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CLIMATE CHANGE IMPACTS ON GLOBAL BIODIVERSITY RESOURCES

Abdul Qadir, Amara Nasar, Ayesha Khurram, Sajid Rashid Ahmad

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Summary

A new epoch Anthropocene has started with humans, a single dominating species capable of altering the nature and systems of the blue planet. The systems of the earth are highly complex and interdependent complexes of living, chemical-physical interactions which make this capable of self-maintaining its homeostasis. James Lovelock (1979) introduced the idea of Gaia (Mother Earth) as a self-sustaining system in the solar system and considered the earth as a single superorganism. The climate and chemical cycles of the earth are self-regulating and repairing systems in their optimum conditions within the biosphere. As human intelligence, industrialization, and adaptions in severe environments grew by controlling fire, electricity, and other types of energy, using technologies, and artificial intelligence. Human as the single dominating force has already started to disrupt the integrity and self-sustaining system of the earth. Now, this is the human age; Anthropocene. Human activities disturb the balance of this planet viz; rising temperatures and sea levels, changes in weather patterns, acidification of oceans, coral bleaching, and extreme natural disasters. These are the attributes of climate change. Consequently, the functioning, interaction, and distribution of organisms have been altered by climate change. Mainly, the environment is experiencing severe changes, whereas species distribution and behavior are also impacted. The climatic systems of our planet are on the verge of collapse and their self-sustaining mechanism is highly compromised. Responsibility for all negative impacts could be fixed on humans. To reduce human impacts on the planet, we should minimize the production of greenhouse gases, support clean energy, protect biodiversity, and stop encroaching into natural habitats.

Keywords: Global self-sustaining system, Mother Earth, Sustainable development, Human activities

Introduction:

James Lovelock proposed the idea that Earth functions like a superorganism in the early 1970s, and this idea eventually became known as the Gaia hypothesis. There is an inexorable connection between living beings and their physical environments. Being a superorganism, the linked system exhibits a new quality as it develops: the capacity to control its own chemistry and climate. The fundamental premise of this theory is that the physicochemical parameters of Earth self-regulate to keep them within a range that is

[1] College of Earth and Environmental Sciences, University of the Punjab, Quaid-e- Azam Campus, Lahore, Pakistan. Corresponding Author Email: *aqadir.cees@pu.edu.pk*

hospitable to life. (Maier, 2015). The Gaia hypothesis asserts that Earth and its systems operate as one enormous single organism and is named after the ancient Greek goddess of the Earth. This creature maintains the planet's environment within bounds that are beneficial for life using well-regulated self-regulatory negative feedback loops (Boston, 2008). James Lovelock's (1972) self-regulating and synergistic system originated from interaction and now allows life to exist by maintaining biochemical and climatic conditions. Gaia as a superorganism with complexity and integrated autoregulating systems is in trouble and going out of balance (Reichle, 2019). Gaia's existing autoregulation is no longer sufficient to preserve the equilibrium of the terrestrial system. Humans even though high environmental interferences resulted in atmospheric composition change, biodiversity loss, perceptible rise in sea level, and rise in average ocean temperature. These changes indicate that Gaia is on the verge of an eco-catastrophe as compared to the previous period of the Holocene, as the terrestrial system is no longer in equilibrium. (Carpejani et al., 2020). The planet earth was a self-sustaining planet before human evolution but with the passage of time humans achieved the climax of intelligence, and increased rate of anthropogenic activities, and earth gradually lost its self-sustaining capacity, and now it has become more of a human-dependent sustainable planet (Figure-01).

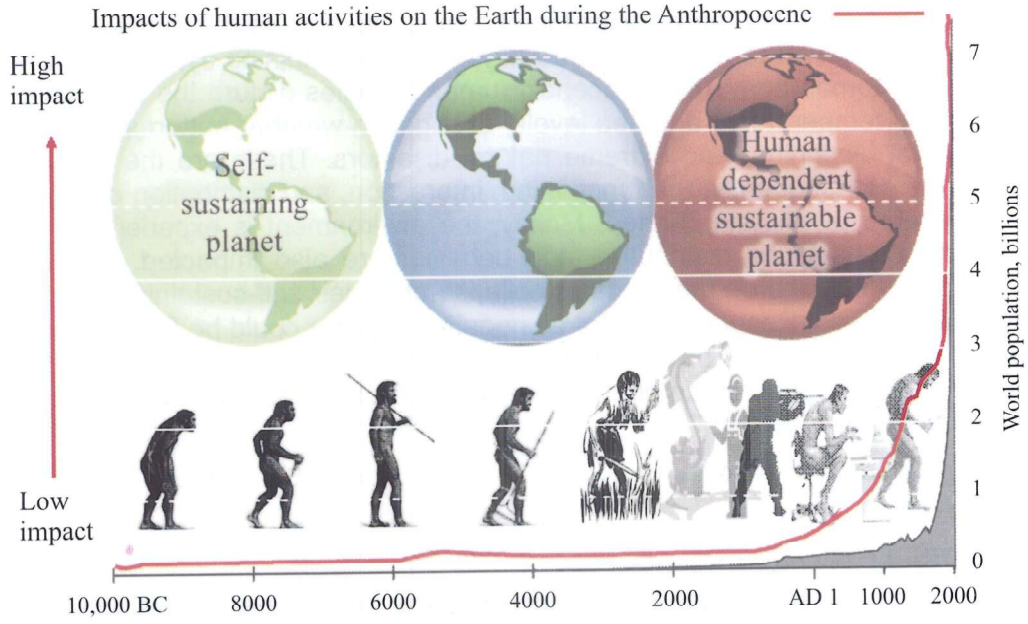

Figure-01: Impacts of human activities during the Anthropocene on the earth sustainability

Catalytic Role of Human Activities on Climate Change:

Since the last 15,000 years, human influence on the natural resources of the planet has not been obvious. The advent of the colonial era, fossil fuel combustion, deforestation, mining industrialization, and transportation are just a few examples of human activities that emit significant amounts of CO_2 into the atmosphere, which has disrupted the CO_2

cycle and caused global climate change (Amanullah et al., 2020). Climate change refers to the anthropogenically increased recurrence and harshness of extreme weather circumstances (Clayton, 2020). The high concentration of CO_2 emissions triggered climatic changes even in some countries with the lowest levels of GHG emissions, which leads to a wide spectrum of climatic difficulty and tragedy. The list of consequences is extensive and includes things like diseases, water shortages, flooding, drought, extreme weather events, loss of habitat, sea level rise, mortality, sanitation issues, food scarcity and insecurity, shelter and human settlement issues, and relocation of populations. (Crookall, 2013). Anthropogenic activities for the sophisticated industrial and social structure, cities (36.9%), rural areas (20.9%) and roads (1.3), pastures (16.7) and cropland (12.5%), sea floor (7.5%) and land degradation (2.5%), plantation (0.9%), reservoirs (0.7%) and railways (0.1%) have a huge impact the planet (Zalasiewicz, et al., 2017) and human weightage on the planet has been shown Figure-02.

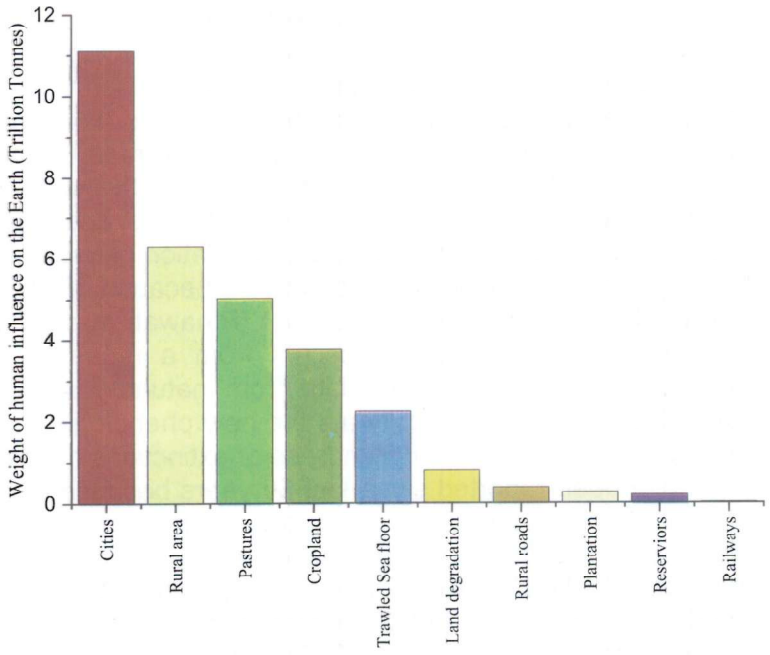

Figure-02: The human impact weightage on the planet (Trillion Tonnes) due to sophisticated industrial and social structure (Zalasiewicz, et al., 2017)

According to projections, both directly and through intricate interactions with other stressors, climate change will become a significant source of stress for ecosystems. Climate change is anticipated to have a greater and more immediate impact on ecosystems that are already under stress from habitat loss, natural resource depletion, species, extraction, pollution, and biological disturbances. Since many ecosystems are already under stress, there are numerous ways that climate change affects the environment and biodiversity. Although individual pressures can counteract one another,

but their cumulative effects of climate change combine with other stressors my lead to irreversible changes in natural systems. (Staudt et al., 2013). It greatly influences biodiversity because its variables control the geographical features of mother earth and distributional range of species (Nunez et al., 2019).

Homo sapiens accelerating the Species extinction

This is the most prevalent danger to biodiversity and ecosystems that is amplifying the threats of species extinction (Pörtner et al., 2021). It is considered a root cause for many viable complexities of mother earth such as ecosystem disruption, unbalanced biogeochemical cycles, degradation of environment, and loss of biodiversity (Díaz et al., 2019). Drastic changes in marine ecosystems for instance, distribution and abundance of species, rising the ocean temperature combined with affected yield of aquatic flora and coral bleaching are attributed to climate change (Bryndum-Buchholz et al., 2019). Anthropogenically accelerated physiochemical phenomenon like emissions of greenhouse gases, acidification of water bodies, enhanced concentration of carbon dioxide in atmosphere, and rising sea levels are worsening the impacts of climate change on earth (He & Silliman, 2019). The unexpected migrations and early breeding behaviors of migratory birds are the examples of altered phenological processes on grounds that climate change is severely affecting the life on earth (Weiskopf et al., 2020). According to (Díaz et al., 2019), anthropogenic activities have lost the 20% of total biodiversity on earth. Such activities have multiplied many non-synchronous phenological processes of earth that are causing the ineffectiveness, rareness and fragility of species and their ecosystems along with ecosystem services (Weiskopf et al., 2020). Directional selection, range shits, genetic drift, population differentiation and early migration of migratory species are the alarming outcomes because of which the climate change can alter the biodiversity at a very basic level (Rinawati et al., 2013). When a prevalent and drastic environmental change occurs from a recurrent happening of climate change events, the species may deviate from natural distributional ranges towards areas of favorable conditions or acclimate the new phenological plasticity while local species get extinct (Vittoz et al., 2013). Hundreds of extinctions cases of thousands of vertebrate species have been reported since last 50 years because of anthropogenic activities (Di Marco et al., 2019). Loss of thermal habitat for numerous species because of climate change is causing the shifting of species towards areas with hot atmospheric conditions (Pörtner et al., 2021). Due to the rise in temperature the extinction rate of species has increased from 2.8 percent to 5.2 percent globally and it is expected to rise 8.5 percent if the earth keeps warming (Urban, 2015). Extinction rate of different species varies according to region. Extinction risks of different countries (Figure 03) have been categorized; South America with 23% and New Zealand and Australia with 14 % were considered at high risk while Europe and North America were considered at low risk with 6 and 5%. The zones with limited and lack of research like Asia are at high risk while in Europe and North America 60 percent projection centers are signifying the need of focus. Native species like amphibians and reptiles are more vulnerable, ranked at higher risk and this extinction risk is rising with the extreme climatic and man-made disasters.

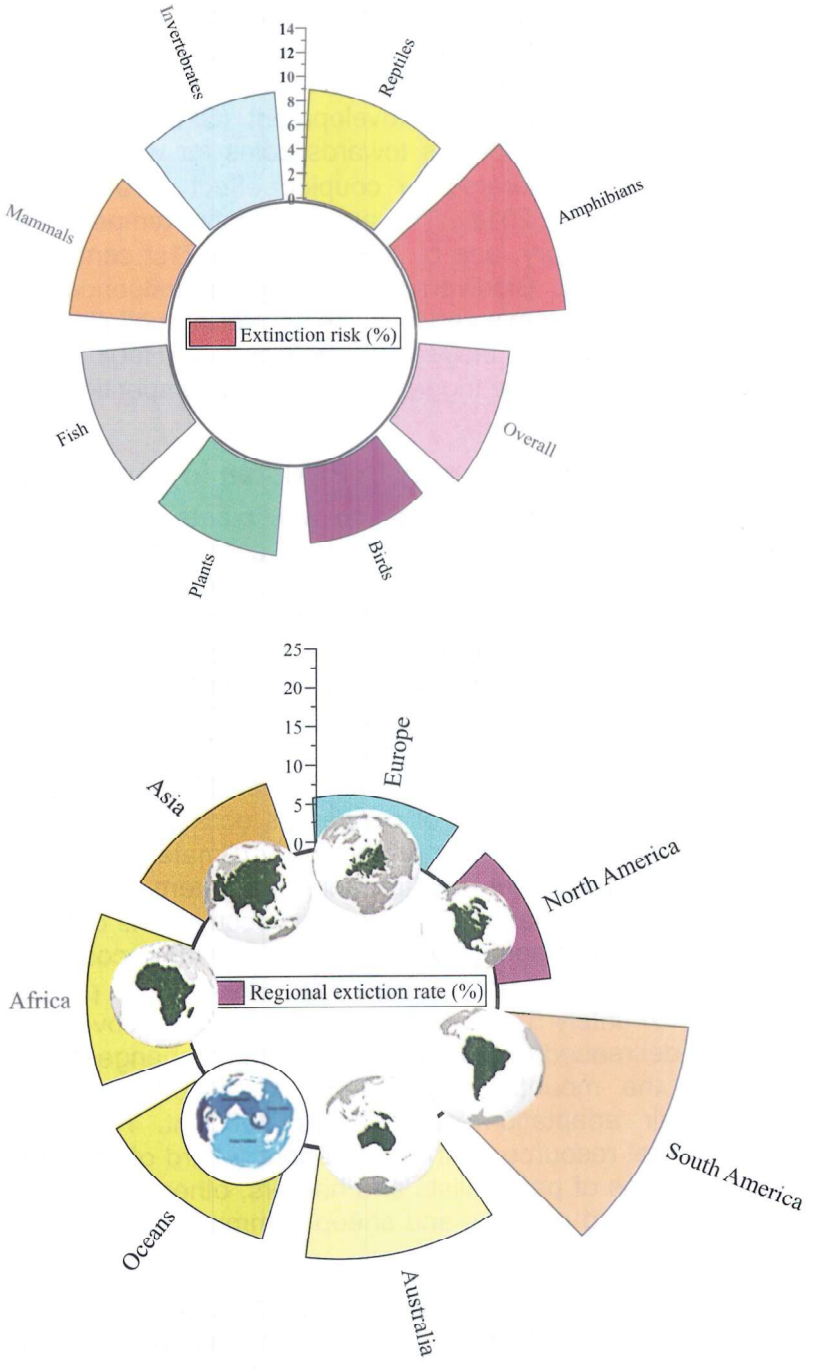

Figure-03: Global Extinction risk (%) in (a) different Taxa and (b). Regional species extinction rates in different regions (Urban, et al., 2015)

Extinction of species and disruption of food webs are indicating the alarming future of natural processes (Ghanta, 2022). Decline in species richness because of greenhouse gas emissions is attributed to climate change (Hof et al., 2018). Biodiversity influences the aims and regulations of ecosystem services that's why the loss of biodiversity has become a dispute for sustainable development (Di-Marco et al., 2019). The IPCC reported that the shifting of species towards poles for warmer habitats and decline in species diversity are accelerated by coupled effect of anthropogenic activities and climate change (Hof et al., 2018). The average global temperature has risen by 0.7 °C since the turn of the century, and by the end of the 21st century, it might reach 1 °C - 6.4°C. (Sintayehu, 2018). Biodiversity has a great influence on environment as it supports variety of ecosystem's services like controlling pollution, climate regulation and an important component of biogeochemical cycles (Habibullah et al., 2022). The phenomenon of climate change triggered the severe competition among species for their survival (Pires et al., 2018).

The current status of biodiversity in Pakistan in context to climate change

Humans impacts on ecological interaction with plants, animals, microorganisms, and fungi population makes a complex network of ecosystems. Human well-being is well connected with rich biodiversity in ecosystems and the great size, structure, and complexity of ecosystem. Biodiversity has been greatly reduced by the increasing human activities on aquatic and in terrestrial ecosystem (Qureshi, et al., 2011). Indus Basin is the biggest integrated irrigation system with 22 million hectare harvested area and agriculture including 19 percent share in GDP; this makes Pakistan a large agricultural economy. About 60% of entire population depends on agrarian economy for their livings, directly or indirectly, other than that 45% are employed under agrarian economy services. The frequency of dangerous occasions like droughts and floods is more likely to be increased further, predicted by climate change (Kamal, et al., 2022). The ecological conditions like habitat and ecosystem alteration has been greatly influenced due to climate change. The exposed ecosystems of Pakistan like mountains, deteriorated lands and rangelands, marine ecosystem, coastal environment, forest ecosystem and biodiversity are at high risk. Pakistan is presently deficit in forest resource as approximately 5% of its area is below forest cover; the forest efficiency is more likely to be decreased further in result of climate change. Climate changes oppose major threat on the mountain ecosystem, desertified and deteriorated land, and rangeland as their adaptation capability is deficient. Rangeland is an essential component of natural resource as it covers about a third of total area of Pakistan. They offer shelter to millions of pastoralists and herders, other than that more than half cattle community and two third of goats and sheep community of the country is supported by them (Khan, et al., 2016).

The precipitation level at lower altitude of Gilgit-Baltistan's rangelands hardly goes above 200 mm per annum and during winter the higher altitude receives more snow overall this rangeland obtains low precipitation. In summers the average temperature ranges from +35°C to -10°C in winters. Contrary to the overall worldwide trend, large rises in the region's winter mean and maximum temperatures have been recorded, while regular declines in summer maximum temperatures have resulted in an increase in annual mean temperatures between 1980 and 2006. The rate of desertification of the

rangelands, particularly in the dry and semi-arid zones, has increased alarmingly as a result of these climatic fluctuations in combination with other biotic and human variables. The Pakistan Metrological Department (PMD) has analyzed the temporal data. Through this it is revealed that as compared to 1998 there is decline in the vegetation cover of northern half. This is assumed to be caused by the winter rains not being as effective as they should have been. (Khan, et al., 2013). Numerous floral and faunal species have lost habitat as a result of the rapid glacier melt brought on by climate change. Several migrating species' migration paths have also been disrupted. In the Himalaya and its sister mountains, climate change has also had an impact on plant phenology, or the physiology, reproduction, and metabolism of plants. As a result, the alpine floral community is directly impacted by climate change, and it has been noted that different mountain vegetation types are moving from lower to higher altitudes due to a lack of tolerance for higher temperatures. (Bhatta, et al., 2020).

Climate Adaptation activities and conservation of Biodiversity

Federal, state, and local government organizations, conservation organizations, and land trusts are increasingly challenged with foreseeing and integrating adaptation strategies and natural resilience into resource and land use plans as the impacts of climate change on biodiversity become more obvious. At least 42 methods for adjusting to the climate have been proposed by conservation science. (Schmitz, et al., 2015). Approximately half of the world's vulnerable terrestrial carbon stocks, or 500 gigatonnes of carbon, could be protected by preserving 30% of land in key locations around the world, according to a recent UN Environment Programme (UNEP) report. Nearly 9 out of 10 vulnerable terrestrial species would have a lower chance of extinction as a result. The importance of nature in tackling the climate issue is highlighted by this finding, which shows that protecting biodiversity and carbon reserves in priority places is essential to meeting the specific goals for both climate and nature. (Stefanakis et al., 2021). The method for achieving comparable advancement in biodiversity projections can be seen in the IPCC's development of climate change predictions. (Urban et al., 2016).

These are the methods that are frequently employed to protect biodiversity. Due to their crucial role in stopping habitat loss, protected areas are usually regarded as the most effective conservation strategy. The best protected area additions for climate change have been found using a variety of assessments, typically using species distribution models with future climate forecasts of acceptable habitat for species, and reserve selection algorithms. The basis of many action plans for addressing climate change is restoration, which might entail rebuilding damaged systems, building corridors, national parks, and extending reserve networks. The function of the land's ecology can be improved by restoring terrestrial systems. Regardless of the eventual result, monitoring and adaptive management are essential to the success of restoration initiatives. There are novel tactics being developed, even if many conservation efforts that take climate change into consideration will be fairly similar to earlier efforts. Targeted Gene Flow is one instance in which individuals who are already well-adapted to the conditions of the future are moved to another group to improve its ability for adaptation. (Reside et al., 2018)

In Pakistan, recent reforestation, and afforestation initiatives, to improve the rangelands by proper management of the habitats for biodiversity as well as for human needs. Growing salt-tolerant, quick-growing grasses, shrubs, and trees for use as feed to reclaim roughly 6 million hectares of salt-affected waste land and sizable portions of sandy desert. Increase the protected areas for wildlife and ecosystem conservation. The promotion of captive breeding for ex situ biodiversity preservation by creating a national database of endangered and threatened species should be the integral part of conservation efforts at national level (Khan et al., 2016)

Future of Humans is hidden in friendship with nature

To progress in predictive measurements and more, it is important to build the knowledge and understanding about the threat climate change opposes on biodiversity as biodiversity provides climate adaptation and mitigation strategies directly or indirectly by means of ecosystem services, making it a vital resource (Prakash, 2017). To control the protection of biodiversity, it is now a crucial task to make most appropriate predictions about biotic reactions because the climate change is accelerating globally. To resist harm caused by climate change and human activities and to create a strong strategy that anticipates species' ability to response, there is need for proper planning and important information of living communities. Scientists can project more accurately for biodiversity by improving accuracy with no void left for uncertainties also this will help land managers and policy makers to support accurate decision (Urban, et al., 2016). Due to the anthropogenic activities and the lack of action and poor decision making by governmental panels even so future can be foreseen, the decline in biodiversity has occurred. There is no time for many species to take advantage of the solutions so it is urgently needed for conservationists to be as competent and proficient as possible under such severe pressure. Besides governmental indifferences and unprecedented stresses, conservation science has played important role in preserving natural resources to a great extent, but to protect biodiversity for future generation it need to be much more efficient than before by doing the right use of natural resources climate change can be reduced and biodiversity is believed to be saved for future (Williams, et al., 2020).

The global environment is experiencing severe changes, whereas species distribution also, the timing of biological activity, growth rates, an abundance of species, extinction ranges of species, and extreme climatic events accelerate the risk of fire incidents, insects, pests, invasive species, and range of tropical species is shifting northward and some migratory birds now become resident. In this situation, this is our moral responsibility to minimize the production of greenhouse gases and stop encroaching into natural habitats. This could be possible by changing the behavior toward nature at the personal, community, and national levels to reduce the rate of anthropogenic climate change for future generations as a restoration of the earth's self-sustaining system.

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