

EXAMINING THE LINK BETWEEN AGRICULTURE AND BIODIVERSITY CONSERVATION IN KENYA

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Abstract. Biodiversity generally entails the flora and fauna present in the natural world. It includes diverse forms of life that are present in each locality (plants, animals, fungi, microorganisms present in the ecosystem). The essence of biodiversity is that the species and microorganisms present in an ecosystem function together to support life and establish a balance. Biodiversity sustains life and allows human beings to access resources necessary for survival, resources such as shelter, clean water, food and so forth. In relation to agriculture, biodiversity entails various factors that support the agricultural system in terms of soil fertility, pollination, pest control and crop quality and yield. It also enhances and supports quality landscape. Nonetheless, the amplification of agricultural practices poses a threat to biodiversity in significant ways due to the intensive use of synthetic pesticides, mineral fertilizers including the division of farming lands, leading to the loss of biodiversity. The research is guided by the view that even though the growth in agricultural practices has enabled continuous feeding of the increasing world population, the growth is approached as one of the major factors that have led to the loss of biodiversity in Kenya. The study employed a desk review of scholarly articles published between 2019 and 2023 to analyze the connection between agricultural practices and biodiversity conservation in Kenya. As per the research findings, various factors that include poor land management practices, and unsustainable agricultural techniques threaten biodiversity conservation in Kenya. Nonetheless there are practical options that can be applied in Kenya's agricultural practices that can both enhance biodiversity conservation as well as facilitate sufficient food production.

Keywords: Climate Change, Pastoral Communities, Adaptation strategies, Mitigation strategies

INTRODUCTION

Biodiversity generally entails the flora and fauna present in the natural world. It includes diverse forms of life that are present in a given locality (plants, animals, fungi, microorganisms present in the ecosystem) (van der PLAS, 2019). The term "biodiversity" functions as an abbreviation of the terms biological diversity-bio to mean life and diversity to mean variety. It implies that biodiversity functions as the whole variety of life that exists on the earth. These include sum of all animals and plants, and diverse forms of microbes that exist in a given locality. It puts into perspective the concept of biomes where biomes refer life zones that are characterised by similar soil, climatic and topographic conditions (VAN DER PLAS, 2019). A significant aspect to note is that the more the diverse a biome, the more biodiversity beautifies the world. Biodiversity can also be approached from three diverse angles that include ecosystem diversity, species diversity and genetic diversity. Ecosystem diversity, also approached as ecological diversity, refers to the complexity and abundance of a given biological community that also features ecological processes, material recycling, food webs and tropic levels. Species diversity, on the other hand, entails the types and number of organisms present in a given ecosystem or community. Genetic diversity refers to the diverse forms of the same gene among specific species (PASCUAL ET AL., 2021).

It is also critical to highlight the biological hotspots. According to geological research, a major part of the biodiversity across the globe, lies almost next to the equator particularly on the coral reefs and the tropical rain forest. It is also estimated that about 15% of the species in the world are found in Europe and North America (WANG ET AL., 2019). Biodiversity is significant as it assists in the preservation of life. It is the presence of diverse species in the biosphere that makes it possible for the ecosystem to be maintained. It ascertains a healthy, proper functioning, and a stable biosphere. It is also relevant in terms of promoting aesthetic values, ethical values, productive use values, social values and consumptive use values. The perspective is that the essence of biodiversity is that the species and microorganisms present in an ecosystem function together to support life and establish a balance. Biodiversity sustains life and allows human beings to access resources necessary for survival, resources such as shelter, clean water, food and so forth (WANG ET AL., 2019).

The link between biodiversity and agriculture puts into perspective the concept of agro-biodiversity. Agro-biodiversity refers to the variety and variability of living organisms that contribute to food production, agriculture and associated activities in their largest sense (FATIMA ET AL., 2020). Agricultural practices can pose a significant threat to biodiversity in a number of ways. One of the biggest threats is habitat loss and fragmentation, which occurs when natural ecosystems are converted into agricultural land. This can result in the loss of habitats for a wide range of plant and animal species, leading to a decline in biodiversity. The expansion of agricultural land can also lead to the fragmentation of natural habitats, which can further reduce the viability of local ecosystems. The use of pesticides and fertilizers can have negative impacts on non-target organisms, such as beneficial insects, birds, and soil microorganisms, which play important roles in maintain ecosystem functions (FATIMA ET AL., 2020). The use of pesticides can also lead to the development of resistance in pest populations, which can further reduce the effectiveness of these chemicals and increase their use over time. The use of monoculture, in which large areas are planted with a single crop, can also reduce biodiversity by creating a homogeneous landscape that supports only a few species. This can make the ecosystem more vulnerable to pests and diseases and reduce the resilience of the ecosystem to environmental stressors. Finally, the use of genetically modified crops can also pose a threat to biodiversity by reducing the genetic diversity of crops and increasing the use of pesticides and herbicides (FATIMA ET AL., 2020).

Statement of the Research

The research is guided by the view that even though the growth in agricultural practices has enabled continuous feeding of the increasing world population, the growth is approached as one of the major factors that have led to the loss of biodiversity in Kenya.

Research Question

What is the impact of agricultural practices on biodiversity loss in Kenya?

Research Objectives

1. To examine the factors through which agricultural growth leads to the loss of biodiversity in Kenya.
2. To highlight potential conservation approaches to implement in agricultural practices in Kenya to minimize biodiversity loss.

MATERIAL AND METHODS

The research incorporated a desk review to examine the connection between agriculture and biodiversity conservation in Kenya. It entailed examining various scholarly sources that address the subject of interest. It is approached as an efficient qualitative research methodology particularly when resources and time function as constraints (Froese & Bader, 2019). The research incorporated studies done between 2019 and 2023 whereby the articles were obtained from databases that include Science Direct and Google Scholar. The search terms included “biodiversity,” “biodiversity conservation” and “agriculture in Kenya.” The involved data analysis incorporated reading and examining the key findings from the articles. Information was then divided into key themes.

Table 1.

A list of the articles used in the review

Articles	Key Points
Kogo et al. (2021)	Kenya’s agricultural sector
Muigai (2021)	Land use and agricultural potential in Kenya
Anyango et al. (2021)	Agriculture as a major contributor to biodiversity loss
Warra & Prasad (2020)	Intensive use of chemicals in agriculture and biodiversity
Odino & Ogada (2021)	Poisoning of wildlife and misuse of pesticides in agriculture
Kipngeno et al. (2020)	Impacts of fertilizer misuse on soil health and biodiversity
Bendzko et al. (2019)	Land planning issues and their contribution to biodiversity loss
Njora & Yilmaz (2020)	Deforestation and its impact on water resources in Kenya
Sang et al. (2023)	Land cover changes and their implications for biodiversity
Tittonell et al. (2020)	Integrated nutrient management for biodiversity conservation
Chen et al. (2022)	Involvement of stakeholders in biodiversity conservation

RESULTS AND DISCUSSIONS

The connection between agricultural practices and biodiversity conservation in Kenya

Kenya’s agricultural sector entails the following sections that include food crops, horticulture, industrial crops, forestry, fisheries and livestock. It also includes production factors that include farmers unions and associations, land and water. The country is estimated to have an area of 587,000 km² and that about 11,000 km² of the total is covered by water (Kogo et al., 2021). Of the remaining landmass, it is approximated that 16% is characterized as medium and high when it comes to agricultural potential in addition to having reliable and sufficient rainfall. Commercial agriculture is the main activity in this land with 22% being covered by forestry, 30% grazing land and 31% cropland (Kogo et al., 2021). The remaining percentage is utilized for infrastructure, homesteads, markets, urban centers and game parks.

A significant aspect to note is that in 2008, the Vision 2030 framework was developed in Kenya with the aim of transforming the country into “a newly-industrialized, middle-income country providing a high quality of life to all its citizens in a clean and secure environment.” It puts into perspective the agricultural sector that is viewed to significantly contribute to Kenya’s economic development. In highlighting this perspective, Muigai (2021, p.6) states, “As a result, the Development Blueprint leans heavily towards promotion of a commercially-oriented, and modern agricultural sector, which it plans to accomplish by institutional reforms in agriculture and livestock...introducing land use policies for better utilization of high and medium potential lands.” This entails having more farming section in the arid and semi-arid lands (ASALs) that

support both livestock keeping and crop production including having an improved supply chain management system that ensures that smallholders benefit from the agricultural sector.

Nonetheless, research shows that agriculture functions as one of the major contributors to the loss of biodiversity (Anyango et al., 2020). This is attributed to the increasing populations, and changing patterns of consumption leading to the destruction of biodiversity in terms of transforming natural habitats to trade and commercial systems and releasing greenhouse gases and other pollutants. From a historical perspective, law was utilized by the colonialists to acquire land and the associated resources from Africans. It enabled the colonialists to also give the attained land to settlers. This gave the colonialists an advantage as they settled in lands that were more productive, the highlands, and pushed the indigenous communities to the native reserves that were highly restricted (Anyango et al., 2020).

Some of the challenges faced by the people in the reserves were poor sanitation, soil erosion and overcrowding. The colonial acquisition of land and the pushing of the people to the reserves is viewed to have caused a significant loss of biodiversity in Kenya especially with the locals trying to use their small portions of land to engage in agricultural practises. It is argued that the whole African continent is yet to heal from the colonial land practices and the involved negative impacts to the ecosystem particularly in Kenya. Muigai emphasizes (2021, p.7), “Conflicts between local groups and other more powerful actors, including both state agencies and private sector investors, remain widespread across the sub-continent and are often intensifying with strong political economic incentives for political elites and central bureaucracies to consolidate their control over natural resources.” The idea is that Kenya is among the many countries that are faced by many issues that severely impact its biodiversity.

Table 2

Thematic Analysis of the connection between agricultural practices and biodiversity conservation in Kenya

Theme	Key Points
Agricultural Sector	- Various sections: food crops, horticulture, industrial crops, forestry, fisheries, and livestock. - Land use allocation: commercial agriculture, forestry, grazing land, cropland, and other purposes
Vision 2030 Framework	- Aims to transform Kenya into a newly-industrialized, middle-income country with a high quality of life. - Emphasizes a commercially-oriented, modern agricultural sector through institutional reforms and land use policies.
Agriculture and Biodiversity	- Agriculture as a major contributor to biodiversity loss in Kenya. - Factors: increasing populations, changing consumption patterns, habitat transformation for trade, and commercial systems.
Colonial Land Practices	- Historical impact: colonial land acquisition, displacement of indigenous communities. - Consequences: loss of biodiversity, challenges in reserves (poor sanitation, soil erosion, overcrowding).
Challenges and Conflicts	- Ongoing impacts: conflicts between local groups, state agencies, and private sector investors. - Political and economic incentives driving consolidation of control over natural resources.
Wider context	- Kenya's biodiversity challenges reflect broader issues across the African continent. - Healing from the negative impacts of colonial land practices remains a continental concern.

Identification of factors contributing to biodiversity loss in relation to agriculture

The amplification of agricultural practises poses a threat to biodiversity in significant ways due to the intensive use of synthetic pesticides, mineral fertilizers including the division of farming lands, leading to the loss of biodiversity. Agricultural industrialization is viewed to significantly burden the ecosystem through the intensive use of chemicals. Chemical pesticides and fertilizers are viewed to be highly used in the advancing agriculture sector in Sub-Saharan Africa (Warra & Prasad, 2020). Pesticides are mainly used to control pests and manage postharvest losses, an aspect that is viewed to heighten the demand for efficient pesticides options that have low medical risks, support biological diversity and preserve ecosystems. The use of mineral fertilizers in developing countries is viewed to experience a renaissance due to their intensive use today when compared to decades ago. This has made environmental groups to approach the use of agrochemicals as a sensitive subject that needs attention. According to Warra and Prasad (2020), industrial inputs are capable of supporting farmers to produce higher yields per person and per hectare. However, their research also shows that the reliance on agrochemicals entail significant adverse externalities and particularly negative impacts on soil biochemical and microbial functions. Recent research shows that farms in Kenya that constantly use agrochemicals depict poor soil health when compared to those that do not use them.

According to research by Odino and Ogada (2021), the intentional poisoning of poultry birds for consumption is an activity that occurs mainly on large scale, especially irrigated cereal plantations. This also involves the poisoning of vultures when they eat the poisoned carcasses. The scholars state, “This occurs when livestock farmers poison livestock carcasses to use as bait for wild predators suspected of killing livestock, with vultures falling victim to such retaliatory efforts.” The associated view is that topical antiparasitics and pesticides in Kenya can be accessed over the counter, an aspect that have made them be misused and overused by farmers. Most of them are used without considering the adverse effects that they have on biodiversity health. With specific focus on Bunyala Rice Irrigation Scheme, the study by Odino and Ogada (2021) examined the severity of the use of the poison, carbamate pesticide carbofuran and other forms of poisons in controlling birds in the rice fields. The studies showed that the poisoning did not only harm the birds but also the scavenger-predator wildlife. This also led to unintentional poisoning of pets, humans including livestock (Odino & Ogada, 2021). The emphasis is on the view that the lack of proper legislation, and control of how pesticide is used in Kenya in agricultural practises has led to their misuse leading to adverse effects to the environment.

Kipngeno et al. (2020) emphasize on how the misuse of fertilizers interfere with soil health, and thus, severely impacting biodiversity. The basic view is that fertilizer is primarily used in agriculture to increase production to sustain the increasing global population. However, its use also entails complex interactions with biodiversity due to the changes that it brings to the soil, and thus, significantly impacts the environment. The immense utilization of agriculture has heightened crop production and ascertained food security in various parts of the world. However, there have been consistent yield gaps in many areas, an aspect that is associated with poor soil health. The yield gaps are viewed to both undermine human health and nutrition and influence the extension of agricultural lands at the expense of the ecosystem. This has significantly led to soil erosion and emission of greenhouse gases leading to biodiversity loss (Kipngeno et al., 2020). The idea is that the use of mineral fertilizers makes it challenging to conserve biodiversity due to effects such as decreased soil biota diversity,

lowered plant diversity including indirect implications that include air pollution through the emission of greenhouse gases and pollution of the marine environment.

On matters concerning land planning, issues that include overgrazing, pollution, destruction of habitats, deforestation, biopiracy including the integration of alien species and the reaping of natural resources are viewed to significantly contribute to biodiversity loss in Kenya (Bendzko et al., 2019). It is argued that the inclusion of invasive and new species functions as a significant threat to Kenya’s ecosystem. This puts into perspective problems such as the interference of ecosystem processes, habitat alteration and predation that are brought about by the new species. This has led to the environmental degradation of certain areas that currently require restoration. The areas include hilltops, riverbanks, wetlands, overused mines and quarries, eroded shorelines and deforested areas. This also puts into perspective the impacts of climate change due to the recurrent occurrence of water shortages and drought that also impact hydro-electric power resources (Bendzko et al., 2019). Other disasters that have been brought about by climate change include landslides and floods, disasters continue to adversely impact the nation’s biodiversity.

Kenya is viewed to experience dynamic land cover changes that are influenced by several factors. Njora and Yilmaz (2020) mention one of the factors to be deforestation that frequently occurs in the Rift Valley region especially with the encroachment of resources such as the Mau forest. The effect of deforestation is that it leads to the decline of soil infiltration rates including a reduction in the quality of water and the capacity of catchment areas to facilitate the flow of water during the dry season (Njora & Yilmaz, 2020). Sang et al., (2023) mention the massive transition in barren lands, shrub lands, croplands and grasslands as another factor. The scholars posit that there is a significant decline in grasslands and shrub lands with an increase in built-up lands and crop lands, an aspect that has interfered with the portions of barren lands, shrub lands, croplands and grasslands. Another issue entails population pressure that involved the movement of people to the arid and semi-arid lands and development of settlements in the areas (Sang et al., 2022). An example entails the establishment of techno-city that covers more than 2000 acres of land, land that was initially used for agricultural practises in Eastern County. This has become a popular phenomenon in several counties across the nation in their focus on urbanization. The urbanization is characterised with the development of buildings that lack adequate drainage systems, and roads on slopes that lack adequate barriers, actions that have led to soil degradation and water pollution on rivers making the water unsuitable for consumption (Sang et al., 2022). The associated view is that the developments directly and indirectly influence land degradation resulting in an imbalance in the ecosystem. The expansion of cropped areas also come into perspective in terms of a high increase in cropped areas in Central, North-Eastern, and Coastal provinces, and a decrease in cropped areas in highly productive areas such as Western, Eastern, Rift Valley and Nyanza provinces. It also includes a decrease in the area covered by water bodies as a result of extensive droughts (Sang et al., 2022).

Table 3

Thematic Analysis of factors contributing to biodiversity loss in relation to agriculture

Theme	Key Points
Agrochemical use	- Intensive use of synthetic pesticides and mineral fertilizers - Negative impacts on soil health and biodiversity
Pesticide Misuse	- Intentional poisoning of poultry birds and vultures - Overuse and misuse of pesticides in agriculture
Land Planning Issues	- Overgrazing, pollution, deforestation, habitat destruction

	- Invasive species and ecosystem disruption
Land Cover Changes	- Deforestation and its impact on soil and water resources - Transition from natural lands to built-up and cropped areas
Population Pressure	- Movement of people to arid and semi-arid lands - Urbanization leading to soil degradation and water pollution

Possible Strategies for enhancing biodiversity conservation and food production in Kenya

As per the research by Tittonell et al. (2020), the best approach to manage agriculture such that it does not challenge biodiversity conservation is by integrating a more effective and rational utilization of fertilizers instead of considering a broad scale decrease of their use that can only destabilize both nutrition and food security and result in the need for expanding farmlands and interfere further with the ecosystem. A suggestion is to increase and sustain agrobiodiversity and incorporate diverse methods such as legume integration, tree crop, crop rotations, and intercropping that may be adjusted to fit diverse local conditions. This also involves integrating adequate land planning methods to prevent the extension of farmlands to areas that might lead to biodiversity loss (Tittonell et al., 2020).

Another approach entails engaging various stakeholders from agriculture, conservation and environmental domains to contribute in diverse ways (Chen et al., 2022). For the policy makers, it is critical for them to seek opinion and information from experts such as agriculturalists, environment conservation professionals and the fertilizer industry for them to formulate and implement more efficient policies that aim at preserving biodiversity. For the conservation organizations, the organizations might coordinate efforts with other stakeholders to create incentives to assist farmers to utilize better sustainable nutrient management methods. Furthermore, for researchers, it is critical to conduct studies to fill the knowledge gaps regarding biodiversity and nutrient management including social scientists that can assist with the comprehension of behavioural and socioeconomic issues to facilitate the adoption of adequate nutrient management methods (Chen et al., 2022).

Limitations of the Study

One of the limitations associated with the research design is that it limited itself to existing data, and thus, lacking some basic information. The findings may also not be applicable in all areas in Kenya due to their diverse climatic conditions. The limitations prompt the need for more studies on the research topic particularly with the use of primary data.

CONCLUSIONS

The research reveals that it is critical to adopt conservation and mitigation strategies for biodiversity in agricultural practices. This may entail the government and the relevant institutions promoting the use of hybrid techniques to improve biodiverse growth in aquaculture, agriculture and community development by promoting community participation as the medicine to control food insecurity. Nonetheless, the research topic also brings about the impact of climate change on both agriculture and biodiversity conservation, making it necessary for further research on how the former presents limitations on the latter.

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