	Patrolling and awareness strengthening at Kes. 1 million per year per 1000 sub-catchments for new and illegal water users 10 years	10,000	500	4,000	2,500	2,000	1,000
	7.2	Monitor compliance of water use conditions, e.g. installation of measuring and control device	Monitoring/enforcement expenses at Kes. 1 million Kes. per year per sub-catchment for a total of 2000 active sub-catchments for 20 years	40,000	1,000	16,000	10,000	8,000	5,000

Output		Activity	Inputs	Amount (million) Kes.	MTP1 2008-2012	MTP2 2013-2017	MTP3 2018-2022	MTP4 2023-2027	MTP5 2028-2032
	7.3	Enforcement of relevant provisions in the Forests Act, Minerals Act, EMCA, to enhance protection of land cover and in appropriate development, e.g. monitor compliance on livestock grazing beyond carrying capacity Enforcement of relevant provisions in the water Act, EMCA to prevent wetland encroachment	Monitoring/enforcement expenses at Kes. 1 million Kes. per year per district for a total of 300 districts for 20 years	6,000	500	1,500	1,500	1,500	1,000
	7.4	Enforcement of bylaws to prevent storm water damage, e.g. soil erosion, to bare land within counties	Monitoring/enforcement expenses at Kes. 1 million. per year per districts for a total of 47 counties for 20 years	940	35	235	235	235	200
	7.5	Ensure road designs that provide for storm water management on farms next to the road	Development of policy and regulations (within three years) and monitor implementation at Kes. 1 billion	1,000	0	500	300	100	100
	7.6	Establishment of a mechanism for plough back to conservation and management, e.g. a conservation levy by beneficiaries such as KENGEN, Kenya's Tourism industry, Kenya's Horticultural and Cut flower industry and Kenya Fisheries Industry	Develop and implement PES programme at Kes. 100 million	100	0	50	30	10	10

Output		Activity	Inputs	Amount (million) Kes.	MTP1 2008-2012	MTP2 2013-2017	MTP3 2018-2022	MTP4 2023-2027	MTP5 2028-2032
	7.7	Establish water balances through resource assessment and demand survey	Water resource assessment and water use survey for 2000 sub-catchments at 1.5 million for 10 years	30,000	0	30,000	0	0	0
	7.8	Map out erosion hotspots and use of vertiva grass on road sides and other difficult erosion hotspots	Map out 5 and rehabilitate hotspots in 2000 sub-catchments at Kes. 100,000	1,000	0	1,000	0	0	0
	7.9	Development of water allocation (apportionment) plan for each sub-catchment to ensure equity for ecosystems and basic human needs	Consultation meetings, workshops and seminars for 2000 sub catchments at Kes. 1 million each for 5 years	10,000	0	4,000	2,000	2,000	2,000
	7.10	Establishment and delineation of water resource management units	Use GIS application, stakeholder meeting for 5 drainage basins at 5 million for 2 years	50	0	50	0	0	0
	7.11	Initiate forums for transboundary water negotiation	Meeting expenses, international and local travel for 3 meeting per year for 6 international water bodies at 10 m each for 5 years	900	0	225	225	225	225
	7.12	Constructing inter-basin and intra-basin water transfers to channel water from areas with excess water to areas with water deficit	One project for 5 transfers over 20 years at 3 year interval at 1 billion	30,000	0	7,500	7,500	7,500	7,500

Output		Activity	Inputs	Amount (million) Kes.	MTP1 2008-2012	MTP2 2013-2017	MTP3 2018-2022	MTP4 2023-2027	MTP5 2028-2032
	7.13	Increasing capture and retention of rainwater through the construction of waterways, strategic boreholes and other water harvesting structures to ensure availability of water during dry seasons	Implement 2 projects (dam, pan) per sub-catchment at 5 m x 2000 x 20 years	200,000	0	50,000	50,000	50,000	50,000
	7.14	Undertake applied water resource Research	Projects on research in forest hydrology, water recycling, pollution control, land management at Kes. 100 million grant to research institutions for 20 years	2,000	100	600	600	400	300
	7.15	Promote safe use of agrochemicals of water catchment areas	Implement projects (safe use at farm level, manufacturer, monitoring in water bodies) at Kes. 10 million for 20 yrs	200	10	60	60	40	30
		SUB TOTAL		332,190	2,145	115,720	74,950	72,010	67,365
Output 8: Water storage infrastructure developed and maintained in all WCA	8.1	Promote rainwater harvesting at household and institutional level	Pilot projects on surface and underground storage in 2000 sub-catchments at Kes. 2 million for 10 yrs	40,000	5,000	20,000	15,000	0	0
	8.2	Promote rainwater harvesting at farm level for livestock and irrigation	Pilot projects on surface storage in 2000 sub-catchments at Kes. 5 million for 10 yrs	100,000	10,000	50,000	40,000	0	0
	8.3	Building capacity for water quality monitoring including training personnel to protect watersheds and monitor water quality	see output 4	0	0	0	0	0	0

Output		Activity	Inputs	Amount (million) Kes.	MTP1 2008-2012	MTP2 2013-2017	MTP3 2018-2022	MTP4 2023-2027	MTP5 2028-2032
	8.4	De-silting rivers and dams to improve carrying capacity, water storage and water quality	Undertake during each year 10km river desilting, 10 large dams, 10 medium dams, and 20 small dams at overall cost of 2 billion for 20 years every 5 years	40,000	0	20,000	20,000	0	0
	8.5	Construct watering infrastructure (ramps, troughs) to prevent destruction of water pans and boreholes by watering livestock	Undertake during each year 100 projects for livestock watering at overall cost of Kes. 2 million for 20 years	4,000	0	1,000	1,000	1,000	1,000
	8.6	Promote water use efficiency e.g. by drip irrigation, production of high value crops and livestock.	Pilot projects on drip irrigation, adoption of high value crops, in 2000 sub-catchments at Kes. 5 million for 10 yrs	40,000	0	10,000	10,000	10,000	10,000
		SUB TOTAL		224,000	15,000	101,000	86,000	11,000	11,000
Output 9: Improved management of urban and industrial waste and sanitation harmonised and enforced	9.1	Management including recycling and use of constructed wetlands of industrial, Urban and municipal waste	Upgrading and modernise wastewater and solid waste treatment facilities incl. constructed wetlands for 10 towns for 10 years at 1 billion (justify selection)	10,000	0	5,000	5,000	0	0
	9.2	Develop wastewater treatment and solid waste facilities incl. wetlands for 20 towns for 10 years at 1 billion (Justify selection)	Allocate 1 billion for 20 towns for 10 years	20,000	0	10,000	10,000	0	0
	9.3	Management of domestic, human and solid waste	Develop ecosan (define) toilets (1m x 200 per year)	4,000	200	1,000	1,000	1,000	800

Output		Activity	Inputs	Amount (million) Kes.	MTP1 2008-2012	MTP2 2013-2017	MTP3 2018-2022	MTP4 2023-2027	MTP5 2028-2032
			Ventilated Improved Pit latrine - VIP Latrines (10000 x 50,000 per year)	6,000	500	1,500	1,500	1,500	1,000
	9.4	Cleaner production technology to minimise industrial pollution	Modernise factories to minimise pollution generation at 200m x 47 factories x 10 years	94,000	0	47,000	47,000	0	0
	9.5	Develop and separation of waste and recycling of at least counties at Kes.	Link to output 3 (communication strategy)	0	0	0	0	0	0
		SUB TOTAL		134,000	700	64,500	64,500	2,500	1,800
Output 10: Alternative livelihoods for sustainable resource use in water catchment conservation programmes supported	10.1	Carry out a needs assessment in 40 catchment areas	Allocate 5 million per catchment for 40 sub-catchments	200	10	50	50	50	40
	10.2	Establish eco tourism centres and equip them with facilities	Allocate 10 million per catchment for 40 sub-catchments	400	20	100	100	100	80
	10.3	Develop Nature based enterprises (Beekeeping, butter fly farming, fish farming, silkworm farming, stevia farming etc) in all catchment areas	Allocate 10 million per catchment for 40 sub-catchments	400	20	100	100	100	80
	10.4	Develop contract based marketing systems	Consultancy costing 5 million	5	5	0	0	0	0

Output		Activity	Inputs	Amount (million) Kes.	MTP1 2008-2012	MTP2 2013-2017	MTP3 2018-2022	MTP4 2023-2027	MTP5 2028-2032
	10.5	Commercialisation of community products to increase their prices	Allocate 5 million per catchment for 40 sub-catchments	400	20	100	100	100	80
		SUB TOTAL		1,405	75	350	350	350	280
Output 11: Renewable energy technologies identified, developed and promoted	11.1	Support the use of solar energy for half of Kenya's households to meet the energy demands of rural populations	Allocate 10,000 x 4,000,000 households	40,000	2,000	10,000	10,000	10,000	8,000
	11.2	Carry out feasibility studies to identify the potential of wind energy in Kenya	Consultancy for 20,000	20	0	20	0	0	0
	11.3	Install 10 wind energy equipment per year	Allocate 10,000,000 per wind energy source	2,000	0	1,000	1,000	0	0
	11.4	Support growth tree growing in farms and forests to sustain wood fuel requirements	See output 5	0	0	0	0	0	0
	11.5	Promote the use of energy saving appliances	Allocate 5 million per county x 20 yrs	4,700	175	1,175	1,175	1,175	1,000
	11.6	Enhance the Hydro power production of the country	Allocate 1 billion per year x 20 yrs	20,000	1,000	5,000	5,000	5,000	4,000
	11.7	Develop the country's geothermal power production	Allocate 1 billion per year x 20 yrs	20,000	1,000	5,000	5,000	5,000	4,000
	11.8	Promote the use of solar energy and rechargeable batteries for motorcycles	Allocate 5 million per county x 20 yrs	4,700	175	1,175	1,175	1,175	1,000
	11.9	Develop the country' offshore wave energy harvesting	Allocate 1 billion per year x 20 yrs	20,000	1,000	5,000	5,000	5,000	4,000

Output		Activity	Inputs	Amount (million) Kes.	MTP1 2008-2012	MTP2 2013-2017	MTP3 2018-2022	MTP4 2023-2027	MTP5 2028-2032
	11.10	Develop and promote biofuels	Allocate 1 billion per year x 20 yrs	20,000	1,000	5,000	5,000	5,000	4,000
	11.11	Develop and promote biogas technologies	Allocate 1 billion per year x 20 yrs	20,000	1,000	5,000	5,000	5,000	4,000
		SUB TOTAL		151,420	7,350	38,370	38,350	37,350	30,000
Output 12: Gender, youth and vulnerable groups mainstreamed in WCA activities	12.1	Hold regular sensitisation workshops	Link to output 4	0	0	0	0	0	0
	12.2	Develop capacity building manual	Link to output 4	0	0	0	0	0	0
	12.3	Gender training on technical aspects, proposals, and other aspects of WCA programme	Allocate 50 million for 20 years	1,000	50	250	250	250	200
	12.4	Training of youth and special interest groups on WCA aspects	Allocated 50 million for 20 years	1,000	50	250	250	250	200
	12.5	Establish tree seedling capacity nurseries for youth groups	Allocate 50 million for 20 years	1,000	50	250	250	250	200
	12.6	Establish tree seedling capacity nurseries for women groups	Allocate 50 million for 20 years	1,000	50	250	250	250	200
	12.7	Use women groups to communicate WCA issues (See also 5.15)	Allocate 2 million	40	2	10	10	10	8
	12.8	Use youth groups to communicate WCA issues (see 5.15)	Allocate 2 million	40	2	10	10	10	8

Output		Activity	Inputs	Amount (million) Kes.	MTP1 2008-2012	MTP2 2013-2017	MTP3 2018-2022	MTP4 2023-2027	MTP5 2028-2032
	12.9	Establish gender mainstreaming strategy	Allocate 10,000,000	10	0	10	0	0	0
	12.10	Establish youth, physically challenged and other vulnerable groups strategy	Allocate 20,000,000	20	0	20	0	0	0
	12.11	Waste management projects for women, youth and special interest groups	Allocate 200 million for 20 years	4,000	200	1,000	1,000	1,000	800
		SUB TOTAL		8,110	404	2,050	2,020	2,020	1,616
Output 13: Water catchment areas funding mechanisms streamlined and mainstreamed in budgets at all levels.	13.1	Review harmonise and (and enforce) consolidate environment restoration funds	Consultancy @20 million	20	0	20	0	0	0
	13.2	Identify current and potential sources of funding	Desk study @ 1 million	1	0	1	0	0	0
	13.3	List the priority areas based on WCA programmes	Desk study TOR for 13.2	0	0	0	0	0	0
	13.4	Rationalise WCA funding requirements based on priorities	Desk study TOR 13.2	0	0	0	0	0	0
	13.5	Develop a financial, procurement and management handbook for WCA at all levels	Consultancy @ 4 million	4	0	4	0	0	0
	13.6	Review and evaluate the current funding mechanisms and streamline their operations	TOR for 13.1	0	0	0	0	0	0

Output		Activity	Inputs	Amount (million) Kes.	MTP1 2008-2012	MTP2 2013-2017	MTP3 2018-2022	MTP4 2023-2027	MTP5 2028-2032
	13.7	Develop mechanisms/ways of allocating funds to WCAs at all levels	Tor for 13.1	0	0	0	0	0	0
	13.8	Strengthen and publicise all WCA sources of funds	5 Donor forums @ 500,000	3	1	1	1	1	1
			20 Seminars @600,000	12	1	3	3	3	2
	13.9	Develop and circulate a directory of WCA funding sources	Publish directory @4 million	4	0	4	0	0	0
	13.10	Establish a WCA fund coordinating body	Meetings for stakeholders = 10 million	10	0	10	0	0	0
			Office space @1.2 million annually for 20 years	24	1	6	6	6	5
	13.11	Establish/Strengthen and operationalise application of payment of ecosystem services (PES)	Consultancy @ 10 million	10	0	10	0	0	0
	13.12	Create/establish a WCA centre of excellence for research and management	Set up in existing institution – 100 million	100	0	100	0	0	0
			Annual budget 100 million x 20 years	2,000	0	500	500	500	500
	13.13	Introduce conservancy levy and payment for ecosystem services	Consultancy @ 5 million	5	0	5	0	0	0

Output		Activity	Inputs	Amount (million) Kes.	MTP1 2008-2012	MTP2 2013-2017	MTP3 2018-2022	MTP4 2023-2027	MTP5 2028-2032
	13.14	Strengthen water management WCA and funds committee at district (wards) and county levels with auditing mechanism put in place	Training (annually) 5 million x 20 years	100	0	25	25	25	25
		SUB TOTAL		2,293	2	689	535	535	533
Output 14: Water catchment areas monitoring and evaluation systems integrated and strengthened.	14.1	Develop ME tools for natural resource users groups and other legally constituted WCAs supporting community groups	100000 per county for 47 = 4.7 million	5	0	5	0	0	0
	14.2	Develop and operationalise M&E framework tailored to national and county	Consultancy 10 million	10	0	10	0	0	0
	14.3	Support publication and dissemination of WCA annual report	Consultancy @4 million	4	0	4	0	0	0
	14.4	Install water catchment M&E systems in all catchments	47 counties @5 million = 235 million	235	0	118	118	0	0
	14.5	Monthly data collection in all WCA's	Monthly @50,000 = 47 x 12 x 20 years	564	35	141	141	141	106
	14.6	Build NRUAs and other legally constituted organisations capacity in monitoring	Link to output 14.2	0	0	0	0	0	0
	14.7	Equip all NRUA's and other legally constituted organisations with monitoring tools	Link to output 14.2	0	0	0	0	0	0

Output		Activity	Inputs	Amount (million) Kes.	MTP1 2008-2012	MTP2 2013-2017	MTP3 2018-2022	MTP4 2023-2027	MTP5 2028-2032
	14.8	Regular updates for each catchment area at county and district levels.	Monthly Reports 20,000 per county x 12 x 20 years	226	14	56	56	56	42
	14.9	Identify and list all monitoring and reporting system within WCA	TOR Consultancy see 14.2	0	0	0	0	0	0
	14.10	Evaluate their performance and validity and recommend improvement	TOR for 14.2	0	0	0	0	0	0
	14.11	Develop M&E strategy that involves development of instruments, pretesting, standards and reporting framework	TOR for 14.2	0	0	0	0	0	0
	14.12	Conduct pre- monitoring, midterm and end of programme M&E process	Consultancy 12 million (4 million per part)	12	0	4	4	0	4
	14.13	Sensitise and train stakeholders on M&E	Train 50 pax in 47 counties @ 50,000 x 20 years	2,233	140	558	558	558	419
	14.14	Develop an M&E manual for natural resource user groups	Consultancy @ 5 million	5	0	5	0	0	0
	14.15	Supply install and commission additional data collection equipments	Link to output 14.4	0	0	0	0	0	0
	14.16	Implement regular M&E in WCA	Link to output 14.4	0	0	0	0	0	0
	14.17	Incorporate PC in WCA programmes	Link to output 14.4	0	0	0	0	0	0

Output		Activity	Inputs	Amount (million) Kes.	MTP1 2008-2012	MTP2 2013-2017	MTP3 2018-2022	MTP4 2023-2027	MTP5 2028-2032
	14.18	Enforcing self monitoring by resource users	Link to output 14.4	0	0	0	0	0	0
	14.19	Mid-term Review of the Master Plan after 10 years	Allocate 40 million for the year 2020	40	0	0	40	0	0
	14.20	End term review of the Master Plan	Allocate 50 million for the year 2030	50	0	0	0	0	50
			SUB TOTAL	3,383	189	901	917	756	621
			GRAND TOTAL	941,234	30,322	353,128	288,100	143,799	125,885




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