INNSPUB

Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 12, No. 6, p. 204-209, 2018
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

Estimation of the NDVI vegetation index to the Canaan forest using temporal spatial images

Ahmed Bahjat Khalaf*

Soil and Water Resources Department, College of Agriculture, Diyala University, Iraq

Article published on June 30, 2018

Key words: Remote Sensing, Vegetative Index, NDVI, Forests.

Abstract

This study was conducted on the Kanaan Forest within the Diyala Governorate between latitude 44°50'33.30"-44°54"27.58" and 33°39'51.46"-33°34'25.54" and an area of 971,51km². Using 12 satellite images of Landsat 8 satellite OLI_TIRS (row 37 and path 168) for 2015-2016 and 2017 by 4 images per year for the purpose of calculating NDVI values, the study found that there were significant differences for NDVI values (P-value for t-test was 0.0015, and the chi-square test is 0,0009 and the probability level is 0.05. For the years of study, the highest value of the index NDVI (0.514) was recorded on 12/3/2016 and the lowest value (0.234) on 18/9/2015. There was a difference at the quarterly and annual levels.

***Corresponding Author:** Ahmed Bahjat Khalaf ✉ ahmad.bagat@yahoo.com

Introduction

The NDVI (Normalized Difference Vegetation Index) is one of the most proven experimental forest-derived plant index used in the study of the temporal and spatial dynamics of forest cover (Lukasova *et al*., 2014), as well as its use in growth estimates, biomass, Productivity and biodiversity. The NDVI manual was used to estimate forest indices such as the leave area index (Mohammed, 2015) as well as to estimate the various variables such as wood stock, basal area, average tree diameters, etc.

The NDVI index is based on the spectral characteristics of the vegetation, compared to the areas where there is no vegetation, Green plants absorb the red color strongly, and reflect the nearby infrared radiation. This occurs by the chlorophyll found in the green leaves, so the areas with dense vegetation cover different characteristics Spectral range in the red and infrared bands compared to areas with less dense vegetation or plant-free vegetation. The NDVI index is calculated using the difference in the amount of reflected radiation in the nearby red and infrared channels divided by the sum of reflection in the two channels mentioned. The value of the NDVI index is between (-1 and + 1), the value of which is close to 1, betwen (0.8-0.3) when there is dense vegetation, about 0.1 in the case of bare soil, and (0.2 - 0.3) with the presence of shrubs and herbs, and the negative values of the index is recorded in the case of clouds and snow-covered areas (Eileen and Wael, 2016).

In a study carried out by Iyad and Jasim (2013) for NDVI for selected areas within the Nineveh Governorate using satellite images Landsat 7, the highest value in the sites of Bashika and Tailev (0.29 and 0.16), respectively, In the Alhader and Shorouk sites, which reached (0.09 and 0.04), respectively. The researcher Ehsan and Kazem (2013) NDVI manual for the Ardakan region in Iran classified 4 are low (0.1-0.2), medium (0.2-0.3), high (0.3-0.4). It was very high (more than 0.4) using satellite images Landsat ETM + for the years 1990 and 2006 for a total area of 15760 hectares. In his study of the relationship between temperature and humidity change with NDVI in China for 1998-2007, Chuai *et al*. (2013) noted a strong correlation between seasonal and annual variations of temperature and rainfall and NDVI.

Bindhu and Narasimhan (2014) used 6 satellite images Landsat ETM+ to produce NDVI maps for the years 2011-2012 in the northern Indian region of Gadana, with NDVI values ranging from 0.1-0.9 cm, including agricultural land and forests.

In a study carried out by Iyad and wrada (2016) to monitor changes in vegetation cover using NDVI, the NDVI sample maps of the MODIS images for the 2000-2012 time series showed three values, representing vegetation types, from 0.3 to 0.7, representing crop vegetation Irrigated and a certain percentage of orchards, from 0.2 to 0.5 and representative of vegetation and herbaceous vegetation, from 0.1 to 0.4 and representative of the vegetation cover with simple vegetation cover and crops. The researcher Ezraa (2016) used the satellite images Landsat 7 (ETM +) and Landsat 8 to calculate the vegetation index NDVI for the period 2000-2014 for the purpose of determining the change in the vegetation cover of the city of Baghdad, the study found that there is an increase in pixels, Green is 0.2-0.8 in 2014 compared with 2000.

Ravi *et al.* (2016) reported that remote sensing techniques have become a major tool in the analysis of land and vegetation use changes and the adoption of vegetative indices at spatial and temporal scales. The researcher used NDVI to monitor change in Assam forests in India by analyzing space images For Landsat 5, 7 for the period 1990-2014 using the program Erdas Imagine 14.0, and the study found that there is a loss of forest area in the study area by 113 km 2 and by 2.9%. Tingting *et al.* (2017) study in China selected four sites for the NDVI account for the period 2011-2015, and the study found that the value of NDVI decreased from 0.28 to 0.15 at location 1 and 3 respectively while there was an increase to 0.22 in situ 4 due to Vegetation.

The importance of this study stems from the recent increasing use of the NDVI index in the studies of vegetation cover in general and forests in particular for the sensitivity of this index to the various environmental conditions under which vegetation is exposed.

The study aimed at adopting modern scientific methods based on the software required to calculate the NDVI values of the Canaan forest A database to be used in various developmental and practical applications that work on resource development and demonstrate various practical applications of remote sensing.

Materials and methods

Study area

The study area was determined by means of field visits, using GPS Test program and downloading it on the Galaxy J7 and comparing it with the coordinates of the study with the Global Positioning System (GPS). The readings corresponded to 100%. The study area is within the administrative boundaries of Diyala Governorate And its coordinates are between 44°50'33.30" - 44°54"27.58" and 33°39'51.46" - 33°34'25.54" and an area of 971.51km². Fig. 1 shows the study area.

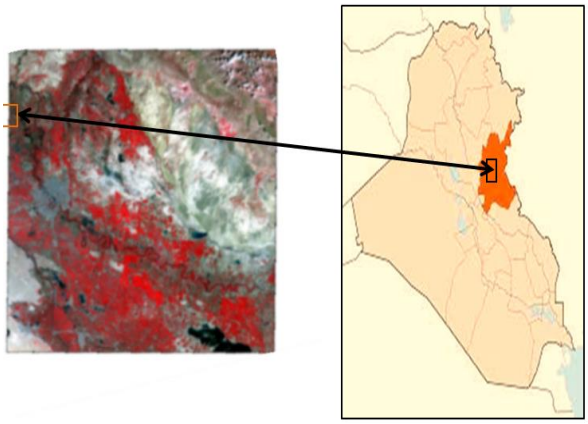

Fig. 1. The area of study in Canaan is part of the satellite image Landsat 8 and Diyala Governorate.

Satellite data

After selecting the study area, 12 satellite data or images were adopted for Landsat 8 OLI_TIRS sensor (row 37 and path 168) for the years 2015, 2016 and 2017 captured by 4 images per year as shown in Table 1.

Kanaan Forest Map

Using ARC GIS V.10.3, the Kanaan Forest was delineated in the study area and according to the outer limits of the forest and a map of the forest was prepared as in Fig. 2.

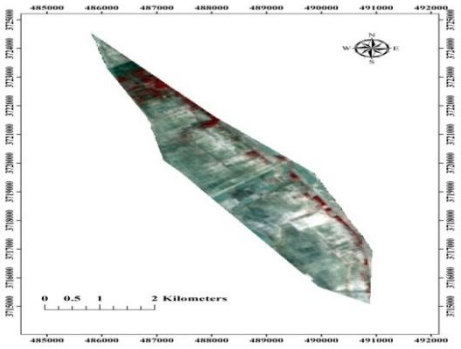

Fig. 2. Canaan Forest part of the satellite image Landsat 8.

Table 1. Satellite data used in the study.

No	The satellite	Row	Path	Date of capture
1	Landsat 8	37	168	05/01/2015
2	Landsat 8	37	168	10/03/2015
3	Landsat 8	37	168	30/06/2015
4	Landsat 8	37	168	18/09/2015
5	Landsat 8	37	168	24/01/2016
6	Landsat 8	37	168	12/03/2016
7	Landsat 8	37	168	02/07/2016
8	Landsat 8	37	168	20/09/2016
9	Landsat 8	37	168	10/01/2017
10	Landsat 8	37	168	15/03/2017
11	Landsat 8	37	168	19/06/2017
12	Landsat 8	37	168	23/09/2017

Calculate NDVI

To calculate the NDVI values of satellite data for the study area, use the Erdas Imagine V.14 program and apply the following formula (Tomas and Elias, 2014)

$$NDVI = \frac{\mathbf{Band(NIR)} - \boldsymbol{Band(Red)}}{\mathbf{Band(NIR)} + \boldsymbol{Band(Red)}}$$ As:

NIR = Near Infrared rays .

RED = red rays.

Results and discussion

Using ARC GIS V.10.3 and Erdas Imagine V.14, a map of the NDVI for Canaan forest was prepared as in Fig. 3.

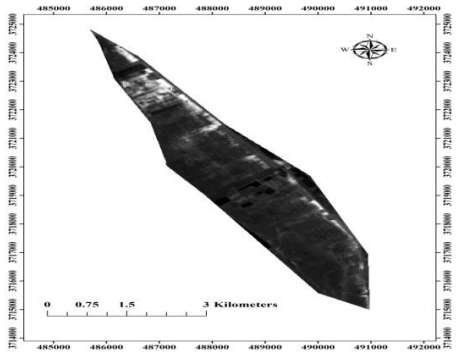

Fig. 3. The NDVI map for Canaan forest.

Using Erdas Imagine V.14 to calculate the NDVI values, we got Table 2.

Table 2. Statistical values of the index vegetation NDVI Forest Canaan.

No	Date of capture	Minimum value	Maximum value	Medium	Standard deviation
1	05/01/2015	0.034	0.279	0.157	0.071
2	10/03/2015	0.05	0.283	0.166	0.068
3	30/06/2015	0.062	0.318	0.19	0.074
4	18/09/2015	0.06	0.234	0.147	0.05
5	24/01/2016	0.061	0.336	0.199	0.08
6	12/03/2016	0.081	0.514	0.297	0.126
7	02/07/2016	0.069	0.364	0.216	0.086
8	20/09/2016	0.054	0.356	0.205	0.088
9	10/01/2017	0.048	0.289	0.168	0.07
10	15/03/2017	0.069	0.477	0.273	0.118
11	19/06/2017	0.052	0.39	0.221	0.098
12	23/09/2017	-0.054	0.31	0.128	0.106

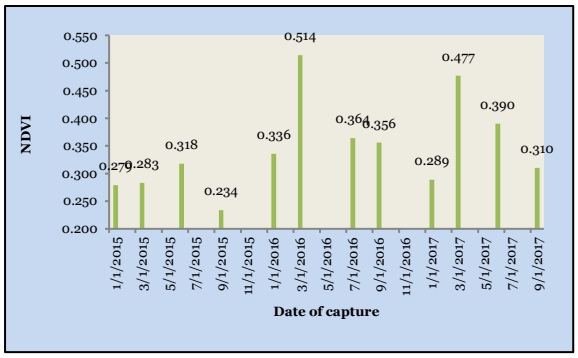

Fig. 4. Distribution of NDVI values for years of study.

Table 2 shows that there is a significant difference in the NDVI values of the Kanaan forest and the study years, especially the higher values. The higher values reflect the density of the vegetation because there is a direct correlation between NDVI and the vegetation density (Iyad and Jassim, 2013; Tingting *et al.* 2017) These values are for the layer of trees and shrubs in the various densities (Eileen and Wael 2016). The lowest values are the other layers (weeds, grasses, buildings, bare soil, etc.). The medium represent overlapping between the layers, so NDVI can be used to distinguish between ground coverings (Bindhu and Narasimhan, 2014).

Using the statistical program Statgraphics 2018 and using the statistical scale P-value was carried out statistical analysis of the higher values, as the value of P-value is the smallest value of a significant level of a society can reject the hypothesis of nothingness, the value of P-value has the ability to answer about accepting the hypothesis of nothingness or not, and in the application of this value, we will typically observe four possible probabilities, the first probability is that the value of P-value> 0.1 and this indicates the lack of significance, the second possibility is that the value of P-value is limited between (0.1 - 0.05) indicates a significant And the third possibility is that the value of P-value> 0.05 indicates a significant presence (Alrawe, 2000). The P-value for the t-test is 0.0015 and the chi-square test is 0,0009 and the probability level is 0.05 for both tests, indicating On the existence of a significant difference.

From Table 2 and Fig. 4 we can classify the NDVI values of the tree layer and shrubs into 4 categories, which are low (0.2-0.3), medium (0.3-0.4), high (0.4-0.5), very high (More than 0.5). The researchers Ahsan and Kazem (2013) noted that NDVI can be classified according to the density of vegetation and thus we obtained Table 3.

Table 3. NDVI categories and their values in the Canaan Forest for years of study.

Categories	NDVI values	History of satellite image
Low	0.279	05/01/2015
	0.283	10/03/2015
	0.234	18/09/2015
	0.289	10/01/2017
Medium	0.318	30/06/2015
	0.336	24/01/2016
	0.364	02/07/2016
	0.356	20/09/2016
	0.39	19/06/2017
	0.31	23/09/2017
High	0.477	15/03/2017
Very high	0.514	12/03/2016

From Table 3, the highest value of NDVI (0,514) was recorded on 12/3/2016 and the lowest value was (0,234) on 18/9/2015. The reason may be due to climatic conditions as the spring season is more suitable in terms of temperature, humidity and radiation reflectivity, Especially near infrared (by leaves) are more in spring than in the rest of the seasons (Chuai *et al.* 2013). Climate factors affect vegetation activity and physiological processes, especially photosynthesis, as well as the plant's phylogenetic phases (Eileen and Wail 2016).

We also note that the NDVI values vary according to the season and have the highest value in the spring for the years 2016 and 2017. The lowest values of the NDVI were recorded in winter and fall for the years 2015 and 2017, and it was noted that the decline in values in winter but less than autumn, And it is believed that the behavior of the NDVI index was influenced by the vegetative content of the water, which differed between seasons under the effect of precipitation. Some studies have indicated that the value of NDVI calculated for vegetation cover has a strong correlation with rainfall and temperature, so climate factors (rainfall and temperature) prevailing at a given place or time may significantly affect the increase or decrease in the value of NDVI (Chuai *et al*., 2013).

At the annual level, the annual average values of NDVI were 0.279, 0.393 and 0.367 for the years 2015, 2016 and 2017, respectively, as there is an excess of 2016 for the rest of the years may be due to the climatic conditions in this year were more appropriate than the rest of the years As well as the exploitation of land without trees for agricultural purposes from one year to another Affect the values of NDVI (Ravi *et al*., 2016). Climate conditions and light clouds can affect the calculation of the guide when satellite data are used. When the vegetation consists of layers, the low layer, whatever under a plant layer, affects the recorded reflection signal. They can be bare soil, plant waste, or any other plant species, each of which has a specific spectral response different from the ones being studied (Jones and Vaughan, 2010).

It is possible to observe that the images taken in the spring show a high reflection in the field of infrared means necessarily the presence of green areas and the ability of the high plants in contrast to large amounts of near infrared, on the other side, the image taken during the rest of the year showing a less reflection of the rays (near infrared). This is expected in this region, where during the spring many crops, other herbs and even trees will be in the maximum vegetative stage while during the other seasons many plants will have already entered or are on their way to maturity. During this period, the concentration of the plant juice is concentrated in the production of the crop and not in the total vegetable production. As a result, the plant content changes from chlorophyll, the anatomical composition of the leaves changes and the reflection in the near infrared field decreases as a result of changing the anatomical structure of the cells (Jinru and Baofeng, 2017).

Conclusions

In this study we found that the change in the values of the NDVI index is related to the different climatic conditions and that the highest value was in the spring. There is a strong correlation between the density and the composition of the vegetation with the NDVI index. The use of remote sensing techniques, the satellite images thus detect the changes in NDVI and seasonal values and therefore benefit from the results for various scientific and applied purposes.

References

Aiad AK, Jasim K. 2013. Calculate value of (NDVI) and vegetation Indexes for evaluation degradation status of rangelands by using remote sensing techniques. University Tkirt Agricultural Sciences Journal **13(1),** 264-274.

Alrawe KM. 2000. Introduction to Statistics. Ministry of Higher Education and Scientific Research. University of Al Mosul. Dar Al Kuttab for Printing and Publishing, University of Mosul. (in Arabic).

Bindhu VM, Narasimhan B. 2014. Temporal disaggregation method to derive time series of Normalized Difference Vegetation Index and Land surface temperature at spatial resolution, The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences Journal **8,** 1397-1401.

Chuai W, Huang J, Wang W. 2013. NDVI temperature and precipitation changes and their relationships with different vegetation types during 1998–2007 in Inner Mongolia, China. Int. J. Climatol **33,** 1696–1706.

Ehsan S, Kazem, D. 2013. Analysis of land use-land covers changes using normalized difference vegetation index (NDV) differencing and classification methods, African Journal of Agricultural Research **8(37),** 4614-4622.

Eyad A, Rada K. 2016. Monitoring Changes in Vegetation cover in Agriculture Stability Zones of Syria Using Time Series NDVI/MODIS During 2000-2012. Syrian Journal of Agricultural Research **3(2),** 188-205.

Ilene M, Wael A. 2016. Calculating the Normalized Difference Vegetation Index (NDVI) for Pinus bruutia ten. Satnds using satellite images in Jableh at Spatial and Temporal Scales. Tishreen University Journal for Research and Scientific Studies - Biological Sciences Series **38(3),** 25-40.

Israa JM. 2016. Change detection of remotely sensed image using NDVI subtractive and classification methods, Iraqi Journal of Physics **14(29),** 125-137.

Jinru X, Baofeng S. 2017. Significant Remote Sensing Vegetation Indices: A Review of Developments and Applications. Journal of Sensors. **Volume 2017,** Article ID 1353691, 17 pages.

Jones HG, Vaughan, RA. 2010. Remote Sensing of Vegetation. Principles, Techniques and Applications. Oxford University Press, UK.

Lukasova V, Lang M, Skvarenina J. 2014. Seasonal Changes in NDVI in relation to Phenological Phases, LAI and PAI of Beech Forests, Baltic **20(2),** 248-262.

Mohamed R. 2015. Estimation Leave area index of pinus bruti group in Jabala using satellite images, Master Thesis, collage of Agriculture, Tishreen University press.

Ravi P, Neha S, Saumitra M. 2016. Normalized Difference Vegetation Index (NDVI) Based Classification to Assess the Change in Land Use/Land Cover (LULC) in Lower Assam, India, International Journal of Advanced Remote Sensing and GIS **5(10),** 1963-1970.

Thomas P, Elias S. 2014. Assessing Land Degradation and Desertification Using Vegetation Index Data: Current Frameworks and Future Directions Remote Sens **6,** 9552-9575.

Tingting G, Huimin L, Dawen Y, Yang J, Hanbo Y. 2017. Monitoring the variations of evapotranspiration due to land use/cover change in a semiarid shrubland. Hydrol. Earth Syst. Sci. **21,** 863–877.