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Abstract- This study focused on the assessment and evaluation of land degradation and desertification in Wadi Al Kanger area, Khartoum State, Sudan. The goal of this study was monitoring and mapping the land use and land cover (LU/LC) in relation to drought, sand encroachment and land degradation processes. Moreover, the study attempted to investigate the potential use of remote sensing and geographical information system (GIS) in this study. Satellite imageries of the years 1973, 1987, 2001 and 2011 were used to measure the extent of the sand movement and sand encroachments during the above addressed periods. The study showed that Wadi Al Kanger area witnessed some changes through the period time, with reference to the years 1973, 1987, 2001 and 2011. In 1973, more than 6.14 % of the total area was covered by sand or sand sheet; while this area increased to 7.31% in 1987. Then, it decreased to 6.7% in 2001 and 7.31% in 2011 respectively. The study concluded that, most of the study area witnessed a remarkable change due to drought and sand encroachment (land degradation). It is worth to mention that sand dunes surround the vegetated land, which in turn will lead to the loss of some of the productive lands through sand encroachment. This fact necessitates the adoption of suitable management practices to retard and, if possible, to stop the land degradation. The study proved that remote sensing, geographic information system (GIS), and global poisoning system (GPS) are important techniques which can be used in exploiting such studies.

Index Terms- Land degradation, Land use/Land cover, Sand dunes, Sand encroachment.

I. INTRODUCTION

Sudan falls within the risk zone of desertification [1]. The low production of sorghum, sesame, millet and gum Arabic in western Sudan, in addition to the domination of less palatable grazing plants as well as the extinction of wildlife species are all strong indicators of the seriousness of this problem [2]. Desertification is the degradation of land in arid and dry sub-humid areas. Primarily, it results from human activities as well as the influences of climatic variability. It is principally caused by wind, overgrazing, over drafting of groundwater and diversion of water from rivers for human consumption and industrial use [3]. All these phenomena, fundamentally driven by overpopulation [4]. [5] used remote sensing techniques for assessment of land degradation. He indicated that some degradation process like rill and gully erosion, that forming a spatial pattern in the landscape, could be assessed directly from aerial photo or high-resolution satellite images. But chemical, physical or biological degradation is difficult to map directly from remote sensing imagery although, salinity could be mapped if it is very severe. However, also he pointed out that other degradation processes, like loss of nutrients, and soil pollution, could be inferred from vegetation cover. Nevertheless, it is not easy to map the extent of the problem in such cases along image analysis. [6] argued that desertification is a form of land degradation occurring particularly, but not exclusively, in semi-arid areas. He showed the vulnerable areas to desertification in the world like the semi-arid to weakly arid areas of Africa which are particularly vulnerable, as they have fragile soils, localized high population densities, and generally a low-input form of agriculture. About 33% of the global land surface (42 million km²) is subject to desertification. Where 25% of the region is affected, and if not addressed; the quality of life of large sections of the population will be affected. However, many countries cannot afford losses in agricultural productivity. There are no
good estimates of the number of persons affected by desertification nor the number who are directly or indirectly contributed to the process.

[7] used aerial photographs and landsat thematic mapper (TM) images to assess and map soil degradation in relation to land cover and land use. He combined aerial photo interpretation with normalized difference vegetation index (NDVI) images and field visits to assess wind erosion and vegetation cover. However, [8] stated that interpretation of photogrammetric aerial photograph is not an effective approach to map wind erosion. He used Small Format Aerial Photography (SFAP) for assessing and mapping wind erosion. The advantage of this procedure is that it can provide up to date and high-resolution information (colored), but the disadvantage is the small coverage of SFAP as compared to conventional aerial photographs. Mapping of land use/land cover classes is an important task to conserve natural resources and to recommend suitable management practices. Remote sensing techniques provide promising possibilities to map land use/land cover classes since remotely sensed data cover a large area with periodic synoptic view. The goal of this study is to determine the land cover changes, and deterioration in this arid and semi arid zones of Sudan by using remote sensing techniques with more emphasis on the effect of sand encroachment on vegetation cover.

II. MATERIALS AND METHODS

Study area

The study area (Wadi Al Kanger) is located in north east of Bahri Locality, Khartoum State, Sudan (Fig 1). It is situated approximately south east Khartoum refinery, between latitude 15°.946 to 15°.947 N, and longitude 28°.78 to 32°.67 E. It is characterized by summer rains which fall during July to October with an annual average rainfall of less than 200 mm and maximum mean annual temperature of 47°C [9]. Most of the Study area covered by sand sheet, Gravel and rocks, the water flows in the main stream (Wadi Al Kanger) from the high land in western Butana area to main River Nile in northern Khartoum State. The soil of Wadi Al Kanger area can be divided into four main types, namely, clay soil, sandy soil, sandy clay and gravel areas.

The study area is more or less devoid of vegetation possibly due to land degradation, grazing and the land clearance.

Data collection

In this study, geometrically and radiometrically corrected Enhanced Thematic Mapper Plus (ETM+) scene of path 173 and row 49 was used. Four sub images from land-sat (TM, MSS and ETM) covering the study area were used in this study. All of them are a false colour composite (FCC). Images of 2000 and 2011 are Enhanced Thematic Mapper (ETM), while the others images are thematic Mapper or Multi Spectral Scanner (TM & MSS). Land-sat (ETM) 2011 was used to assess the change detection and to compare among these images. The images were freely downloaded from Global Land Cover Facility [10]. Visible bands 1, 2, in addition to near infrared bands 4, 5, 7 were stacked to form false composite image. Visual and digital interpretations were carried out to determine the major apparent land use/land cover patterns. Some patterns such as, gravel area, vegetation and sand dunes, were recognized and then used as inputs during the process of unsupervised and supervised classification. Fieldwork was conducted within the period 05/6/2013 to 06/6/2013. Where, GPS (Garmin 60C) was used to navigate among check sites and to record the coordinates of each check site. Soil samples were collected at each check site. A total of 32 soils samples were collected from 16 locations (from 2 depths, 0 -30 cm and 30 – 60 cm). GIS and Remote sensing Software’s (ArcGIS 9.3 and ERDAS 8.5) were used. It was of utmost importance for this study. It was used for data and image analysis and final hard copy maps production.

III. RESULTS AND DISCUSSION

Wadi Al Kanger area witnessed some changes through the years 1973, 1987, 2001 and 2011. In 1973, more than 6.14 % of the total area sand sheet and sand dunes; while this area increased to 7.31% in 1987, but; it decreased to 6.7% in 2001. Then in 2011, it increased to 7.16% of the total area (see fig 2, 3, 4 and figure 5). Similar result was found by [11] in the semi desert area of ElGitaina Area, in the White Nile State.

The measured soil Ece and soil pH values are shown in table (1). The results indicated that all the area samples were within alkaline range with pH value between 7.41 to 8.71, while the Ece of the soil samples of the study area indicated that most of the area is non-saline soil [11], used the same soil methods to evaluate the Tahamid Agricultural Section (Gezira Scheme-Sudan). He found a high Ece values at the top north and south part of the Tahamid Agricultural Section, while most of the area was non-saline (0.3 to 1.0).

Soil reaction is moderate to slightly alkaline, which is unexpected for soils of arid and semiarid regions. Moreover, he indicated that neutral soils cover 30.3% and 18.2% of the top and sub surface soils, respectively, while slightly alkaline soils constitute 56.1%. However moderately alkaline soils cover 13.6% and 28.5% in the top surface and sub surface soil samples, respectively.
IV. CONCLUSION

The study revealed different signs of desertification and land degradation in the study area as judged by change in patterns of land use and land cover types. These changes indicated an increase of degrading land, vegetation cover, sandy soil and sandy clay in the study area. These signs could be revised with the use of agricultural indicators.

Based on the research result, we conclude that:

1. Sand encroachment threatens the highly productive land, drainage system and range land in Wadi Al kanger area.
2. Periodic monitoring of severity and extent of land degradation is needed.
3. Some measures are needed to retard land degradation in the study area.

V. REFERENCES


Fig 2. Classified Image year 1973
Fig 3. Classified Image year 1987

Fig 4. Classified Image year 2001
Fig 5. Classified Image year 2011