A Review Of The Effects Of Desertification On Food Security

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ABSTRACT: Desertification is the process of destruction of the biological potential of land that can ultimately lead to desert-like conditions due to widespread deterioration of ecosystems under the combined pressure of adverse and fluctuating climate and excessive exploitation of the land. It is an advanced stage of land degradation where soil has lost part of its capability to support human communities and ecosystem. The main causes of desertification are climatic variation (drought) and human activities which include extensive agriculture, deforestation, overgrazing and urbanization. Desertification can results to land degradation leading to decreased productivity of the arable land, resulting to a serious threat to the environment, agricultural sustainability and human welfare. It is directly linked to deterioration of soil health which in turn affects crop productivity and sustainability, causing food insecurity. Reduction in food availability, use and accessibility can be attributed to the deleterious effects of desertification. Approaches for combating desertification include planting of trees, landscape restoration, application of fertilizers on the soil etc. Furthermore, International Organization and governments at national, state and local level should enlighten the general public on the effects of desertification on food security.
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1. INTRODUCTION

Desertification was first defined in 1949 by Aubreville as the process of transformation of productive land anywhere, into an ecological desert due to the ruinous act of erosion, often impelled by manmade deforestation (Aubreville, 1949). It can also be defined as the process of diminution or destruction of the biological potential of land that can lead ultimately to desert-like conditions and is the great aspect of the widespread deterioration of ecosystems under the combined pressure of adverse and fluctuating climate and excessive exploitation of land (UN, 1978). It is an advanced stage of land degradation where soil has lost part of its capability to support human communities and ecosystem (Pienaru *et al.*, 2009). According to United Nation Convention to Combat Desertification (UNCCD), desertification is defined as land degradation in arid, semi-arid and humid areas resulting to various factors, including climatic variations and human activities (UNCCD, 1997).

The direct effect of land degradation is either a decrease of land productivity or complete abandonment of agricultural land, which leads to the food crisis confronted by arid regions. Severe soil degradation may ultimately result from complete desertification (Cao *et al*., 2001). One quarter of the earth's surface is threatened by desertification-an area of over 3.6 billion hectares (Sheikh and Soomro, 2006). Since 1990, 6 million hectares of productive land are lost every year due to land degradation and the world's drinking water supplies have fallen by almost two thirds since 1950 (Sheikh and Soomro, 2006). Every year, 12 million people die as a result of water shortages or contaminated drinking water (Sheikh and Soomro, 2009). Desertification threatens the livelihoods of one billion people and has already made 135 million people homeless (UNEP, 2005).

1.1 Global Status Of Desertification

Over 200 billion people are directly affected by desertification and one billion people in over 100 countries are at risk (Sheikh and Soomro, 2006). Two-thirds of the world's degraded lands are found in Asia and Africa, but human-induced degradation is most severe in Africa, where 30% of the agricultural land, pastures, forests, and woodlands are degraded, followed by Asia (27%) and Latin America (18%) (Per and Rajul, 1995). Worldwide, desertification renders approximately 12 million hectares useless for cultivation every year.

Africa contains a substantial portion of the world's arid and semi-arid rangeland, extending over three million square kilometres (Oba and Lusigi, 1987). These arid zones support an estimated 16-22 million pastoral population and nearly 500 million head of livestock (Widstrand, 1975). Recurrent drought and famine are common features of African rangelands and these have been vividly illustrated in the Sahelian drought of 1969-1973 and 1983-1984 which has claimed numerous lives as well as affect the productivity of the agricultural lands (Oba and Lusigi, 1987).

Table 1: Global Status of Desertification in Agriculturally Used Dryland

Total Agriculturally used Dryland (m/Ha)			
Continent	Total	Degraded	Percentage
Africa	1433	1046	73%
Asia	1881	1312	70%
Australia	701	375	54%
Europe	146	94	65%
North America	578	428	74%
South America	421	306	73%
Total	**5160**	**3562**	**69**

Source: Adapted From Dregne *et al.* (1991)

Around the turn of the century, West Africa had some 193,000 sq. miles (500,000 sq. km) of coastal rainforest (www.mongabay.com/rates-_africa.htm). However, the tropical forests of West Africa, mostly lowland formations easily accessible from the coast, have been largely depleted by commercial exploitation, namely logging, and conversion for agriculture. According to the FAO (1997), only 22.8% of West Africa's moist forests have not been degraded. In most developing countries, notably Nigeria, human population pressures have put a tremendous strain on forests, while other countries like Cote d'Ivoire have suffered extensive forest loss as a result of commercial logging and agriculture.

In some developing countries eg Nigeria, research findings have indicated that the desertification occupies between 35% and 40% of the land mass of the frontline States of Borno, Yobe, Jigawa, Kano, Katsina, Zamfara, Sokoto and Kebbi. The African Institute for Applied Economics, AIAE, had estimated that in 2005 Nigeria had lost about N180 billion annually to deforestation. The AIAE hinged the destructive trend to crop land expansion and the felling of trees for fuel. Northern states like Katsina, Jigawa, Kano, Borno, Sokoto, Adamawa, Taraba, Niger, Kaduna, Kebbi and some parts of Plateau has recorded some notable ecological and desertification problems. They face problems like water scarcity and stress desertification, crop failure, loss of livestock, famine, malnutrition and distress migration

2. CAUSES OF DESERTIFICATION

Desertification is an ecological problem which is results generally from the interaction between people and the environment. The causes of desertification include

2.1 Climatic Variations

Drought is a naturally occurring phenomenon that exists when precipitation has been significantly below normal recorded levels, causing serious hydrological imbalances that adversely affect land resource production systems (UNCCD, 2011). Drought is one of the main causes of desertification. It can be attributed to inadequate seasonal precipitation, a prolonged dry season or a series of sub-average rainy seasons (Sheikh and Soomro, 2006). Continued land abuse during droughts, however, increases land degradation.

2.2 Human Activities

Four major human activities that are regarded as the most immediate cause of desertification include the following:

I. Extensive Cultivation: Due to the rapid growing human populace, there is an increase in the cultivation of crops in order to meet up with the food requirements of the populace. This has led to land over-utilization for cultivation and thus causing land degradation.

II. Deforestation: Deforestation is illegal cutting down of trees resulting to non-forest areas for urbanization, agriculture and for some other reasons such as logging. Report put it that the world current rate of deforestation is 160,000 square kilometres per year which equates to a loss of approximately 1% of the original forest habitat each year. Deforestation, however, destroys the trees that bind the soil to the land.

III. Overgrazing: Overgrazing is common in the areas that depend mostly on rearing of animals for their upkeep and living. However, overgrazing removes the vegetation cover that protects soil from erosion (UNCCD, 2011). Apart from the degradation of natural vegetation cover, over-grazing results in a decrease in the quality of rangelands (Sheikh and Soomro, 2006).

IV. Urbanisation: Due to the rapid economic growth, there is an increasing trend in the rate of urbanization especially in the developing countries. There is no problem with urbanization, but most of them are always observed without proper environmental impact assessment of the proposed developmental project. The problem of superimposing developmental projects without preliminary impact assessment on environment is more severe and complicated in developing world. Places with rapid

urbanization are always denuded of total vegetation making land totally degraded due to desertification.

3. CONCEPT OF FOOD SECURITY

Food security in its most basic form is the access of all people to the food needed for a healthy life at all times. It refers to the availability of food and one's access to it. A household is considered food-secure when its occupants do not live in hunger or fear of starvation (FAO, 2006). Food security for a household means access by all members at all times to enough food for an active, healthy life. Food security includes at a minimum (1) the ready availability of nutritionally adequate and safe foods, and (2) an assured ability to acquire acceptable foods in socially acceptable ways (that is, without resorting to emergency food supplies, scavenging, stealing, or other coping strategies) (USDA, 2008).

The stages of food insecurity range from food secure situations to full-scale famine. Famine and hunger are both rooted in food insecurity. Food insecurity can be categorized as either chronic or transitory. Chronic food insecurity translates into a high degree of vulnerability to famine and hunger; ensuring food security presupposes elimination of that vulnerability.

Food security should not be seen only from the perspective of availability as earlier mentioned either in quantitative or qualitative terms. In essence, a country should be considered as food-secure when food is not only available in the quantity needed by the population consistent with decent living, but also when the consumption of the food should not pose any health hazard to the citizens.

3.1 Pillars of Food Security

The WHO states that there are three pillars that determine food security: food availability, food access, and food use (WHO, 2003). The FAO adds a fourth pillar: the stability of the first three dimensions of food security over time (FAO, 2006). In 2009, the World Summit on Food Security stated that the "four pillars of food security are availability, access, utilization, and stability" (FAO, 2009)

3.1.1 Food Availability

Food availability relates to the food supplied through production, distribution, and exchange (Gregory *et al*., 2005). Food production is determined by a variety of factors including land ownership and use; soil management; crop selection, breeding, and management; livestock breeding and management; and harvesting (FAO, 1997). Crop production can be impacted by changes in rainfall and temperatures (Gregory *et al*., 2005). The use of land, water, and energy to grow food often competes with other uses, which can effect food production (Godfray *et al.*, 2010). Land used for agriculture can be used for urbanization or lost to desertification, salinization, and soil erosion due to unsustainable agricultural practices (Godfray *et al.*, 2010). Food distribution involves the storage, processing, transport, packaging, and marketing of food (FAO, 1997). Food-chain infrastructure and storage technologies on farms can also impact the amount of food wasted in the distribution process (Godfray *et al.*, 2010). Poor transport infrastructure can increase the price of supplying water and fertilizer as well as the price of moving food to national and global markets (Godfray *et al.*, 2010).

3.1.2 Food Access

Food access refers to the affordability and allocation of food, as well as the preferences of individuals and households (Gregory *et al*., 2005). Poverty can limit access to food, and can also increase how vulnerable an individual or household is to food price spikes (Ecker and Breisinger, 2012). There are two distinct types of access to food: direct access, in which a household produces food using human and material resources, and economic access, in which a household purchases food produced elsewhere (FAO, 1997). Location can affect access to food and which type of access a family will rely on (Garrett and Ruel, 1999). The assets of a household, including income, land, products of labor, inheritances, and gifts can determine a household's access to food (FAO, 1997). However, the ability to access sufficient food may not lead to the purchase of food over other materials and services (Ecker and Breisinger, 2012).

3.1.3 Food Utilization

The final pillar of food security is food utilization, which refers to the metabolism of food by individuals (Tweeten, 1999). Once food is obtained by a household, a variety of factors impact the quantity and quality of food that reaches members of the household. In order to achieve food security, the food ingested must be safe and must be enough to meet the physiological requirements of each individual (Ecker and Breisinger, 2012). Nutritional values of the household determine the types of food that households choose to buy (FAO, 1997). Access to healthcare is another determinant of food utilization, since the health of individuals controls how the food is metabolized (FAO, 1997). For example, intestinal parasites can take nutrients from the body and decrease food utilization (Tweeten, 1999). Sanitation can also decrease the occurance and spread of diseases that can affect food utilization (FAO, 1997). Education about nutrition and food preparation can impact food utilization and improve this pillar of food security (Tweeten, 1999).

3.1.4 Food Stability

Food stability refers to the ability to obtain food over time. Food security can be transitory,

seasonal, or chronic (FAO, 1997). In transitory food insecurity, food may be unavailable during certain periods of time (Ecker and Breisinger, 2012). At the food production level, natural disasters and drought result in crop failure and decreased food availability (Ecker and Breisinger, 2012; FAO, 1997). Civil conflicts can also decrease access to food (Ecker and Breisinger, 2012). Instability in markets resulting in food-price spikes can cause transitory food insecurity. Other factors that can temporarily cause food insecurity are loss of employment or productivity, which can be caused by illness. Seasonal food insecurity can result from the regular pattern of growing seasons in food production (FAO, 1997). Chronic (or permanent) food insecurity is defined as the long-term, persistent lack of adequate food (Ecker and Breisinger, 2012). In this case, households are constantly at risk of being unable to acquire food to meet the needs of all members. Chronic and transitory food insecurity are linked, since the reoccurrence of transitory food security can make households more vulnerable to chronic food insecurity (FAO, 1997).

3.2 Relationship between Desertification and Food Security

As earlier defined, desertification is land degradation at arid, semiarid and dry subhumid areas resulting from various factors, including climatic variations and human activities, leading to decreased productivity of the arable land and resulting to a serious threat to the environment, agricultural sustainability and human welfare. One of the indicators of desertification identified in this definition is agricultural sustainability. Agricultural sustainability further encompasses the availability and sustainable food resources which include livestock and crops in the farms. Higher temperatures, longer droughts, and increasingly frequent and violent storms are predicted to exacerbate the current challenges faced by agricultural productions system. Desertification has a negative impact on sustainable agricultural productivity over time which also has direct effect on the availability and access to sufficient quantities of food for the nation on a consistent basis over time. Furthermore, desertification has a strong and direct relationship with the food security, as desertification leads to decreased agricultural productivity which is a key determinant of food security.

4.0 EFFECTS OF DESERTIFICATION ON FOOD SECURITY

Persistent and substantial reduction in the provision of ecosystem services as a result of drought, intensive agriculture, deforestation and rapid urbanization possess great threats to agricultural productivity. Desertification is directly linked to deterioration of soil health which in turn affects crop productivity and sustainability. Drought, intensive agriculture, deforestation, overgrazing and rapid urbanization takes away with it every year 14 million tonnes of such major nutrients as nitrogen, phosphorus, and potassium form the soils. These effects of desertification on food security have been demonstrated in Ethiopia, Somalia, Kenya and some Sahelian countries (Lewis, 1975; Caldwell, 1977; Kaplan *et al.*, 1977; Cahill, 1980; Hogg, 1980).

According to the FAO (2006), population growth will lead to a 50 per cent rise in the demand for food by 2050. The need to produce more food will increase the risk that land which is unsuitable for intensive farming, or which should be protected to prevent deforestation or biodiversity loss, will be claimed for agricultural purposes; it thus also increases the risk that such land will become more degraded. A growing population cannot afford to lose fertile land, which is essential to food security, biodiversity conservation and climate change mitigation. Given the high rates of population growth in recent decades across the globe, adequate levels of food production has reduced significantly to feed local populations as well as supply maximum food for the growing populace (FEPAE, 2006). However, if the extent of desertification is not reversed in the coming years, food yields in many affected areas are likely to decline.

Drought and land degradation often help to trigger a crisis, which is then made worse by poor food availability and the inability to buy the available food. The relationship between soil degradation and crop yields, however, is seldom straightforward (Huang *et al*., 1998). However, the effects of desertification at the local and international level is the reduction in biodiversity, since it contributes to the destruction of the habitats of animal and vegetable species and micro-organisms. It encourages the genetic erosion of local livestock and plant varieties and species living in fragile ecosystems. Reducing the biodiversity directly affects the food and health of the local people who rely on a large number of different animal and vegetable species. Many genetic strains of cultivated plants which form the basis of the food and health of the world's population originate from the dry zones: their disappearance can affect the possibility of producing plant-based medicines to combat specific diseases or epidemics (Hulme, 2001).

Furthermore, drought, overgrazing, water development without sound ecological considerations and deforestation have all contributed to the deterioration of agricultural lands especially in developing countries. During the drought of 1972 - 73 in the northeastern Nigeria for instance, about 300,000 animals representing 13% of the livestock population

of the region were reported dead, while agricultural yield dropped to between 12% and 40% of the annual averages (Fagbemi, 2002). The effects of drought in terms of reduced food production have been even more severe during 1982 - 84 than 1972 - 74. In some parts of Borno State (Then, comprising Borno & Yobe States) nearly 100% crop losses were recorded (Enabor, 1987).

The term desertification evokes an image of the advancing land degradation leading unfertile lands which may lead to decrease in food availability. The loss of natural resources, environmental degradation and desertification affects food security (UNCCD, 2004). By impoverishing the natural potential of the ecosystems, desertification reduces agricultural yields, making them more unpredictable. It therefore affects the food availability of the people living in the affected areas (Gonzalez, 2001). The poor households that are affected by desertification do not have adequate resources to deal with food shortages leading to food insecurity and hunger that can affects millions of people. The people develop a survival strategy in order to attend to their most urgent requirements, and this in turn helps to aggravate desertification and hold up development. The most immediate and frequent consequence of these survival attitudes is the increased over-exploitation of accessible natural resources

If land degradation continues at the current pace, it is projected that more than half of cultivated agricultural area in Africa could be unusable by the year 2050 and the region may be able to feed just 25 percent of its population by 2025 (FAO, 2006). Agriculture being one of the main economic activities in Africa (which represents around 40 percent of the region's GDP and employs about 60 percent of the active labour force), this would lead to a catastrophe with unprecedented repercussions. The most severe consequence of desertification is loss of adequate crop yield which directly influence the food availability of the nation.

5. APPROACHES FOR COMBATING DESERTIFICATION

At the local level, individuals and governments can help to reclaim and protect their lands. Research on the reclamation of deserts focuses on discovering proper methods of combating the rate of deforestation as well constant removal of the cover grasses from the environment (Bogardi *et al*., 2005). The most effective intervention can come only from the wise use of the best earth-science information available. Researchers have reported that the drought-resistant crops, desert agriculture techniques and use plants, shrubs and grasses to stabilize dunes can help to minimize desertification. Some of the ways of reducing the desertification include the following:

5.1 Planting of Trees and Straw Grids

Trees are planted to prevent erosion, stop destructive sand dunes and provide windbreaks. Tree roots block wind erosion and help rain penetrate the earth. Poplars are ideal desert trees and windbreaks (Herman *et al.*, 1997). They are resistant to winds, salty soils and salty groundwater. Eucalyptus, tamarind, popular, pines and castor plants grow well in arid climates and provide windbreaks. Sometimes they had grown in rows around oasis towns to prevent them from being swallowed up by dunes. Grids of straw are used to stabilize dunes and stop sand from blowing. Arranged roughly in one-meter square checkerboards, the grids are pressed into the sand, so this stalk stand four to six inches above the ground (Hulme *et al*., 2001). This creates enough of a windbreak to slow surface sand movement, allowing plants to establish themselves The technique was devised to keep sand from blowing across railroad tracks,. This was once a serious problem, blocking tracks and slowing commerce and passenger service. Straw grids decrease the surface wind velocity (Desanker *et al*., 2001). Shrubs and trees planted within the grids are protected by the straw until they take root. In areas where some water is available for irrigation, shrubs planted on the lower one-third of a dune's windward side will stabilize the dune (IPCC, 2001). This vegetation decreases the wind velocity near the base of the dune and prevents much of the sand from moving. Higher velocity winds at the top of the dune level it off and trees can be planted atop these flattened surfaces.

5.2 Landscape Restoration

Forest landscape restoration is a process which holds great promise globally for combating deforestation, desertification and global warming and it involves replanting of native vegetation and restricting grazing and over use to rejuvenate land to support local agriculture. The new vegetation also reduces flooding by anchoring the region's soil and acts as a large carbon sink by sucking in carbon dioxide. Landscape restoration is a slow, complex and painstaking process (Schlesinger *et al*., 1990). Because ecosystems vary based on geography, and lasting success depends on the support of local residents, the process is pesteringly cross-disciplinary. Any forest landscape restoration project requires the know-how of engineers, ecologists and soil scientists and an understanding of local economics and politics. It is becoming harder to deny the importance of forest landscape restoration in combating climate change (Wang *et al*., 2000). A new study by the World Resources Institute shows that about 1 billion hectares of land could be restored across the globe. Rough estimates indicate that carbon sequestration through this process could eliminate 50 percent more carbon

from the atmosphere than a proactive cessation of deforestation could (UNDP, 1997).

5.3 Application of Fertilizer in Low Productive Farm Land

Fertilizer is either organic (natural) or inorganic (synthetic) material that is added to the soil to improve the nutrients essential to the growth of plants. The main advantage of fertilizer is that it aids in improving the fertility of the soil. In an arable land with low productivity, application of fertilizer can be used to improve fertility of the soil which directly improves agricultural produce of the farm land.

CONCLUSION

Deserts all over the world are known to be increasing at the expense of agricultural land and this is most severe in arid and semi-arid regions of the developing countries. Intensive farming often leads to a vicious cycle of exhaustion of soil fertility and decline of agricultural yields. Approximately 40% of the world's agricultural land is seriously degraded. However, this problem of desertification can be averted through afforestation programme, landscape restoration and the application of fertilizers on the soil in order to enhance the fertility of the soil.

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