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The use of sensors and GIS in studying the dynamics of vegetation coverage in the Algerian steppes

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Abstract. The present research aims to study the dynamics of vegetation coverage in the Algerian steppe region. In order to calculate the vegetation coverage index (N_{dvi}) for three distinct time periods between 1984 and 2022, we used satellite imagery analysis and remote sensing and geographic information systems (GIS). Remote sensing and GIS are two of the most significant digital tools for gathering, analyzing, and studying the geographic field in all of its dimensions. They also help track changes that are occurring in that field. The changes that were known to the vegetation cover in the study area, and we also employed the Union icon in the Arcmap program in order to know the most important changes that occurred.

Keywords. vegetation coverage index, remote sensing, geographic information systems, Algerian steppes

1. Introduction

One of the most efficient ways to study a field, identify its characteristics, and track changes to it is to use remote sensing technology and geographic information systems. Because we can control and monitor these tools, we can study and track how people use the land, including identifying the most significant changes that take place at the level of the vegetation.

1.1. Statement of the problem:

The steppes are one of the regions of Algeria that are distinguished by the spread of grazing plants and allied plants, so the responsible authorities tried to develop an agricultural reclamation project to breathe new life into these areas in the agricultural field. We will attempt to determine the impact of the reclamation project on expanding the green spaces in the region or vice versa.

1.2. Objectives of the research:

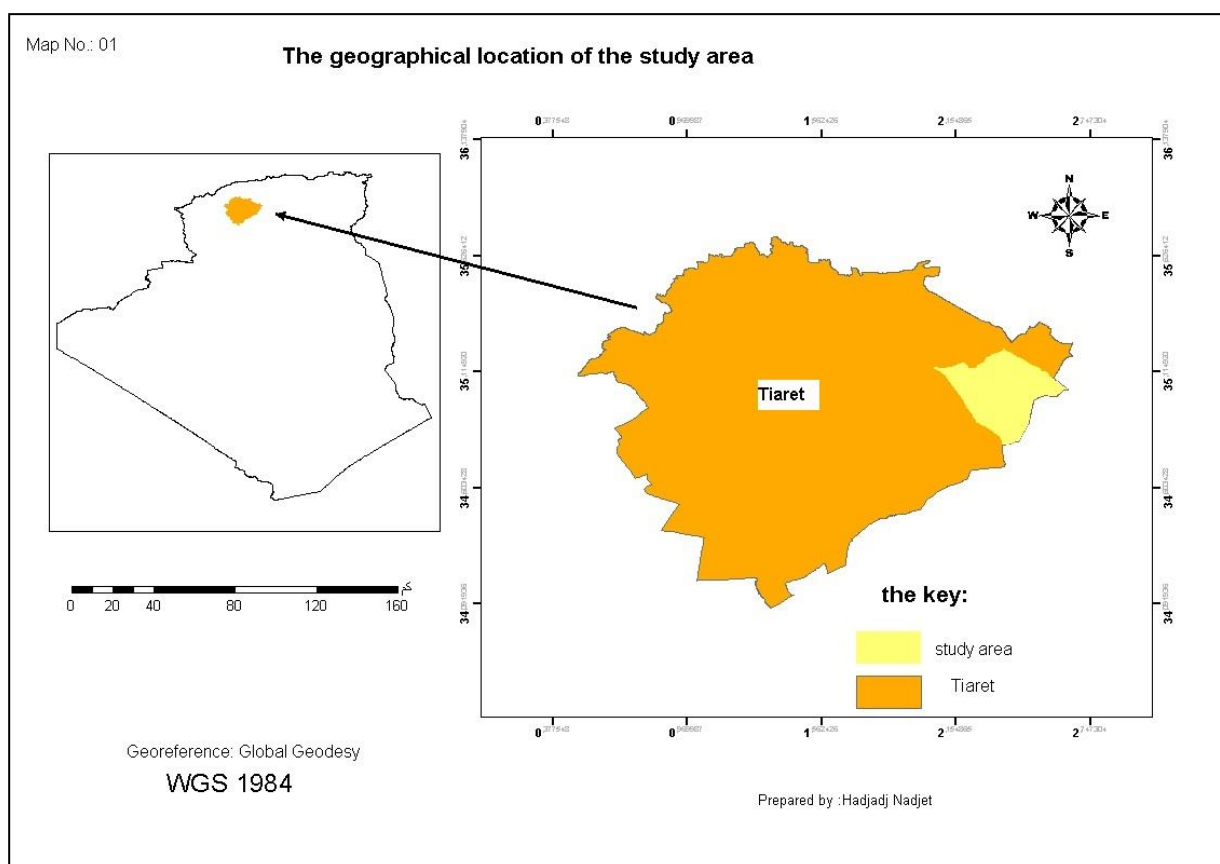
The primary objective of this research is to determine the extent of the agricultural reclamation project's effectiveness by using geographic information systems to extract and

identify the most significant spatial changes that took place at the scale of the Algerian steppes, particularly after the state adopted the project.

1.3. Methodology of the research:

This descriptive and analytical technique for data processing was employed in our research to examine the most significant spatial changes over a span of years.

Study area: The Capital (Al Zamala) of Prince Abd-El Kader is located in the Wilayat of Tiaret. It is bordered on the north by the municipality of Qasr al-Shallala and the municipality of Rachiq, on the east by the municipality of Ain and Sarah and the municipality of Sidi Sidi al-Adjal, and on the west by the municipality of Ain al-Dahab, and from the south, it is bordered



by the municipality of Gedid and Al-Idrisiya.

2. Geographic Information Systems GIS

One of the newest computer-based applied fields, geographic information systems (GIS), offers automated ways for analyzing geographical data after integrating it with descriptive data and producing a variety of outcomes that improve the extraction and support of contemporary applied concepts. Moreover, it is a harmonious complex that includes computer components, programs, and databases, in addition to the distinguished human cadre, and in its totality, an accurate inventory of spatial and descriptive information is stored, updated, processed, analyzed, and presented in the form of maps, reports, and tables, with different scales, colours, and sizes.

Geographical information systems can be defined as a means that depends mainly on the use of computers in collecting, processing, displaying, and analyzing data related to geographical locations to derive information of great importance in making appropriate decisions. Geographical information systems are the usual operations of the database such as query and query of databases with the possibility of analysis and visual processing of geographic data from maps, satellite images and aerial photos, which is the feature that distinguishes it from the usual and makes it available for many public and private applications to interpret events and calculate indicators and developing strategies to increase the need for geographic information systems.

NDVI (Natural Variation Indicator of Vegetation Coverage):

One of the most commonly used natural indicators for assessing satellite photos and researching vegetation cover, fires, desertification, landslides, and other natural occurrences is the Normalized Difference Vegetation Index. Furthermore, the condition of the plant informs us of the value of the vegetation cover in any location as well as the likelihood that a crop will succeed or fail. Following this, the NDVI index is one of the useful methods for plant review, and it is a method based on an equation based on the relationship between the near-infrared rays (NIR) and the visible red rays (R).

The visible red rays range, the third band representing red rays with a wavelength of light ranging from 0.63-0.60 m and used to distinguish between dry and green areas, and the fourth bundle representing short infrared rays with a wavelength ranging from 0.76-0.90 m and used to monitor the density and distribution of vegetation cover and distinguish between plants, soil, and water.

In the Saharan Atlas, adjacent to Aflou (Laghouat state), the Sbakak and Shallala valleys converge, giving rise to the Wadi El Taweel basin, which includes the area surrounding Wadi El Taweel.

Research steps:

1. Collecting previous studies that dealt with such a topic
2. Data collection: Satellite visuals for the years 1985 and 2021 were extracted for analysis and to extract the most important changes that occurred at the level of the study area after the agricultural reclamation project that was pursued in 1983.
3. Calculating the NDVI vegetation coverage index in ArcGIS using a raster calculator.

$$\text{NDVI} = (\text{NIR} - \text{Red}) / (\text{NIR} + \text{Red})$$

NDVI: Vegetation Coverage Index

NIR: Near Red Spectral Field

Red: the red spectral field

4. Discussion and analysis of the results:

We identified a mismatch in the vegetation coverage index's values for the years 1984 and 2022 by applying the equation for it, as its value in the year (1984) was 0.49, while it rose to 0.55 in the year 2022, while only negative values were recorded for the year (1985) with -0.25 to rise to -0.22 for the year 2022, which expresses the areas devoid of vegetation cover, and to know the nature of the distribution of vegetation cover in the Wad El Taweel area, we divided the vegetation cover indicator into two categories (Tables (1), (2)

The first category is the areas devoid of vegetation cover, the percentage of which was high in the two years, as we noticed a decrease in the percentage of the latter in 2022 by 6%.

The second category was the vegetation cover areas, which had a low percentage compared to the first category. We also noticed an increase in the vegetation cover in 2022 by 6%

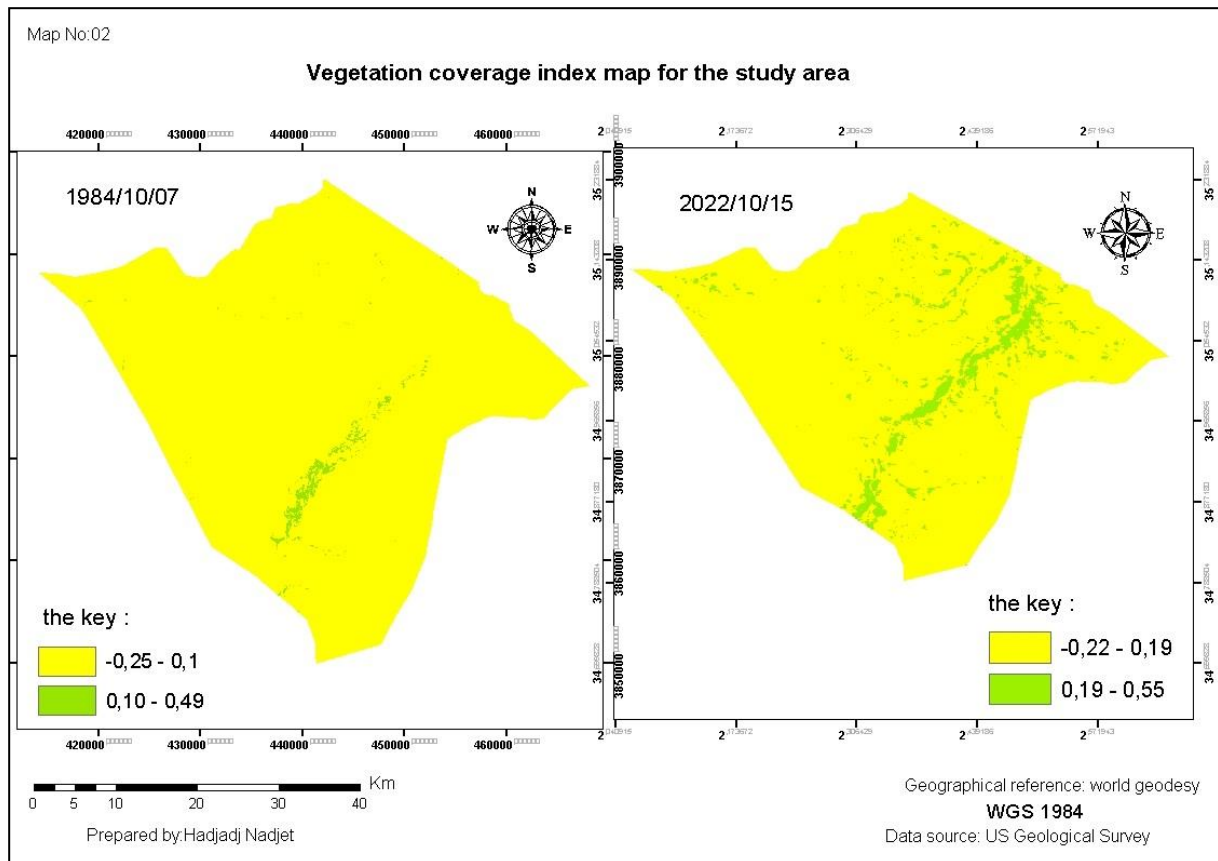


Table 01: *The area of vegetation for study area*

	1984		2022	
	Area (km) ²	the percentage(%)	Area (km) ²	the percentage(%)
Bare areas	1175,7	99	1101,8	93
Vegetation areas	12,2	1	86,1	7

Source: designed by the Researcher using Arcgis 10.3

The amount of vegetation is increasing, but it is not enough (in 38 years, there has only been a 7% increase in vegetation cover), as the authorities have been attempting since 1983 to enact a set of laws and projects that define agricultural mobility and agricultural growth in the steppe areas. There was also a reluctance on the part of the farmers to cultivate their lands. They accepted merely grazing sheep in exchange, though. However, because of the recent drop in precipitation, the natural conditions in the area were unfavourable for several crops.

The dynamics of vegetation by applying the (Union) process

The dynamics of vegetation cover were determined using the Arc map program, through géoprocessing tools, so we merged (union) the two layers (NDVI1984 and NDVI2022) to know the changes that occurred to the vegetation cover in the study area.

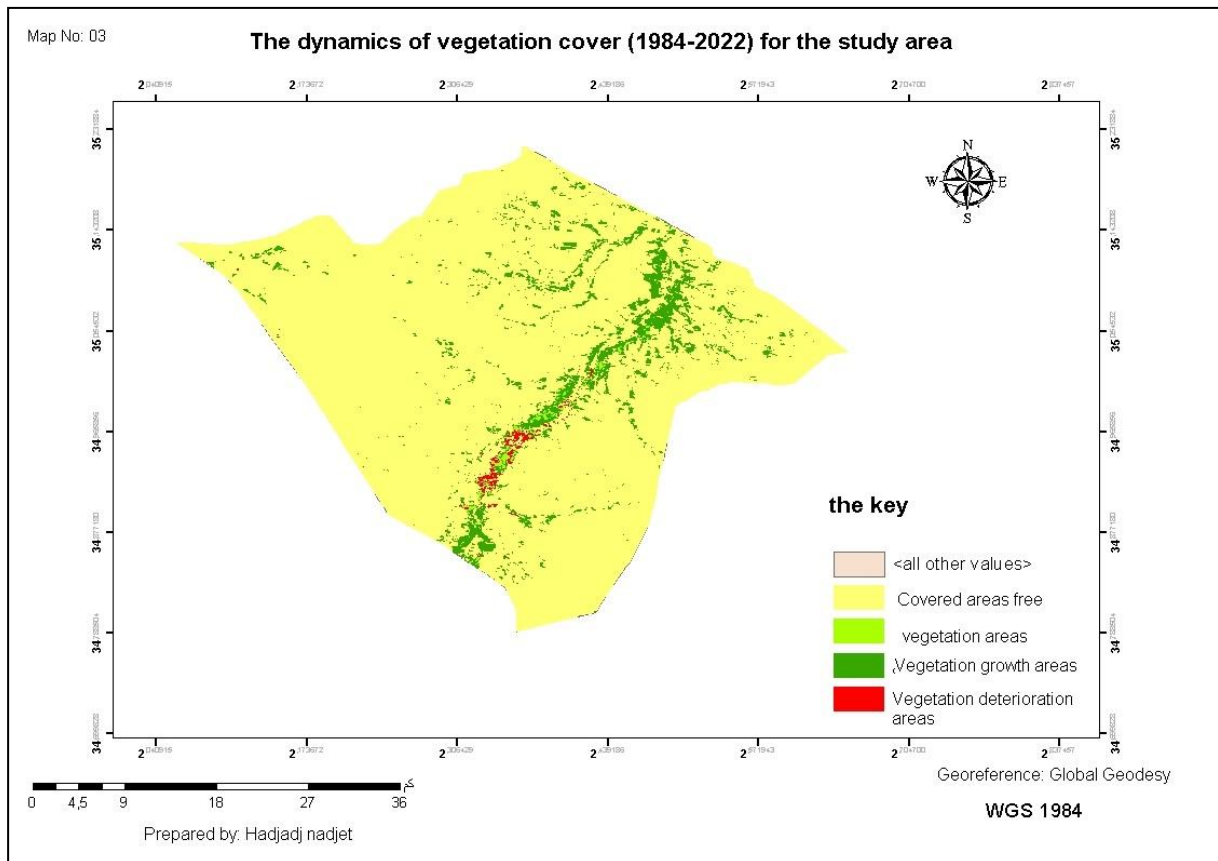


Table No. (02): The dynamics of the vegetation cover of the study area (1984-2022)
Source: Designed by the Researcher using Arcgis 10.3

	Land area (square kilometers)	the percentage (%)
Areas with no vegetation	1096	92,3
Areas with vegetation	6	0,5
Vegetation growth areas	80	6,7
Vegetation deterioration areas	6	0,5

In 2022, there was an expected 6.7% increase in vegetation cover in the study region. This growth is a result of the state's steppe areas' agricultural reclamation effort. In contrast, the region'

s vegetation cover declined by 0.5% as a result of both natural (lack of precipitation and good soil) and human (overgrazing and disregard for the agricultural cycle) factors; however, the areas devoid of vegetation still make up the majority of the area, which is a sign that the state's reform efforts to advance the steppe region's agricultural sector have been flawed.

Conclusions

By using the vegetation cover index (NDVI), we were able to determine the area that was covered by vegetation and identify changes that occurred between (1984 and 2022). We discovered that areas without vegetation make up the majority of the study area.

This research was able to reveal the dynamics of the vegetation cover between 1984 and 2022, as the region witnessed a slight increase in its vegetation cover. Finally, we concluded that the agricultural reclamation law in the steppe regions of Algeria did not alter the characteristics of the agricultural region.

Recommendations:

- Researchers can save time and effort by relying on remote sensing and GIS to assess the quality of plant density for any area without using fieldwork.
- The state must restore the agrarian reform law according to the nature of the agricultural area

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