



Challenges and Current Strategies in Biodiversity Conservation in Kenya: A Review

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Abstract

Kenya's biological resources are critical in its efforts to achieve sustainable development and ensure improved living standards for its population. The country's biological resources are diverse and include those that are found in protected areas such as game parks and game reserves, gazetted forests, non-protected areas, water bodies, coastal and marine environments, and in the ASALs. Kenya's biodiversity strategies derive from a legal regime that includes the constitution and other legislation including both *in situ* and *ex-situ* approaches at both macro level and at sectoral levels. The country's biodiversity conservation efforts are also anchored in domesticated international agreements and protocols that include the CBD and Nagoya Protocols. The main objective of the study was to review the status of biodiversity conservation in Kenya by considering the legal and policy frameworks as well as the main challenges the country is facing in its efforts to conserve biodiversity. Key issues identified as needing action and greater coordination include protection of gazetted forest areas, threatened, endangered and alien species and the role of indigenous knowledge systems as well as the need to improve co-ordination by implementing agencies. The country faces many challenges in its conservation efforts. These challenges arise from policy contradictions, resource constraints, increasing population that exerts pressure on biological resources and approaches that do not fully integrate communities who are custodians of these resources in their conservation. The other challenge is how local communities can access and equitably benefit from these resources. It is argued that there is a need to shift strategy and policies from their technocentric approaches to be more participatory and involve communities to own not only the conservation efforts but have increased benefit from these resources.

Subject Areas

Environmental Sciences, Geography

Keywords

Biodiversity, Legal, Policy Challenges and Strategies

1. Introduction

Biodiversity conservation can be defined as the protection, uplift and management of biodiversity with the aim of maintaining it at its threshold level so as to derive sustainable benefits for the present and future generations. Its objectives include preserving the diversity of species, sustainable utilization of species and ecosystem and maintaining life-supporting systems and essential ecological processes.

Most developing countries, including Kenya, rely on biological resources for their economic and social development. Biological resources provide food, shelter, fuel, and wood, generate employment and earn foreign exchange, especially from the tourism sector. In many rural communities, it is the fundamental pillar for livelihoods and the basis for social interaction and economic prosperity. Conserving biodiversity helps in the maintenance of biological cycles, regulation of climate, protection of soil and cycling of essential nutrients as well as in the absorption and breakdown of pollutants. As Haig, S.M. *et al.* [1] point out it also offers opportunities for new medicines, foods, and energy production.

The global concern for biodiversity was first given prominence in the United Nations Conference on Environment and Development (Earth Summit in Rio in 1992) that saw member states sign the Convention on Biological Diversity (CBD). The convention highlighted the need to conserve biodiversity to stem its' global decline and degradation of ecosystem services. At the World Summit on Sustainable Development in 2002, the Millennium Development Goals (MDGs) were designed to inspire efforts to improve people's lives by, among other priorities, halving extreme poverty by 2015 [2]. The MDGs emphasized the need to integrate poverty alleviation and biodiversity conservation agendas.

In 2002, the Convention on Biological Diversity (CBD) committed member states to a significant reduction in the rate of biodiversity loss by 2010. These targets have not been met when we consider the indicators that were developed within the CBD framework such as the number of species, population size, extinction risk, habitat extent and condition, pressures on biodiversity hot spots and general responses to maintain biodiversity. On the contrary, pressure on biodiversity has increased as reflected in the rise of resource consumption, invasive alien species, pollution, overexploitation of key resources, and climate change impacts. In 2015, the Global Community through the UN agreed on Sustainable Development Goals, which aimed to create a better and fairer world by 2030 and a more sustainable future for all. Two of these goals that focused on life under water (SDG 13) and life on land (SDG 15) were meant to directly address issues of sustainability of resource use in the waters and land and help address the chal-

lenge of biodiversity conservation. This came at a time when the United Nations through a General Assembly resolution in 2011 had declared 2011-2020 as the UN decade on biodiversity and governments were expected to mainstream and develop national strategies for implementation of the Strategic Plan for Biodiversity. To achieve the goals of sustainable development, member states were expected to not only commit resources but to work towards certain timeline targets. According to [3] in sub-Saharan Africa, there is a wide range of habitats and ecosystems that host many varied species within them. Some of these ecosystems have seen a reduction in their biodiversity due to a number of factors that include deforestation, infrastructural developments and expansion of human settlements that lead to habitat loss. In East Africa, the variation in climatic conditions, population size and densities as well as the general topography has resulted in diverse biological resources. The coastal forest areas in East Africa are considered biodiversity hotspots and are considered vulnerable in terms of loss of biodiversity [4].

It is against this background that this review examines the strategies the government of Kenya has undertaken to implement and complement the global and regional level policies and legal frameworks on biodiversity. The main purpose of the research is to provide an overview of the existing framework on biodiversity and highlight their adequacy or inadequacy in light of changing local and global dynamics in conserving biological resources. In the following sections, I look at the legal framework for biodiversity conservation in Kenya, the major challenges that face biodiversity conservation in the country, the strategies adopted by the Kenyan government and lastly make a conclusion of the review.

2. The Legal Framework for Biodiversity Conservation in Kenya

Kenya joined the global community in the protection of the environment and its resources by participating in the Stockholm Conference on Environment in 1972. The Stockholm conference led to the formation of the United Nations Environmental Programme (UNEP), an agency that focuses on global efforts to protect the environment and which is currently headquartered in Nairobi, Kenya. In 1974, the country founded the National Environment Secretariat (NES) as a lead agency to coordinate and oversee environmental activities in the country.

The country participated in the United Nations Conference on Environment and Development (UNCED), the *Earth Summit*, in Rio de Janeiro in 1992 that adopted Agenda 21 to commit member states and Parties on the need to integrate environmental issues in their development agenda. During the summit, there was an emphasis on the need to conserve biodiversity that led to the subsequent signing of the Convention on Biological Diversity (CBD) by member states. The CBD became law in 1993 and was meant to govern and protect global flora and fauna. The country ratified the convention in 1994 and through NES formed the Inter-ministerial Committee on Environment. This was a multi-sectoral and mul-

tidisciplinary team that drew its membership from the public sector, private sector and non-state actors or non-governmental organizations. By ratifying the convention (CBD) the country undertook to protect endangered and threatened species, increase forest cover as a habitat for many species and ban trade that would contribute to endangering the continued existence of different species e.g. the ban on ivory trade to help protect the African elephant.

Kenya became a party to the Nagoya protocol on access and equitable benefit sharing of gains that arise from the utilization of genetic resources in 2012. The *Protocol* was adopted in Nagoya, Japan in October 2010 and meant to create greater legal certainty and transparency for both providers and users of genetic resources.

The framework that guides Kenya's efforts in biodiversity conservation comes from the country's Multilateral Environmental Agreements (MEAs) and its' own legislative actions including the constitution of the country. The MEAs include treaties, protocols, agreements and conventions and act as pillars in the conservation of the environment and achieving sustainable development goals [5]. The main implementing authority for the MEAs in the country is the National Environmental Management Authority (NEMA) which was established by an Act of Parliament, Environmental Management and Coordination Act (EMCA) in 1999 and is meant to co-ordinate environmental activities across the various sectors and key holders in the country. It was also mandated to exercise control over development activities that were deemed to have environmental impacts including environmental impact assessments of projects and proposed developments. Besides NEMA, Kenya Wildlife Service (KWS) is another agency that implements MEAs. These include the Convention on International Trade in Endangered Species (CITES) (1973) that prohibits and regulates trade on endangered species, the Ramsar Convention on Wetlands (1971) that considers the protection and conservation of wetlands, the Convention on the Conservation of Migratory Species (CMS (1979), World Heritage Convention (1972), and the Nagoya protocol. Other Multilateral agreements to which the country is a signatory and contributes to conserving biodiversity include the UN Framework Convention on Climate Change (UNFCCC), the UN Convention on Combating Desertification and the Stockholm Convention on Persistent Organic Pollutants (POPs).

The other source of policies and laws that govern biodiversity conservation is government legislation at the national and local levels. Such legislation may cover different sectors that touch on biodiversity. The specific goals of the legislation may vary but include the need to protect natural habitats by outlawing development, limited harvesting of natural resources, or other human activities that can have a huge impact on maintaining natural biodiversity.

In Kenya, the 2010 Constitution makes environmental protection and conservation (and by extension biodiversity conservation) a fundamental part of the development agenda [6], The constitution is clear on safeguarding our environment through its principles of the polluter pays and the need for the country's

agencies and stakeholders to work towards sustainable development. The right to a clean and healthy environment is a constitutional right for every Kenyan to enjoy as espoused in Article 42 of the constitution and obligates citizens to seek judicial recourse whenever they feel that this right is being violated. All the organs of state and public officers who exercise power directly or through some form of delegation are directed to ensure that environmental protection is incorporated into development activities and that public participation in managing these resources is mainstreamed. The enactment of the 2010 constitution has also meant that the county governments act as custodians of these genetic resources on behalf of the communities who live within the county.

Other legislations that guide and impact on biodiversity conservation in the country include the Environmental Management and Co-ordination Act (EMCA 1999-revised in 2012), The Wildlife Conservation and Management Act (2013), The Forest Conservation and Management Act (2016), The Water Act (2016), the Fisheries Management and Development Act of 2016, The Registration of Land Act of 2012 and the Community Land Act of 2016.

The Environmental Management and Coordination Act (EMCA) is based on the general principle of a clean and healthy environment being an entitlement to Kenyan citizens. The Act established the National Environment Management Authority to coordinate matters on the environment and ensured a safe and healthy environment for the country to achieve sustainable development. Specifically, in section 50 of the Act, the Authority is mandated, in consultation with lead agencies to prescribe measures necessary to ensure conservation of biological diversity in the country. It is expected to prepare and maintain an inventory of biological diversity in the country as well as establish the components that are rare, endangered or threatened with extinction and identify potential threats to biodiversity. In 2006 National Environment Management Authority (NEMA) published regulations that were expected to address the conservation of Biodiversity, Access to Genetic Resources and Benefit sharing. These regulations were also meant to provide for access to a fair and equitable sharing of the benefits that arise from utilizing genetic resources and associated traditional knowledge. It is also meant to provide mechanisms to protect and prevent the exploitation of endangered and threatened plant and animal species. These regulations are currently undergoing a review by a technical committee to align it to the 2010 constitution and the Nagoya protocol that has been domesticated and the Authority has called for input from members of the public [7].

The Wildlife Conservation and Management Act (2013) which became operational in 2014, created Kenya Wildlife Services (KWS) with the key mandate of protecting and managing Kenya's wildlife within and outside the protected areas, KWS recognizes that large ecosystems that house many wildlife species are already under threat with significant loss of biodiversity and have attracted a wide range of competing and conflicting land use activities (KWS 2021) These competing land uses have resulted in the loss of wildlife habitat, land fragmentations, blockage of wildlife corridors and increasing human-wildlife conflict.

Given that the land outside protected areas is controlled by private individuals and communities, KWS has engaged these individuals and communities in its conservation efforts by encouraging community enterprises such as various wildlife conservancies. Secondly, KWS has been designated by the Kenyan Government as the management authority for CITES and KWS has consequently established a fully-fledged department for CITES implementation and a whole division for Species Conservation and Management.

The Forest Conservation and Management Act of 2016 established the Kenya Forest Service (KFS) whose mandate amongst others is to protect forests in the country, manage state forests, and maintain and conserve indigenous forests. Regarding biodiversity, KFS was expected to collaborate with other organizations and communities in the management and conservation of forests for the utilization of the biodiversity found within these forests. It would also protect and manage unique trees for biodiversity conservation. To achieve this, KFS is expected to promote the empowerment of forest associations and communities in the control and management of forests. The act also allows the minister in charge of Forests to declare an area as a nature reserve for the purpose of preserving its biodiversity and natural amenities thereof.

The Water Act of 2016 regulates water use and protects water bodies in the country. It criminalizes any form of pollution that may affect a water resource and, in the process, make it harmful to the welfare of human beings and aquatic life forms as well as the environment a fact that addresses the need to conserve the biodiversity of aquatic lifeforms

The Fisheries Management and Development Act of 2016 established the Kenya Fisheries Service whose mandates include the conservation and protection of fisheries habitats and ensuring that biodiversity and genetic diversity in the marine environment is maintained and enhanced. This has to be achieved by ensuring the effective application of the ecosystem approach to fisheries management.

Other pieces of legislation that have a bearing on biodiversity conservation include The Land Registration Act (2012) and The Community Land Act (2016). These legislations on land guide access to biological resources and how the benefits can be shared given that each land ownership regime bestows certain rights and obligations to the land owner and institution. The Community Land Act of 2016, for example, provides a framework for community members to utilize and demand benefits that may arise from genetic resources in their communal lands.

In summary, while these legislative actions are sectoral in nature they do contribute to biodiversity conservation by either directly protecting some of the biological resources (e.g. fisheries, tree species and wildlife resources) or restricting the use and exploitation of some of these resources by prescribing the nature and type of human activities that are permissible in certain areas or habitats (e.g. in areas classified as wetlands). They also provide mechanisms to protect and prevent the exploitation of endangered and threatened plant and animal species.

3. Challenges to Kenya's Strategies in Biodiversity Conservation

In reviewing recent patterns of biodiversity conservation in 2010 which was twenty years since the signing of CBD in Rio, [8] argued that success in conserving biodiversity should be based on governments treating biodiversity as a public good and conservation responsibility being integrated across all sectors of society and government. They call for radical approaches that would integrate biodiversity conservation into policies and decision frameworks for resource production and consumption. To achieve this, institutions must be focused but flexible to accommodate emerging issues and challenges in the conservation arena. Similarly, research on Kenya's challenges in implementing Multilateral Environmental Agreements, [9] points out key issues of financial resources, weak environmental governance within the country and poor or ineffective coordination as constraining the country's ability to achieve 'optimum' conservation goals.

While the country has put up measures to conserve biodiversity, the country still faces challenges that lead to continued loss and pollution of biodiversity. For instance, a wildlife census conducted by Kenya Wildlife Service in 2016 found that at least five species in the country are critically endangered, implying that they have a 50% likelihood of going extinct within ten years or three generations. These species include the black rhino, the sable antelope and the roan antelope. Nine other species including the elephant, the lion, the cheetah, the white rhino and the Gravy's zebra, the Nubian giraffe, the Rothschild's giraffe and the Sitatunga are considered endangered. There are also eighteen species of birds that are also considered endangered.

The key factors that contribute to the loss of biodiversity in the country include:

3.1. Habitat Loss and Degradation

Habitat loss and fragmentation have been identified by a number of conservationists as a major threat to biodiversity conservation. Such loss may be due to deforestation, expansion of agricultural activities, urbanization, mining and infrastructure development. Fragmented habitat can lead to isolation of some species, limit migration and mating areas, reduce genetic diversity and weaken the ability of species to adjust to environmental and climatic changes.

A major cause of habitat loss in Kenya is land development associated with expansion in agricultural land and urbanization that has been increasing in the last fifty years [10]. Kenya's current population stands at over 47.5 million people as per the 2019 Census [11]. With a fertility rate of 3.3%, the population is expected to increase by around one million people per year. The estimated mid-year population in 2023 is 51.3 million people. As the country's population continues to increase demand for land for agricultural purposes and urban settlement will continue. As noted by [12] while expansion and intensification of agriculture over the years has helped reduce poverty and contributed to food security, it has

been a major cause of loss of biodiversity. Converting natural ecosystems into agricultural lands has meant that these systems have been damaged or degraded with loss in the biodiversity that they contain. The demand for agricultural land is certainly going to increase as the country's population increases and there is a need to have agricultural management systems that would promote biodiversity conservation even as we increase agricultural output.

According to the 2019 census, the country had 307 urban centers with a total population of 14.8 million or 31% of the country's population residing in urban areas [11]. This rate of urbanization is bound to increase as rural-urban migration continues and the urban centers are viewed as areas that offer more rewarding opportunities than rural areas. While the country has a land use planning policy, implementing its guiding principles has been difficult due to conflicting legislation positions. The Land Registration Act (2012) for example gives leeway to title holders to use their land in ways that they deem suitable as long as it is not injurious to other users or the use is not illegal. Citizens who hold freehold titles are also free to transfer any interest in their land to other persons—a fact that has seen peri-urban land turned into urban development especially where urban planning regulations may be lax. Habitat restoration to enable threatened species to recover and thrive in their natural setting should be part of the country's conservation efforts.

3.2. Climate Change and Variability

The change in the global climatic system poses a serious threat to biodiversity conservation. There is ample evidence that climate change and variability affect species in different habitats. The species may be forced to migrate from areas that have been affected by extreme climatic conditions such as floods, prolonged droughts, wildfires or increasing temperatures. Changing climatic conditions also impact on water resources and their availability thus directly affecting the survival of many animals. One indirect effect of climate change and variability on biodiversity is that it leads to increased extraction of natural resources and utilization of fragile ecosystems that often host a number of species that may be endemic to these habitats. The altered use of these habitats directly threatens the survival of such species. A review essay on the impact of climate change on biodiversity and key ecosystem services in Africa [13] notes that multiple components of climate change are likely to affect biodiversity at different levels ranging from genes, species and up to biome levels. Such changes will also result in loss of biodiversity leading to the alteration of structures and ecological functions of the ecosystems as pointed out by [14] who argues that the interlink between climate change and biodiversity makes it necessary to understand the interactions and cause effect of climate change on biodiversity.

3.3. Population Increase

Kenya's population currently stands at around 47.5 million people [11] and is increasingly becoming urbanized. The current rate of urbanization in the coun-

try is 31% and this will continue as more people migrate to the urban centers. According to [15] the country's high population growth rate in the face of limited resources makes it difficult to reconcile the need of sustaining economic development with that of biodiversity conservation.

The continued increase in population will continue to exert pressure on forest resources through a growing demand for forest products, services and land for alternative uses. The need to conserve the soil, water, wildlife habitats, and biological diversity will become even greater and the increasing population will pose a greater challenge in achieving sustainable development. It leads to the expansion of human activities into biodiversity rich ecosystems and has meant an increase in per capita consumption of biological resources that is unsustainable in the long term. While the needs of a growing human population must be met even as we pay attention to conserving biodiversity, we must have the tools and good will at policy level to make this a reality. Population control measures are long term in nature and involve changes in people's attitudes regarding ideal family sizes and changing livelihood systems that are less reliant on extractive activities.

3.4. Deforestation

At the global level, tropical forests contain over half of the earth's biodiversity and have an important influence on the climate system as well as providing important ecosystem functions and services. The critical role that forests play in ensuring sustainable development goals that are achieved has been captured by a review essay that linked the Indian Forestry to Sustainable Development Goals [16].

Kenya is a low forest cover country, and a 2018 land cover mapping showed a forest cover of about 5.9% of the country's total area, which was a slight decline from about 6.2% in the year 2002. The constitution expects the government to enhance forest cover to a minimum of 10% by 2030 [10]. The forests provide many ecological services and are the main water towers that feed the many rivers that drain either into Lake Victoria or the Indian Ocean. They are also home to many bird and animal species whose existence is threatened when these forests are cleared for different purposes.

Successive administrations in Kenya have excised and degazetted forests for different purposes but largely to settle the land less or squatters. The Mau Forests Complex (MFC) which forms the largest closed-canopy forest ecosystem in Kenya and is considered the largest indigenous montane forest in East Africa is the most important water catchment in the Kenyan Rift Valley and Western Kenya [17]. Deforestation in the country is a major cause of biodiversity loss. The Mau Complex is considered an important biodiversity area because of its rich highland bird communities. The degazettement of forest reserves as well as human encroachment that has been accompanied by deforestation have destroyed approximately a quarter of the Mau Forest Complex over the last 15 years with

serious impacts on its biological resources. This scenario is the same with other Kenyan water towers such as Mt. Kenya forest, Cheranganyi Hills, the Aberdare ranges and Mt. Elgon.

As the country's population increases and its urban component increases, the demand for forest products will increase with an adverse effect on biodiversity conservation. A combination of these pressures with an intensification of global environmental change may severely degrade forests affecting their roles as habitats for different flora and fauna.

The government acknowledges that deforestation and forest degradation driven by among others pressure for conversion to agriculture, urbanization and other developments, unsustainable utilization of forest resources, inadequate forest governance and forest fires continue to pose challenges to forest conservation [10]. The government's forest strategy built on Vision 2030 is to achieve 10% forest cover by 2030 and plant at least 15 billion trees in the country. Other measures include promoting afforestation and agro-forestry as well as rehabilitation of degraded forest areas in the country.

3.5. Invasive Species

The emergence and spread of invasive species *i.e.* plants or animals that are not naturally found in a region and often come from very far away can easily lead to loss of biodiversity. These organisms are moved intentionally and unintentionally by different agents of migration and can colonize and overcompete existing species to the extent that some may go extinct. In a study that looked at the status and management of invasive species in Kenya. According to [18] at least 34 species have been introduced into the country. This calls for early detection and assessment of the threat posed by the new species, In the Kenyan context, the introduction of the *Nile perch (Latec niloticus)* in Lake Victoria in 1954 to address issues of overfishing [19] and expansion of water hyacinth in both Lakes Victoria and Naivasha have not only affected the fisheries industry but also contributed to biodiversity loss. As a predator of other fish species, the *Nile perch* has been argued has led to the disappearance of over 200 endemic fish species in Lake Victoria. Similarly, the introduction of *Prosopis juliflora* (commonly known as Mathenge by the local population), a woody species in Baringo, and that has since spread aggressively in the region has caused loss of pasture as well as agricultural land [19] and [20]. Other plant species considered invasive in the country include the *Tick berry (Lantana camara)* as well as a number of birds and reptiles [18]. The country, through Kenya Plant Health Inspectorate Service (KEPHIS) monitors and controls any importation of plant materials into the country. Any strategies adopted to tackle the challenge of invasive species should be eco-friendly and not lead to the endangering of other species.

3.6. Pollution

There are many activities that contribute to the pollution of the water bodies and

therefore lead to threatening the survival of their biological resources. Pollution arises from the establishment of industries and expansion of urban centers that generate different types of effluents, which if not treated before discharge, can easily lead to pollution of the water bodies. Pollution that affects biological resources is both from point sources and non-point sources such as agricultural activities that may lead to polluting rivers and other waterways. It is often more difficult to tackle pollution from these non-point sources as they may be spread over a wide area and come from different activities. According to [21] threats of pollution on biodiversity are subtle and accumulative over time and may not be overt as in the case of deforestation or habitat destruction, yet its consequences may not be easy to reverse. A 2023 report [22] notes that pollution that especially arises from chemicals in the environment is often given scant attention in the debate on the loss of biodiversity and considers this as a missing link that has to be addressed. The country must adopt strategies that engage various players who may be contributing to the pollution of the environment not only to minimize but help eliminate these pollutants as part of biodiversity conservation measures.

3.7. Incorporation of Local Knowledge

While local communities are the custodians of biodiversity and have done so for generations, there is a tendency to ignore indigenous knowledge systems in biodiversity conservation. This is in spite of existing research showing that indigenous knowledge and practices can make major contributions to conservation, especially for its biomedical value as argued by [23]. The country's development agenda and equation tend to emphasize western science and technology relying on technocratic approaches to solve the many challenges facing the country. Policy making and implementation tends to be led by technocrats at both levels of government without any serious engagement with the local knowledge system. This policy orientation affects the conservation policies as well.

The existing legal requirement for public participation in development projects and government initiated programmes does not provide a clear framework for integrating local knowledge. Although the country is a signatory to the Nagoya protocol that emphasizes equity in access and benefit sharing of genetic resources, many local communities are often in conflict with conservation efforts because they do not see any direct benefits from such activities. This is evidenced by the increasing human-wildlife conflicts that occur around protected national parks and game reserves. Other than integrating the local knowledge in conservation, [24] has pointed out that successful engagement of communities, individuals, and private organizations by committed governments and institutions is vital for increasing protected areas and their long-term viability.

3.8. Financial Challenges

The country also faces the challenge of inadequate financing in conserving biodiversity given the many competing demands on government resources. There is

a tendency to depend on international organizations, non-governmental organizations and the private sector as key actors in financing biodiversity conservation. These sources ought to complement actual government budgetary commitments necessary for long term planning and effective implementation of biodiversity conservation policies. One approach that has been suggested by scholars to reduce the burden of financial challenges is to establish private sector led conservation enterprises that can harness resources for biodiversity conservation and contribute to improving community livelihoods [25]. While such an approach may lead to some level of success in mobilizing financial resources, it is important to emphasize the 'public good' nature of conservation that requires financial commitment from the government. In incorporating the private sector and international partners in addressing the financial challenge of conservation, attention must be paid to the nature of partnership and the need for equity in accessing the returns of biological conservation to local communities and the country at large.

4. Kenya's Biodiversity Conservation Strategies

Kenya's biodiversity conservation strategies include both *in situ* and *ex-situ* strategies. *In situ* strategies involve conserving the biodiversity within the natural habitat of the animal and plants often by creating protected areas such as national parks and game reserves, gazzeted forest areas, protected community lands, and marine parks. *In situ* conservation safeguards biodiversity in areas that include the most representative or unique ecosystems [26] and helps maintain and protect the ecosystem in its natural form. It allows the animals and plants to easily adapt to changes in the ecosystem. Its advantages include the fact that it is a cost effective and convenient way of conserving biodiversity, it allows for the conservation of many species simultaneously

Ex situ conservation involves conserving the species outside their natural habitat such as zoos and botanical gardens. These species may be endangered or threatened if left in their natural habitat. The advantage of *ex-situ* conservation strategy is that the animals are provided with protection and a longer time for breeding activity. It can also allow genetic techniques to be used in the preservation of endangered and threatened species.

As an *in-situ* conservation strategy, the government has designated protected areas where human activities are not permitted or are restricted as in national parks and game reserves, restricted forests, and marine parks as well as overall protection of ecologically sensitive areas such as wetlands and coastal mangrove forests. The protected areas in Kenya account for 8% of the country's land and up to 75% of wildlife is found in private and community held land [15]. The country currently has 23 terrestrial National Parks, 28 terrestrial National Reserves, 4 marine National Parks, 6 marine National Reserves and 4 national sanctuaries as protected areas. Of these protected areas, the Tsavo National Park is the largest covering around 25,000 square kilometers. The protected areas are ma-

naged by different agencies such as Kenya Forest Services, Kenya Wildlife Services and in the case of Marine resources, Kenya Fisheries Service, However, some of the protected areas are managed by county governments or county government owned conservancies such as in the case of the Mara Conservancy with the technical backing from KWS.

A key advantage of the *in-situ* strategy as in the case of protected areas is that biodiversity remains high and the species have the ability to adapt within the physical environment to any changes. It allows species to flourish within the ecosystem and allows for the protection of large areas of varying ecosystems and different species at the same time. However, it has disadvantages that include incidences of illegal extraction e.g. poaching, timber harvesting and trapping of small game and increasing human-wildlife conflicts over key resources. There is also the risk of a decrease in genetic diversity and the species can still be endangered by diseases or open competition for survival resources.

Kenya identifies land degradation and soil erosion that results from encroachments on natural vegetation, forests and agricultural land, as the major threats to our biodiversity resources. Consequently, Kenya aims to minimize habitat fragmentation as much as possible through land use regulations and control of subdivisions. Other causes of biodiversity loss include deforestation, habitat degradation and fragmentation, poaching, the threat of invasive species, overfishing, especially in inland waters, infrastructure development and uncontrolled harvesting of plant and animal species. These threats are exacerbated by an increasing population and effects of climate change.

A key strategy in Kenya's biodiversity conservation is the setting aside of protected areas, either as forests or national parks and reserves. The Kenya Wildlife Services (KWS) identifies loss of habitat for wildlife conservation due to increasing population as one of the key challenges it faces in carrying out its mandate. The increase in population around the protected areas has led to the creation of settlements and other human activities on wildlife corridors leading to increased human wildlife conflicts. The government has encouraged communities who border these parks to form community run conservancies but these have often been captured by elite members of these communities and the benefits have not been felt by a majority of the community members.

The other protected areas are government gazetted forests that are managed by Kenya Forest Service with the mandate of forest conservation and protection as well as the various Marine National Parks. Some of the game reserves such as the world famous Maasai Mara are managed by the county governments while a number of non-governmental organizations that work within the conservation sector have also established a number of conservancies that operate like national parks in terms of restrictions to public access and management.

5. Conclusions

The main objective of this study has been to review the status of biodiversity

conservation in Kenya by considering the legal and policy frameworks, and strategies adopted as well as the main challenges the country is facing in its' efforts to conserve biodiversity. The country has made considerable efforts by adopting MEAs such as CITES (1973), CMS (1979) and Ramsar Convention (1971) amongst others. The implementation aspect of these conventions is undertaken by a number of ministries and agencies such as the Ministry of Environment, Forestry and Climate Change, Kenya Wildlife Service (KWS) and National Environmental and Management Authority (NEMA) as noted by [27]-[35] in discussing the national framework for conserving biodiversity. Besides this, the government of Kenya has developed a legal framework that protects and governs the utilization of biological resources that include the Forestry Conservation and Management Act of 2016, The Wildlife Conservation and Management Act of 2013, The Fisheries Management and Development Act of 2016, and the Water Act of 2016. In addition to the legal framework, Kenya's biodiversity conservation strategies include both *in situ* and *ex-situ* strategies. This has entailed the establishment of protected areas such as National Parks, Game Reserves, Marine Parks and gazetted forests. Despite these efforts, biodiversity conservation in Kenya continues to face a myriad of challenges. These include institutional challenges that hinge on finances, human resources, technical capability and institutional coordination as well as the transboundary nature of some of these challenges. The realization that biological resources are a global public good calls for an approach that combines local, national and global actors so as to achieve the desired goals. Its' conservation requires a multi-sectoral, multi-institutional and governance coordination at different scales to be effective.

The current framework for conserving biodiversity in the country tends to be sector based with a multiplicity of institutions with different mandates. Institutions that are mandated to implement conservation policies and strategies must be cognizant of other institutions and key stake holders and strive to develop and exploit any synergies that would help actualize the policies. While NEMA has the mandate of coordinating environmental issues in the country, it has to be strengthened institutionally to have the capacity and resources to bring these issues to the fore in complementary and syngenetic manner, that is acceptable to other key stakeholders. It must of necessity involve communities who are custodians of these resources and there is a need to provide clear guidelines on benefit sharing to community members to create a sense of partnership, ownership and custodians of these resources. There is also a need to devolve the governance and strategies on conservation and avoid the current militaristic attitude that criminalizes most community-based activities that touch on biodiversity in their local areas.

The Constitutional requirement for public participation in decisions that affect the public in regard to utilization of resources means that lead institutions need to design and implement arrangements that are truly participatory so as to promote biodiversity conservation and ensure sustainable socio-economic development of the local people, and ensure equitable sharing of these resources.

Policies and strategies need to create and enhance public awareness of the gains of biodiversity conservation and address cross cutting issues such as capacity building of various stakeholders, gender, the reality of climate change and incorporating indigenous knowledge in the strategies. Considering biological resources as a global public good, the international community should offer the financial and institutional support necessary and where possible help in the capacity building of communities to safeguard biodiversity.

Conflicts of Interest

The author declares no conflicts of interest.

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