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Impacts of Climate Change on Biodiversity Conservation. A review

Benson Turyasingura[1] and Fatima Sule Mohammed[2]

[1]Department of Agricultural Sciences, Kabale University, Faculty of Agriculture and Environmental Sciences, Kabale University, P. O. Box 317, Kabale, Uganda; ORCID ID: 0000-0003-1325-4483, **Uganda**: Email; bturyasingura@kab.ac.ug:
[2]Department of Agricultural Sciences, Kabale University, Faculty of Agriculture and Environmental Sciences, Kabale University, P. O. Box 317, Kabale, Uganda: **Uganda:** E-mail: sumfats2002@gmail.com:

*Corresponding author: bensonturyasingura/bturyasingura@kab.ac.ug

Abstract: Both habitat loss and climate change are major threatening factors contributing to the loss of biodiversity worldwide. But due to the complexity of both processes, little is known about their synergistic effects on biological populations. At worst, current conservation management measures may be wasteful and, at worst, useless if the combined effects of habitat loss and climate change are higher than the consequences of either danger alone. Therefore, there is a pressing need to identify the impacts of climate change on biodiversity. The study assessed the components of biodiversity; the classification of biodiversity based on their importance; the impacts of climate change on biodiversity; and the relationship between climate change and biodiversity. There was a relationship between climate change and biodiversity in that *climate change has significant direct and indirect impacts on biodiversity, and is expected to be a major cause of potential biodiversity loss; which magnifies the negative effects of climate change. It was also found that biodiversity is being lost due to habitat loss and degradation, resource overexploitation, unprecedented climatic shifts, deforestation, pests, cultivation shifting, and wildlife poaching.* It was concluded that the loss of biodiversity is undoubtedly caused by climate change, and that in order to maintain the ecosystem's balance, it is necessary to understand how plants, animals, and biodiversity interact. As a result, efforts should be made to promote biodiversity conservation and protection by designating hotspots as biosphere reserves and expanding afforestation, reforestation, and agroforestry practices.

Keywords: *Climate change, Biodiversity, Habitat loss and interactions, Agroforestry practices, restoration, Ecosystems and biodiversity*

1. INTRODUCTION

Globally, long-term weather patterns, including temperature, humidity, wind, and the amount and kind of precipitation, are referred to as its climate. Climate is typically discussed in terms of years, decades, centuries, and millennia, while weather refers to periodic, monthly, or weekly changes in the environment. A region's climate is a quantitative summary of significant meteorological factors in terms of means and fluctuations over a period of time, often around 30 years (Palita, 2021). Ecosystems and biodiversity are under constant and escalating threat from climate change

Climate change poses new challenges for managers and policy makers with wide-ranging and sometimes complex consequences which prevent predicting and designing management actions accurately to mitigate undesirable impacts (Friggens *et al.*, 2013).Climate change is a worldwide problem that poses threats to agriculture, wildlife, and sustainability. It has a greater effect in Eastern and Southern African countries than in other parts of the continent. Agriculture, natural resources, habitats, and consequently the nation's efforts to reduce poverty are all threatened by climate change. Climate change is associated with food insecurity, hunger, habitat loss, and poverty, all of which continue to be significant development challenges for nations in Eastern and Southern Africa (Dechassa *et al.*, 2016).

Climate change is now a serious concern in developed countries (Morton, 2007). Biodiversity is the 'Absolute range of Life on Earth'. It includes diversity within species, and of ecosystem. Biodiversity has a huge effect on climate control and significant impact on human life (Masih *et al.*, 2020). Unfortunately, global statistics show a rapid decline in the diversity of flora and fauna, with many species facing extinction (Adom *et al.*, 2019).

Individual circumstances in developing countries vary greatly, and the precise impacts of climate change on a country are determined by the climate it encounters as well as its geographical, social, cultural, economic, and political circumstances (Dale *et al.*, 2017). The environment is inextricably linked to biodiversity and biodiversity-based ecosystem services. Climate change has posed significant threats to biodiversity in Africa over the twentieth century, and the impacts are projected to worsen as climate change progresses, or even accelerates (Sintayehu, 2018).

In Ethiopia, problems of the health of Ethiopia related to climate change, including flood and warming morbidity, vector transmitted diseases (Wilby and Perry, 2006), water-borne diseases; meningitis and respiratory illnesses linked to air pollution are on the increase. Sensitive structures such as crops, health and water were impacted and, without adequate adaptation and mitigation, the impacts of climate change would begin to widen (Analysis, 2017).

2. LITARETURE REVIEW

2.1. Definitions and Concepts

2.1.1. Climate Changes

Climate change is a long-term improvement in a location's regions (Pepin *et al.*, 2022), or planet's climate Changes in features consistent with average conditions, such as temperature wind patterns, and precipitation, are used to quantify the transition (Zerga & Mengesha, 2016). Climate change, as described by the IPCC, is a change in the state of the climate that can be observed (e.g., using statistical tests) (Heidari *et al.*, 2020), by changes in the mean and/or variability of its properties over time, usually decades or longer. It refers to any change in the climate. Climate change over time, whether caused by natural fluctuations or human activity (UNFCCC, 2011).

2.1.2. Biodiversity

Biodiversity is defined as "variability of living organisms from all origins, including terrestrial, marine, and other aquatic environments, and the ecological complexes of which they are a part; this involves diversity among plants, within species, and among ecosystems" by the United Nations Convention on Biological Diversity (UNCBD). The IPCC regularly highlights these three levels: genetic, plant, and ecosystem (Mackey *et al.*, 2008).

Simply expressed, it refers to the diversity of plant and animal life in a particular ecosystem or the presence of a wide variety of plant and animal species in their natural habitats (Verma, 2016). The goal of this essay's author was to make clear how the sarus crane, agriculture, and biodiversity are all interconnected in positive ways (Masih *et al.*, 2020).

2.2. Components Of Biodiversity

Biodiversity explored into three main components namely genetic diversity, species diversity and ecosystem diversity (Rawat *et al*., 2015 ;Verma, 2016).

2.2.1. Genetic Diversity

The genetic variety of a species refers to the variation among the fundamental pieces of genetic material (genes) that are passed down from one generation to the next (Wolter, Schindele and Puchta, 2019). The primary component of biodiversity is variety, which emerges from genetic diversity, and speciation is based on the level of genetic variation (Stephan *et al.*, 2022).

Natural selection relies on genetic diversity because it allows populations to adapt to their environments (Schluter and Rieseberg, 2022). Although environmental heterogeneity sometimes leads to an increase in genetic diversity within a species, not all animal groups exhibit the same level of genetic diversity (De Kort *et al.*, 2021). It is necessary to protect many populations of a species in order to preserve genetic variety (Turyasingura, Mwanjalolo and Ayiga, 2022).

2.2.2 Species Diversity

The diversity of species within a region is referred to as species diversity (Turyasingura, Mwanjalolo and Ayiga, 2022). It is the variation within a species' population or between the several species that make up a community (van Schalkwyk *et al.*, 2020). The species is the most fundamental unit of classification for organisms, and its diversity is the terminology used most frequently to describe biodiversity (van der Plas, 2019). It broadly depicts the variety and quantity of species within a community. Therefore, species are unique units of diversity, with each one having a particular function in the ecosystem (Wetzel and Whitehead, 2020).

In nature, there is greater diversity since there are a variety of species, each with a different number of individuals. In accordance with shared traits, the species are divided into families. A species is a group of living organisms that can interbreed with each other. Species diversity refers to the different kinds of species within a particular Region. For instance, in a small river, there can be plants, frogs, fishes, snakes and so forth constituting diversity in species (Daly, Baetens and De Baets, 2018). Species diversity is also referred to as ‘species richness’ thus the extent of the biodiversity resources of a site.

2.3. Classification of Biodiversity Based on Importance

In addition to its inherent value (nature functioning as it should; animals are the result of a long history of continuous evolution by ecological processes, and they therefore have the right to continue existing), biodiversity plays a crucial role as environmental services in the conservation of natural eco-logical systems. Biodiversity environmental services are influenced by the creation and maintenance of soil, the recycling and purification of water, the maintenance of hydrological cycles, the regulation of biochemical cycles, the absorption and degradation of toxins and waste materials by decomposition, and the determination and management of the natural environment (Rawat and Agarwal, 2015).

The foundation of life is biodiversity. It is necessary for the water we drink, the food we eat, and the air we breathe. Toxins are removed from water by wetlands, biomass is consumed by trees and plants, and the soil is fertilized by bacteria and fungi, both of which reduce global warming (Timmis and Ramos, 2021). There is scientific evidence linking human well-being and native animal abundance to ecological health.

The cornerstone of ecosystems' essential products and services is biodiversity, which is also significant for current uses, potential future uses (option values), and inherent value (Muys *et al.*, no date). For many reasons, people respect nature. Many people believe that biodiversity has intrinsic worth, which implies that every species has worth and a right to exist whether or not it is thought to have value by humans. Climate control, fish breeding and feeding ecosystems, earthworms, termites, and bacteria that can establish soil fertility through intricate cycles and interactions (Zimmerer, de Haan and Lupp, 2019), as well as fungi that cycle nutrients like nitrogen, phosphorus, and sulfur and make them available for plant absorption are additional

environmental resources that are included (Management, 2010).

2.3.1. Economic

Humans can use biodiversity as a source of raw resources for production and consumption. The biodiversity is essential to many livelihoods, including that of farmers, fishers, and forest workers. Man's reliance on biodiversity serves as the foundation for the economic or utilitarian principles of biodiversity. Natural resources that can be produced by man include wood, fruit, fabrics for paper, resins, chemical organic products, genes, and biotechnology expertise, including medicine and cosmetics (Rawat and Agarwal, 2015).

2.3.2. Ecological Life Support

Ecosystems that function due to biodiversity produce oxygen, clean air and water, pollinate plants, regulate pests, treat wastewater, and provide many other ecosystem services (Donald *et al.*, 2019).

2.3.3. Recreation

Our distinctive biodiversity is essential to many leisure activities, including birdwatching, hiking, camping, and fishing. Biodiversity is equally important to our tourism sector (Kabil *et al.*, 2022).

2.3.4. Cultural

Through the expression of identity, spirituality, and love of beauty, Australian culture is inextricably linked to biodiversity. Indigenous Australians have significant ties to biodiversity and responsibilities to it because of their spiritual beliefs on plants and animals.

2.4. The Impacts of Climate Change on Biodiversity

Weiskopf *et al.* (2020) notes that a growing threat to biodiversity and environments around the world is climate change. It has wide-ranging consequences on the environment, socioeconomic sectors, and linked businesses, as well as on human health, terrestrial ecosystems, biodiversity, and water supplies (Nunez *et al.*, 2019).

Climate change has an impact on certain species, their interactions with other living things, and their habitats, which changes how ecosystems work and what products and services are produced by natural systems for society. By altering plant distribution, warming, shifting precipitation, altering weather event patterns, and altering disturbance regimes, climate change poses a threat to biodiversity and has an important effect on forests.

There is a growing likelihood of adverse effects from climate change if the warming trend persists. Even a slight shift in climatic trend has a significant impact on animals, alters the surroundings of particular species, and puts a threat to their existence, making them susceptible to extinction. The Millennium Biodiversity Assessment (MEA) predicts the main risks that a changing climate would pose to natural diversity and ecosystems.

Climate change's various components are expected to have an effect on habitats at all stages, Individuals, communities, habitats, ecological networks, and ecosystems are all affected by multiple strengths and forms of fitness loss, which manifest themselves at different levels and affect individuals, populations, species, ecological networks, and ecosystems (Pires *et al.*, 2018). Plant responses to climate change are affected by both direct and indirect effects. A species whose distribution shifts as a result of climate change may, for example, 'invade' the range of another species, creating a new competitive relationship (Turyasingura *et al.*, 2022).

As a result, climate change is expected to impact minimum and maximum temperatures, as well as increase the frequency of heavy rainfall and storms (Prakash and Srivastava, 2019). If climate change persists at its current rate; significant changes in biodiversity are anticipated. Changes in species environments and compositions (Benson and Ayiga, 2022), as well as changes in ecosystem functioning, are examples of negative effects. Climate change has an effect on biodiversity, causing changes in distribution patterns, movement of animals, invasion of invasive species, and changes in phonological activity such as breeding cycles, migration times, and pest attacks (Mackey *et al.*, 2008) .Humans are reducing biodiversity in many parts of the world by changes in land cover and use, deforestation, invasive species invasions, and potentially climate change (Zaremba &Smoleński, 2000).

An Invasive Species

The best example of a non-native species that has been introduced due to climate change is the water hyacinth, which was officially reported in Ethiopia about 60 years ago in Koka Lake and the Tana River due to climate change. Non-native species that have been introduced, either accidentally or deliberately, outside of their normal past or present distribution, and have a negative economic, environmental, or ecological impact on habitats where they have been introduced (Masters & Norgrove, 2010).

Eutrophication

Climate change-related heavy rainfall causes eutrophication in aquatic settings such lakes, ponds, slow rivers, and river mouths, which reduces a quartic ecosystem's need for bi-oxygen. The ongoing availability of nutrients, primarily phosphate and nitrogen, encourages the growth of certain algae. These algae consume an excessive amount of oxygen as they decompose (Moloro, 2022). The number of species that the aquatic environment can support decreases as a result of this hypoxia. Worldwide, there is a lot of competition between people and wildlife for space.

In the oceans the elevated concentrations of CO2 in the atmosphere have led to an increase in acidity of approximately 30% (0.1 pH unit) (18). This is a profound change in oceanic chemistry, with worrisome implications for

all species that construct shells and skeletons out of calcium carbonate, including those that exist in untold numbers at the base of marine food chains. Those organisms depend on the calcium carbonate equilibrium that is in turn dependent on pH and temperature if the water is colder and more acidic it will be harder to mobilize calcium carbonate.

Habitat Destruction and Fragmentation

Outright habitat destruction, as well as habitat alteration and fragmentation of large habitats into smaller patches, pose the greatest single threat to biological diversity on the planet. Physical landscape features, in combination with very slow geomorphic processes (such as erosion), can cause some patches to remain isolated over evolutionary time scales (Debuse, King and House, 2007).

2.5. The Relationship between Climate Change and Biodiversity

Climate change and biodiversity are inextricably linked: climate change has significant direct and indirect impacts on biodiversity, and is expected to be a major cause of potential biodiversity loss; at the same time, biodiversity loss magnifies the negative effects of climate change. Other causes of biodiversity loss include habitat degradation/destruction and the invasion of invasive alien species into habitats, but these challenges would be amplified by climate change's consequences and hence are related to the same issue. Similarly, biodiversity conservation and climate change mitigation go hand in hand and are inextricably linked (Impacts of Climate Change on Biodiversity A review of the recent scientific literature, 2008).

Biodiversity is being lost due to habitat loss and degradation, resource overexploitation, unprecedented climatic shifts, deforestation, pests, cultivation shifting, and wildlife poaching, among other factors. If climate change persists at its current rate, major changes in biodiversity are expected. Changes in species environments and compositions, as well as changes in ecosystem functioning, are examples of negative effects (Nunez *et al.*, 2019).

In climate control, biodiversity plays an important role. In responding to and combating climate change, protection of habitats, sustainable use and soil management, and multiple natural, social and economic advantages, maintaining and preserving a balanced ecosystem play a key role (Srivastava, Shukla & Singh, 2019). Through biodiversity conservation, sustainable use, and sustainable land management, preserving and restoring healthy habitats plays a key role in adapting to and mitigating climate change, yielding numerous environmental, economic, and social benefits (Mackey *et al.*, 2008).

The relationship between biodiversity and climate change is symbiotic: climate change threatens biodiversity, but careful conservation of biodiversity will lessen the effects of climate change. By employing biodiversity-based adaptive and mitigation methods, ecosystem resilience can be increased and the risk of harm to human and natural ecologies can be decreased. As opposed to adaptation to climate change, which refers to changes in natural or human systems in response to climatic stimuli or their impacts, which minimizes harm or optimizes benefits, mitigation refers to human measures that lower greenhouse gas emissions or increase carbon sequestration (Behera *et al.*, 2018).

Since biodiversity is the basis for natural environment control systems, it is inextricably linked to the earth's atmosphere and, therefore, to climate change. Poverty and biodiversity are inextricably linked (Management, 2010). Climate change is speeding up as a result of increased greenhouse gas pollution, which has an effect on humans and habitats. Any change in the ecosystem process is based on Newton's law of motion (every action has an equal and opposite reaction), which can be harmful or beneficial. Climate regulation is directly influenced by biodiversity and change is always the result of evolutionary changes in the species (Mackey *et al.*, 2008).

CONCLUSION

It is obvious that the changing climate is to blame for the decline in biodiversity. All of these environmental changes brought on by the weather are detrimental. The decline in activities that contribute to biodiversity is mostly the fault of humans. The rate of global warming is accelerating due to rising greenhouse gas emissions, which also affect biodiversity, people, and the ecological balance. An essential component is the ecological balance. It is a necessity for human survival. According to Newton's rule of motion, every change to an ecosystem's functioning or ecological balance has an equal and opposite reaction that may be beneficial or detrimental. Some delicate and vulnerable species can become extinct as a result of even a slight shift in the temperature. Changes in species distribution patterns, species movement, invasive species invasion, changes in phonological behavior such as breeding season, migratory time, etc., as well as a rise in forest fires and pest attacks are all consequences of climate change.

Understanding the interactions between plants, animals, and biodiversity is necessary to maintain the ecosystem's balance, so it is important to promote its conservation and protection by designating hotspots as biosphere reserves and boosting afforestation, reforestation, and agroforestry practices. Strategies for adaptation and mitigation that are biodiversity-based will increase ecosystems' resilience and stop harm to both human and natural environments.

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