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Causes and Economic Consequences of Desertification in Sudan

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ABSTRACT
Desertification is a significant global ecological and environmental problem that affects negatively all aspects of life. It is caused by a number of factors that change over time and vary by location. This paper attempts to shed light on the economic consequences of desertification in Sudan. The paper relies heavily on secondary data. The paper finds that desertification in Sudan is caused by both natural factors and human factors. Desertification leads to poverty, hunger, displacement, flooding, water scarcity, illiteracy, and spread of diseases, increase of infant mortality and morbidity and loss of herds. It affects negatively livelihood of citizens, cultivable land, soil, Gum Arabic production belt, land productivity and extinction of wildlife. It is recommended that, Awareness programs and trainings on rational utilization and proper management of natural resources are to be conducted to build the capacity of local communities. Efforts should be made by government, organizations and local communities to conserve natural resources. Proper and sustainable forest management is highly needed. Basic services should be provided by the government and international community to the people of the affected areas and this would contribute positively to poverty reduction.
***Keywords**: Causes, Consequence, Desertification, Sudan, Land degradation.*

INTRODUCTION

Sudan covers 1.9 million square kilometers of land making it the 16th largest nation in terms of land area. Its population was estimated at 39.6 million in 2016. Sudan is characterized by different climatic zones and all of them are liable to desertification which is regarded as an obstacle to achieving sustainable development (Maha and Mustafa, 2015). The country is 29 percent desert, 19 percent semi-desert, 27 percent low rainfall savanna, 14 percent high rainfall savanna, 10 percent flood regions and less than 1 percent mountain vegetation (Mutasim,2008). Irrigated agriculture, mechanized rain fed agriculture and traditional rain fed agriculture are practiced in Sudan. Livestock in Sudan includes camels, cattle, sheep, and goats and it is regarded as one of the largest livestock population in Africa. Natural disasters such as droughts, floods and desertification experienced in Sudan. The majority of Sudan's population (over 80%) lives in rural areas depending on agriculture and livestock. Severe droughts affected the country between 1886 and 1984 (Amna and Yahia, 2009).

Desertification is a significant global ecological and environmental problem from which many countries around the world suffer. It affects negatively environment and all aspects of life and it constitutes social, economic, environmental and health challenge (Abdul Gafoor and Siham, 2013). Desertification affects topsoil, groundwater reserves, surface runoff, human, and animal and plant populations. Water scarcity in dry lands limits the production of wood, crops, forage and other services that ecosystems provide

to our community. (www.conserve-enrgy-future.com). Pessimistic studies stipulate that around one third of the cultivated land in the world will go out of cultivation, due to desertification in the 21st century .Different international and regional organizations make considerable efforts to combat this danger. (Abdul Gafoor and Siham,2013). Desertification has played a significant role in human history, contributing to the collapse of several large empires, as well as causing displacement of local populations. Desertification level in Sahel region is very high compared to other areas in the world and droughts are the rule in this region (https://en.wikipedia.org). Climatologically, the Sahel is characterized by frequent droughts - low, poorly distributed and highly variable monthly and seasonal unpredictable rainfall (Omer et.tal 2013).

Sudan is the most seriously affected country by desertification in Africa. Throughout the 20th century, the climate reported to be changing noticeably and the rate of deforestation and forest depletion in Sudan are continuously increasing (Abdelmagid et.tal 2008).Desertification in Sudan has been accelerating at a faster rate over the last two decades leading to marginalization and loss of arable land. Factors such as drought, population growth, and spread of extensive agriculture, deforestation, and rapid urbanization, loss of local political power and lack of political institutions contribute to desertification in Sudan (Laki, 2009). Deserts have spread southwards by an average of 100 kilometers over the past four decades (World Watch Institute, 2017). The aim of this paper is to examine the causes and economic consequences of desertification in Sudan. The rest of the paper is structured into A literature review, methodology, Analysis and discussion and conclusion.

CONCEPTS AND LITERATURE REVIEW

Concepts of Desertification

United Nations Conference on Desertification has induced numerous definitions of desertification depending on different concepts used. Desertification is the intensification or extension of desert condition leading to reduced biological productivity, with consequent reductions in plant biomass, in the carrying capacity, for livestock, in crop yields and human wellbeing. Desertification is the development of desert like landscape in areas in which were once green. Its practical meaning is a sustainable decline in the yield of useful crops from a dry area accompanying certain kind of environmental change, both natural and induced (Abdalmohsin,2015). Desertification is the spread of desert-like conditions in arid and semi-arid conditions. It is a result of pressure from both climatic and human factors (Laki, 2009). Desertification is the deterioration of the fertility of the soil in areas which are arid or semi-arid and dry or semi-dry. It is mainly due to climatic changes and human activities. Desertification is a process which destroys the vital bio – energy of the land, causing the deterioration of the environmental system by causing it loses its balance (Abdul Gafoor and Siham ,2013). Desertification is a type of land degradation in which relatively dry area of land becomes increasingly arid, typically losing its bodies of water as well as vegetation and wildlife. It is caused by a variety of factors, such as through climate change and through the overexploitation of soil through human activity (https://en.wikipedia.org).

Desertification is conversion of grassland or an already arid land into a desert through indiscriminate human actions magnified by droughts. Such actions include overgrazing, repeated burning, intensive farming, and stripping of vegetation for firewood (http://www.businessdictionary.com). Desertification is land degradation in arid, semi-arid and dry sub humid areas resulting from various factors including climate variation and human activity .This definition is regarded as the most current and the least problematic definition of desertification (Abdalmohsin, 2015). Desert areas are considered as the starting areas from where desertification begins. Desertification breaks out, usually at times of drought stress, in areas of naturally vulnerable land subject to pressures of land use (https://link.springer.com). Land degradation is the result of complex inter-relationships between biophysical and socio-economic issues which affect many people and their land especially in the tropics and developing countries. Land degradation involves both soil and vegetation degradation (Omer et.tal 2013).

Literature Review

Desertification and land degradation constitute a serious environmental problem. Desertification threatens the dry lands of Sub-Saharan Africa more than any other region in the world. In the case of Sudan, desertification and land degradation are among the problems which hinder sustainable development. Human factors such as Over cultivation of croplands, overgrazing of range and pastoral lands, slash and burn techniques, shifting cultivation and inappropriate use of irrigation water are some of the factors which accelerated land degradation in Sudan. Highly populated areas and livestock watering points were the places where signs of desertification first became apparent. Desertification is considered one of the main factors that cause the migration of rural populations to urban centers (Omer et.tal 2013).

The recent increase in population in Sudan led to impoverishment of natural resources of semi-arid zone of Sudan. Transgression of millet cultivation over the agronomic dry boundary is considered as one of the main causes of desertification in Sudan. The high variability of rainfall caused high vulnerability of ecological systems (Abdalmohsin, 2015). Desertification in Sudan had threatened all parts of the country, mainly the irrigated sector, mechanized rain-fed agriculture and traditional rain-fed agriculture. Moreover, desertification is threatening almost all the potentially cultivable land in the country. Large tracts of soils have fallen out of production due to desertification. Similarly, forest lands over the country are threatened by desertification to a very large extent with all consequences on the country's economy (Maha and Mustafa, 2015) . The rates of deforestation and forest depletion in Sudan are continuously increasing. People living in the rural and urban areas illegally access forests for collection of wood and non-wood forest products and on crop cultivation to sustain their livelihood (Abdelmagid et.tal 2008). The population in the rural areas of Sudan relies heavily on natural resources for subsistence and this caused serious land degradation. Desertification is a man made problem through misuse and mal practices of natural resources. Land degradation is accompanied by degradation of human well being and social prospects. Climate is the second causal agent of desertification. The frequent severe droughts that hit Sudan led to famine and human displacement. Overgrazing is the most prevalent cause of desertification in almost all over Sudan. Sudan with its rich

livestock is vulnerable to desertification through overgrazing. Other factors such as deforestation, over cultivation, cultivation of marginal lands, irrational use of heavy machinery and bush removal contribute greatly to desertification (Ministry of Agriculture and Forestry, 2006). Improved cultivation methods, rational grazing management, reforestation and integration of livestock and crop production systems, coupled with good linkages to light processing industries are needed to control desert encroachment (Laki, 2009).

METHODOLOGY

This paper relies heavily on secondary data. The data used is generated from secondary sources such as textbooks, journals, papers, newspapers, magazines, publications, studies conducted by researchers and websites. Descriptive statistics is used to analyze the data.

ANALYSIS AND DISCUSSION

Causes of Desertification

Desertification is caused by a number of factors that change over time and vary by location .The causes leading to desertification in Sudan are natural causes and human causes.

a) Natural Causes

Natural causes include factors related to climate and soil such as low average rainfall, and short rainy season and natural disasters such as drought and flooding.

Climate Change

Climate change is the most important cause of desertification. When the days get warmer and periods of drought become more frequent, desertification becomes more and more (www.conserve-energy-future.com). Sudan's inherent vulnerability to climate change is captured by the fact that food security is mainly determined by rainfall, particularly in rural areas where more than 65% of the population lives. Rainfall is erratic and varies significantly from the north to the south. (Mutasim, 2008). Declining and highly irregular patterns of rainfall in parts of the country (particularly in Kordofan and Darfur states) provides mounting evidence of long-term regional climate change. In Northern Darfur, precipitation has fallen by a third in the past 80 years (World Watch Institute, 2017).Sudan experienced drought and floods in addition to other climate events such as dust storms, thunderstorms and heat waves. Climate change in Sudan affects negatively agriculture and forestry sector, water sector and health sector and it leads to adverse social and economic impacts (Mutasim, 2008).

Natural Disasters:

Natural disasters such as drought damage land and people have nothing to do except to work in order to rehabilitate the land which has been damaged by nature. Natural disasters in forms of drought and flooding have historically occurred frequently in Sudan and have significantly contributed to population displacement and desertification. Sudan has suffered a number of long and devastating droughts in the past decades and all regions have been affected (UNEP, 2007).

b) Human Causes

Human causes include, overgrazing, farming practices, deforestation, bush removal and unplanned burning and urbanization.

Overgrazing

Overgrazing is the main cause of desertification in almost all over Sudan especially around water points. Over grazing has led to disappearance of some palatable species and replacement by non-palatable types in some rangelands in western Sudan (Ministry of Agriculture and Forestry, 2006). Overgrazing represents an environmental hazard whereby wildlife or livestock excessively feeds on pasture (www.conserve-energy-future.com). It is difficult for plants to grow back if too many animals overgrazing in certain spots (www.conserve-energy-future.com). Land degradation is linked with overgrazing of fragile soils. The number of livestock has exploded from close to 27 million animals to around 135 million (World Watch Institute, 2017). Overgrazing occurred in the Sudan for centuries, but it assumes a wide scale and acute intensity only during the past few decades (Abdalmohsin, 2015). This is supported by the following census data for Sudan.

Table 1: Animal Census in Sudan

Animal Species	Numbers
Cattle	39,479,000
Sheep	48,136,000
Goats	41,485,000
Camels	3,342,000
Equines (horses)	21,000
Equines (donkeys)	660,000
Poultry, rabbits, game animals, etc.	A sizable number

Source: (M.A.R., 1999).

Farming Practices

When farmers do not use land effectively, they may essentially strip land of everything that it has and this leads to desertification (www.conserve-energy-future.com). Unsuitable and damaging forms of land use are the main casual factors of land degradation. Population growth is a major cause of land use-change as farmers try to grow more food to feed rising numbers of people by increasing either the yield per hectare or the area under cultivation (Omer et.tal 2013).Over cultivation and cultivation of marginal land is a serious cause of desertification in Sudan. Over cultivation causes loss of soil fertility, loss of nutrients and biological activity and soil impermeability (Ministry of Agriculture and Forestry, 2006).

Deforestation

Deforestation is the clearance of naturally occurring forests for burning and logging (http://www4.ncsu.edu). Rampant desertification led to a loss of about 11% of Sudan's forest cover between 1990 and 2005(Sudan Environment and Climate Change Brief, 2007).Deforestation, especially to meet energy needs and expand agricultural land is a serious direct cause of desertification. High dependence on biomass fuel has resulted into an alarming rate of tree felling and deforestation (United Nations Economic Commission for Africa, 2007). Most deforestation in Sudan is a result of subsidence activities, especially the harvesting of fuel wood (http://www4.ncsu.edu).People contributed to the problems related to desertification when they need trees to make houses and do other tasks (www.conserve-energy-future.com). Cutting of wood by pastoralists and cultivation and harvest of vegetation for feed, building homes, enclosures for animals and for fuel contributes to deforestation (Abdalmohsin, 2015).

Bush Removal and Unplanned Burning

Uprooting of bushes for wood and burning of grass and forest shrubs for crop cultivation lead to desertification. Fires destroy the soil cover leaving it vulnerable to erosion and desertification. (Ministry of Agriculture and Forestry, 2006). The dry season in Sudan is the burning season and the great majority of pasture burning is deliberate. Pasture burning is highly destructive for the environment, the rural economy and society (www.fao.org).

Urbanization

Desertification leads to a considerable movement into Sudanese towns and encourages urbanization process. Rapid urbanization would result in intensified desert conditions (Babiker, 1982). As areas become more urbanized, there are less places for plants to grow and this causes desertification (www.conserve-energy-future.com). Rapid increase of urban population and the rapid growth of urban centers have led to difficulties in procuring wood fuel or naturally grown raw materials for traditional and small urban industries (Babiker, 1982).

Degrees of Desertification

Table 2 below shows the decertified areas and the degrees of desertification in Sudan. The state of desertification has been classified by using the indicators of geomorphology and soils, water resources, land use and population distribution (Sudan National Report to the Conference of Parties (1999).

Table 2: Degrees of Desertification (Using G.I.S.)

S.N	Degree of Desertification	Area (Km2)	% in Relation to Total Country Area
1	Desert	593366	23.8
2	Very Severe	109599	4.4
3	Severe	72674	2.4
4	Moderate	82822	3.3
5	Slight	96038	3.9
6	Very Slight	305243	12.2
7	Total	1259742	50.0

Source: Sudan National Report to the Conference of Parties, 1999.

Economic Consequences

It is impossible to grow substantial crops when an area becomes desert, unless special technologies are adopted and that is so costly. Food will become much scarcer and this would lead to hunger problems. Without plant life, flooding is a lot more eminent. Flooding affects negatively water supply and water quantity will become worse if an area becomes a desert because plant life plays an essential role in keeping water clean and clear. Desertification can lead to poverty if it is not kept in check and without food and water it becomes difficult for people to thrive (www.conserve-energy-future.com). It increases illiteracy, spread of some diseases and the rate of infant mortality and morbidity (Maha and Mustafa, 2015). Drought and desertification threatened all the agricultural sectors in Sudan and desert encroachment is threatening almost all the potentially cultivable land in the country and large tracts of soils have fallen out of production due to desertification. Forestlands over the country, especially the gum Arabic production belt in Kordofan are threatened with desert encroachment to a very large extent with all consequences on the country's economy (Ministry of Agriculture and Forestry, 2006). Desertification reduced production of dura, sesame, millet and gum Arabic in Western Sudan and led to extinction of wildlife species in areas where they once had flourished (El-Karouri,1986o.Desertification affects negatively the socio-economic livelihoods, land productivity, food production, environmental quality and rangelands and pastoral resources (Ministry of Agriculture and Forestry ,2006). Drought and desertification lead to famine, displacement and refugees and this in turn leads to misuse of natural resources. People move to cities and their arrival causes stress and shortages of already limited services (Mutasim, 2008). Drought in Darfur has led to desertification and reduction of farmable land. Drought and desertification conditions in Darfur contributed to poverty and reduced the livelihood of citizens. Herders and farmers have been affected greatly. Herders lacked the necessary sources of water and land for grazing and they lost many of their herds. Subsistence farmers can barely feed their families on the meager crops produced in this unsustainable climate (www1.american.edu).

Combating Desertification

Sudan is one of the most seriously affected countries by desertification in Africa; therefore combating desertification has become a fundamental task. Sudan was one of the first countries to sign and ratify the United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa (UNCCD) (Maha and Mustafa, 2015). Sudan attempted through Desert Encroachment and Rehabilitation Program, National Council for Research and Ministry of Agriculture, Food and Resources to combat desertification and mitigate its effects, but failed to achieve the objectives of the program due to the approaches used (Abdalmohsin, 2015). Restocking of Gum Arabic, Integrated Resource Management and Western Savanna Development Project (WSDP) were some of the projects implemented in Sudan to control desertification. The objectives included establishment of extension service centers, promotion of individual and community involvement in the restocking of the gum belt, establishment of institutional structure to promote individual and community involvement for the generation, conservation and proper management of natural resources, increasing small farmer incomes, adoption of

improved farming system, arresting the ongoing land degradation, water supply, extension of new technologies and conservation of rangelands and pastures (Abdelmagid et.tal 2008).

Climate adaptation efforts in Sudan require a national land use policy, supportive food security policies, provision of clean water, enhancement of agricultural productivity and national early warning system (Mutasim, 2008). Education is an important tool that should be utilized to help people to understand the best ways for farming their land (www.conserve-enrgy-future.com). Awareness programs to empower men and women to increase their role in combating desertification should be organized (Maha and Mustafa, 2015). Calling for a ranching system as an approach for livestock rising is necessary to combat overgrazing (Omer et.tal 2013).When it is difficult to prevent desertification from happening, advanced technologies should be adopted to prevent desertification from becoming epidemic (www.conserve-enrgy-future.com). Improving irrigation technologies increases irrigation efficiency (Maha and Mustafa, 2015). Time and money are to be invested to rehabilitate the land that has already been pushed into desertification. Afforestation and agro forestry are necessary to restore plant cover and other sources of energy such as solar, wind biogas, etc should be adopted. Policy changes related to how often people can farm and how much they can farm on certain areas could be put into place to limit the problems of farming and desertification (www.conserve-enrgy-future.com). Breeding for drought resistant and/ or quick maturing crops in all sub-Saharan African countries is to be encouraged. Plants are crucial for soil and water conservation and biodiversity protection (Maha and Mustafa, 2015).

CONCLUSION

Sudan is one of the most seriously affected countries by desertification in Africa. Desertification in Sudan is threatening almost all the potentially cultivable land in the country, mainly the irrigated sector, mechanized rain-fed agriculture and traditional rain-fed agriculture. The causes of desertification in Sudan include natural causes such as climate change and natural disasters and human causes such as overgrazing, farming practices, deforestation bush removal and unplanned burning and urbanization. Desertification leads to poverty, hunger, displacement, flooding, water scarcity, illiteracy, and spread of diseases, increase of infant mortality and morbidity and loss of herds. It affects negatively livelihood of citizens, cultivable land, soil, Gum Arabic production belt, land productivity and extinction of wildlife .Desertification can be combated through education, conservation and proper management of natural resources ,adoption of improved farming techniques and technologies, national land use policy, supportive food security policies, provision of clean water, enhancement of agricultural productivity, restocking of Gum Arabic, establishment of extension service centers afforestation and agro forestry and calling for a ranching system to combat overgrazing. It is recommended that, Awareness programs and trainings on rational utilization and proper management of natural resources are to be conducted to build the capacity of local communities. Efforts should be made by government, organizations and local communities to conserve natural resources. Proper and sustainable forest management is highly needed. Basic services should be provided by the government and international

community to people in affected areas and this would contribute positively to poverty reduction.

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