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Urban land Use Change Detection Using RS and GIS case study: Khartoum state –Sudan

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ABSTRACT

Soils are vital for the existence of many forms of life that have evolved on our planet. Soil itself is very complex. The loss of soil from farmland may be reflected in reduced crop production potential, lower surface water quality and damaged drainage networks. The idea of the study is developed from the fact that the part of area was subject to successive soil erosion and vegetation degradation. Study area is located in the province of Omdurman in Khartoum state direction of the west and the White Nile, 40 km from the capital Khartoum. Data analysis showed that the study area is suffering from severe sand encroachment in forms of vegetation degradation and wind erosion. The area of the White Nile in the study area was decreased due to movement of the sand and placed in the river banks. This showed the decrease in amounts of water not in the study area but regionally.

INTRODUCTION

An important factor influencing the productivity of our planet's various ecosystems is the nature of their soils. Soils are vital for the existence of many forms of life that have evolved on our planet. For example, soils provide vascular plants with a medium for growth and supply these organisms with most of their nutritional requirements. Further, the nutrient statuses of ecosystem's soils not only limit both plant growth, but also the productivity of consumer type organisms further down the food chain.

Soil itself is very complex. It would be very wrong to think of soils as just a collection of fine mineral particles. Soil also contains air, water, dead organic matter, and various types of living organisms as shown in Figure (1).

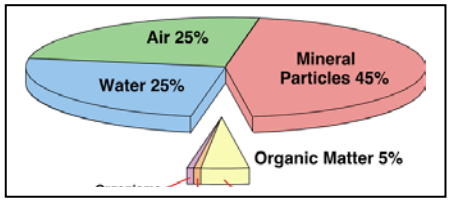

Fig. 1 soil structure

The formation of a soil is influenced by organisms, climate, topography, parent material, and time.

The speed and duration of the wind have direct relationship to the extent of soil erosion. Soil moisture levels can be very low at the surface of excessively drained soils or during periods of drought, thus releasing the particles for transport by wind.

Loss of fine sand, silt, clay and organic particles from sandy soils serves to lower the moisture holding capacity of the soil. This, in turn, increases the erodibility of the soil and compounds the problem. The advent and growth of space Programs since 1960s has a revolutionary impact, particularly on our understanding of our own environment. Remote sensing satellite orbiting the Earth to observe and monitor features of its land surface, oceans and atmosphere have become an important complement to more convention techniques. The major advantages offered by satellite are that they provide repetitive and continuous coverage, if necessary on a global scale. For progress to be made, we need accurate and timely sources of information that can be fed into the models currently being developed to describe these dynamic phenomena. Remote-sensing satellites are likely to constitute an essential information source. This report is representing the change detection by display the vegetation assessment and soil erosion in Qoz Abou Dulu and west area of Khartoum state.

The idea of the study is developed from the fact that the part of area was subject to successive soil erosion and vegetation degradation. The main objectives of this study are:-

1-To monitor and mapping soil erosion
2- To monitor the vegetation degradation.

MATERIAL AND METHODOLOGY

Study area is located in the province of Omdurman in Khartoum state direction of the west and the White Nile, 40 km from the capital Khartoum and the longitude 23 13 32 16 East and 15 6 15 30 North in an area of

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414 km^2 on the border between the state of Khartoum and North Kordofan as shown in fig (2).

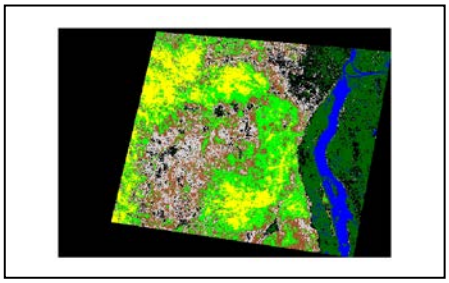

Fig. 2 Qoz Abu Dulu - Khartoum state

The mandate of this site makes the region within the dry land Sudan where the annual average rainfall between 150-200 mm, features the distinctive climate of the region

Climate in the region to the arid semi-desert, a hot dry summer and rainy and cool dry winter, with a high summer temperatures between 40 ˚ - 34.9 ˚ C and low winter temperatures between 27 ˚ - 30.8 ˚ C rate, which allows the production of crops for temperate regions, especially horticultural multi-species and varieties, rainfall during the month of July and August, rates range between 75 to 160 mm per year.

Weather is clear from the information that the achievement of sustainable development needs to be a permanent irrigation system and the various forms of a regular flow of irrigation, drip, machine guns with water harvesting large valleys (dams. Soil in the region: many types of soils in the study area are in the following species, (A.Mutalib, A.Rahim, 2009)

1 - Al-Quoz, where the soil consisted of basic materials for the Nubian sandstone rock by weathering.

2 - Clay soil, a brown soil mainly of mud and is the quality of the soil in the valleys stomachs.

3 – Loamy soil formed along enti soil easy for West Nile and dark brown.

For the vegetation in the study area was classified (Andrew,1948) semi arid plants cover almost semi arid characteristics of the vegetation mix of shrubs and seasonal shrubs, but some small trees confined to streams and areas of clusters such as Alsial, Seder, and Tonadb and Moukeet (Baiumi,1996).

MATERIALS

The data used in this study is included the Following:

The study area covers by four scenes (Land-sat Enhanced Thematic Mapper (2000). The Land-sat ETM+7 data have the spatial resolution of 30 m for the six multispectral bands and 15 m for the panchromatic band, where the thermal band has been ignored in this study for its different characters and specifications. The data has been received from the Remote Sensing Authority-Sudan. Other sets of data are used such as existing maps, field data

Digital processing and GIS tasks were performed on a PC-based system using ERDAS 9.1 Imagine and Arc-GIS 9.1 (ESRI products) as GIS and RS software and Microsoft office excel.

METHODS

The method used was designed to exploit the multi concept of modern space technologies such as remote sensing and geographical information system as described below:

Multi temporal (multi data) analysis by which satellite data for 3 years was used to detect the change in the area through space and time. Landsat images acquired for this area are MSS Landsat (186/50) 1972, TM Landsat (173/49) 1987, ETM+ Landsat (173/49) 2000.

The layer stack was used to get the best bands or combination of bands to identifying the different features on the scene. Geo-referencing was used to correct and adapt the image geometrically. Image to map rectification keyboard model through Erdas imagine 8.5 was used to correct the other images.

A subset to the study area was made from the main image, and the result was three sub images to the study area (1972, 1987, and 2000).

Unsupervised classification was used to distribute the study area into seven classes:

- White Nile and water bodies
- Agricultural area
- Rock land
- Alluvium land
- Bare land
- Alluvium covered by shrubs area
- Active sand dune

Normalized Deference Vegetation Index (NDVI) was used based on visual and Digital interpretation.

Areas and percentage of the areas affected by sand and vegetation area in each year were calculated, and then post classification change detection approach was adopted based on map calculation which was applied to determine the dynamic of change in sand encroachment and vegetation degradation.

Geographical Information System (GIS) was used for data capture, input, manipulation, transformation, visualization, combination, analysis, and output.

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ArcIMS was used to publish the geographical information system output as shape file to be used through the internet.

RESULTS and DISCUSSION

Data analysis showed that the study area is suffering from severe sand encroachment in forms of vegetation degradation and wind erosion as shown in fig (3).

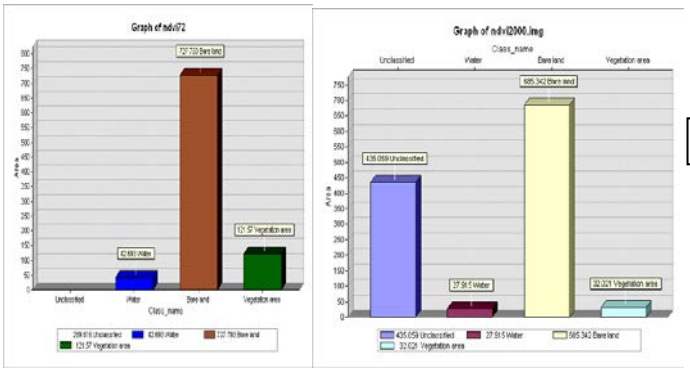

Fig.3. sand, vegetation, water histogram (1972and 2000)

As shown in figure (4) the severe classes of sand encroachment in Qoz Abu Dulu passed through Wadi Abu Alsyal, wadi Debasa, and Wadi Alroakeeb to the west of Khartoum state. This may be due to the intensity of land use, which is largely related to increase in animal and human population in the area.

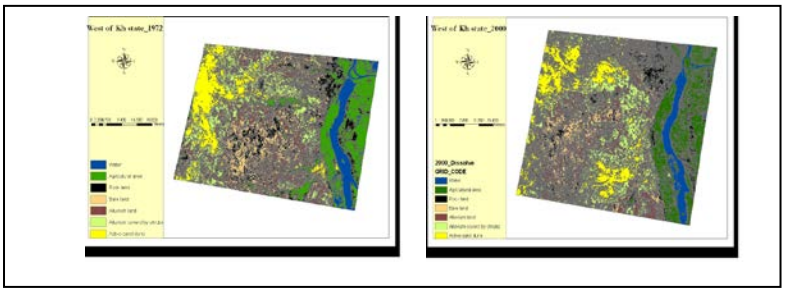

Fig. 4study area classes in (1972and 2000)

The natural vegetation is degraded but the cultivated vegetation is increased, especially in near Nile area and this reflects the growth of population in Khartoum state and around. The cultivated area around the Nile consists of the regular vegetables and fruits used by humans as shown in fig (5).

The area of the White Nile in the study area was decreased due to movement of the sand and placed in the river banks. This showed the decrease in amounts of water not in the study area but regionally.

The space technology such as satellite image and Geographical information system GIS proved to be efficient and cost effective in

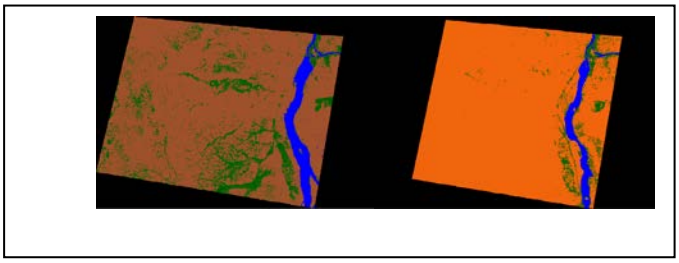

Fig. 5 NDVI unsupervised classification

The space technology such as satellite image and Geographical information system GIS proved to be efficient and cost effective in detecting and monitoring the progress of soil erosion and vegetation degradation in the study area.

CONCLUSION

1. The study area is suffering from severe sand encroachment in forms of vegetation degradation
2. There is a severe sand encroachment in Qoz Abu Dulu passed through Wadi Abu Alsyal, wadi Debasa, and Wadi Alroakeeb
3. The natural vegetation is degraded but the cultivated vegetation is increased, especially in near Nile area
4. The area of the White Nile in the study area was decreased due to movement of the sand and placed in the river banks

RECOMMONDATION

From the research, it is recommended that:-

1. Increase the vegetation cover of the area around Khartoum state was prevent the movement of the sand
2. More work and analysis should be carried out in the areas around Khartoum state to study the hazard of the soil erosion which s happening but cannot be realized unless a comparison of years is done.
3. The Nile River, the main source of water in Sudan, is facing real danger and the amounts of water are decreasing. Due to this fact, a comprehensive studied should be carried out.

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[Recommended. Written in non-technical language, to give a practical understanding of the matter.]

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