REPUBLIC OF KENYA

WILDLIFE RESEARCH & TRAINING INSTITUTE

Discover Beyond

THE NATIONAL WILDLIFE RESEARCH AGENDA 2023 – 2027

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FOREWORD

Wildlife resources refer to any wild and indigenous animal, plant or microorganism or parts thereof within its constituent habitat or ecosystem on land or in water, as well as species that have been introduced into or established in Kenya and are extremely important for both people and nature. These essential natural resources contribute to the maintenance of ecosystems such as forests, grasslands, woodlands, aquatic ecosystems, terrestrial landscapes, and seascapes. Wildlife plays a key role in regulating natural processes and delivers goods and services essential to support life on earth and human wellbeing.

In addition, wildlife plays key roles in supporting national food security; providing employment and income-generating opportunities; and, supporting the physical, spiritual and cultural well-being of people. Such support shows how wildlife contributes to the national economy through by contributing to the subsistence livelihoods of local communities, commercial exploitation, and recreation. Therefore, wildlife conservation and management are part of the environmental foundation for achieving Kenya's sustainable development agenda as articulated by the Constitution of Kenya, the Wildlife Conservation and Management Act No. 47 of 2013, the Vision 2030, and the Kenya Kwanza Manifesto 2022 as well as the Bottoms-Up Economic Model being implemented by the Government of Kenya.

Currently, a series of natural and human-induced pressures have resulted in climate change; continued land degradation; loss and fragmentation of wildlife habitats; unsustainable utilization of wildlife resources; loss of critical wildlife species; the spread of zoopathogens and wildlife diseases; the proliferation of invasive species; and increased human-wildlife conflicts among others. These threats have serious consequences for vital ecological processes, the livelihoods of people who depend on wildlife resources, and on our national socio-economic development.

Despite these multiple pressures on wildlife resources, Kenya is committed to enhancing sustainable wildlife conservation and management for the benefit of the present and future generations. This can be achieved through enhancing scientific knowledge and understanding of our wildlife resources, habitats, and human interactions. Implementation of scientific knowledge is expected to support the sound conservation and management of wildlife species to sustain their populations and habitats while taking into account the socio-economic needs of human populations. As such, the national wildlife research agenda intends to provide scientific, evidence-based information to support wildlife conservation and management decision-making and policy formulation while addressing present and emerging wildlife conservation and management challenges in Kenya.

HON. PENINAH MALONZA, OGW
CABINET SECRETARY
MINISTRY OF TOURISM, WILDLIFE AND HERITAGE

PREFACE

Kenya is blessed with abundant and diverse wildlife resources. Loss of wildlife resources would inevitably lead to ecosystem degradation and subsequent loss of important ecosystem goods and services. Kenya's move towards achieving environmental sustainability, sustainable socio-economic development, and enhanced human well-being is, therefore, dependent on how well we are able to manage and protect our wildlife resources. It is therefore important for Kenya to have a National Wildlife Research Agenda that guides the research needs of the Country.

This national wildlife research agenda was developed in a participatory manner involving various key stakeholders in the wildlife conservation and management sector. The main objective of this national wildlife research agenda is to provide an overarching science-driven framework that will support the implementation of the National Wildlife Strategy 2030, Wildlife Research and Training Institute (WRTI) Strategic Plan 2022-2027, Kenya Wildlife Service (KWS) Strategic Plan 2019-2024, relevant Multilateral Environmental Agreements (MEAs) and the Wildlife Conservation and Management Act, 2013.

This document presents seven (7) priority thematic areas for wildlife research in all Kenyan protected areas, community/ private wildlife conservancies, and non-protected areas. These thematic areas include Wildlife Species Population Dynamics; Wildlife-Habitat Dynamics; Wildlife Health and Population Genetics; Natural Resource Governance and Socio-Economics; Bioprospecting; Climate change; and Wildlife resource information management. The document further provides an overview of each priority thematic area and outlines various research topics that were identified. I note that the topics are quite broad giving an opportunity for all interested researchers to explore further and generate relevant scientific data and knowledge to guide wildlife management. Therefore, researchers are encouraged to develop and submit proposals that address the priority research topics highlighted in this national research agenda. We hope that this document will be valuable to national, regional and international researchers and stakeholders interested in conducting wildlife research in Kenya.

I acknowledge with gratitude the involvement of all relevant stakeholders during the process of developing this national wildlife research agenda. These include the Kenya Wildlife Service, community and private wildlife conservancies, research institutions, institutions of higher learning, and Non-Governmental Organizations among others. This demonstrates that by working together and forming effective partnerships, we can address the research gaps in the wildlife sector while strengthening the science-policy nexus in our wildlife conservation endeavors.

SILVIA MUSEIYA
PRINCIPAL SECRETARY
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ACKNOWLEDGEMENT

The country has for the first time developed a National Wildlife Research Agenda which will guide research in the country to scientifically inform wildlife conservation and management for the next 5 years. This is a great milestone as wildlife research was not previously guided by nationally-prioritized research areas. The agenda will greatly assist in implementing the Institute's Strategic Plan 2022-2027.

I take this opportunity to thank the Cabinet Secretary, Ministry of Tourism, Wildlife and Heritage Hon. Peninah Malonza, OGW; the Principal Secretary, State Department of Wildlife, Silvia Museiya and staff of the State Department of Wildlife for the policy guidance during the process of developing the agenda document. I also thank the Director General, Kenya Wildlife Service and his staff for the technical assistance offered during the development of the agenda.

I wish to thank all the experts and stakeholders who reviewed the document and validated it through a series of consultative meetings with the consultant and stakeholder workshops. I also thank the consultant Mr. Sam Weru for guiding the process very professionally. I further thank Save the Elephants (STE) for funding the stakeholders' engagement forum to review and validate the document.

Finally, I would like to thank the Board of the Institute for providing invaluable guidance during the development of the research agenda. I further thank the technical team from the Institute who worked tirelessly to develop the draft, review and finalize the document.

DR. PATRICK OMONDI, OGW
DIRECTOR/CEO
WILDLIFE RESEARCH AND TRAINING INSTITUTE

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Acronyms and Abbreviations

CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species of Flora and Fauna
CMS	Convention on Migratory Species
COVID-19	Corona Virus Disease 2019
DSI	Digital Sequence Information
EID	Emerging Infectious Disease
GEF	Global Environment Facility
GIS	Geographical Information System
GIZ	Deutsche Gesellschaft fur Internationale Zusammenarbeit
GPS	Global Positioning System
HWC	Human-Wildlife Conflict
IBA	Important Bird Area
ICT	Information and Communications Technology
IK	Indigenous Knowledge
IP	Intellectual Property
IUCN	International Union for Conservation of Nature
KAP	Knowledge, Attitude and Perception
KWS	Kenya Wildlife Service
LMO	Living Modified Organisms
MEA	Multilateral Environmental Agreement
NWCSR	National Wildlife Conservation Status Report
PA	Protected Area
PES	Payment for Environmental Services
RS	Remote Sensing
spp	Species
WCMA	Wildlife Conservation and Management Act
WRTI	Wildlife Research and Training Institute

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01

INTRODUCTION

Wildlife resources and habitats are extremely important socio-economic and bio-ecological assets which provide direct and indirect benefits which support human well-being and a healthy planet. It is on this basis that the constitution of Kenya 2010 and the Wildlife Conservation and Management Act (WCMA), 2013 recognizes these socio-economic benefits and advocates for sustainable exploitation and utilization; protection, conservation and management; and, equitable benefit sharing of wildlife and other natural resources. The wildlife resources provide goods and services that are important for attainment of the aspirations outlined in Kenya's national development blueprints such as Kenya Vision 2030 and the Big 4 Agenda. At regional and international levels, Kenya is obliged to commit in supporting sustainable wildlife resource conservation and management as part of domestication of the Convention on Biological Diversity (CBD), AICHI

Targets, Post 2020 Global Biodiversity Framework and Sustainable Development Goals (SDGs) among other Multilateral Environmental Agreements (MEAs). At national level, the Wildlife Research and Training Institute (WRTI) research programmes provides an overarching framework for implementation of the MEAs and priority research that meets the national needs identified in the WCMA, 2013, National Wildlife Strategy 2030, Draft WRTI strategic plan 2021-2025, Kenya Wildlife Service (KWS) Strategic Plan 2019-2024 and the National Wildlife Census Report 2021.

Despite the importance of Kenya's wildlife resources, they are currently facing threats due to fragmentation of wildlife habitats. The fragmentation is as a result of increase of human population over the years, which has resulted to demand for more land for settlement and crop farming. In addition, infrastructural development (roads, railway lines and oil pipelines) has also contributed to fragmentation of

wildlife range as the Government seeks to inter-connect the Counties, Cities and Towns as well as ports with other landlocked countries within Eastern Africa. These changes in our Country have resulted to settlements, farms, roads, railway lines, pipelines occupying land that was initially utilized by wildlife. As the human population pressure increases, the increased demand for scarce fresh water resources for domestic, industrial and agricultural use have resulted in unprecedented over abstraction of water from natural freshwater ecosystems and wetlands. This has subsequently led to low environmental flows compromising the ecological integrity of these water systems. Anthropogenic and climate induced factors have also resulted in declining status of wildlife in coastal and marine ecosystems found along the Kenyan coastal strip. In addition, insufficient implementation of land use and ecosystem conservation plans have also resulted in immense land degradation, proliferation of invasive plant species, pollution and siltation of water resources and overall loss of suitable wildlife habitats.

Based on the aforementioned factors, wildlife species have lost their former range, corridors, migratory routes and dispersal areas. The National Wildlife Strategy, 2030 provides documented evidence showing 68% loss of wildlife populations in savanna ecosystems between 1977- 2016; 40% decline in freshwater wetland ecosystems; 7.4% loss of forest cover between 1990-2014; 9% decline in insect pollinators; 74% loss of coral reefs by 1999; and 90% decrease in Mt. Kenya snow cap cover due to climate change. These changes have an implication (positive or negative) on wildlife-habitat-human interactions under the fragmented landscapes of Kenya's protected areas system. This loss of wildlife resources and habitats is jeopardizing human well-being and sustainable development. This is demonstrated through increased instances of human-wildlife conflicts, poaching, illegal wildlife trade and diminishing food security.

This national wildlife research programme agenda is intended to provide scientific, evidence based information to support decision making while addressing today's wildlife conservation and management challenges which include: loss, fragmentation, and degradation of wildlife habitats; overharvesting and overutilization of wildlife resources; loss of critical wildlife species; competition for water and land resources; wildlife diseases; introduction and establishment of invasive species; human-wildlife conflicts; poaching; illegal wildlife trade; and climate change.

The research programme agenda identifies seven (7) thematic areas which are interdependent and necessary to accomplish our mission. For each thematic area, there is a description of the specific challenges, objectives and priority research areas that requires in-depth studies for the purpose of providing science-driven information to guide protection, conservation and management of wildlife resources in Kenya for posterity.

This programme agenda will use a multi-disciplinary approach by combining data from wildlife species, habitats and human dimension using Remote Sensing (RS) and Geographic Information Environment System (GIS) environment to clearly understand the wildlife-habitats-human interactions in fragmented landscape. Aspects of biotechnology and nature-based enterprises will be considered. It will also ensure integration of cross-cutting issues related to socio-economics, policy frameworks and climate change. This will be undertaken at protected area level, ecosystems, landscapes and seascape within our national jurisdiction and at transboundary level. The program will be implemented through strategic partnership and stakeholder collaboration, including citizen science, to ensure proper stewardship, science-based decision making, and adaptive management in the wildlife sector.

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THEMATIC RESEARCH PROGRAMS

2.1 Wildlife Species Population Dynamics

Overview

Changes in wildlife populations, species, communities and ecosystem continuously occur over time. There are also changes that occur as a result of anthropogenic activities and may lead to extirpation of a population or species. All these dynamics require to be monitored and their root causes understood. The WCMA, 2013 mandates WRTI to conduct, coordinate wildlife research and ensure application of research findings in wildlife conservation and management, decision making and policy formulation.

In addition, the International Treaties, Conventions and Agreements (popularly referred to as Multilateral Environmental Agreements) indicate that the Cabinet secretary shall regularly publish the progress of Kenya's implementation of the wildlife related bilateral or multilateral environmental agreements to which Kenya is a party. To achieve the above, Kenya undertook the first National Wildlife Census in 2021.

The National Wildlife Census 2021 (Waweru et al., 2021) provides a baseline of the population status, trend and distribution of some species of wildlife in Kenya. This programme aims to build on this base line information to further understand the wildlife species population dynamics in the Country against the changing environment. We intend to establish and update the status, trends and distribution of nationally listed critically endangered, vulnerable, nearly threatened and protected wildlife species listed in schedule 6 of the WCMA, 2013; determine species viability over time; and, prepare recovery measures for those species whose populations are declining. The programme will also model wildlife movements, assess stocking rates and initiate innovative wildlife species research projects geared towards better understanding of these species. This is aimed at providing the required data and information in response to both local and international obligations as spelt out by the wildlife policy documents. Of particular interest are the wildlife species that are indicators of broader changes in a community or ecosystem; endangered, rare and endemic species such as the rhino, mountain bongo, roan antelope, sable antelope, hirola, sitatunga, Grevy zebra, sea turtles among others; threatened or vulnerable species; ecological keystone species; and, conservation flagship species.

Objective

To gain a better understanding of the status and trends of wild animal populations and their habitats in the country

Research areas

i. Wildlife population status, trends and distribution
ii. Wildlife species populations age and sex structures for declining species
iii. Assessment of endangered and threatened wildlife species to guide listing of Kenya's wildlife according to IUCN Red Listing Criteria
iv. Interaction of bio-physical and human factors that affect wildlife population trends and distribution
v. Modelling wildlife movement patterns and distribution
vi. Use of modern technology (e.g., remote sensing and artificial intelligence) in wildlife tracking and census nationally and cross-border ecosystems
vii. Estimation of wildlife home ranges in fragmented landscapes
viii. Modelling wildlife mortality hotspots

ix. Estimating wildlife carrying capacities and stocking rates in protected areas
x. Predator-prey interactions in fragmented landscapes
xi. Wildlife distribution against bio-physical and human factors (including human population, infrastructure development and urbanization)
xii. Pilot models of wildlife utilization and game farming to support wildlife species conservation and management; and enhance benefits to land owners with wildlife occupying their land
xiii. Breeding and culture of threatened and endangered freshwater fish species and semi-aquatic mammals.
xiv. Assessment for introduction and reintroduction as well as restocking and destocking of wildlife species
xv. Breeding and culture of Spirulina spp. and other algae species for exploitation and restoration

2.2 Wildlife-Habitat Dynamics

Overview

Maintaining the integrity of our wildlife habitats in conservation areas is both a challenge and a duty for wildlife managers as the quality of an animal habitat determines the health and productivity of a species. Through habitat research, monitoring and assessments, data and scientific information is generated to guide habitat management especially the ecologically sensitive habitats and ensure species population performance targets are met.

The protected area system experiences challenges either due to habitat fragmentation, habitat loss or degradation depending on the type and nature of the conservation area. A number of parks, reserves and species' sanctuaries are enclosed ecosystem and information on the species-species, species-habitat interactions, bio-physical and anthropogenic impacts is critical to the understanding of the well-being of the communities therein. Some landscape species require habitat connectivity to ensure survival, vitality and resilience towards climatic factors. Implementation of our research interventions and recommendations will help Kenya achieve its targets of enhancing connectivity and integrity of natural systems by at least 5%; and ,ensuring 30% of land and sea areas of biodiversity importance are effectively conserved and managed as stipulated in the Convention of Biological Diversity (CBD) Post-2020 Global Biodiversity Framework.

This programme, intends to assess the land-use and land cover changes over time in protected areas system and deploy predictive models on ecological disasters, invasive species, map out wildlife migratory corridors and provide scientific information and data to support expansion of protected area networks in Kenya, habitat restoration projects, carbon credit and financing including Payment for ecosystem services (PES). The programme will also assess the habitat condition and quality in satisfying the needs of the wildlife species and the interactions among and between species and their habitat including sensitivity to habitat change and habitat specificity.

Objective

To gain a better understanding of the habitat dynamics and ecological processes for more effective conservation

Research Areas

i. Use of modern technology to better understand impacts of land-use and land cover changes
ii. Quantification of wildlife corridors, habitat connectivity and migrations nationally and cross-border ecosystems
iii. Urban ecology and influence of fencing (fragmentation)
iv. Mapping and modelling plant species distribution in protected areas and landscapes
v. Mapping and modelling suitable wildlife habitat.
vi. Bio-physical factors, wildlife habitat selection, utilization and distribution in fragmented landscapes

vii. Ecological restoration of degraded habitats.
viii. Predictive modelling on ecological disasters e.g., fire, floods, drought, landslides, storms.
ix. Invasive species mapping, modeling and mitigation measures.
x. Ecosystem valuation and payment incentives for conservation, e.g., PES
xi. Plant species succession studies in critical habitats.

2.3 Wildlife Health, Genetics, and Forensics

Overview

One of the recent global concerns has been the increase in the number of important wildlife, human and livestock diseases; particularly infectious diseases. Of particular concern has been emerging zoonotic diseases of wildlife origin. Diseases have also been identified as an important threat to wildlife conservation with particular concern being their potential to cause immediate local wildlife population extinction.

The world has witnessed a number of local extinctions due to diseases. Despite threatening wildlife populations, wildlife diseases especially those of zoonotic nature are also threatening human health and wellbeing. The recent Emerging Infectious Disease (EID) events are dominated by zoonoses (60.3% of EIDs) and the majority of these (71.8%) originate in wildlife and are increasing significantly over time (Kate et al., 2008). EIDs have two major biological implications: first, many wildlife species are reservoirs of pathogens that threaten domestic animal and human health; second, wildlife EIDsthey pose a substantial threat to the conservation of global biodiversity (Peter et al., 2000). Some recent emerging zoonotic diseases that have caused major impact includes Ebola, SARS-Cov, MERS-Cov and most recently SARS-Cov2 (COVID-19). Others such as PPR, Rabies, Canine Distemper and Anthrax have caused massive loss in wildlife.

The threat of diseases to wildlife, livestock and human is currently exacerbated by population growth, habitat loss, global movement of people, livestock and wildlife (which all move with their pathogens). The global movement of people, livestock and wildlife has increased the interaction among them resulting into pathogens crossing the species-specific barrier. Models using global datasets on the underlying causes of Emerging Infectious Diseases (EIDs) have been able to demonstrate that EIDs will continue to increase in frequency over the next few decades. The models have also identified global EIDs 'hot spots' e.g. regions where the next pathogen/disease is most likely to emerge. These regions are largely in tropical developing countries where wildlife biodiversity is high and human population is dense and growing. Therefore, in order to safeguard wildlife resources, human welfare and livestock productivity in Kenya, there is a need for comprehensive research on wildlife diseases and ecosystem health especially at the human-livestock-wildlife interface. Improved surveillance, particularly for neglected host taxa, geographical regions and infectious agents, would enable more effective management should emergence occur (Daniel et al., 2016). Research on wildlife diseases will help to understand among others what drives the process of disease emergence. Although exposure to domestic sources of infection and human-assisted exposure to wild sources have been identified as the two main drivers of emergence across host taxa there is generally insufficient evidence for major roles of other hypothesized drivers of disease emergence (Daniel et al., 2016).

Due to fragmentation of landscapes, there has been increased inbreeding and hybridization among related species which impacts on wildlife health, reproduction and increased vulnerability to intrinsic and extrinsic ecological factors. Restoration of wildlife populations through translocation is increasingly becoming an important tool for wildlife conservation and management. For successful species recovery programmes, understanding of the genetic composition of the targeted population is critical. The country requires a genetic map and genetic bio-bank of its wildlife resources.

Forensic science has become a major tool for generation of scientific evidence for prosecution of wildlife crime. With increased wildlife crime such as bush meat harvesting and trophy poaching, new and improved forensic techniques will be required to enhance prosecution of wildlife crime.

This research programme is an initiative to promote conservation and livelihoods through intelligent disease surveillance and management in resource shared habitats. We will combine multiple disciplines and techniques to track wildlife movements and their pathogens and use modern cutting edge and real-time methods to monitor presence and evolution of pathogens. The programme will also develop novel and improved wildlife genetics and forensic techniques to enhance population genetic studies, develop species genetic maps and bio-banks; and,support prosecution of wildlife crimes. The goal is to aid in early warning strategies, robust disease preventive measures, and implementation of robust genetics and forensic techniques to reduce population threats and extinction risks.

Objective

The overall objectives of the research program will be:

i. **To safeguard wildlife, livestock and human health through prevention, early detection, identification and management of wildlife diseases and their ecological drivers through a One-Health Approach**

ii. **To understand patterns of disease transmission and spillover/ spillback dynamics**

iii. **To understand the genetic characteristics of our wildlife populations**

iv. **Develop and provide forensic tools, knowledge, and expertise to aid in the management and protection of wildlife**

Research Areas

i. Emerging and re-emerging diseases
ii. Trans-boundary animal diseases
  • One Heath
  • Zoonoses
  • Epidemiology and ecology of wildlife diseases
iii. Diseases at the human-livestock-wildlife interface
iv. Prediction and modelling of disease occurrence in wildlife populations
v. Vector and vector-borne diseases
vi. Wildlife genetics
vii. Wildlife forensics
viii. Breeding of endangered wildlife species for restoration
ix. Wildlife farming and captive management
x. Biomedical research

2.4 Natural Resource Governance, Human-Wildlife Interactions and Socio-Economics

Overview

Governance is a critical determinant of the social equity, effectiveness, and sustainability of natural resource use and conservation. It is the keystone of sound natural resource management and its core principles of accountability, transparency, participation, and the rule of law. Natural resource governance issues are at the heart of the efforts being made at local, national, bilateral and multilateral levels to ensure that decisions that affect natural resources and resource users are well-informed and implemented equitably. Improving natural resource governance, including securing rights and sharing power and responsibilities, can benefit both people and biodiversity,for instance, through improved ecosystem health and human well-being. Despite this, governance remains poorly understood and addressed in natural resource and conservation policy and practice. It is critical that the conservation community continue to work towards improved science-led natural resource governance.

Objective

i. **To generate scientific information that will guide the development of standards, methods and tools to assess and strengthen natural resource governance at multiple levels and in diverse contents.**

ii. **Establish the socio-economic and socio-ecological dimensions of wildlife resource management.**

iii. **Identify models that promote human-wildlife co-existence**

Research Areas

i. Compliance and enforcement of policy frameworks on natural resource governance, access and benefit sharing.
ii. Mapping and modelling human-wildlife conflict hotspots
iii. Research on Human-Wildlife Conflict (HWC) interventions
iv. Human-wildlife interactions, including urban and peri-urban zones.
v. Wildlife utilization and enterprise development
vi. Attitudes and perceptions on wildlife by communities next to protected areas and those living with wildlife
vii. Wildlife Economy
viii. Wildlife harvesting
ix. Models for conservation financing
x. Knowledge, attitude and perceptions (KAP) of wildlife conservation
xi. Anthropogenic factors affecting wildlife distribution and protected areas
xii. Document indigenous knowledge on wildlife conservation and bio-prospecting
xiii. Evaluation of management effectiveness of protected areas and other critical habitats

2.5 Bioprospecting

Overview

Kenya's has rich wildlife resources and indigenous knowledge assets associated with genetic resources which contribute significantly to various economic sectors and livelihoods based on bio-trade and gene-trade to both global, national, county, and local communities. The genetic resourcesare widely distributed in a wide range of ecosystems, from marine, montane, savanna, drylands, forests among others.

Bioprospecting facilitated by bio-technology have the capacity to identify and isolate useful components from various organisms and combine them with others or insert them into foreign animals and plants. It covers a wide range of commercial activities in different industrial sectors including pharmaceuticals, food and beverages, biotechnology, seed, crop protection, horticulture, botanical medicines, cosmetics and personal care products.

Bioprospecting provides valuable information for ecological connectivity and leads for new product development, and which is basis of many academia, researchers, and companies for generation of new intellectual assets for the market place. The IP assets range from copy rights such as media assets, information, data, genes, products, derivatives, patents, among others. A study commissioned by the ABS Capacity Development Initiative, implemented by the Deutsche Gesellschaft fur Internationale Zusammenarbeit (GIZ) GmbH under the GEFfunded ABS Africa project showed a high access demand for Kenya's genetic resources and traditional knowledge at the global level in terms of gene and biotrade and used as feedstock in various sectors, such as agriculture, food industry, flavours, fragrance, cosmetics, biotechnology and pharmaceuticals. The study further revealed that Kenyan genetic resources are widely utilized in various patent claims; over 3,000 species have been cited in 180,000, patents. Some of the key examples include the globally used organisms in, biological control and development of living modified organisms (LMOs, for example, the bacterium Bacillus thuringiensis (Bt) that is used in the agriculture, industry. Some of the strains of Bt that have been successfully used were, isolated from Ruma National Park and areas near Homa Bay in Kenya. Kenya's soda lakes and marine microbials including other extremophiles such as the algae are widely accessed, patented and various technologies commercialized at global level. Trade records further reveal that a wide range of Kenyan biological and genetic, resources are utilized widely for agricultural bio-controls. Venom from Kenyan snake species has been accessed for development of biomedical products, including anti-venom therapeutics, cancer, stroke, and other drugs arising, from venom peptides. Kenya's orchids have been accessed and utilized in the floriculture industry.

The benefits realized from the country's wildlife resources accessed for biotrade and gene trade have not been adequately realized at the national level. This is partly due to lack of effective enablers such as absence of a substantive access and benefit sharing legal framework to provide clarity and certainty. Various efforts being put in place to minimize resource misappropriation and optimize benefits arising from access and utilization of the country's Wildlife resources. These include but not limited to the National Wildlife bioprospecting strategy, Wildlife strategy 2030,focusing access,benefits and incentives, antivenom program, Wildlife Policy 2020,bioprospecting component,Wildlife Act 2013 section 22 and 23.

Bioprospecting research program will be modelled towards fulfilling the identified gaps and in line with both the international and national strategies for access, utilization and equitable share of benefits accruing from wildlife research and development. Bioprospecting is multidisciplinary, involving science, technology, access to resources, trade, legal andintellectual property rights. There is need to recognize the rights and responsibilities of users and providers in connection with the use of valuable discoveries, inventions and other development resulting from research, involving research specimen and associated know how.

Objective

To valorize the country's wildlife resources and associated traditional knowledge for optimized benefits that promote livelihoods, conservation and national development.

Research Areas

i. Natural products bioprospecting and value addition

ii. Biosecurity and biosafety research

iii. Effective bioprospecting frameworks for access utilization and share of benefits arising research and development of wildlife resource

iv. Modelling systems of access, benefits and incentives that attract investments in wildlife biodiversity that promote conservation and livelihoods.

v. Map out and identify key areas/priority species /taxa for bioprospecting and commodification for various sectors such as, venom, drugdiscovery, vaccine, cosmetics, agriculture, industrial applications among others

vi. Effective systems for ex-situ/in-situ linkages as per Nagoya protocols

vii. Systems for monitoring access and utilization of country's genetic resources and traditional knowledge

viii. Map out, identify and prioritize key IK intellectual assets associated with wildlife resources and vaporize for the marketplace.

ix. Generation, valuation, and commodification of IP assets arising from utilization of wildlife resources

x. Bioinformatics system for the country's wildlife resources utilization for R&D in line with Nagoya protocol

xi. Undertake non-detrimental findings on wildlife resources accessed and utilized for bio trade and genetrade. eg wildlife farming (non-wood forests products, etc)

xii. Uptake of technology transfer

xiii. Legislative framework for management of bioprospecting activities - Intellectual Property rights (IP) and DSI access
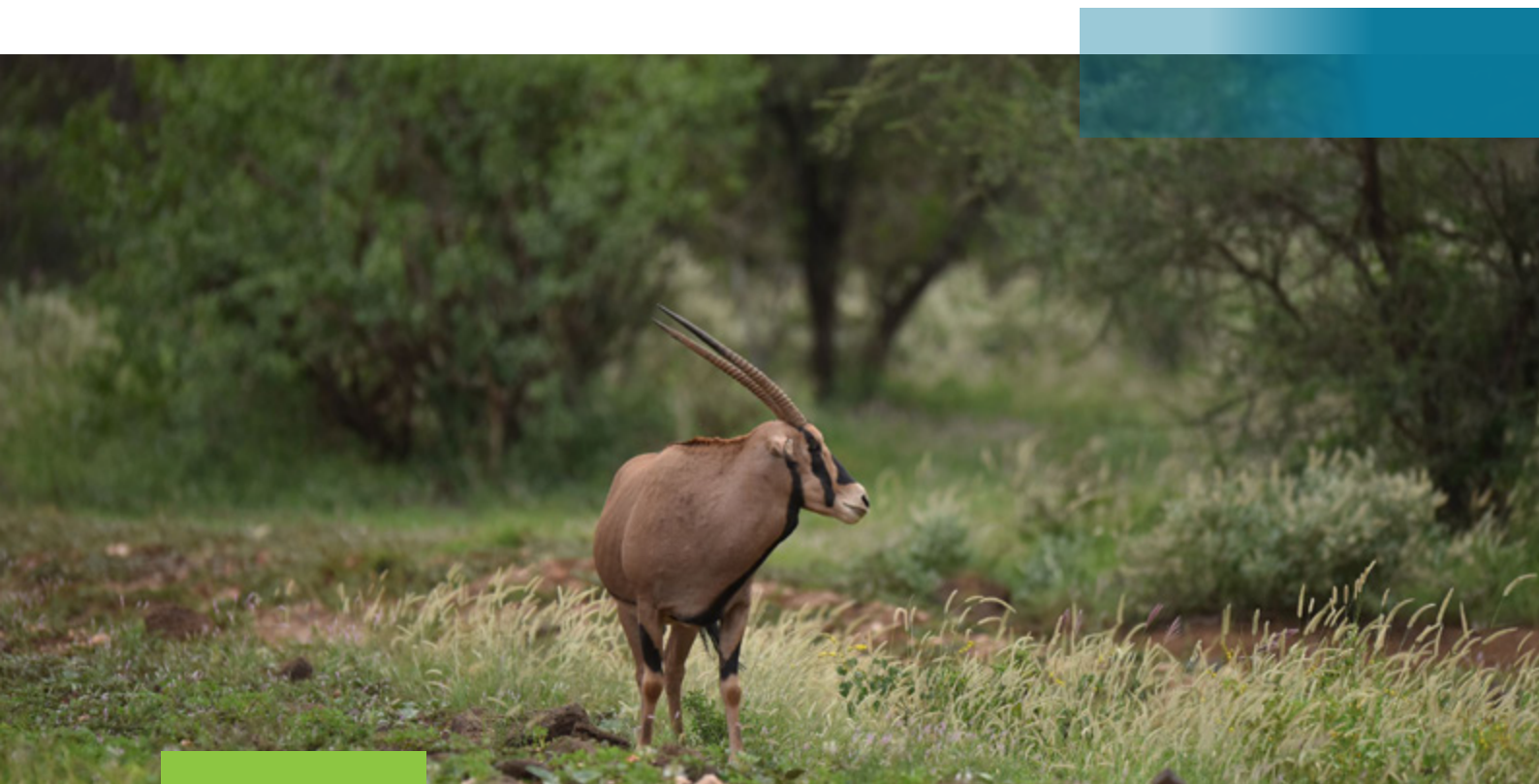
2.6 Climate Change

Overview

Kenya is vulnerable to climate change with current projections suggesting that its temperature will rise upto 2.5 0C between 2000 and 2050 while rainfall will become more intense and less predictable. Even the slightest increase in frequency of droughts will present major challenges for food security and water availability especially in Kenya's arid and semi-arid lands in the North and East of the country. Other parts of the country, most notably in the Rift Valley are also vulnerable to climate change due to increasing extreme events (droughts and floods combined with landslides) while glacier melt in the highland mountains will further reduce future water availability. Coastal areas will suffer from rising sea levels and associated floods and salt water intrusion.

Kenya has experienced the impacts of climate change through recurrence of droughts and floods. Notable impacts of climate change on the wildlife and biodiversity sector include changes in habitat and species distribution, migration patterns, reduction in population size which may lead to extinction of some species. In addition, climate change is expected to exacerbate spread of wildlife diseases, increased colonization by invasive species, water scarcity in protected areas, increased human-wildlife conflicts, increased poaching for bush meat, outbreak of wildfires, inundation of coastal habitats and salt water intrusion and among others. Fluctuation of temperatures have direct impact on plant flowering and resultant seed dispersal for continued plant growth and re-establishments into new or degraded areas.

In order to be able to mitigate the impacts of climate change, it is important to have good quality and timely climate data (rainfall, temperature, wind speed, wind direction and humidity). This will allow for prediction of any climate change phenomenon that could negatively impact on our wildlife resources in the protected areas system. Therefore, it is important to install modern monitoring equipment in our protected areas so that adequate and timely weather data is collected at a fine scale level. This programme will aim atin-situ installation of scientific equipment for long-term data collection within the protected areas.

Despite the substantial body of scientific literature that describes the impacts & effects of climate change. There is need for continuous research and monitoring on the impact of climatic change on wildlife resources; and adoption of adaptive management strategies that will enhance implementation of climate change mitigation and adaptation measures. The information is also relevant while developing land and ecosystem management plans, species recovery action plans, and other broader adaptation plans by county and national government.

Objective

Develop early warning systems for wildlife species management and implement mitigation and adaptation measures.

Research Areas

i. Modeling and predicting implications of climate change on wildlife

ii. Climate vulnerability and sensitivity analysis of critical habitats

iii. Climate change mitigation and adaptation

iv. Carbon financing

v. Paleo-limnological studies in lakes, rivers and wetlands

vi. Climate change impacts on human-wildlife interactions

vii. Contribution of climate change to proliferation of invasive species

viii. Impacts of climate change on ecosystem goods and services

ix. Technological opportunities for wildlife conservation under the effects of climate change

x. Economic implications of climate change on wildlife-on-wildlife resources

xi. Effectiveness of marine and coastal ecosystems as carbon sinks

xii. Effects of climate change on wildlife security in transboundary ecosystems and other wildlife corridors

xiii. Leveraging on private-public partnerships in mitigation of climate change effects on wildlife populations and ecosystems

2.7 Wildlife Resource Information Management

Overview

The potential contribution of wildlife resources to the Kenyan economy and livelihoods is enormous and to sustainably benefit, the Government has deliberately initiated strategies toward addressing the existing challenges. One key stumbling block has been the haphazard and scattered scientific information in the sector impacting negatively to the policy makers, wildlife managers, researchers and academicians. To address this problem, the government has instituted measures to ensure that the sector is organized and business processes thereof are reengineered. This will be done by unlocking the existing huge wildlife datasets and scientific publication and reports which are hosted in Kenya Wildlife service and different conservation partners and stakeholders within the Country and beyond by making it available and accessible to the citizens.

The Constitution of Kenya 2010, gives all citizens the right to information while the wildlife Act 2013 prescribes a framework to develop regulations for access and sharing of wildlife data and information in the wildlife sector between the Service, relevant government agencies and other stakeholders. Towards this end, the newly formed Wildlife Research and Training Institute (WRTI) has prioritised provision of scientific data and information by addressing the challenges of limited wildlife data and information. This is geared towards better governance in wildlife data management, centralize data repositories, improved access to wildlife data and reduced restrictions and hurdles on data flows among conservation partners.

One of the driving forces behind the declining wildlife populations and habitat degradation has been lack or failure to develop data and information management systems in protected area systems. This implies that, it's not possible to accurately assess the status of biodiversity and condition of natural resources and to implement long term and proactive ecosystem management plans and strategies.

The country lacks a digital portal for wildlife resource baseline data as a number of different agencies are involved in natural resource surveys, assessments and monitoring with data and information hosted in different state agencies and non-state actors. This has resulted to challenges which has affected generation and storage of scientific data to inform policy and decision making in the wildlife sector. Often, only technical reports are found as evidence, while the original data have gone missing with disposed individual and institutional computers.

Objective

Establish an integrated platform for wildlife resources data and information management.

Programme Areas

i. Modernization of Information and Communication Technology (ICT) infrastructure for wildlife data storage, access and sharing

ii. Establish a wildlife resource database

iii. Establish a coordination framework for data and information management and sharing protocol

iv. Provide historical, current and future scenarios of conservation landscapes

v. Packaging of data and information products for the consumer

vi. Digitize and upgrade library/referencing services

vii. Ex-situ flora and fauna specimen collections (gene bank, herbarium, sample bank, voucher specimen)

03 IMPLEMENTATION FRAMEWORK FOR THE NATIONAL WILDLIFE RESEARCH PROGRAMME

The seven (7) research programs will be implemented through four (4) Field Research Centers which were established based on Kenya's agro-climatic and ecological zones.

These field research centers include:

i. Savanah, Arid and Semi-arid Ecosystem Research Centre in Tsavo, Voi

ii. Montane/Forest Ecosystem Research Centre in Mweiga, Nyeri

iii. Coastal and Marine Ecosystem Research Centre in Malindi

iv. Inland Waters and Wetlands Research Centre in Naivasha

These research centers will be responsible for coordinating and implementing research and monitoring activities in wildlife conservation areas through innovative and responsive scientific research. The coordination of all field research work will be through the respective departments based at the WRTI headquarters.

WRTI will work closely with internal and external partners and stakeholders in implementation of the programmes

04

MONITORING AND EVALUATION

WRTI will monitor progress of implementation of the programmes and its impact on wildlife conservation and management through periodical evaluations based on performance indicators for each program. Evaluation reports will be shared with all stakeholders so that the overall implementation of the programs can be assessed.

05

REVIEW OF THE RESEARCH PROGRAMMES

The programmes will be subject to a Mid-term review and a final review after 5 years of implementation. The reviews will provide insights on the extent to which the programmes have been implemented, gaps identified and the progress made in achieving the national wildlife research and development agenda. The review will also consider new priority themes and research areas for the country. The review will be undertaken by WRTI in collaboration with key stakeholders.

06

ANNEXES

6.1 Annex 1: Proposed Research Initiatives Under Each Research Programme

S/No.	Research Programs	Research initiatives
1	**Wildlife species population dynamics**	• Wildlife population status, trends and distribution • Mapping and modelling wildlife movement patterns and distribution • Mapping wildlife home ranges in fragmented landscapes • Mapping and modelling wildlife mortality hotspots • Estimating wildlife carrying capacities and stocking rates in protected areas • Effects of livestock incursion in Protected areas • Mapping and modelling plant species distribution in protected areas and landscapes • Prepare a national Red List in line with IUCN red listing criteria • Monitoring rare and endangered wildlife species breeding in sanctuaries **Inland Freshwater & Wetlands Research Center** • Population dynamics and distribution of Sitatunga, a specialized semi-aquatic antelope Kenyan wetlands • Sitatunga species breeding project for restocking conservation areas. • Population dynamics and distribution of hippopotamus and crocodiles in critical freshwater bodies: towards providing innovative mechanisms for controlling human-wildlife conflicts. • Spatial-temporal monitoring of water birds in Important Bid Areas (IBAs), Ramsar sites, Protected Areas, and World Heritage Sites. • Population dynamics of freshwater fish species of conservation concern. • Breeding and culture of threatened and endangered freshwater fish species (focus on *Labeovictorianus* & *Barbusaltinialis*) for restocking depleted populations. **Marine & Coastal Field Research Center** • Spatial- temporal analysis of sea turtles nesting patterns along the Kenyan coast • Monitoring distribution, abundance and population Structure of Sable Antelope in Shimba Hills National Reserve • Monitoring distribution pattern and habitat use by elephants using dung sampling: case of Shimba Hills Conservation Area & Arabuko Sokoke forest reserve and national park. • Primates survey in Tana Primates National Reserve and adjacent patch forest ecosystems • Small mammals survey: focus on Dikdiks, Aders duiker and pangolins • Spatial and temporal analysis of marine megafauna • Assessing Coral reefs, seagrass beds and mangroves vulnerabilities and adaptation to climate change • Evaluate effective shoreline change mitigation measures and develop innovative ways to manage shorelines • Assess and establish fish biomass in protected areas

Savanna, Arid & Semi-Arid Ecosystems Field Research Centre
- Elephant demography and group structure in Tsavo East National Park as a result of frequent droughts
- Modelling the Distribution of Dik-diks in Tsavo Conservation Area
- Modelling the spatial distribution and occurrence of Prickly Pear (*Opuntia Stricta*) in the Southern part of Tsavo East National Park and Its adjacent areas, Kenya
- Understanding the inter & intra species interaction dynamics and demographic status of Topi (*Damaliscuslunatusjimel*) anthropogenic pressures and habitat change induced factors influencing its population growth in the Maasai Mara Ecosystem.
- Understand the impact of translocated species on habitats and their management implications.
- Population dynamics of endangered wildlife species
- Spatial and temporal distribution of birds of prey in savannah arid and semi-arid ecosystems and the threats that are limiting their population growth.
- Distribution, threats and population dynamics of carnivores in the savannah arid and semi-arid ecosystem.
- Carrying capacity of the savannah arid and semi-arid ecosystems especially on the elephants and other ungulates.
- The reproductive ecology of endangered and vulnerable species in savannah Arid and semi-arid ecosystem.
- Spatial and temporal dynamics of critical mammalian populations in the savannah ecosystem.
- Forage availability and carrying capacity assessment for giraffe and Roan antelopes in Ruma National Park
- Understanding the Ungulate and Primate ecology in the Kibwezi Forest Reserve

Montane/ forest field Research Center
- Understanding the species population dynamics of the endangered and elusive mountain bongo & black rhino (*Dicerosbicornis*) populations in Aberdare National Park through camera trapping
- Monitoring the status of the endangered and endemic montane bird species in the Aberdare ranges
- Undertaking dung count studies to establish the population densities of elephants in Mt Elgon forest

2	**Wildlife habitat dynamics**	• Assess Impacts of infrastructure development (roads, pipelines, power lines, ports) and extractive industries (mining, oil & gas exploration) on wildlife habitats and species. • Modelling space use and distribution of wild animals in landscapes. • Mapping land-use and land cover changes and impacts of wildlife populations. • Mapping wildlife corridors connectivity and ecological processes. • Habitat selection by wild animals in protected area and landscapes. • Soil chemical analysis in protected areas.

- Chemical analysis of plants species preferred by wild animals in protected areas and landscapes.
- Effects of bio-physical and human factors on wildlife distribution.

Inland Freshwater & Wetlands Research Center
- Environmental flow patterns of key river systems: implications on wildlife populations
- Long-term monitoring of hydrological and ecological dynamics of critical inland freshwater, saline water bodies and wetland ecosystems supporting critical wildlife species.
- Experimental ecological restoration of critical wetlands freshwater bodies and wetlands.
- Effects of land use changes on inland water and wetlands ecosystems.

Marine & Coastal Field Research Center
- Assessment of the status and structure of protected coastal forests
- Long term ecological monitoring of the status if coral reefs and seagrass beds and mangrove ecosystems in protected areas
- Long term ecological monitoring of coastal rivers and lacustrine habitats

Savanna, Arid & Semi-Arid Ecosystems Field Research Centre
- Understand how urbanization and its fencing has affected the conservation of biodiversity in savannah arid and semi-arid ecosystem.
- Effects of infrastructural developments on the conservation of biodiversity in savannah arid and semi-arid ecosystem.
- Habitat suitability assessment of endangered wildlife species in their home ranges.
- Rangeland ecology and effects of fire on conservation of wildlife.
- Factors influencing spread of invasive plant species in conservation areas.
- Innovative mechanisms of eradication and prevention of the spread of invasive plant species in conservation areas.
- Effects of habitat degradation, fragmentation and loss to biodiversity in savannah arid and semi-arid ecosystems.

Montane/ forest field Research Center
- Understanding the status, inter & intra species interactions, demographic pressures and climate change induced factors influencing the suppressed endangered wildlife population growth in the Montane/forest ecosystems in the Aberdares, Mt. Kenya and Mt. Elgon.
- Restoring wildlife corridors in the montane/forest habitats in Kenya: quantifying benefits to people and biodiversity
- Establishing permanent vegetation transects in Aberdare, Mt Kenya, Kakamega & Mt Kenya forests to monitor the ecosystem health and determine impacts of anthropogenic pressures and climate change

3	**Wildlife Health, Genetics and Forensics**	- Tracking pathogen spill-over patterns and events - Wildlife disease surveillance - Pastoralism and park-system dynamics on important animal and zoonotic diseases. - Mapping of important wildlife diseases - Risk assessment of outbreaks of important wildlife diseases - Genetics studies of elephants at the forest/savannah interface (Mt.Kenya/Laikipia, Mau/Masai Mara) - Genetic studies on endangered antelopes (Sable antelopes, Hirola, Mountain Bongo). - National survey of species targeted for bushmeat harvesting. - Monitor efficacy of control methods for invasive bird species: the Indian House Crow **Marine & Coastal Field Research Center** - Control of tsetse flies in Simba Hills Conservation Area to better wildlife health - Establish the linkage of the Kenyan population of dugongs to the populations in Mozambique, Tanzania, Seychelles and the Middle East via genetic studies - Assess and establish the status of shark populations in Kenya
4	**Natural resource governance and socio-economics**	- Natural capital valuation of the wildlife sector and its contribution to the economy - Evaluate the legislative framework governing formation, management and recognition of community conservancies as protected areas - Interaction of bio-physical and human factors that affect wildlife population trends and distribution - Mapping and modelling human-wildlife conflict hotspots - Develop and test innovative systems to mitigate human wildlife conflict - Studying human-lion conflicts around Nairobi National Park using satellite collars - Attitudes and perceptions on wildlife by communities next to protected area and living with wildlife - Market value-chain in bushmeat trade - Assessment of wildlife utilization opportunities: review of past, current and future opportunities - Develop and pilot conservation financing mechanisms **Inland Freshwater & Wetlands Research Center** - Tapping into the Kenyan blue economy framework: the role of biodiversity conservation of inland freshwater ecosystems. - Science- Policy nexus: Effectiveness of water and wildlife related policy implementation in Kenya. - Management effectiveness of critical wetlands and Wetlands of International Importance (Ramsar sites). - Trans-boundary wetland conservation initiative: towards enhancing trans-frontier conservation areas in East Africa. - Assessing impacts of tourism activities on behavioral ecology of wetlands dependent wildlife species.

		Marine & coastal research center • Evaluate management effectiveness for both coastal and marine protected area systems to identify deficiencies in management, and inform on enhancing their sustainability as a mechanism for conservation. • Carry out social surveys to understand the anthropogenic pressures on PAs, stakeholder interactions with the PAs, and advice on improving opportunities for involvement of local stakeholders in PA management decisions. • Evaluate the principles applied in management of shared marine resources so as identify key transboundary conflicts with Tanzania and Somalia, and advice on enhancing and achieving peaceful coexistence. **Savanna, Arid & Semi-Arid Ecosystems Field Research Centre** • Understand the spatial and temporal impacts of poaching on biodiversity in savannah arid and semi-arid ecosystems. • Spatial and temporal occurrences of Human wildlife conflicts in savannah arid and semi-arid ecosystems. **Montane/ forest field Research Center** • Understanding the temporal and spatial patterns of human wildlife conflicts in the Kenyan montane/forest landscapes, the influence of climatic variability and land use changes and determining the effectiveness of electric fences. • Establishing the status and ecosystem values of the threatened community forests in Laikipia and Samburu landscape and determining potential benefits to the local communities
5	**Bioprospecting**	• Microbial bioprospecting in Kenyan soda lakes. • Biodiversity Value chains: towards establishing bio-trade, gene trade value chains. **Inland Freshwater & Wetlands Research Center** • Community based culture and value addition of aquatic algae (*Spirulina* spp.): a case of enhancing benefits and improving livelihoods of local communities. **Marine & coastal research center** • Bioprospecting in marine natural products. **Montane/ forest field Research Center** • Utilization of *Mondiawhytei* biological resources derivatives and associated information for fragrance and flavoring industry
6	**Climate change**	• Modeling implications of climate change on wildlife in fragmented landscapes. **Inland Freshwater & Wetlands Research Center** • Impacts of rising level of freshwater lakes levels on biodiversity and implications on food security.

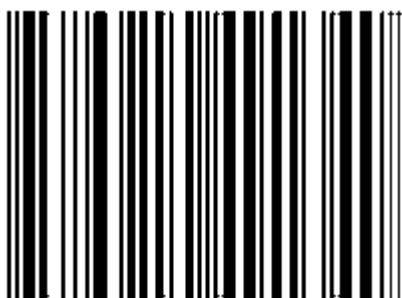|		
		• Climate change vulnerability assessments of protected areas: a tool for enhancing climate smart design of ecosystem-based management plans for PAs. **Savanna, Arid & Semi-Arid Ecosystems Field Research Centre** • Understanding the spatial and temporal severity of climate change especially drought in Savannah arid and semi-arid ecosystems and how it affects the conservation. **Montane/ forest field Research Center** • Establishing climate change indicators in the montane forests of Aberdare, Mt Kenya and Mt Elgon ecosystems
7	**Wildlife resource information management**	• Development of data and information sharing guidelines. • Capacity development/training for data collection, storage, organizing and quality control. • Procurement and installation of ICT infrastructure; and networking information flow between departments and all field research centers. • Establishment of earth ranger for research **WRTI Field Research Centers** • Establishment of integrated information database system. • Establishment of libraries.

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