ARTÍCULOS DE REVISION

Climate change as a trigger for desertification and possible alternatives to reduce biodiversity loss

El cambio climático como detonante de la desertificación y posibles alternativas para reducir la pérdida de biodiversidad

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Abstract: Climate change is one of the numerous things that are believed to speed up desertification. It is caused by the emission of greenhouse gases into the atmosphere which have an impact on our environment. It is also one of the biggest environmental, socioeconomic, and political issues of our day. The primary objective of this article was to analyze the causes and consequences, of desertification and possible solution to reduce biodiversity loss. 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 refers to the genetic erosion of plants, animals, and microorganisms that make up the living components of arid environments. Most plants and animals as well as soil microorganisms that have adapted to favorable condition are most likely extinct due to desertification. Even if some species and genes have adapted in drier environments, the rate of species extinction is higher due to this conditions. The reduction of forests, wildlife ecosystems, and total biodiversity has clearly under severe condition. Therefore, rural peoples must be supported by initiating income diversification in order to reduce pressure on drylands, and thus environmental management methods to combat desertification are interdependent.

Keywords: Biodiversity, climate change, deforestation, desertification, greenhouse gases, land degradation.

Resumen: El cambio climático es una de las numerosas cosas que se cree que aceleran la desertificación. Es causada por la emisión de gases de efecto invernadero a la atmósfera que tienen un impacto en nuestro medio ambiente. También es uno de los mayores problemas ambientales, socioeconómicos y políticos de nuestros días. El objetivo principal de este artículo fue analizar las causas y consecuencias de la desertificación y la posible solución para reducir la pérdida de biodiversidad. Las principales causas de la desertificación incluyen: factores climáticos y actividades humanas como la sobreexplotación y las prácticas agrícolas inadecuadas, la deforestación, el alto crecimiento demográfico, la tierra y los derechos de acceso inseguro. La desertificación se refiere a la erosión genética de plantas, animales y microorganismos que constituyen los componentes vivos de los ambientes áridos. La mayoría de las plantas y animales, así como los microorganismos del suelo que se han adaptado a condiciones favorables, probablemente se hayan extinguido debido a la desertificación. Incluso si algunas especies y genes se han adaptado a ambientes más secos, la tasa de extinción de especies es mayor debido a estas condiciones. La reducción de los bosques, los ecosistemas de vida silvestre y la biodiversidad total se encuentran claramente en condiciones severas. Por lo tanto, los pueblos rurales deben ser apoyados iniciando la diversificación de ingresos para reducir la presión sobre las tierras secas y, por lo tanto, los métodos de gestión ambiental para combatir la desertificación son interdependientes.

Palabras clave: Biodiversidad, cambio climático, deforestación, desertificación, gases de efecto invernadero, degradación de la tierra.

Introduction

Climate change (CC) is a change in weather patterns caused primarily by greenhouse gas emissions (GGE) from industries and natural systems. GGE raise the temperature of the earth's atmosphere, which is one of the primary causes of global warming. Human activities have caused about 1.0° C of global warming above pre-industrial levels, and this is likely to increase to 1.5° C between 2030 and 2052 if current emissions continue[1]. In 2018, there were 315 cases of natural disasters that were primarily caused by CC. Natural systems are believed to be self-balancing, whereas anthropogenic activities put additional pressure to the global system[2]. Global CC is the most serious threat of our century, and as a result, temperatures in the Earth's atmosphere have risen by 0.740° C. The atmospheric CO. concentration has risen to 385 ppm, much higher than at any other time in history, resulting in global CC that is linked to the causes of desertification[3].

As NASA, reported that the world average temperature is increasing from time to time and its affects our surroundings from longer drought seasons and warmth waves to more aggressive hurricanes. Moreover, the rise of the earth's average temperature generated GGE that caused a variety of problems on our environments. GGE are very capable in trapping hotness into the atmosphere and therefore the main contributor to global CC in the world[4]. The emitting of CO_2 from volcanos led to extend global CC in natural systems. On the other hand, an outsized amount of global CC happens by human activities, due to burning fossil fuels which increases gases like CO_2, methane, and a few other gases within the atmosphere[4]. The world population depends on burning of fossil fuels to a large degree, and gas for 80 % of its energy needs which makes it very difficult to use the other energy sources instead of fossil fuels. Therefore, in recent time the emission of GGE has amplified intensely from the economic revolution, regularly from the burning of fossil fuels for energy, agriculture, industry, and transportation that make a huge amount of global CC.

Globally, desertification is a quiet and imperceptible disaster that's threatening societies[5]. It damages the surroundings and diminishes the potential productivity of agricultural lands and forest lands. This affects the livelihoods of the local communities. The United Nations Convention to Combat Desertification shows that: quite 1.5 billion peoples 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, Agricultural yields

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might drop up to 50 % in a few African countries. Furthermore, 52 % of the arable land is harshly degraded and 2 billion hectares of productive land become barren per annum because of desertification and drought alone, which is adversely affect about 1.5 billion peoples[6].

Desertification is a series environmental matter that has been a subject of political, social, economic, and scientific debate[7], and targeted under Sustainable Development 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 of the Sahara[8]. However, this perception seemed to be wrong, and many of debate have arisen about the definition of desertification, causes, occurrences and its impacts on the dryland environments. The different clarifications and misperception about desertification and alarming numbers on the degree of desertification were issued. Approximately, half of the dry lands are affected to some extent by desertification[9], and these numbers were deeply criticized by scientists essentially 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. Some study revealed that, in the arid environments, there's a touch organic matter (OM) that would provide binding force for soils, making it susceptible to wind erosion[10]. Many people particularly, farmers are forced to maneuver from their lands that are previously barren. Additionally, the finding of[5] 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 are the indication 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 be made that exacerbating things. In many dry lands, biodiversity is currently undergoing dramatic changes which may ultimately causes of desertification[11]. It is often assumed that the losses of species richness, the declining of ecosystems and the invasion of latest species, will continue and might accelerate in the future. These changes are primarily associated to human activities directly or indirectly.

Land degradation through erosion, nutrient depletion and loss of OM, acidification and salinization express the occurrence of extreme desertification[12]. Plants, animals and microorganisms which form the living elements of the dryland environments are also removed due to desertification. When plants, animals and microorganism are lost, from the surrounding, it's very likely that is lost forever[13]. Even if some species and genes are adapted to the drier conditions but, the loss percent of species is higher. The severe affects are remarkably seen in reduction of the biodiversity range, forest and wildlife ecosystems. The objective of this review article was to evaluate the causes and consequences of CC led desertification and the possible actions to reduce biodiversity loss.

Development

Concepts of desertification and biodiversity. The degradation of land in dry environments, a phenomenon that's strictly intensified by drought is named desertification[14]. 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 includes: erosion, bush encroachment, soil salinization and depletion of soil nutrients and the accumulation of pollutants within the soil[15]. It's predictable that bush encroachment alone currently transforms into economic losses of quite N$700 million per annual in the world.

Worldwide, communities became worried about the complications of drought and land degradation. The first conference of (UNCOD) in 1977 was organized at Nairobi to debate and formalize the occurrence of desertification[9] defined desertification as: the reduction of biological and physical parts of 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, plant and animal production that used for various purposes.

Desertification may be a term which describes the degradation of productive 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 factors including: climatic factors and anthropogenic activities[16]. The results of desertification are barren and unfruitful land that can't be used for crops and other agricultural productions and has slight importance of biodiversity. It's a serious challenge and threat facing sustainable development in a few parts of African countries and totally in the world. The issues have an effect on human health, food security, economic activity, natural resources, and therefore the environment both national and global security is additionally suffering from desertification[17]. Land degradation expresses itself through erosion, water scarcity, reduced agricultural productivity, loss of vegetation covers and microorganisms, drought and poverty.

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 social welfare[9]. Even though, desertification is an 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 was now alleged to be chief causes of desertification and land degradation. Consistent with[18], desertification is increase environmental degradation that happens when the water balance 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[19]. Drought, rain patterns, increasing temperatures and global CC contribute to the drying arid environments, and thus the areas are enormously sensitive to human beings. About 10-20 % 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 response effects that led the loss of biodiversity also as other negative consequences that affects us and therefore, desertification is caused by several human activities and natural systems.

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 of various infrastructure and industries were identified as the main drivers of desertification[20,21]. They're also identified that the crucial driver of land degradation and developing consumption of land-based resources, for instance through deforestation and agricultural expansion which accelerated by human being activities.

The conversion of forest, rangeland, and woodland ecosystems into cropland due to increasing food demand is one among the driving forces of deforestation that causes desertification[22]. 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[23]. Moreover, the demands of food might be seen by finding food from other areas which increase the pressure on lands at the place where the food importing.

Labor mobility is another drive which will interact with environmental changes. Emigration will have numerous effects on desertification and also it increases a direct pressure onto dry land; if it results in dependency 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 might certificate land alliance, gradually resulting in modernization and agricultural amplification[24]. This raises the costs of labor and sustainable land management processes which make less obtainability of rural agricultural labor. Emigration raises the burden ashore if higher labor that rural 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[25]. However, the net effects of those reverse techniques are various within 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 of economic encouragements for sustainable land managements also contribute to desertification[22,26]. It also serves as the causes of unmanageable land use systems and that they do play a crucial role in restraining answers for global CC adaptation and mitigation. However, there's no strong suggestion that these factors are going to be significantly suffering from global CC.

The expansion of agricultural land in various regions is counted as a significant 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 other ecosystems 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 %), Rwanda and Central African Republic (90 %), Mozambique (89 %), Burkina Faso (87 %), Benin (86 %), and Madagascar and Niger (85 %)[27]. It is frequently accelerating the process of desertification due to a little trivial issue like high levels of poverty, the increment of human population, poor natural resources tenure and access regimes and conflicts within the region.

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 a great process which is extensively covered a wide areas[21]. 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 revealed might be inacceptable[28]. Those drivers are concerning to the precise processes of land degradation and also as desertification under global CC.

The removal of top soil by water, winds, which is often caused by improper farming activities like tillage, is resulted in land degradation[29]. The worldwide approximations of soil erosions are varying based on the supported scale, study period and the technique we used. According to the study of[30] soils erosion is ranging approximately from 20 Gt yr^{-1} to quite 30 Gt yr^{-1}. The significant changes in CC led to extend 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 microorganisms and fertility related with reduction of soil depth, nutrients, OM and therefore the deterioration of water quality[31].

Hydrological change due to climate variations results soil salinization by growing the mineralized groundwater. Minor salinization happens after the concentration of dissolved salts in water 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 seawater interruption are upgraded by global CC. The warming of environments is projected to hasten soil organic carbon turnover, subsequently the decomposition of the soil OM by microbial activity starts with little soil water availability, which is inadequate for agricultural production[32]. Soil organic carbon is additionally lost due to erosion[33] and a few dryland areas resulting in the decline of organic carbon and therefore the removal of carbon from soils.

The irregularities of sea surface temperature change the rainfall patterns, and this implication helps to the occurrence of desertification. While the variances of eastern tropical Pacific sea surface temperature have indirect correlation with Sahel rainfall; the North Atlantic sea surface temperature are positively correlated with Sahel rainfall irregularities[11,34]. A cooler North Atlantic is linked to a drier Sahel and this relationship improved there's an immediate comparative warming of the South Atlantic. The association among sea surface temperature differences and satellite observed Sahel vegetation dynamics is parallel. The results of[35] shows that a cooling of the North Atlantic played a task almost like 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 most drylands areas, because bare soil is extremely vulnerable to water erosion[36]. The rising of CO. levels due to heating favour more rapid expansion of a few invasive species in our surroundings. For instance, the good Basin region in western North America where over 20 % of ecosystems are significantly altered by invasive species, particularly exotic grasses and conifers, leading to loss of biodiversity. Such type of land-cover conversion has declines the forage availability, wildlife habitat, and biodiversity in general[37].

Wildfire is another cause of desertification that decreases biodiversity and increases erosion of soil which resulting to reduce fertility of soil and affects the microorganisms of the soil. The increases in temperature and therefore the severity of drought events across some dryland regions can increase the probabilities of wildfire occurrence[38]. In the dry environmental condition, wildfire profound an impact observed on vegetation, mainly the relative abundance of grasses is decreases. Globally, the massive doubt exists regarding to the tendencies of droughts as examining by[39] and therefore the dry lands exposes an outsized inter-annual variability that increasing dryland areas suffering from droughts since 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.

Impacts of desertification

Impacts of desertification on 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 CO_2, methane, laughing gas and other GGE. These resulted to trap the warmth from radiation within the upper layers of the Earth's atmosphere. The subsequent worries linked to the impacts of desertification on the natural ecosystems. These threats are often interrelated and may exacerbate several their existing threats to wildlife like habitat loss and fragmentation, invasive species, and diseases.

The Ecosystem services in dry lands are vulnerable to the impacts of global CC due to high variability of temperature, precipitation and OM. The process of desertification like erosion and salinization has negatively impact on the provisioning of ecosystem services in dry environments, predominantly in food production[40]. CC 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 an extensive droughts[41]. Increasing in temperature features has a direct impact on animals' physiological stress[42]. 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[43]. For example, groundwater reserves are reduced, with the very greatest rate of estimated reductions of 145 m^3 yr^{-1} between 2000 and 2008. Various dry areas 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[44].

Globally, desertification can influence the amount of atmospheric CO.. 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 system often cause the reductions of OM inputs into soils[45], which increasing soil salinity and erosion. Furthermore, the loss of soil OM thereby influences the capacity 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[46].

The releasing of carbon into the atmosphere for different sites located in Mongolia, China and North America due to the decreasing of rainfall annually[47]. Similarly, the availability of soil water encourages soil microbial respiration, however there's insufficient moisture to stimulate plant productivity, which affecting the emissions of carbon at an ecosystem level. 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 the Southern hemisphere semi-arid ecosystems can contributed 51 % of the worldwide net carbon sink[48]. Conversely, dry lands are mostly projected to be warmer with an increasing rate of utmost drought and high rainfall events[49].

The reduction of flora covers due to desertification, changes the soil surface, which affecting the albedo and therefore the water balance. The losses of soil particles by wind erosion lead to reducing the power of soil to sequester carbon[50]. Besides, dust storms decrease 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 to soil. Dust storms are also influence the yields of crops by reducing the number of water availability for irrigation and they will decrease the storage capacity of reservoirs by siltation, and block transportation canals[51]. 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.

Biodiversity loss. The biodiversity we see today is the consequence of thousands years that formed by natural processes and gradually influence of human beings[52]. 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[53]. As[54] revealed that, the most sources of biodiversity loss are land use changes, usually related with increasing populations, unsustainable management and exploitation of natural resources, invasive species, global CC and pollution. Whereas these are the immediate sources of biodiversity loss and the underlying problem is that biodiversity is typically not fully accounted by consumers within the market place, 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 CC led desertification[22]. 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, these trends were observed in the desert of Mongolia[55]. 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[56].

Many species in the dry lands are exposed to 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[57]. Mammals and birds were sensitive to droughts since they believe evaporative cooling to preserve their body temperatures within an optimal range and risk dehydration in water scarcity environments[58]. 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.

The consequence of Biodiversity loss

Farming becomes impossible. If an area 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 clean and 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. A person without food and water are harder to measure and those 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 of temperatures 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 cold water. 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[59]. Similarly, the rising of water level recorded over the past 40 years is liable for the loss of 28 % of the mangrove ecosystem. *Range Shift.* The plant species and animal's ecological communities are shifting because the planet warms. Some species are ready to adapt and move whereas, others cannot, and these will disappear with their habitat. A source of water, like springs, has dried up due to the disappearing oak trees and invading pines[60]. *Invasive species.* Change in climate and invasive species are two major threats to biodiversity. Global CC will deliver new ways for invasive species encroach on the new 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.

Impacts on socio economic systems. The impacts of desertification due to global CC and human factors are challenging to separate from the consequences of other socio-economic, institutional and political factors[61]. There's high agreement that global CC will intensify the susceptibility of dryland environments. The matter occurring from CC led desertification will decrease the opportunities for reducing poverty, enhancing food and nutritional security, reducing disease burden, and improving access to water and sanitation. The 2015 United Nations Development Programme shows CC and desertification is embedded under sustainable development goals 13 and 15 respectively. The high impacts on sustainable development goals indicate that the interactions among CC and desertification strongly affect the achievement of sustainable development goals 13 and 15 which targeting the coordination of land 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. Most of the investigation showed that the links among poverty, CC 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 & Sarpong[62] projected that land degradation due to CC reduced 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 % in Malawi and 48 % in Tanzania[63].

Desertification was found to possess resulted in significant losses of income, food production and lack of jobs in China[64]. In rare cases desertification was positively related to growing incomes in Inner Mongolia within the short run since no costs were invited for sustainable land management; while higher incomes allowed for the allocation of investments to reverse desertification in the long run process[65]. This association agrees to the Environmental Kuznets Curve, which suggests that initially environmental degradation rises and consequently falls with rising income[66]. 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[67]. Additionally, the worldwide number of food insecure people rose by 37 million since 2014. The changes in global climate, 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 a very preeminent share of starving populations within the world in 2017, with 28.8 %, 31.4 % and 33.7 % respectively[67].

The key mechanism which global CC led desertification affects food security is through reducing agricultural productivity. There's strong indication to the negative impacts of global CC on crop yields in dryland environments[68]. Additionally, there are the highest losses in agricultural productivity which reduces the incomes of local community due to desertification[63]. Consistent with the study of[69] projected that cultivating of wheat, maize, and rice with unmanageable practices 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 the 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[70], broader Middle East[71] and Central Asia[72], have a negative impact on human health. Dust storms serve as transportation pollutants, particulate matter, pathogens and potential allergens that are dangerous for human body. Particulate matters affect human health which is found at the suspended particles within the air up to 10 micrometres or fewer in size[73].

The impacts of dust storms cover largest areas where the immediate vicinity of their origin, predominantly the Sahara, followed by Central and eastern Asia, and Australia[10]. Within the countries of the Sahara region, Middle East, South and East Asia, dust storms were proposed to be the explanation for 15-50 % of all cardiopulmonary deaths[74]. Additionally, the occurrence of water and food-borne diseases, respiratory diseases and the wide spread of infectious diseases are the result of CC led desertification.

Actions to reduce the effect of desertification

The prevention of desertification. Expanding protected areas is one among the foremost important strategies to minimize the increasing human pressure on ecosystems services[75,76]. The indigenous management and macro policy approaches are also the effective prevention of desertification that encourages the 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 the level of desertification which 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 in policy decisions.

Despite this the worldwide network of protected areas is simpler at protecting the foremost susceptible species than one would expect supported area alone[53]. 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 than people 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 the eradication of utmost poverty and hunger. It has various local and global benefits and help to mitigate global CC and minimize the loss of biodiversity. Similarly, Environmental management approaches for opposing desertification, global CC mitigation and adaptation, and conserving biodiversity are interlinked.

The potential actions to impede desertification. In order to solve the impacts of global CC or desertification, some potentials measures recognized which is named CC adaptation and mitigation. It includes the utilization of carbon capture & storage technology and trading plants for carbon, breeding of fuzzy-leaved crops and irrigation techniques for cooling the atmosphere. In addition, global CC adaptation through a multi-dimensional and multi-sectoral approach became vital strategies to conversant in CC as a result of inequalities among the developed and developing nations in terms of limited capital resources and expertise to use technologies[77]. The results recorded thus far through these efforts are hopeful but, they need not been ready to significantly reduce the increase in atmospheric temperature, especially within the developing countries.

CC mitigation approaches are 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 the skills to use such technologies. CC and desertification is clearly a danger to humanity and effective policy options that required for tackling hurdles and barriers are serious to CC adaptation and mitigation. Several outlines are developed to support policymakers and scientists to recognize fences that would delay to global CC adaptation and mitigation[78,79]. The authors maintained 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 many issues like bio-physical, socio-economic and cultural aspects[80] 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[81]. The long-term experience and active innovation can stay before desertification affecting agricultural and grazing practices during a sustainable way at the dryland areas. The following actions must be addressed to tackling desertification: CC adaptation and mitigation, through the reduction of CO. at source and proactively avoiding land degradation, through reactively falling and rehabilitating desertified environments[82,83]. The proactive approach includes: i) Incorporating land and water management practices to protect soils erosion, salinization, and other forms of land degradation. ii) Protecting vegetation cover, which can be a major mechanism for soil conservation against wind and water erosion. iii) Assimilating the use of land for grazing and farming where conditions are favorable, permitting for more efficient cycling of nutrients within the agricultural systems. iv) Using a traditional practice which is locally suitable and adapted land use technologies. v) Increasing the capability of local communities to stop desertification and to manage dryland resources efficiently. vi) Using a substitute livelihood that do not depend on traditional land uses, like dryland aquaculture, greenhouse agriculture and tourism-related activities. vii) Forming economic opportunities in dryland urban centers and in areas outside of dry lands. viii) 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[84]. Therefore, both local and scientific skills are often expert and may be challenged. The cooperation of local stakeholders and scientists is required during study in which both can learn from one another. When the desertification process has already started within the area, current pressures on the ecosystem like global CC, overgrazing, and large-scale irrigation may cause further desertification. To revive the dryland ecosystems some interventions can apply[83,85]. This intervention is named reactive approaches that used to restore desertified environments and it includes: i) Diversify production of crops and animals, avoid monocultures. ii) Enrich soil with OM. iii) Reforestation. iv) Reintroduce selected species and control of invasive species. v) Reduce the 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. vi) Using plant and animal species that adapted to changing climate conditions. vii) Afforestation.

Conclusion and recommendation

CC and desertification is certainly an exterior shock to the world that resulted 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 GGE by human activities has faster the movement of global CC or desertification and made our surroundings more unsuitable. 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 caused by social, political, and climatic factors that subsidize to an unsustainable use of 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 of desertification processes, which sometimes avoid cost-effective actions in affected areas.

The occurrence of dust storms which influence thousands of kilometers far away from the desert areas and cause political and social problems due to the migrations of human 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 handle desertification. The rehabilitation of degraded areas is also expensive 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 CC. Scientists, environmentalists, communities and also policy makers got to work cooperatively to measure up to those large problems and fight against CC and desertification. Ecosystem management approaches targeting to combat desertification are interlinked, to global CC mitigation, and conservation of biodiversity. Thus, the combined implementations of major environmental agreements can result to increased cooperation and effectiveness, that helping dryland population.

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