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Monitoring Vegetation Degradation in Baghdad

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Abstract

This study examines the use of G.I.S and Remote Sensing in monitoring vegetation growth and Health Problems in part of Baghdad between 1972 and 2021 and to determine whether there has been any degradation in this state between these periods. In this study Landsat Satellites sensors MSS, TM, ETM+, OLI /TIRS were used for NDVI classification combined with RGB images. The results produced from the NDVI images gave a good indication of vegetation degradation through the period (2001 – 2021). The study illustrates that a decrease in Healthy vegetation, with a high drought ratio in (2021). The final result was that the NDVI Landsat image gives an assessment for classifying vegetation health and growth, which give a good indication of healthy vegetation areas and those under risk of unhealthy, climate change, water pollution, air pollution, with many other factors get in the way of limiting growth and development of vegetation in Baghdad. GIS and remote sensing data were used. to monitor the changes of vegetation Health over large areas of Baghdad the capital of Iraq.

Keywords: spatial analysis, Remote Sensing, pollution, climate change, Iraq

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رصد تدهور الغطاء النباتي في بغداد

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الخلاصة

تبحث هذه الدراسة في استخدام نظم المعلومات الجغرافية والاستشعار عن بعد في مراقبة نمو الغطاء النباتي والمشاكل الصحية للنبات في جزء من بغداد بين عامي 1972 و2021 ولتحديد ما إذا كان هناك أي تدهور في الغطاء النباتي بين هذه الفترات. في هذه الدراسة، تم استخدام مستشعرات القمر الصناعي Landsat، MSS، TM ، ETM + وOLI / TIRS لتصنيف NDVI ودمجه مع صور RGB لجعل الصورة أكثر دقة. أعطت النتائج التي تم الحصول عليها من صور NDVI مؤشرا جيدا على تدهور الغطاء النباتي خلال الفترة (2001 - 2021). توضح الدراسة الى ان انخفاض الغطاء النباتي الصحي مع ارتفاع نسبة الجفاف في عام (2021). كانت النتيجة النهائية أن صورة NDVI Landsat تعطي تقييمًا لتصنيف صحة الغطاء النباتي ونموه، مما يعطي مؤشرًا جيدًا لمناطق الغطاء النباتي الصحي وتلك المعرضة لخطر كونها غير صحية. تغير المناخ وتلوث المياه وتلوث الهواء، مع العديد من العوامل الأخرى يعيق نمو وتطور الغطاء النباتي في بغداد. تم استخدام تقنيات الاستشعار عن بعد ونظم المعلومات الجغرافية لرصد التغيرات في صحة الغطاء النباتي في مناطق واسعة من بغداد عاصمة العراق.

الكلمات المفتاحية: التحليل المكاني، الاستشعار عن بعد، التلوث، التغير المناخي، العراق

انتساب الباحث

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معلومات البحث

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Introduction

Baghdad is the Iraq's capital and the largest inhabited country's largest city, located between latitude and longitude (33°20′N 44°23′E and 33.333°N 44.383°E). The Tigris River bisects Baghdad, which is situated on a large plain. It gets

its water from the Tigris River as well as groundwater. The Tigris River divides Baghdad in half, with the eastern branch known as Al "Risafa" and the western branch known as Al "Karkh" as shown in (Figure 1). The soil on which Baghdad is built is completely flat and low-lying, owing to the geological origins of the Tigris and the relatively high floods It has a diverse range of vegetation. "Soil is a teeming micro universe of varied living organisms that is essential to the health of our planet, but is hidden from our eyes. Soil ecosystems contain all of the same components as more visible ecosystems such as forests, grasslands, and wetlands. Healthy soil not only supports its own ecosystem, but it is also necessary for the survival of the ecosystems that live on it. In a forest, for example, healthy soil is essential. It serves as a place for vegetations to anchor and grow, and also a water source and nutrients and a hatching area for burrowing animals. Human efforts to grow and harvest food are also supported through soil" (1). Therefor when soil drought the ecosystem collapse and the vegetation become unhealthy. "The satellite sensors measure red and near-infrared light waves reflected by terrestrial surfaces. Scientists convert raw satellite data regarding these light waves into vegetation indices using complex algorithms (equations). A vegetation index in the satellite image describes Greenness refers to the density and health of vegetation in a certain area. of each image element, or pixel." (2). "Changes in the Earth's land surface do have capability to provide a daily impact on people, economies, and the environment. Continuous monitoring of the Earth's there for study, and explain land change on a local, regional, and international scales is essential to our nation's environmental vitality" (3). The classification of the past studies shows that "There was a significant percentage of no vegetation places for branching in the eastern half of Baghdad (Rasafa), It has several poor settlement districts, high population density, bare land, and low NDVI values" (4).

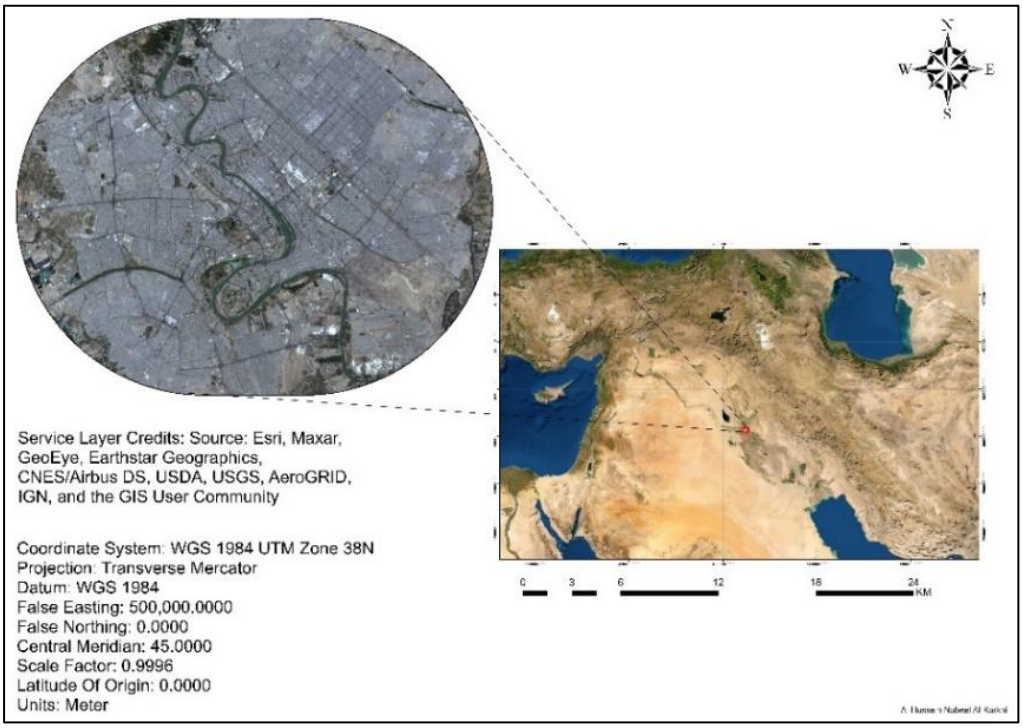


Figure (1): State the Location of Baghdad

Research Objective

This study measures the vegetation health problems and its growth rate in the center of Baghdad city that is Al "Risafa" and Al "Karkh" by using satellite data analyses and Landsat imagery. The purpose of the study is to figure out if and why there have been any changes in vegetation. With investigating the differences for areas of healthy vegetation significant NDVI increase and for areas with a low significant NDVI increase that indicate unhealthy vegetation.

Research issue

The study shows that the unhealthy vegetation in the two parts of Baghdad (Al "Risafa" and Al "Karkh") showed an increase for the past 20years. Investigating why is the goal for this issue and finding a solution for this problem. And do we have the potential to recover 60% of the studied area in Baghdad vegetations. Vegetation health and its effect on human civilization and culture, as well as vegetation health issues, with the continues impact on our daily life.

Material and Method

Study Area

The study area is located between coordinates 33°20′N 44°23′E and 33.333°N 44.383°E, and it is the capital of Iraq. With an estimated population of 8.5 million people, Baghdad is the second largest metropolis in the Arabic world and the fourth largest in the Middle East. The soil on which Baghdad is built entirely on a flat, low-lying surface., having been formed by alluvial flooding. periodic large floods on which the Tigris occurred. The main water source of Baghdad is the Tigris River, due to climate change and many political and neighboring countries the water of the Tigris dropped significantly the past 2 decades and since the water is decreased the amount evaporates the water level is increasing, this affects the vegetation health. The Tigris recorded significant floods on a frequent basis. The Tigris River is Baghdad's main water source; however, due to climate change and many political and neighboring countries, the Tigris' water level has dropped significantly during the last 10 years, and since the water level has decreased, the amount evaporates is increasing, causes the temperature level rises, affecting vegetation health. This study uses Landsat satellites (1-5-7-8), to study the area from (1972 to 2021) the health level of Baghdad Al "Risafa" and Al "Karkh" vegetation that has been decreasing with each passing day. Baghdad showed a remarkable increase in temperature values that indicate cold dry winter and hot dry summer with "Average rainfall mm (inches) about 156 (6.1)" (5). There are many interesting Gardens and parks in Al "Risafa" and Al "Karkh" as shown in Figure 1.

Data Source and Program Processing

Landsat Satellite images were taken for the study area location during different periods of time and the selected images following years (1972-1984-1991-2001-2013-2021) With a spatial resolution of (30 - 60) meters from Landsat 1, Landsat 5, Landsat 7 and Landsat 8 satellites from (USGS) website. The Satellite images were collected during June in summer because it has the day with the most daylight hours this is for the purpose of minimizing the impact of uncultivated land and its impact on the (e.g., Normalized Difference Vegetation Index (NDVI)) value classification. Using ArcMap 10.7.1 many procedures have been performed after obtaining Landsat's images giving the first is adjustment of projection system to UTM after that

the corrected map was used in the process of debugging and a series of radiometric correction was performed by using Map Algebra in ArcMap 10.7.1. The second step is to process the bands of satellite images, in this study Landsat bands were composite to produce layer of false color image with a layer of (e.g., Red Green Blue (RGB)) image for the sensors (MSS, TM, ETM+, OLI) and the satellite bands are used for the purpose of compositing are shown in (Table 1), then third step is to calculate the Normalized Difference Vegetation Index for the purpose of classifying, diagnose and determining the Vegetation covering area from other cover areas with high accuracy. "Landsat satellites have been continually acquiring space-based photographs of the Earth's land surface since 1972, giving data which is valuable for land use/land change studies. The data can be used for forestry, agriculture, geology, regional planning, and education, among other things. Landsat was developed in collaboration with the (e.g., National Aeronautics and Space Administration (NASA)) and (e.g., United States Geological Survey (USGS)). (NASA) for building remote sensing devices and spacecraft, then launches and tests the sensors' and satellites' functionality. Then, the (USGS) takes over ownership and management of the satellites, as well as all ground receiving, data archiving, product production, and data distribution. The initiative has resulted in an unprecedented record of Changes caused by the nature and humans in the worldwide landscape has been created" (6).

Table (1): Results of Bands Near-Infrared and Visible Red Composited from Landsat satellites image

Satellite Sensors	Spatial Resolution (meters)	Spectral Bands Composited	Wavelength (micrometers)	Color
Landsat 1 (MSS)	60	Band 6	0.70 - 0.80 µm	Near-Infrared
	60	Band 5	0.60 - 0.70 µm	Visible Red
Landsat 5 (TM)	30	Band 4	0.76 - 0.90 µm	Near-Infrared
	30	Band 3	0.63 - 0.69 µm	Visible Red
Landsat 7 (ETM+)	30	Band 4	0.77 - 0.90 µm	Near-Infrared
	30	Band 3	0.63 - 0.69 µm	Visible Red
Landsat 8 OLI /TIRS	30	Band 5	0.85 - 0.88 µm	Near-Infrared
	30	Band 4	0.64 - 0.67 µm	Visible Red

Image Classification and analysis

The study classification illustrates the eastern branch which have known as Al "Risafa" and the western branch known as Al "Karkh" vegetation growth and health. supervised classification based on field survey information which was added, Landsat satellites are also being used. (1, 5, 7, and 8), to determine the nature with a strong discriminating capacity of the Vegetation cover of the study area. Field visits to Al "Karkh" and Al "Risafa" were made to collect samples and analyzing the vegetation growth and health. Both the imagery classification and the classification process were completed for the calculation of

vegetation areas by using ArcMap 10.7.1. Within the study area, three classes were identified. represented by (Very Healthy vegetation, Moderately Healthy Vegetation, and Unhealthy Vegetation) for years (1972, 1984, 1991, 2001, 2013, and 2021) Figure 2 shows the results. The areas of vegetation cover in the following table are shown (KM2). Figure 2 illustrates how vegetation growth levels of the studied area have been decreased rapidly during the past 20 years. The classification shows the decrease of 15.4% in Very Healthy vegetation, decrease of 26% in Moderately Healthy Vegetation and decrease of 24% in Unhealthy Vegetation with drought ratio 68.4% in (2021). The NDVI Classification of vegetation growth for the studied area showed an increase of 23.4% between the period of (1972 – 1991) due to many factors which are Cultural awareness, political stability and climate change as a result of the global warming are also added and for the period of time (2001 – 2021) significant drop of 22.8% during this period of time the unpolitical stability and people ignoring the overall health of vegetation; many factors made this significant drop in healthy vegetation.

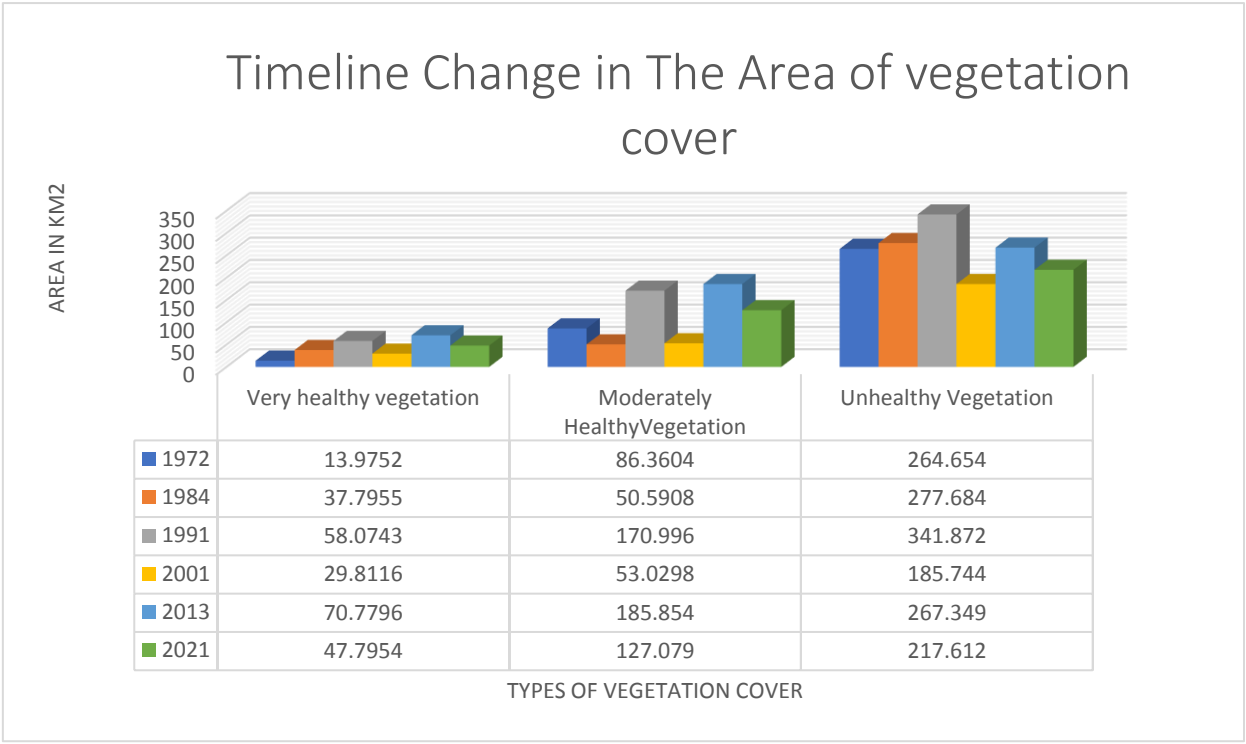


Figure (2): State the Vegetation Cover area for study area

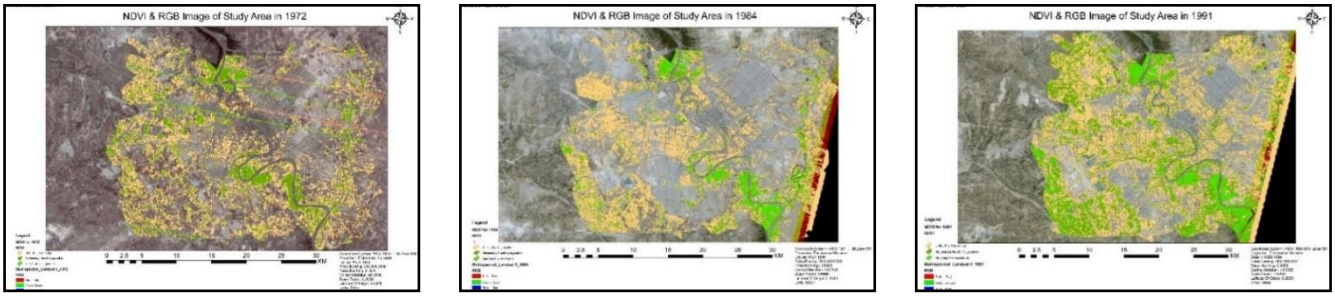
Normalized Difference Vegetation Index

"Despite insufficient evidence on how it compares to empirical measurements of fodder quality and quantity, the satellite-derived Normalized Difference Vegetation Index (NDVI) is studied widely to describe changes in vegetation index in landscapes around the world" (7). The Normalized Difference Vegetation Index (NDVI) is a measure of how much vegetation exists in (NDVI). Low NDVI values (0.1 and below) denote barren rock, sand, environments. Moderate amounts indicate bushes and grassland (0.2 to 0.3), whereas high levels indicate tropical rainforests and dense forests

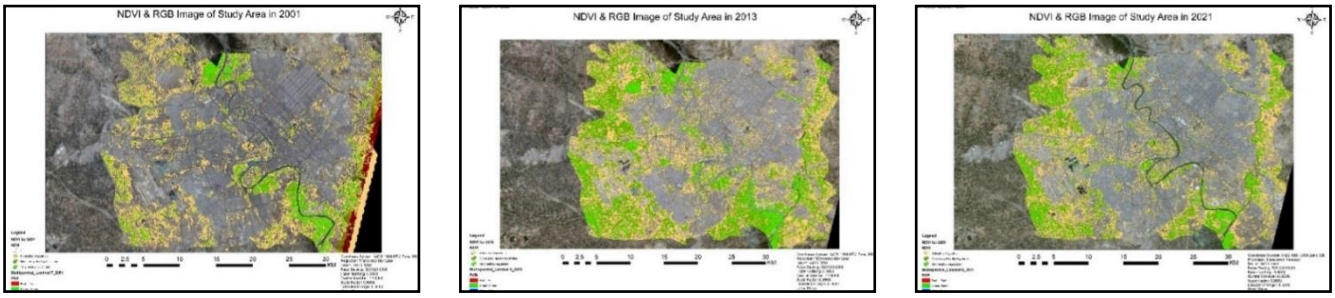
for a range of values between 0.6 and 0.8. The NDVI is calculated from the following equation:

NDVI = (NIR – RED)/ (NIR + RED) ……. (1)
where NIR = Near-Infrared, RED = Visible Red

Cloud contamination, atmospheric perturbations, fluctuating light, and viewing geometry, all of which diminish the NDVI, can cause NDVI data to be exceedingly noisy. Using ArcMap 10.7.1, the region of vegetation cover was isolated by the study area location and classified according to the level of vegetation cover, after classifying the study area, a mixture of NDVI and RGB which is used to depict the change in Baghdad over time the results showed a cleaner image with more accurate, as shown in Figure 3. Classification by using both supervised and unsupervised methods, the study area's temporal variation was examined over a prolonged period of time (1972 to 2021).



(A) NDVI and RGB for 1972 (B) NDVI and RGB for 1984 (C) NDVI and RGB for 1991



(D) NDVI and RGB for 2001 (E) NDVI and RGB for 2013 (F) NDVI and RGB for 2021

Figure (3): State the Image Classification of study area during the extended period (1972-2021) using "Eq. (1)". The base layer is RGB Landsat image combination with the layer over it is NDVI image.

Conclusion and Discussion

The result of NDVI image Classification with RGB Landsat satellite images gave a good indication of degradation in vegetation health and growth between periods of time (2001 – 2021). With the majority of vegetation area in Al "Risafa" and Al "Karkh" is Unhealthy Vegetation cover with a 217.612 KM^2. With an increase of drought rate

every day, this is due to many involved factors with the most affected ones which are (water pollution, air pollution, climate change). The NDVI Classification of vegetation growth in Al "Risafa" and Al "Karkh" showed an increase of 23.4% between the period of (1972 – 1991) and for the period of time (2001 – 2021) significant drop of 22.8%.

Recommendation

The lack of vegetation health care can cause the vegetation in landscapes, gardens, producing fields, woodlands, and interiors capes face several of the issues that threaten their well-being. These issues can damage the vegetations appearance or have more serious repercussions, such as plant deformity, crop loss owing to yield and quality reductions, and vegetation death. Vegetation diseases have had a long history of impact. In terms of the impact on human existence and culture, as well as vegetation health issues, this causes a continuous impact on our daily life. Food, drink, as well as those in natural environments. The usage of GIS analytical tools and remote sensing data in Baghdad to detect the changes in vegetation cover and health problems is important for the future.

Suggestions

The study proposes an approach, which can significantly support an accurate detection of vegetation health and growth in a little computational effort. The solution proposal of this study:

1. Improve the overall health of Al "Risafa" and Al "Karkh" vegetation in Baghdad with the help of health care specialist.
2. Reduce the air pollution of industrial oil and gas fields with the largest oil refinery in Al "Karkh" is Midland Refineries Company MRC / Daura Refineries.
3. Reduce wastewater and sewage-related water pollution. that pour their water in the Tigris River in Al "Risafa" and Al "Karkh" which is Baghdad's main water source.
4. Improve the government Awareness of global warming and climate change that causes the rise in temperature which leads to vegetation dryness.
5. Reduce the disregard of Unhealthy vegetation areas in public gardens caused by the government officials.
6. The lack of importunity field area in vegetation health by the government officials.
7. Remote sensing technology and a geographic information system can be used to assist. in linking all existing monitoring data systems to improve the overall health of vegetation.

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