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Full Length Research Paper

Drivers and Impacts of Desertification and the Possible Actions to Reduce the Loss of Biodiversity: A Review

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ABSTRACT

Desertification due to climate change has become a mass topic in recent years. It is caused by the emission of greenhouse gases into the atmosphere that have an impact on our environment. It is also one of the most serious socio-economic and environmental problems of our time. The most important objective of this article is to examine the causes and effects of desertification as well as potential solutions to mitigate its effects. The main causes of desertification include: climatic factors and human activities such as overexploitation and inappropriate agricultural practices, deforestation, high population growth, land and rights unsafe access. Desertification also includes soil erosion; capable of genetic erosion of the plants, animals and microorganisms that form the living elements of arid environments. When dry soil plants and animals, including soil microorganisms that have adapted to dry conditions, are lost, they are most likely lost forever. Since some species and genes have adapted well to drier areas, the rate of species loss is greater. Serious impacts are clearly observed in the reduction of forests, wildlife ecosystems and total biodiversity. People in rural areas need to be supported through initiating income diversification to reduce pressure on drylands and therefore environmental management methods to combat desertification are dependent to each other.

Keyword: *Biodiversity, Climate change, Deforestation, Desertification, Greenhouse gases*

1. INTRODUCTION

Climate change is a climate patterns mostly caused by the emission of greenhouse gases from industries and natural systems. Greenhouse gas emission increases heat on the earth's atmosphere and this has been the most causes of worldwide warming. Human activities have produced about 1.0 °C of global warming over the pre-industrial level and this is often likely to boost upto 1.5 °C among 2030 and 2052 if the recent emanation continues (Fawzy *et al*., 2020). Globally, in 2018, the 315 cases of natural disasters were encountered which are mainly connected to the climate. The natural systems are often considered as self-balancing while the anthropogenic activities add extra pressure to the world system (Yue and Gao,2018). Global climate change is the extreme threat of our century and therefore the temperatures of the earth's atmosphere have increased by 0.740 C. The atmosphericconcentration of CO_2 is rises to 385 ppm much more than at any time leading to global climate change that related with the causes of desertification.

As NASA, reported that the world average temperature has increased about -17^0c during the 20th century. This could be not a big change, but its affects our surroundings from longerdrought seasons and warmth waves to more aggressive hurricanes. Moreover, the rise of the earth's average temperature generated greenhouse gases that caused a variety of problemson our environments. Greenhouse gases are very capable in trapping hotness into the atmosphere and therefore the main contributor to global climate change within the world (Kaddo,2016). Within the process of global climate change, natures also as human activities contribute their own values (Riebeek, 2010). Forinstance the emitting of CO2 from volcanos led toextend global climate change in natural systems. On the other hand, an outsized amount of global climate change happens by human activities, due to burning fossil fuels which increasesgases like CO2, methane, and a few other gases within the atmosphere. Theworld population depends on burning of fossil fuels to alarge degree, and gas for 80% of its energyneeds which makes it very difficult to use the other energy sources instead of fossil fuels. Therefore, in recent time the emission of greenhouse gases has amplifiedintensely from theeconomic revolution, regularly from the burning of fossil fuels for energy, agriculture, industry,and transportation that make an outsized amount of global climate change.

Globally, desertification may be a quiet and imperceptible disaster that's threatening societies (Nwokocha, 2015). It damages the surroundings and diminishes the potential productivity ofarable lands, forest lands, and rangelands. These rises landless and rising the costs of food. The United Nations Convention to Combat Desertification shows that: quite 1.5 billionpeoples within the world depend upon degrading lands, and 74% of them have low income. About 50% to 80% of poor people's spend their salary on food. For the moment, Agriculturalyields mightdrop up to 50% in a few African countries; if the assembly practices aren't changed. Furthermore, 52% of the arable land is harshly degraded and 12 million hectares of productiveland become barren per annum because of desertification and drought alone, which may be a lost opportunity to supply 20 million plenty of grain (Wolff *et al*., 2018).

Desertification is a series environmental matter that has been a subject of political, social, economic, and scientific debate (Veron *et al*., 2006); and targeted under SustainableDevelopment Goals (SDG 15). In 1970's when the first satellite images became available to science and therefore desertification was often associated with the southward extension ofthe Sahara (Eckholm and Brown, 1977). However, this perception seemed to be wrong, and many of debate have arisen about the definition of desertification, causes, occurrencesits impacts on the dryland environments. The different clarifications and misperception about desertification and alarming numbers on the degree of desertification were issued.Approximately, 50% of the dry lands actuality affected to some extent by desertification (Herrmann and Hutchinson, 2005), but these numbers were deeply criticized by scientistsessentially working on dryland conditions.

The impacts of desertification are increasing in the global scale, and it influences the innocent peoples who become victims, internally displaced peoples and made migrants and extremism orresource-driven wars for survival. Some study revealed that,in the arid environments, there's a touch organic matter that would provide binding force for soils, making it susceptible to wind erosion (Zhang *et al*., 2018). Many peoples particularly, farmers are forced tomaneuver from their lands that are previously barren. Additionally, the finding of Nwokocha (2015) exposed that not only farmers are affected, but the nomadic peoples who search the better grazing areas for their herds also suffering from desertification.

The early civilizations within the arid and semiarid environments that today lie under desert sands are theindication of the past mistakes. Human beings have not yet understood the process of desertification and its causes early. Therefore,various tragic mistakes are made and still bemade that exacerbating things. In many dry lands, biodiversity is currently undergoing dramatic changes which may ultimately causes of desertification (Sivakumar, 2007). It is often assumedthat the losses of species richness, the declining functionality of ecosystems, the invasion of latest species, also as changes to biomass production will continue and might accelerate inthe future. These changes are primarily associated to human activities including direct and indirect factors.

Land degradation through erosion, nutrient depletion and loss of organic matter, acidification and salinization express the occurrence of utmost desertification (Haile and Fetene, 2012). Desertification also includes the removal of the plants, animals and microorganisms which form the living elements of the dryland environments. When plants, animals and microorganism which adapted to dry situationare lost, it's very likely that it's lost forever (Rashid *et al*., 2016). Some species and genes are adapted to the drier conditions; whereas, the percent loss of species is bigger. The severe effects are remarkably seen in reduction of the biodiversity range, forest and wildlife ecosystems. Therefore, the most objective of this review is to identify the causes, consequences and therefore the solution taken to reverse desertification.

2. CONCEPTS OF DESERTIFICATION AND BIODIVERSITY

The degradation ofland in dry environments and a phenomenon that's strictly intensified by drought is named desertification (Salvia *et al*., 2019). Desertification results a decline in vegetation cover or in one sort of plant being replaced with other and fewer productive species. One among the main effects of desertification is that the loss of habitat and a deterioration of ecosystems in general. The process of desertification include: erosion, bush encroachment, soil salinization and depletion of soil nutrients and the accumulation of pollutants within the soil(Imeson, 2012). It's predictable that bush encroachment alone currently transforms into economic losses of quite N$700 million per annual in the world.

Relatively the wet period within the Sahel during the 1950's and 60's there was no much discussion about desertification, but the argument was revitalized during the drought of thefirst 1970's (Benjaminsen and Hiernaux, 2019). Worldwide, communities became worried about the complications of drought and land degradation. The first conference of (UNCOD) in 1977was organized at Nairobi to debate and formalize the occurrence of desertification. Herrmann and Hutchinson, (2005) defined desertification as: the reduction of biological and physical partsof the lands, which may lead eventually to abandon like conditions. It's a facet of the extensive decline of environments and has reduced or damaged the natural potential, as an example, plantand animal production that used for various purposes.

Desertification may be a term which describesthe degradation ofproductive land in most extreme form, and thus the loss of biological productivity of land in general. It's seen since the process of land degradation particularly in dry environments, resulting from various factorsincluding: climatic factors and anthropogenic activities (Wolff *et al*., 2018). The results of desertification are barren and unfruitful land that can't be used for crops and other agricultural productions and has slightimportance of biodiversity. It's a serious challenge and threat facingsustainable developmentin the world and a few parts of African countries. The issues have an adverse effect on human health, food security, economic activity, natural resources, and therefore the environment both national and global security is additionally suffering from desertification(Thelma, 2015). Land degradation expresses itself through erosion, water scarcity, reduced agricultural productivity, loss of vegetation cover and microorganisms, drought and poverty.

3. CAUSES OF DESERTIFICATION AND BIODIVERSITY LOSS

Desertification is that the strengthening of desert conditions resulting in reduced biological productivity, and this raises the decline of plant biomass, reduced land productivity for livestock, crop yields and socialwelfare (Herrmann and Hutchinson, 2005). Even though, desertification isan old phenomenon, it affects the communities over the planet both directly and indirectly. The consequences of the drought in the late 1960's and early 1970's desertification received attention, and action like: deforestation, over cultivation and over grazing wasnow alleged to be chief causes of desertification and land degradation. Consistent with Jamala *et al*., (2013), desertification is increase environmental degradation

that happens when the waterbalance of nature in an ecosystem is disturbed. This might lead to the disappearance of plants, animals, microorganisms and ecosystems in general.

The drivers of desertification are both naturals and anthropogenic factors (Dorj *et al*., 2013). Drought, rain patterns, increasing temperatures and global climate change contribute to the drying arid environments, and thus the areas are enormously sensitive to human beings. About10-20% of dry lands are already rigorously degraded and a few reports suggested 70% of land degradation to human-induced reasons; predominantly population growth, agricultural technologies, and unverifiable management. These influences dry lands and make responseeffects that led the loss of biodiversity also as other negative consequencesthat affects us all and therefore, desertification is caused by several human activities and natural systems.

3.1. Anthropogenic factors

Several reviews and assessments of anthropogenic drivers of desertification are studied and identified by some scholar. These drivers include: agricultural expansion, unmanageable land use practices such as overgrazing and over cultivation, the development of urban and increment ofvarious infrastructure and industries were identified as the main drivers of desertification (Middleton, 2018; Abhilash, 2021). They're also identified that the crucial driver of landdegradation and developing consumption of land-based resources, forinstance through deforestation and agricultural expansion which accelerated by human beingactivities.

The conversion of forests, rangelands, and woodlands ecosystems into cropland due to increasing food demand is one among the driving forces of deforestation that causes desertification(D'Odorico *et al*., 2013). As an example, the first drivers of erosion in 2012 were cropland expansion and bad agricultural practices like regular and continuous irrigation farming,unsustainable land management, and absence of soil and water conservation which results in land degradation and exacerbate the means of desertification (Borrelli *et al*., 2017). Moreover, thedemands of food might be seen by finding food from other areas which increase the pressure on lands at theplace where the food importing. However, the clear effects of such agricultural production changes ashore situation in dry lands aren't identified in the world.

Labor mobility is another drive which will interact with environmental changes. Emigration will have numerous opposing effects on desertification and also it reduces aninstantaneous pressure onto dry land; if it results in lessdependency on land for livelihoods. The migrant allowances might be wont to fund the implementation of sustainable land management activities. The movement of labor from agricultural practices to others sectors mightcertificateland alliance, gradually resulting in modernization and agricultural amplification (Wang *et al*., 2020). This raises the costs of labor and sustainable land management processes which make lessobtainability of rural agricultural labor. Emigration raises the burden ashore if higher labor thatrural migrants earn in urban centers will cause their higher food consumption, and therefore the migrant payments could even be wont to fund land-use extension to

marginal areas (Taylor *et al*., 2016). However, the net effects of those reversetechniques are variouswithin different areas.

Different institution, strategy and socio-economic activities like tenure insecurity, absence of property rights, and absence of technical knowledge and abilities are other drivers of desertification. The agricultural price alterations, agricultural funding and supports, and lack ofeconomic encouragements for sustainable land managements also contribute to desertification (D'Odorico *et al*., 2013; Mythili and Goedecke, 2016). It also serves as the causes of unmanageable land use systems and that they do play a crucial role in restraininganswersfor global climate change adaptation and mitigation. However, there's no strong suggestion that these factors are going to be significantly suffering from global climate change.

The expansion of agricultural land in various regions is counted as asignificant direct explanation for desertification is that the main problems in the world. Globally, there's a negative impact of the energy sector on forest, land productivity and otherecosystems services. This is often why Biomass constitutes 30% of the energy utilized in Africa and over 80% consumed in many sub-Saharan countries like Burundi (91%), Rwandaand Central African Republic (90%), Mozambique (89%), Burkina Faso (87%), Benin (86%), and Madagascar and Niger (85%), (Mandelli *et al*., 2014). It isfrequently accelerating theprocess of desertification dueto a little trivial issue like high levels of poverty, the increment of human population, poor natural resources tenure and access regimes and conflictswithin the region.

3.2. Climatic factors or Natural systems

The process of desertification contains biological as well as non-biological activities. It's categorized under both physical and biological degradation of various ecosystems.Desertification is taken great process which is extensively covered a wide area (Abhilash, 2021). Early reviews of desertification during mid-20th recognized as desertification is totally non-natural or it's the action of human beings. Conversely, this interpretation of desertification was revealedmight beinacceptable (Reynolds *et al*., 2007).Those drivers are concerning to the precise processes of land degradation andalso as desertification under global climate change.

The removal of top soil by water, winds, which is often caused by improper farming activities like tillage, is resulted in land degradation (Ginoux *et al*., 2012). The worldwide approximations of soil erosions are varying based on supported scale, study periodand the technique we used. According to the study of FAO, (2015) soil erosion is ranging approximately from 20 Gt yr-1 to quite 30 Gt yr-1. Thesignificant changes in climate led toextend soil erosion by water, predominantly in the areas where precipitation capacities and intensity are estimated to increases. Some studies revealed that the loss of soil microorganismsand fertility related with reduction of soil depth, nutrients, organic matter and therefore the deterioration of water quality (Karamesouti, *et al*., 2016).

Hydrological change due to climate variations results soil salinization by growing the mineralized groundwater. Minor salinization happensafter the concentration of dissolved salts inwater and soil is amplified by human activities, mostly over poorly managed irrigation systems. The pressures of soil and water salinization encouraged by water level rises and seawaterinterruption are upgraded by global climate change. The warming of environments is projected to hasten soil organic carbon turnover, subsequently the decomposition of the soil organic matter bymicrobial activity starts with little soil water availability, which is inadequate for agriculturalproduction (Austin *et al*., 2004). Soil organic carbon is additionally lost due to erosion (Lal,2009); anda few dryland areas resulting in the decline of organic carbon and therefore the removal of carbon from soils.

The irregularities ofsea surface temperature changes therainfall patterns, and this implicationhelps to the occurrence of desertification. While the variances of eastern tropical Pacific seasurface temperature have indirect correlation with Sahel rainfall; theNorth Atlantic sea surface temperature are positively correlated with Sahel rainfall irregularities, (Sheen *et al*., 2017). Acooler North Atlantic is linked to a drier Sahel and this relationship improved there's animmediatecomparative warming of the South Atlantic. The association among sea surfacetemperaturedifferences and satellite observed Sahel vegetation dynamicsisparallel.As the result of Tierney *et al*. (2017) show that a cooling of the North Atlantic played a task almostlike that found in modern observations and also aerosols have been proposed as a possible driver of the Sahel droughts.

Invasive species added the occurrence of desertification and loss of ecosystem services mainly in dryland environments. A widespread of plant encroachment changes runoff and erosion in mostdrylands areas, because bare soil is extremely vulnerable to water erosion (Eldridge *et al*., 2015). The rising of CO_2 levels due to heating favour more rapid expansion of a few invasive species inour surroundings. Forinstance the good Basin region in western North America where over 20% of ecosystems are significantly altered by invasive species, particularly exotic grasses andconifers, leading to loss of biodiversity. Such typeof land-cover conversion has declines the forage availability, wildlife habitat, and biodiversity in general (Pierson *et al*., 2013).

Wildfire is another cause of desertification that decreases biodiversity and increases erosion of soil which resulting toreducefertility of soil and affects the microorganisms of the soil. Theincreases in temperature and therefore the severity of drought events across some dryland regions can increase the probabilities of wildfire occurrence (Clarke and Evans, 2019). In the dryenvironmental condition, wildfire profound animpact observed on vegetation, mainly the relative abundance of grasses is decreases. Globally, the massive doubt exists regarding to thetendencies of droughts as examining by Ziese *et al*., (2014) and therefore the dry lands exposes an outsized inter-annual variability that increasing dryland areas suffering from droughtssince the 1950s. Consequently, over the period of 1961–2013, the annual dryland areas has enlarged and slightly quite 1% y-1, with large inter-annual variability.

4. IMPACTS OF DESERTIFICATION

4.1.Impacts of desertificationon ecosystems

The main reason to implicate the anthropogenic activities for desertification is the incontrovertible fact that is often closely related to increasing the concentrations of CO2, methane, laughing gas and other greenhouse gases. These resulted to trap the warmth from radiation within the upper layers of the Earth's atmosphere. The subsequent worries linked to the impact of desertification for nature and species. These threats are often interrelated and may exacerbate the several other existing threats to wildlife like habitatloss and fragmentation, invasive species, and diseases.

The Ecosystem services in dry lands are vulnerable to the impacts of global climate change due to high variability of temperature, precipitation and organic matter. The process of desertification like erosion and salinization has negatively impact on the provisioning ofecosystem services in dry environments, predominantly in food production (Majeed and Muhammad 2019). Climate change between 1976 and 2016 were found to be unfavorable for crop yields in Russia, which the yield decreases up to 40–60% in drylands were caused by anextensive droughts (Tsymbarovich *et al*., 2020). Increasing in temperature features has a direct impact on animals' physiological stress (Rojas-Downing *et al*., 2017). Similarly, the increased in water requirements for drinking and cooling, decreases the production of milk, meat and eggs, which increased the stress during conception and reproduction.

The natural resource extraction is resulting in groundwater reduction in most dryland regions (Mahmod and Watanabe, 2014). Forexample, the groundwater reserves are reduced, with the very greatest rate of estimated reductions of 145 m3 yr^{-1} between 2000 and 2008. Various dryareas are very vulnerable to groundwater reductions, because the present natural recharge rates are less than the previous wetter periods, like the Atacama Desert, and Nubian aquifer system in Africa (Amanambu *et al*., 2020).

Globally, desertification can influence the amount of atmospheric carbon dioxide. In dry lands environments, most of the carbon is stored below ground within the sort of biomass and soil organic carbon. The changes in land-use often cause the reductions organic matter inputs into soils (Albaladejo *et al*., 2013), which increasing soil salinity and erosion. Furthermore, the lossof soil organic matter thereby influences thecapacity of land productivity. For instance, the erosion of soil by water is projected in the loss of 23–42 Mt of nitrogen and 14.6–26.4 Mt of phosphorus from soils annually (Gebrehiwot, 2022).

The releasing of carbon into the atmosphere for different sites located in Mongolia, China and North America due to the decreasing of rainfall annually (Biederman *et al*., 2017). Similarly, theavailability of soil water encourages soil microbial respiration, however there's insufficient moisture to stimulate plant productivity, which affecting theemissions carbon at an ecosystemlevel. For instance, photo degradation of vegetation biomass may often constitute a further loss of carbon from an ecosystem in the dry conditions. However, when the rainfall is good in dryland areas the sequestration of carbon is increased. An exceptionally the rainy year in theSouthern hemisphere semi-arid ecosystems can contributed 51%

of the worldwide net carbon sink (Poulter *et al*., 2014). Conversely, dry lands are mostly projected to be warmer with an increasing rate of utmost drought and high rainfall events (Markus *et al*., 2016).

The reduction of flora covers due to desertification, changes the soil surface, which affecting the albedo and therefore the water balance. Thelosses of soil particles by wind erosion lead to reducing the power of soil to sequester carbon (Wiesmeier *et al*., 2015). Besides, dust stormsdecrease crop yields by loss of plant part produced sandblasting, exposing crop roots, crop seed burial under sand deposits, and resulting in losses of nutrients and fertilizer from topsoil. Dust storms are also influence theyields of crops by reducing the number of water availability forirrigation and they will decrease the storage capacity of reservoirs by siltation, and block transportation canals (Middleton and Kang, 2017). Furthermore, dust storms favour the spreading of microbial and plant species, which may make local endemic species vulnerable to extinction and promote the invasion of plant and microorganism.

4.1.1. Biodiversity loss

The biodiversity we see today is the consequence of thousands years that formed by natural processes and gradually influence of human beings (Pievani, 2014). It forms the network of lifetime which we are an integral part and upon which we so entirely depend on.However, globally biodiversity is being lost and in some areas decreased at an alarming rate (Pimm *et al*., 2018). As Singh and Singh (2017) revealed that, the most sources of biodiversity loss are land use changes usually related with increasing populations, unsustainable managementand exploitation of natural resources, invasive species, global climate change and pollution. Whereas these are the immediate sources of biodiversity loss and the underlying problem is that biodiversity is typically not fully accounted for by consumers within the marketplace; there's often no distinction among biodiversity friendly goods and people that damage biodiversity.

The vegetation within the ecosystems is often extremely threatened by global climate change led desertification (D'Odorico *et al*., 2013). The increasing of aridity exacerbates the danger of extinction of a few plant species; particularly those under threatened due to small populations.The desertification over land-use change, promoted to the loss of biodiversity across dry lands areas. Alike, drought and over extraction resulted to the loss of biodiversity in Pakistan and therefore the only drought-adapted species can survive on the arid rangelands. For instance, thesetrends were observed in the desert of Mongolia (Khishigbayar *et al*., 2015). Some plant species particularly, the Perennial species, are the element of ecosystem, that are usually less affected as they have deeper roots and physiological mechanisms that increase drought tolerance.However the long-term monitoring (1978–2014) in North Africa, has revealed that some perennial species have also disappeared because of drought (Belala *et al*., 2018).

Many species in the dry lands are exposedto extinction due to habitat degradation and desertification. The grazing value of land declines with a discount in vegetation cover which is being more harmful to native vertebrates (Parsons *et al*., 2017). Mammals and birds were sensitive to droughts since

they believe evaporative cooling to preserve their body temperatureswithin an optimal range and risk dehydration in water scarcity environments (Albright *et al*., 2017). The decreasing of rainfall and water unavailability is probably going to be exacerbated by the indirect effects of desertification through a discount in primary productivity.

4.1.2.The consequence of Biodiversity loss

Farming becomes impossible. If anarea becomes degraded due to desertification, then it's almost difficult to grow substantial crops without special technologies. This will cost a lot of cash to undertake and do, thus many farmers will need to sell their lands and leave the areas.

Hunger: Without farm lands, the food that produces from farms will become much scarcer, and therefore the peoples who live in those local areas are going to be suffering from hunger.

Flooding: Flooding may be a lot more eminent, if a neighborhood without plant species. All deserts aren't dry; those that are wet could experience of high flooding since there's nothing to regulate the erosion everywhere.

Water Quality: The standard of water in desert areas is going to pot than it might be otherwise. This is often due to the plants plays a crucial role to keep the water cleanand clear; it's harder for you to be ready to do this.

Poverty: All the above issues that we've talked about are associated to the problems of desertification than can cause poverty if it's not kept in restraint. Citizenry without food and water are harder to measure and that they take tons of your time to undertake and obtain the items that they have.

Sea-Level Rise: Coastal wetlands are one among the productive natural ecosystems. However, the rising of water level affects animals and plants in coastal habitats due to the rising oftemperatures and rainfall. This is often due to combination of melting polar ice caps and montane glaciers alongside thermal expansion, wherein warm water occupies a greater volume than coldwater. It's expected that an increase in water level of 0.5 m will lead within the loss of 32% of marine turtle nesting grounds (Spencer *et al*., 2016). Similarly, the rising of water level recorded over the past 40 years is liable for the loss of 28% of the mangrove ecosystem.

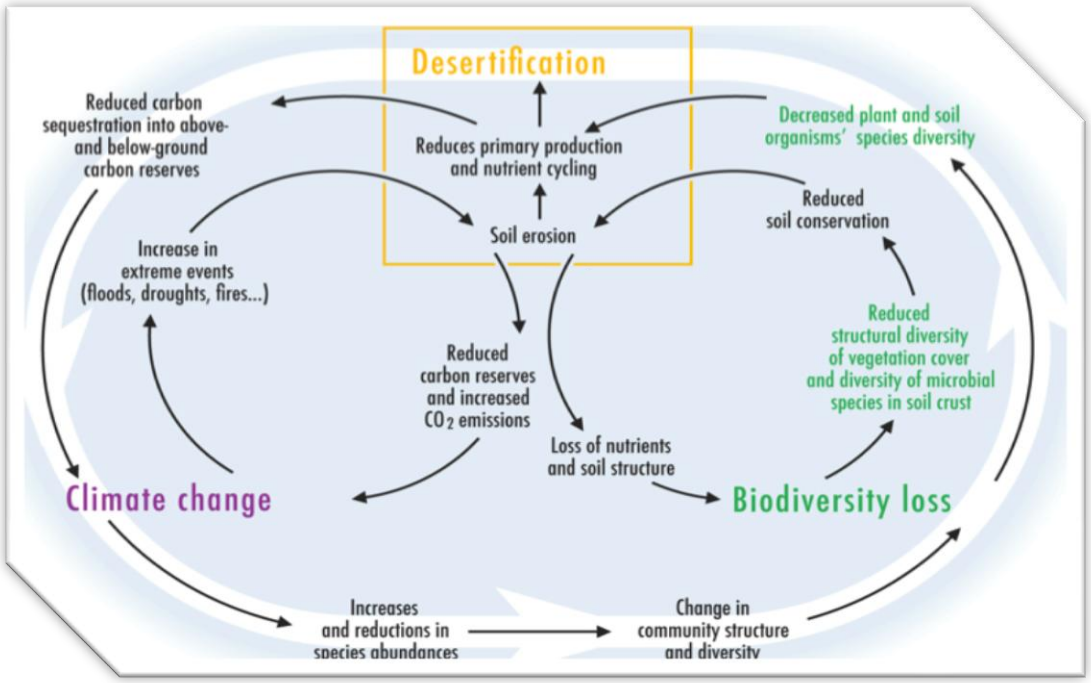

Figure 1: Relationship between desertification, biodiversity loss and climate change
Source: Taken from Millennium Ecosystem Assessment (MEA), (2005).

Range Shift: The plant species and animals ecological communities are shifting because the planet warms. Some species are ready to adapt and move whereas, others cannot, and thesewill disappear with their habitat. A source of water, like springs, has dried up due to the disappearing oak trees and invading pines (Rigling *et al*., 2013).

Invasive Species: Change in climate and invasive species are two major threats to biodiversity. Global climate change will deliver new ways for invasive species encroach on thenew lands. As an example natural disasters like storm surges and high winds increase the amount and severity of earth warms, spread non-native plants and insects to new regions.

4.2. Impacts on socio economic systems

The impacts of desertification due to global climate change and human factors are challenging to separate from the consequences of other socio-economic, institutional and political factors (Pradhan *et al*., 2017). There's high agreement that global climate change will intensify thesusceptibility of dryland environments. The matter occurring from climate change led desertification will decrease the opportunities for reducing poverty, enhancing food andnutritional security, reducing disease burden, and improving access to water and sanitation. The 2015 United Nations Development Programme shows climate change and desertification is embedded under sustainable development goals 13and 15respectively. The high impacts on sustainable development goals indicate that theinteractions among

climate change and desertification strongly affect the achievement ofsustainable development goals 13 and15which targeting the coordination ofland degradation policy, mitigation and adaptation strategies.

Impacts on poverty

The changes in climate have contributed to poverty related agriculture through the risks coming from extreme events. However, the severely attributing changes in observed poverty to global climate change impacts are presently low. Most of the investigation showed that the links amongpoverty, climate change and desertification whether poverty may be an explanation for land degradation. There's a limited evidence that desertification increases the level of poverty in multidimensional at the local level. However, consistent with Diao and Sarpong (2011) projectedthat land degradation due to climate changereduced agricultural incomes in Ghana by 4.2 billion USD between 2006 and 2015, which increasing the national poverty rate by 5.4% in 2015. Similarly, Land degradation increased the prospect of households becoming poor by 35% inMalawi and 48% in Tanzania (Asfaw *et al*., 2020).

Desertification was found to possess resulted in significant losses of income, food production and lack of jobs in China (Jiang *et al*., 2014). On the opposite hand, desertification was positively related to growing incomes in Inner Mongolia within the short run since no costs wereinvited for sustainable land management, while higher incomes allowed for the allocation of investments to reverse desertification in the long run process (Ge *et al*., 2015). This association agrees to the Environmental Kuznets Curve, which suggests that initially environmentaldegradation rises and consequently falls with rising income (Stern, 2017). However, there's no available evidence on the strength of this hypothesis.

Impacts on food and nutritional insecurity

Globally, about 821 million peoples were food insecure in 2017, of whom 63% in Asia, 31% in Africa and 5% in Latin America and also Caribbean (WHO, 2018). Additionally, the worldwide number of food insecure people rose by 37 million since 2014. The changes in globalclimate, shared with a scarcity of climate resilience, were proposed as a key driver of food insecure. As an example, Sub-Saharan Africa, East Africa and South Asia had the very preeminent share of starving populations within the world in 2017, with 28.8%, 31.4% and 33.7% respectively (WHO, 2018).

The key mechanism which global climate change led desertification affect food security is through reducing agricultural productivity. There's strong indication to the negative impacts of global climate change on crop yields in dryland environments (Hochman et al.,2017). Additionally, there are the highest lossesin agricultural productivity which reduces the incomes of local community due to desertification (Asfaw *et al*., 2020). Consistent with the study of Nkonya *et al*. (2016a) projected that cultivating of wheat, maize, and rice with unmanageablepractices is leading to global losses of 56.6 billion USD yearly. Moreover, another annual loses of 8.7 billion USD due to lower livestock's productivity caused by

rangeland degradation.However, the magnitude to which these losses affected food insecurity isn't recognized in most dryland regions.

Impacts of desertification on Health

The occurrence and strength of dust storms are increasing due to land-use and land-cover changes and climate-related factors mostly in some regions of the planet like the Arabian Peninsula (Almazroui *et al*., 2018), broader Middle East (Namdari *et al*., 2018) and Central Asia(Indoitu *et al*., 2015), have a negative impacts on human health. Dust storms serve as transportation pollutants, particulate matter, pathogens and potential allergens that are dangerousfor human body. Particulate matter affect human health which is found at the suspended particles within the air of up to 10 micrometres or fewer in size, (Goudarzi *et al*., 2017).

The impacts of dust storms covers largest areas where the immediate vicinity of their origin, predominantly the Sahara, followed by Central and eastern Asia, the center East and Australia (Zhang *et al*., 2016). Within the countries of the Sahara region, Middle East, South and EastAsia, dust storms were proposed to be the explanation for 15–50% of all cardiopulmonary deaths (Giannadaki *et al*., 2014). Additionally, the occurrence of water and food-borne diseases,respiratory diseases and the wide spread of infectious diseases are the result of climate change led desertification.

5. ACTIONS TO REDUCE THE EFFECT OF DESERTIFICATION

5.1.The preventionof desertification

Expanding protected areas is one among the foremost important strategies to minimize the increasing human pressure on ecosystems services (Jenkins and Joppa 2009; Palomo *et al*., 2014). The indigenous management and macro policy approaches are also the effectiveprevention of desertification that encourages sustainability of ecosystem services. The prevention activities are essential, because the efforts to rehabilitate desertified areas are expensive and have a tendency to bring restricted consequences. So as to stop and reverse desertification, the main policy interventions and changes in management approaches are required. Such interventions should be applied at local to global scales, with the active commitment of stakeholders and native communities. They're essential to manage thelevel of desertificationwhich a society faces or is probably going to face. At the first stages, it's possible to prevent the method of desertification and restore the key services within the degraded areas. The prevention of desertification needs less cost than rehabilitation, and it should be taken under consideration inpolicy decisions.

Despite this the worldwide network of protected areas is simpler at protecting the foremost susceptible species than one would expect supported area alone (Pimm *et al*., 2018). Reversing desertification is serious and vital to meeting the Millennium Development Goals,which targeted to eliminate exciting poverty and safeguarding environmental sustainability among other goals. Almost, local populations in dry

lands have a lower quality of life thanpeople in other areas. Additionally, about half the peoples who live in dry lands are living below the poverty level and their societies are mostly susceptible as results of dryland ecosystem condition that leading to poverty. Therefore, reversing desertification is contributed to theeradication of utmost poverty and hunger. It has various local and global benefits and help to mitigate global climate change and minimize the loss of biodiversity. Similarly, Environmental management approaches for opposing desertification, global climate change mitigation andadaptation, and conserving biodiversity are interlinked.

5.2.The potential actions to impede desertification

In order to solve the impacts of global climate change or desertification, some potentials measures recognized which is named climate change adaptation and mitigation. It includes the utilization of carbon capture & storage technology and trading plants for carbon; breeding offuzzy-leaved crops and irrigation techniques for cooling the atmosphere. In addition global climate change adaptation through a multi-dimensional and multi-sectoral approach became vital strategies to conversant in climate change as a result of inequalities among the developed and therefore the developing nations in terms of limited capital resources and expertise to use technologies (Onoja *et al*., 2011). The results recorded thus far through these efforts are hopefulbut, they need not been ready to significantly reduce the increase in atmospheric temperature, especially within the developing countries.

Climate change mitigation approaches is extremely difference among the developed and the developing countries. The developed countries use technological capability including the utilization of Carbon Capture & Storage Technology, while the developing countries haven't theskills to use such technologies. Climate change and desertification is clearly a danger to humanity and effective policy options that required for tackling hurdles and barriers are serious to climate change adaptation and mitigation. Several outlines are developed to supportpolicymakers and scientists to recognize fences that would delay to global climate change adaptation and mitigation (Moser & Ekstrom, 2010; Kirwan *et al*., 2010). The authorsmaintained that farmers should concentrate on enhancing crop yields on the cleared land to stop the releases of carbon.

The conception of a "culture of prevention" can go extended concerning protecting dry lands when desertification is simply starting and even when it's ongoing. It contains manyissues like bio-physical, socio-economic and cultural aspects (Zhang *et al*., 2007) and wishes a change in governments' and peoples' approaches. When these are in situ, administrative follow up and implementation of guidelines is important to enabling environment (Squires, 2012). The long-term experience and active innovation can stay before desertificationaffecting agricultural and grazing practices during a sustainable way at the dryland areas. Thefollowing actions must be addressed to tackling desertification: climate change adaptation and mitigation, through thereduction of CO2 at source and proactively avoiding land degradation, through reactively falling and rehabilitating desertified environments. Accordingto adapt from Millennium Ecosystem Assessment (2005) the proactive approach includes:

- Incorporating land and water management practices to protect soils erosion, salinization, and other forms of land degradation.
- Protecting vegetation cover, which can be a major mechanism for soil conservation against wind and water erosion
- Assimilating the use of land for grazing and farming where conditions are favorable, permitting for more efficient cycling of nutrients within the agricultural systems.
- Usinga traditional practice which is locally suitable andadapted land use technologies.
- Increasingthe capability of local communities to stop desertification and to manage dryland resources efficiently.
- Using a substitute livelihoods that do not depend on traditional land uses, like dryland aquaculture, greenhouse agriculture and tourism-related activities,
- Forming economic opportunities in dryland urban centers and in areas outside of drylands.
- Monitor land: Using satellite-based remote sensing or aerial photographs with ground-based observations to deliver consistent, repeatable, cost-effective data on vegetation cover.

The indigenous knowledge is typically specific, socially created and rooted in local culture and traditions, and is usually inherent in nature. However, the scientific information about desertification tends to follow more universal theories and mechanisms, is clear and formal(Raymond *et al*., 2010). Therefore, both local and scientific skills are often expert and may be challenged. The cooperation of local stakeholders and scientists is required during studyin which both can learn from one another. When the desertification process has already started within the area, current pressures on the ecosystem like global climate change, overgrazing, and large-scale irrigation may cause further desertification. To revive the drylandecosystems some interventions can apply as Adapted from Millennium Ecosystem Assessment, (2005). This intervention is named reactive approaches that used to restore desertified environments and it includes:

- ✓ Diversify production of crops and animals, avoid monocultures
- ✓ Enrich soil with organic matter
- ✓ Reforestation
- ✓ Reintroduce selected species and control of invasive species
- ✓ Reducethe erosion problems through the construction of terraces, fences or barriers from local plant species, planted hedges, planting of vegetation whose roots protect and fix the soil, and the prevention of livestock from grazing to protect the plantation areas
- ✓ Using plant and animal species that adapted to changing climate conditions
- ✓ Afforestation

6. CONCLUSION AND RECOMMENDATION

Climate change and desertification is certainly an exterior shock to the world thatresulted from human activities and natural systems. It's an outsized problem that's challenging our planet and it's increased mostly after industrial revolution. The production of greenhouse gases byhuman activities has faster the movement of global climate change or desertification and made our surroundings more unsuitable. However, the world's population using fossil fuel for energy, transportation, and in several industries, that have produced a serious difficulty to shift torenewable energy. If the important portions of dryland ecosystems are degraded, and therefore the ongoing desertification threatened the world poorest populations and this influence the livelihoods of many peoples.

Desertification is the persistent degradation of dryland environments and the one among the environmental challenges in the world. It's a serious obstacle to meeting basic human necessities in dry lands and results in losses in terms of human welfare. Desertification caused bysocial, political, and climatic factors that subsidize to an unsustainable use of rare natural resources. The degree of desertification and its impacts are varying from place to place and alter over time. Additionally, an extensive gap remains in our awareness and monitoring ofdesertification processes, which sometimes avoid cost-effective actions in affected areas. Outside dry lands areas, desertification has strong impacts, as an example by increasing the occurrence ofdust storms which influence thousands of kilometers faraway from the desert areas and may cause political and social problems due to themigrations ofhuman beings.

Depending on the level of dryness, desertification is often banned and dryland ecosystems restored through specific interventions and adaptations mechanism. Prevention approaches are far more effective way to handledesertification. The rehabilitationof degraded areasis alsoexpensive and has a tendency to deliver the limited results. From the prevention methods, proactive management approaches will perhaps the foremost effective in handling with desertification. Additionally, to minimize the changes that already occurred and can occur,we must got to transfer our energy utilization to renewable energy. The payments and assistance from developed nations are often considered as a sound to compensate the developing countries for the negative impacts of global climate change. Scientists, environmentalists, communitiesand also policy makers got to work cooperatively to measure up to those large problems and fight against climate change and desertification. Ecosystem management approaches targeting to combat desertification are interlinked, to global climate change mitigation, and conservation ofbiodiversity. Thus, the combinedimplementations of major environmental agreements can results to increased cooperation and effectiveness, that helping dryland population.

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