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Desertification in Sudan, Concept, Causes and Control

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ABSTRACT

This work aimed to review the aspect of desertification, its concept, causes and its control with special reference to Sudan. It appeared that there was a wide controversy among scientists on the concept of desertification and its causes. In Sudan about $5 \times 10^5 \text{ km}^2$ are directly affected by desertification, where more than half the population of the Sudan live in this area. Recent increase in human and livestock has led to the improvement of the semi-arid zone of the Sudan and consequently land cultivation has advanced about 200km north of the agronomic dry boundary. High variability of rainfall which is a norm of typical arid zone indices high vulnerability of ecosystems rendered the semi arid zone to more prone to desertification. The land that was irrationally used by man, the excessive utilization of soil had taken form of over cultivation, overgrazing, and deforestation in addition to fires. (1) was investigated, it is prospective and might be appropriate to control desertification and mitigate its effects if it is implemented appropriately. Results revealed that there was a large controversy in the definition of desertification. In Sudan the increase in population might be the main causes of desertification in semi arid region of the country.

Keywords: *Desertification, Sudan, Concept Causes, Control*

1. INTRODUCTION

The concept of desertification is fraught with controversy not only over the nature, causes, severity and extent of the subject, but also on the methodology that assesses the phenomenon and the proper means to tackle it. (2) wrote his wildly controversial finding that the Sahara desert was marching southwards in Kordofan at a rate of 5.5km/year. The phenomenon affects people world- wide (3).

But what seems more important is its effect on social economic and political aspects. However, the pertinent data of contradictions and inappropriate generalization that stem from insufficient data (3), Passing statements about desertification based on inadequate data have given birth to the present day contradictory definitions of the subject in this regard (4) reviewed hundred definitions pertaining to desertification however they stated that these different definitions of desertification are related to various aspects of the subject. It is perhaps pertinent to the state that even the proceedings of the United Nations Conference on Desertification (5) has induced numerous definitions of this subject depending on different concepts used (6). In this regard the reader may ponder through the following definitions that are cited in the (5) Document:

- 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 (5). (7) defined desertification as "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".

(5) with the same UNCOD document disagree with (7) in their perception of the cause of desertification.

For him desertification is "the impoverishment of arid, semi-arid and some sub humid ecosystems by the impact of human activities".

Be this as it may and that (8) have identified six unresolved themes in the desertification debate. These themes include advancement of the desert, the resilience of the dry land ecosystems and land use systems, the influence of grazing and livestock, the effect of increased population in rainfed dry land agricultural system, soil erosion, and fertility decline, and climate change. In addition to discussing some of the above themes, (9) question the idea that desertification is irreversible. Another controversy over desertification has been brought by (10) who distinguished between desertification and degradation and posed the question, should desertification be conceived as a synonym of land degradation.

(11) Degradation "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. According to (10) "Many experts are in support of the definition adopted by the UNCED which is a compromise and whose aims are not scientific". He goes on adding that these scientists would have preferred to have some connotations to the irreversibility and desert landscape be included in the definition. Notwithstanding, this desertification is generally agreed upon to be a form of change. However, whether it is process of change or an end-state of change; and this in itself is highly debatable (3). However, land degradation is defined by the (5) as "reduction or loss, in arid, semi-arid and dry sub humid areas of biological or economic productivity and complexity of rainfed croplands, or range, or pasture forest and woodlands resulting from land use or from a process or combination of processes arising from human activities and habitation patterns such as:

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1. Soil erosion caused by wind or water.
2. Deterioration of the physical, chemical and biological or economic properties of the soil, and
3. Long-term loss of natural vegetation. Under the UNCD conception, desertification is comparable to land degradation, and have been used interchangeable, yet there is a distinction between the two.

This is partly the reason for conflicting conception of desertification. If desertification is a form of land degradation, what other form of land degradation can be placed in the same category as desertification? Certainly not sanitization, overgrazing, erosion, deforestation, because all these drivers are of both desertification and land degradation. While desertification is a long term process of loss of land and soil productivity whose reversibility is an equally long-term process. Even if given adequate time, favorable climate conditions, the right technology and the appropriate land use practices. On the other hand degradation is a short term process of land impoverishment whose reversibility can be affected when the drivers of land degradation are removed given favorable climate conditions. Furthermore whereas in (11) opines desertification as land degradation under arid, semi-arid, and dry sub humid climates, land degradation actually happens in all kinds of climate (10). However this idea is contrary to the (12) Conception of land degradation as defined above.

2. DESERTIFICATION IN SUDAN

In Sudan about $5 \times 10^5 \text{ km}^2$ are directly affected by desertification, (13). More than half of population of Sudan lives in this area. The recent increase of population has led to the impoverishment of the natural resources of the semi-arid zone of the Sudan, and consequently land cultivation has advanced by about 200km north of the agronomic dry boundary i.e. the climatically controlled border of cultivation. Although this climatically conditioned boundary of millet cultivation extend as far north as 250mm isohyets. It is well understood that the transgression of millet cultivation over the agronomic dry boundary is the main cause of desertification in Sudan (13). The high variability of rainfall, which is a norm or the typical arid zone indices high vulnerability of the ecological systems rendering it more prone to desertification of the land, is irrationally used by man. This excessive utilization of soil takes the form of overgrazing, over cultivation, and deforestation, in addition to wild fires. According to estimation by (14), the nomads uproot a minimum of 548 millions acacia trees and scrub per year just for cooking and for building their huts or making pens for their animals.

Previously in the 1960's and 70's in Sudan, the term "Desert Encroachment" was used. However later the term desertification has been employed and it prevails and gains an international acceptance and that the term desert encroachment is abandoned because it implicit that nature "the desert" is to blame for creating the problem. The fact

is however, that man misuse of the semi-arid land is the real cause for desertification.

The desert through desertification is not a desert encroachment from the north to the south, but the expulsion of man destructive activities northwards into the arid fringes of the Sahara (15). Desertification is a process of the destruction of the ecological potential of land use through incompatible utilization in the desert marginal zone which ultimately leads to desert extension through man himself.

(16) has cited several definitions of desertification and concludes that common features of all these definitions are conditions of decreasing productivity with long lasting and possibly irreversible desert like conditions. Most definitions of desertification include human and human in concert with drought as the driving force of the process.

In his review(17) has concluded that desertification "is the ultimate step of land degradation: irreversibly sterile land, meaning irreversible in human terms and within practical economic limitations". Degradation was one of the first terms used to define the process of change in ecosystems toward more "arid" states (18).

In its modern, degradation generally refers to decrease in productivity or unfavorable changes in species composition but does not indicate the changes are preminent or desert like.

3. CAUSES OF DESERTIFICATION

(11) attributed the cause of desertification to various factors including climate variation and human activities. (18) and (13) and many scientists attributed the desertification to the human where human forces were steadily transforming the savannah wood land into human induced savannah.

(18) concluded that intermittent rainfall and the shortage of the rainy season are contributory factors to desertification "man with his misutilization of the soil was the chief culprit (9).

Despite the fact that drought played a major role in the disasters of the 1965's and 1970's, the organizers of the (12) conference identified the continual process of human induced land degradation as the major problem. In his recent work (19) has recognized the two factors as being co-responsible for desertification, humans or at least human in concert with drought are the driving forces behind the process of desertification".

In Sudan (15) found "That the problem of desertification is often mixed with other accompanying phenomena, such as drought and sand accumulation.

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The problem complex embraces more than drought or the formation of sand dunes on settlements sites.

Drought is a typical part of the climate pattern of semi-arid region and sand accumulations are part and parcel of the arid morphodynamic system. But desertification, i.e. the degradation of vegetation and soil of the steppes and savannah turning them into desert in a short span of time of few decades is the work of man. Desertification leads to the destruction of vulnerable ecosystem which form the basis of living of inhabitants of the semi-arid zone. It is mainly caused by overpopulation.

4. HUMAN FACTORS

According to (20) the major destructive features of human activities leading to noticeable change in aridity and desert areas in Sudan are: (1) overgrazing (2) over and irrational cultivation (3) wood cutting and deforestation (4) uprooting of shrubs and trees (5) lowering of water table due to increased water use. (6) Burning of grass- lands, forest and scrub.

Observations showed that these changes are steadily increasing which is not supervising in view of the present practice of land use in the Sudan, there is general integration between pastoral and agricultural activities and the same area could be used for both purposes. Some nomadic tribes are involved in cultivation, cultivators in pastoralists, and all are competing for resources cultivation of marginal lands during periods of higher than normal rainfall is especially dangerous and perhaps the main cause of desertification when dry year follow a year of plenty, soils from which sparse cover of natural plants has been eliminated by cultivation are vulnerable to wind and water erosion. This time silt and clay are carried away as wind and the sand drift into dunes. Several writers on the subject believe that the real danger to the region south of the Sahara is not the development of sand from the north but desertification in sites from intensive agricultural cultivation that rapidly exhaust soil fertility and binding properties of soil particles.

The system of cultivation also contributed to desertification i.e. Acacia Senegal gum gardens form part of extensive area over which there was a well defined rotational cultivation- bush- fallow system. The cycle started by cleaning the land for a gum garden in order to grow crops like millet, sesame, groundnuts, and water mellon, the older gum trees and seedlings were pruned back close to the ground so as to keep them alive throughout the 4-6 years (13, and 20) of cultivation.

The resulting coppice shoot were out back during weeding operations, but new growth continued even during the early mouths of the dry season. This went through the crop cultivation cycle after which the land was left to revert to bush fallow rotation. The new gum gardens attaining their maximum yield in 7-10 years were cleaned again for cultivation after 10-15 years.

However with increase in population, the rotation have become shorter in order to feed the extra months to provide more income from exportable cash crops.

These crops are given preference to gum gardens as they take less time to produce and, in years of good rain, give more income per unit area than that anticipated from gum gardens.

Hence over cutting of gum trees, for cultivation and firewood and over cultivation has caused desertification of vegetation cover followed by sand movement, soil deterioration, worse is the trend towards year after year cultivation which provides no environmental protection at all.

Over cultivation also cause the lowering of water tables which is a critical factor to desertification in the Sudan. This situation can come about through the pumping of ground water for drinking and irrigation purposes or diversion of water courses.

5. WOOD CUTTING

The cutting of woods by pastoralists and cultivation are also major causes of desertification in the Sudan. Vegetation is harvested for feed, to build homes and enclosures for animals and for fuel. In the absence of forests, the micro-climate is invariably more arid the dry season more accelerated with a probable reduction in the total rainfall.

6. OVERGRAZING

Overgrazing occurred in the Sudan for centuries, but it assumes a wide scale and acute intensity only during the past few decades. This supported by the following census data for Kordofan province (21).

Kind of animal	1957 Census	1966 Census
Cattle	5.2 x 10 ⁵	1 x 10 ⁵
Sheep	3.00 x 10 ⁵	1.5 x 10 ⁵
Goats	2.0 x 10 ⁵	1.0 x 10 ⁵
Camels	1.1 x 10 ⁵	6.5 x 10 ⁵
Total	11.3 x 10 ⁵	41.5 x 10 ⁵

In Kordofan the livestock population increased nearly fourfold from 1957 to 1966 and it is likely having been increased ever since. This rapid increase in the number livestock has off-set equilibrium that once existed between livestock and the natural grazing resources. This leads to direct removal of vegetation cover with a consequent reduction in human and livestock carrying capacity of the land and eventually desertification.

Undoubtedly overgrazing is the major factor causing desertification in the Sudan.

7. COMBATING DESERTIFICATION IN THE SUDAN

Sudan is one of the most seriously affected countries by desertification in Africa. The arid and semi-arid lands cover an area of 1.78 million km² which represent about 72% of the total area of the country (1).

(12) underlined the principles of integrated strategies for poverty alleviation programmes and project through efforts of combating desertification.

Settlers of the Sudan in rural areas largely rely on natural resources for subsistence i.e. cultivation of marginal land, fuel wood, range land ... etc, and hence land degradation.

The Sudan attempted through (20) to combat desertification and mitigate its effect but the project of the programme failed to achieve the programme objectives because of the top-bottom approach used and lack of commitment and participation of the local people and communities. According to (12) agenda, the Sudan processed.

(1) through which a set of integrated measures were identified. In the(1) there are several anti-desertification projects which include the following:

1. Restocking of gum Arabic in order to control desertification. The main objectives of the project are establish ten extension service centers in northern Kordufan at Alobeid, Umruaba, and Bara and to promote individual and community involvement in the restocking of the gum belt, so the community will become self reliant in combating desertification and improving their standards of living.
 2. Integrated resource management for the control of desertification at Alodaya. The main objective of the project is to establish institutional structure to enable individuals and community involvement for the regeneration and creation of self reliant rural communities through establishing operational village councils development committees (VCDC) with their subcommittees that focus on natural resources management.
 3. West savannah development project (WSDP) it is an integrated and rural development programme in southern Darfur. It had two projects namely south Darfur Rural project and the savannah development project are to:
 - a. Increase small farmer incomes through high production.
 - b. Arresting the ongoing land degradation.
 - c. Conservation of range lands and pastures.
- (1) Awareness Raising and partnership.

This is to develop the necessary mechanism to enhance and activate public participation, of NGO's, private sector and local communities in all phases of implementation of the(1) specially on the involvement of

women, youths and administration in the bottom – up approach.

8. RESULT AND DISCUSSION

The results of this study have showed that the concept of desertification, among scientist was not agreed upon and the subject of desertification had got a wide range of controversy, however the (12) definition that "desertification is land degradation in arid, semi-arid and dry sub humid areas resulting from various factors including climatic variations and human activity". This definition is regarded as the most current and least problematic definition of desertification. Despite the fact that there should be a clear distinction between desertification and land degradation, where desertification is irreversible and land degradation is reversible if the causes are removed.

With regard to the causes of desertification it was found that there were unresolved themes in desertification debate which include, desert advancement, the resilience of the dry land ecosystems and the land use systems, the influence of grazing and livestock, soil erosion and fertility decline.

Man with misutilization of the soils was the main cause of desertification despite the fact that drought played a major role of desertification and these two factors were co-responsible for this aspect, they are the driving factors for desertification.

In the Sudan drought and sand dune formation is part of the arid morphodynamic systems and drought is a typical part of the climatic pattern of semi-arid region, but desertification that degraded the soil and vegetation turning it into deserts in a short span of time of few decades is the action of man. Desertification leads to the destruction of ecosystems which form the basis of living of inhabitants of the semi-arid zone. It is mainly caused by overpopulation.

Features of human activities leading to noticeable in aridity and desert areas in the Sudan are:

- 1) Overgrazing.
- 2) Over and irrational cultivation.
- 3) Wood cutting and deforestation.
- 4) Uprooting of shrub and trees.
- 5) Lowering of water table due to increase in water use.
- 6) Burring of grass-lands forests.

Utilization of marginal lands during periods of higher than normal rainfall is especially dangerous and perhaps the main cause of desertification in Sudan. The system of cultivation also contributed to desertification. The wood cutting by pastoralist and cultivation are also major causes of desertification in the Sudan overgrazing occurred in Sudan for centuries but it assumes a wide scale and acute intensity only during the past few decades as shown by the livestock censuses of 1957 and 1966

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where livestock increased fourfold during that period, and it's likely have increased ever since.

9. COMBATING DESERTIFICATION IN SUDAN

Sudan is one of the most seriously affected countries by desertification in Africa. The arid and semi-arid cover an area of 1.7 million km² which represent about 72% of the total area of the country.

(12) convention underlined the principals of integrated strategies for poverty alleviation programs and projects through efforts of combating desertification.

Sudan attemptell through(.20) to combat desertification and mitigate its effects, but failed to achieve the objectives of its programmes due to the approaches used.

According to (12) agenda, Sudan processed the9 1)through which a set of integrated measures were identified. Anti- desertification projects included the following:

1. Restocking of gum Arabic in order to control desertification, with extension service centers in North Kordufan at Alobied, Umrwaba and Bara.
2. Integrated Resource management for the control of desertification at Alodaua.
3. West savannah development project.
4. Awareness raising and partnership for the success of these project, a bottom-up approach should be followed, and establishing of institutional structure to enable individuals and community involvement for regeneration and creation of self- reliant rural communities.

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