Journal of Genetic and Environmental Resources Conservation, 2016, 4(1):1-4.
www.jgerc.com

Examination the efficiency of NDNI index by comparing with STVI-4 index to recognize the vegetation cover

Taghreed A.H. Naji

Dep. of Physics, College of Education for Pure Sciences Ibn Al-Haitham, University of Baghdad, Baghdad, Iraq
taghreedaltaie@yahoo.com

Abstract

Among all segmentation techniques, the vegetation indices are widely used tools for image segmentation. In this study, the vegetation indices which have been applied as the stress related vegetation index (STVI-4), and normalized difference vegetation index (NDVI), on in the area around the Euphrates river and part of Al-Habbaniyah lake, which located at western side of the river in Al-Ramadi city, Al-Anbar province at Iraq, for detecting and monitoring vegetation over large areas. The STVI-4 index result was the best than NDVI index to discriminate the vegetable cover distribution.

Keywords: Remote sensing, Image segmentation, vegetation indices, Image binarization technique, STVI-4 index, NDVI index.

Introduction

One of the most common applications of remote sensing is vegetation assessment and monitoring via vegetation indices (Elhadi *et al.,* 2010). Vegetation indices combine reflectance measurements from different points of the electromagnetic spectrum to provide information about vegetation cover on ground. Healthy green vegetation has distinctive reflectance in the visible and near-infrared regions of the spectrum. At visible and in particular red wavelength, plant pigments strongly absorb the energy for photosynthesis, whereas in the near-infrared region, the energy is strongly reflected by the internal leaf structures. This strong contrast between red and near-infrared reflectance has formed the basis of many different vegetation indices involve numeric combinations of the sensor bands that record land surface reflectance at various wavelengths (Shaoing *et al.*, 2008).

The numerous vegetation indices have been proposed, modified, analyzed, compared and classified. These have been grouped into four types including slope-based, distance-based, orthogonal transformation and plant-water sensitive vegetation indices on the basis of the spectral bands they used and the means by which these are combined (Samarasinfhe *et al.*, 2010). Vegetation indices show a strong correlation with many agronomic and biophysical plant parameters. Nearly all of the commonly used vegetation indices (VIs) are only concerned with red-near-infrared space. The slope-based vegetation indices such as the ratio vegetation index (RVI) (or simple VI) and normalized difference vegetation index (NDVI), perform exceptionally well when management goals require a quantitative means for tracking green biomass or leaf area index through the season or for detecting uneven patterns of growth within a field (Harrison *et al.,* 2000; Jensen, 2000). The plant-water sensitive vegetation indices such as STVI-4 index was designed to respond positively to increasing vegetation response, whereas the STVI indices, such as (STVI-1 and STVI-3) decrease with increasing vegetation influence(Jafari, 2007).

This research presented two vegetation indices groups, such as STVI-4 and NDVI to compare between them and to find the most efficient to detect and recognize the vegetable cover for the Al-Ramadi region.

Materials and Methods

Studied area: The available studied scene is Al-Ramadi city lie in Al-Anbar province. Geographic location of study area is above of the site Al-Habbaniyah lake, the western side of the Euphrates river. The available scene was thematic mapper (TM) exposure at 1990onboard Landsat-5 satellite, illustrated in Figure (1). The satellite image band combination was (R: 5, G: 4, and B: 3), with the spatial resolution of (30 m) for all these spectral bands. It extends between latitudes (33° 25' 36.51") to (33° 10' 29.59") north between longitudes (43°

17' 5.34") to (43° 36' 40.62") east. This area includes a diversity of land cover classes interspersed with large areas of cultivated, bare and land. While several rural lands cover types of cultivated vegetation such as crops, and grass, also pasture land and characterize the surrounding landscape

Methodology of research: This study reviewed and tested the different groups of the vegetation indices; the plant-water sensitive and slope-based vegetation indices, such as (STVI-4) and (NDVI) indices respectively, as shown in figure 2-a. They were calculated using equations(Jafari, 2007);

STVI_4 = NIR - (RED × MIR) / (NIR + MIR) .....(1)

$$NDVI = (NIR - R)/(NIR + R) \quad \text{.....(2)}$$

The slope-based vegetation indices comprise simple arithmetic combinations of reflectance measurements, contrasting the high infrared and low red reflectance that characterizes photosynthetic vegetation. This contrast has been used widely to generate several vegetation indices such as NDVI index (Jafari, 2007). It takes the (NIR - R) difference and normalizes it to help balance out the effects of uneven illumination such as the shadows of clouds or hills. The pixel-by-pixel basis subtracts the value of the "R" band from the value of the "NIR" band and divides by their sum. It performs exceptionally well when management goals require a quantitative means for tracking green biomass or leaf area index through the season or for detecting uneven patterns of growth within a field (Charles *et al.,* 1983). Usually the NDVI is above 0.70 for green leaves of healthy plants. It produces an index value ranging between -1(no vegetation) → +1 (complete healthy green vegetation cover) (Qina *et al.,* 2005).

The plant-water sensitive that include mid and short-wave infrared regions of the electromagnetic spectrum on basis that vegetation has lower reflectance than soil in these regions, a contrast that may assist their discrimination. Since it is water content that largely determines vegetation reflectance in the near-infrared, mid and short-wave infrared regions (Kimes *et al.,* 1981; Dusek *et al.,* 1985; Baret *et al.,* 1988; Thenkabail *et al.,* 1994). These indices were a good predictors of yield, leaf area index, wet biomass, dry biomass and plant height than slope-based vegetation indices (O' Neill, 1996).

The STVI-4 index is a variant of plant-water sensitive group. This contrasts the higher near-infrared reflectance of vegetation with chlorophyll absorption in the red and water absorption in mid-infrared. Because of low chlorophyll levels the visible red reflectance of arid vegetation may be high, but the mid- infrared may be low in response to moisture content. Therefore, the (NIR - (RED × MIR))operation instead of (NIR - RED) that was used in the NDVI formula was used to highlighted the vegetation cover. By normalizing the (NIR - (RED × MIR)) operation over (NIR + MIR) instead of (NIR + RED) as in the NDVI formula, the effects of soil background were reduce and highlighted the sparse vegetation cover. The normalization retains the ability of the index to minimize atmospheric effects (Jafari, 2007).

In order to compare the implementation of these indices and identify pixels most likely contain significant vegetation, a simple threshold values may be implemented on the (STVI-4) and (NDVI) indices. Selection of threshold values depended on the pixel values in the vegetation indices images. Different suitable threshold have been used (i.e. all pixels < threshold have been assigned to represent background (non-vegetated area), while those ≥ threshold have been regarded as to represent the vegetated area and appear white when viewed as logically binary images. The splitting results or vegetation layers binaries by decided threshold are demonstrated in Figure (2b).

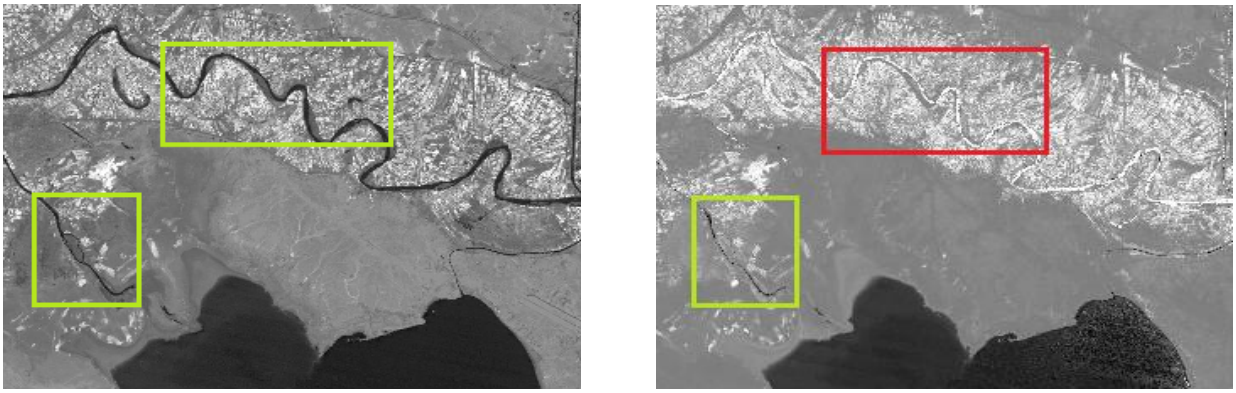
Results and Discussion

Vegetation indices provide the best means to monitoring changes in vegetation over large areas. The STVI-4 and NDVI vegetation indices have been applied on the Ramadi city. This study found that the STVI-4 performed better than NDVI index.

Figure (2a) shows the efficiency of doing the two indices to distinguish the vegetation areas for the river area. The specified areas with green frame are defined of river regions that have been detected by these indices. While the specific area with red frame is the river area, which failed the NDVI on discrimination its reflectance and it's distinguished as a vegetation area. This leads to the wrong account of percentage area for vegetation regions when isolated as a binary image from other land in Figure (2-b) by different suitable threshold have been assigned for these indices to represent the vegetation cover.

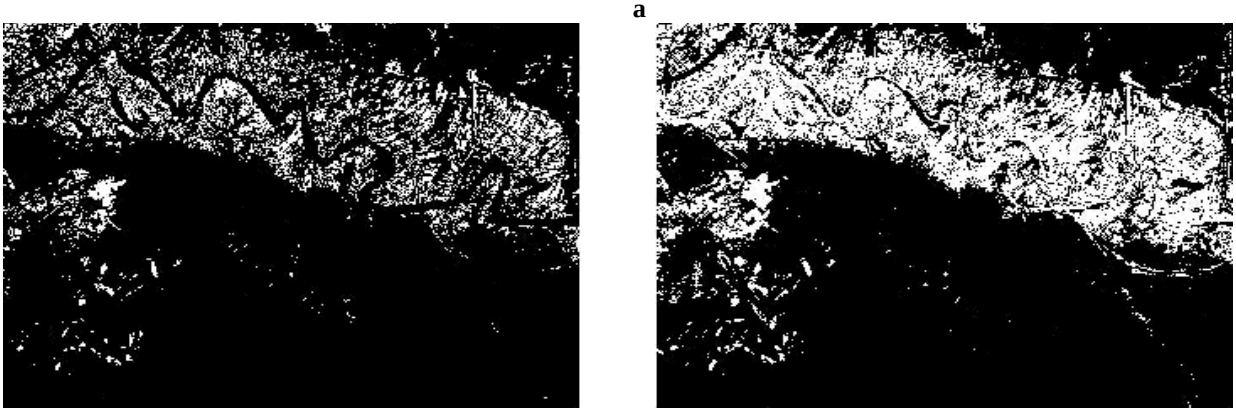
This study was performed using 64-bit computer platform of core 2 Due 2.2 GHz processor, ArcGIS9.3, ENVI 4.5 software's and MATLAB version 2013.

Figure(1): Landsat TM for Ramadi city, in year 1990, (size 738 × 1027 Pixels).



STVI-4 index NDVI index

a



STVI-4 binary image **NDVI binary image**

b

Figure (2): a- Vegetation indices (STVI-4 & NDVI) effects on TM images, the area that was specified with green frame is the river area for two indices, while the area that was assigned by red frame is the wrong river area for NDVI index, b- vegetation layers, binaries by (decided threshold =185 & 180) for STVI-4 & NDVI indices respectively

Conclusions

The STVI-4 and NDVI indices were good indices to detect and predict of the vegetation changes, they performed better improvement than other indices, and they appear to overvalue the quantity of vegetable cover for the study area. Because they have positive relationships and showed to very high correlation with vegetable cover. From practical results for the application of these indices on satellite image, the STVI-4 index was found that more efficient and accurate in distinguishing vegetated regions from the NDVI index. Because the STVI-4 index using red, near-infrared and mid-infrared bands showed significant relationships with vegetation cover. The NDVI index has very high sensitivity of the vegetation reflectance, so it is widely used in many applications and researches. But it is failed to distinguish the river from vegetation area for certain regions in the study area, due to the containment of the river on the amounts of vegetation, as well as the presence of vegetation that surrounded it, which led to overcome the reflectance of the vegetation on the reflectance of the river. While this index was succeeded to discriminate the river areas in other regions of the same study area, because the river is devoid from the existence of vegetation.

References

Baret, F.; Guyot, G.; Begue, A.; Maurel, P. and Podaire, A. 1988. Complementarily of middle-infrared with visible and near reflectance for monitoring wheat canopies. Remo. Sens. Environ., 26(3): 213-225.

Charles, R.P. and Lyle, F.L. 1983. Functional equivalence of spectral vegetation indices, U.S. D.A.J.S.B.S. Johnson Space Center SC2, Houston, Texas 770.58.

Dusek, D.; Jackson, R. and Musick, J. 1985. Winter

wheat vegetation indices calculated from combination of seven spectral bands. Remo. Sens. Environ., 18(3): 255-267.

Elhadi, E. and Zomrawi, N. 2010. Change detection analysis By using ikonos and quick bird imageries. J. American Sci., 6(2): 171-175.

Harrison, B. and David, L.B. 2000. Introduction to Remotely Sensed Data, CSIRO Division of Water Resources.

Jafari, R. 2007. Arid land condition assessment and monitoring using multispectral and hyperspectral imagery, PhD. Thesis, The University of Adelaide, Australia.

Jensen, J.R. 2000. Remote sensing of environment an earth resource perspective, prentice hall upper saddle river, New Jersey 07458, Series in Geographic Information Science.

Kimes, D.; Markham, B.; Turcker, C. and McMurtrey, I. 1981. Temporal relationships between spectral response and agronomic variable of a corn canopy. Remo. Sens. Environ., 11: 401-411.

O' Neill, A., 1996. Satellite-derived vegetation indices applied to semi-arid shrub lands in Australia. Australian Geographer, 27(2): 185-199.

Qina, Z., Lia W., Burgheimerc J. and Karnieli A. 2005. Quantitative estimation of land cover structure in an arid region across the Israel–Egypt border using remote, 5, Institute of Agro Resources and Regional Planning. Chinese Academy of Agricultural Sciences, Beiing 100081. J. Arid Environ., I (IIII): III-Iv.

Samarasinfhe, S.K.; Nandalal, H.; Weliwitiya, D.; Fowze, J.; Hazarika, M. and Samarakoon, L. 2010. Inter. Archiv. Photogram. Remo. Sens. Spat. Inform. Sci., XXXVIII, Part 8, 110-115PP.

Shaoing, Z. and XuLu, 2008. TInter.Archiv. Photogram. Remo. Sens. Spat. Inform. Sci., XXXVII, B7, 1595-1598PP.

Thenkabail, P.; Ward, A.; Lyon J. and Maerry, C. 1994. Thematic mapper vegetation indices for determining soybean and corn growth parameters. Photogram. Eng. Remo. Sens. 60(4): 437-442.