Using unsupervised classification to determined land cover northern of Ninvah provianec by using Remote sensing Techniques

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Abstract. The study was conducted in ten calcareous soil locations at Nineveh provenance / northern Iraq depending on three satellite images Landsat 7 TM have been taken in 2005, 2007 and 2010 which calculated the values of vegetation indices (VI, NDVI,SAVI,).These locations are lies between two coordinates Longitude 43°11’ 27”, 43°30’ 26” E and latitude 36°27’ 18”, 36°32’ 46” N. In order to determine the role of land uses on pedogenic Properties and then formation and development of calcareous soils. Figure (1). The results of the interpretation of satellite image using unsupervised classification method to the existence of (9) classes in study area for the Land uses. this results of directed with field visit results were merged with each other to the presence of minor differences with the fact where the classes became (6) which it was a best than other classifications, The Results of unsupervised Classification at other locations showed increase in green spaces distribution for the Image captured in 2005 (Class 1), which amounted (49.36) km², while it was less for (class2) representing grazing land in the same year amounting to (23:30) km². Then followed by 2010 image which the green space was (31.53) km², while the class1 amounted (14.39) km² for the image captured in 2007, but these mentioned recently observed in an increase in the space that represents the land undeveloped for grazing (Class 2) which reached (45.11) km² table (3).

Keywords: Land use, Unsupervised classification, NDVI, GIS

Introduction
Satellite image classification is one of the final goals in the remote sensing; where the relationship between pixels is investigated in order to cluster the pixels into certain classes. In some cases, it is useful to have the computer sort out which pixels have similar characteristics rather than to try to force the pixels into a class based on our culturally driven sense of their similarities. The NDVI is a ratio of the detected energy in the red and near infrared portions of the electromagnetic spectrum, since they are the most affected by the absorption of chlorophyll in green leafy vegetation. To detect the land-use and land-cover, the long term monitoring by the satellite images is useful as a big heritage (Jensen, J.R. (1996),(Hathout, 2002).This is done using an unsupervised classifier. Local land-use and land-cover change can influence environmental and ecological changes and furthermore contribute to global changes (Meyer and Turner,
1991). All of these changes, especially the loss of agricultural land, have the potential to undermine the long-term harmony of humans and their environment and threaten the food security. There is a pressing need for knowledge about the magnitude, pattern and type of land-use and land-cover changes and for projecting future land development.

Current technologies such as geographical information systems (GIS) and remote sensing provide a cost effective and accurate alternative to understanding landscape dynamics. Digital change detection techniques based on multi-temporal and multi-spectral remotely sensed data have demonstrated a great potential as a means to understanding landscape dynamics—detect, identify, map, and monitor differences in land use and land cover patterns over time, irrespective of the causal factors (Jensen, J.R. (1996). Recent improvements in satellite image quality and availability have made it possible to perform image analysis at much larger scale than in the past. GIS has enormous possible as an environment for the conception of dynamic models of physical environmental processes.

Method and Materials

Study area

The study was conducted in ten calcareous soil locations at Nineveh provenance / northern Iraq. These locations are lies between two coordinates Longitude 43°11’ 27”, 43°30’ 26” E and latitude 36°27’ 18”, 36°32’ 46” N. In order to determine the role of land uses on pedogenic Properties and then formation and development of calcareous soils. Figure (1)

The locations of sampling area have been selected to determine the effect of the Land uses (depending on the diversity of vegetation and the nature of agricultural use) on the development of calcareous soils. The study area represented by 10 locations, latitude and longitude coordinates recorded based on GPS table (1) using a device (Garmin eTrex 20) and to take advantage from its data during use other GIS programs.
Table (1): The selected sites within the study area and its GPS coordinates.

| No | Location | Land Use | E          | N          |
|----|----------|----------|------------|------------|
| 1  | Shallalat| Trees    | 36°27’18” | 43°27’18” |
| 2  | Fadiliah | Olive    | 36°15’45” | 43°30’20” |
| 3  | Mahad    | Wheat    | 36°25’14” | 43°39’10” |
| 4  | Zenawa   | Peach    | 36°28’48” | 43°38’21” |
| 5  | Kalakji 1| Okra     | 36°30’05” | 43°34’26” |
| 6  | Kalakji 2| Pasture  | 36°29’52” | 43°34’30” |
| 7  | Kalakji 3| Bean     | 36°30’26” | 43°34’11” |
| 8  | Darwishan 1 | S. Wheat | 36°33’45” | 43°29’47” |
| 9  | Darwishan 2 | S. Potatoes | 36°33’16” | 43°29’37” |
| 10 | Karmak  | Cucumber | 36°33’06” | 43°32’46” |

Satellite Landsat images and Spectral reflectance measuring:

Thematic Mapper (TM) images had taken by Landsat taken at multiple time to study area (2005, 2007, 2010) to the Path 170 and Row 35 in eight spectral bands, the first, second, third, fourth, fifth and seventh bands owns spatial discrimination ability (28.5 × 28.5) m, Band six has (60 × 60) m and the band 8 (14.28 × 14.28) m. as shown in the Table 2.

| Satellite | Sensor | Discrimination ability (m) | Date       |
|-----------|--------|----------------------------|------------|
| Landsat7  | TM     | 30                         | 07/05/2005 |
| Landsat7  | TM     | 30                         | 10/09/2007 |
| Landsat7  | TM     | 30                         | 17/07/2010 |

Satellite image processing:

digital processing has been done to the satellite image using the Erdas 9.2, a series of mathematical algorithms applied in the program like (Enhancement) which include Radiometric Enhancement, Spectral Enhancement and Spatial Enhancement. Then unsupervised and Supervised Classification made to the Images but after preparation of satellite images for this purpose first, such as Integration of spectral bands using Erdas 9.2 software and select three spectral bands for classification and interpretation using Erdas 9.2 software, Then make Unsupervised Classification.

Also calculated some of the criteria and vegetation indices as follows:

1- Vegetation Index (VI):
It represents the difference between the values of the spectral reflectance between near infrared and red wavelength (Lillesand and Kiefer, 1987).

\[ VI = \frac{BAND(X) - BAND(Y)}{BAND(X) + BAND(Y)} \]

2- Normalized Difference Vegetation index (NDVI) : John et al. (1973).

\[ NDVI = \frac{NIR - R}{NIR + R} \]
3- Soil Adjusted Vegetation Index (SAVI):

Represent of the values (NDVI) multiplied by (1.5) (Heute et al., 1988).

\[
SAVI = \frac{(\text{BAND}(X) - \text{BAND}(Y))}{\text{BAND}(X) + \text{BAND}(Y)} \times 1.5
\]

Results and discussion:

Unsupervised Classification:

The results of the interpretation of satellite image using unsupervised classification method to the existence of (9) classes in study area for the Land uses, this results of directed with field visit results were merged with each other to the presence of minor differences with the fact where the classes became (6) which it was a best than other classifications, with high accuracy and less distortion compared with the previous options that were made to the area studying. it has been made a two scenes of the study area, one of them represent Shallalat and Fadiliyah (Figure 2) and the second one represents the rest of the study sites (Figure 3) to the images of three years (2005, 2007, 2010). to see the deference among them in land uses.

The results showed in Figure (2) an increase in green space density (Class 1 and Class 2), amounting to surface area of (25.41, 41.66) km², respectively as shown in the table (3) which give account of these spaces using Erdas 9.2, and there are a few in abandoned spaces without cultivation and other predisposing to agriculture (Class 3), which amounted (34.77) km² for image captured in 2005, followed by image taken in 2010, which is reached (13.50, 26.80, 33.70) km², respectively for the same classes, and then amounted (8.15, 26.83, 47.34) km² in the Image taken in 2007 and for the same three classes respectively.

The Results of unsupervised Classification at other locations (Figure 3) showed increase in green spaces distribution for the Image captured in 2005 (Class 1), which amounted (49.36) km², while it was less for (Class 2) representing grazing land in the same year amounting to (23:30) km². Then followed by 2010 image which the green space was (31.53) km², while the this class1 amounted (14.39) km² for the image captured in 2007, but these mentioned recently observed in an increase in the space that represents the land undeveloped for grazing (Class 2) which reached (45.11) km² table (3).

| Class | Image1 | Image2 |
|-------|--------|--------|
| 2010  | 2007   | 2005   |
| % Area| Area (Km²) | % Area | Area (Km²) | % Area | Area (Km²) | Class | Image |
|-------|-----------|--------|-----------|--------|-----------|-------|-------|
| 7.71  | 13.50     | 4.65   | 8.15      | 14.51  | 25.41     | 1     | 1     |
| 15.31 | 26.80     | 15.07  | 26.38     | 23.80  | 41.66     | 2     | 2     |
| 19.25 | 33.70     | 27.04  | 47.34     | 19.86  | 34.77     | 3     | 3     |
| 23.28 | 40.76     | 28.08  | 49.15     | 15.77  | 27.60     | 4     | 4     |
| 22.79 | 39.90     | 19.02  | 33.29     | 13.65  | 23.90     | 5     | 5     |
| 11.65 | 20.39     | 6.13   | 10.74     | 12.40  | 21.71     | 6     | 6     |
| -     | 175.05    | -      | 175.05    | -      | 175.05    | Total |       |
| 17.17 | 31.53     | 7.84   | 14.39     | 26.88  | 49.36     | 1     | 1     |
| 16.99 | 31.19     | 24.57  | 45.11     | 12.69  | 23.30     | 2     | 2     |
| 10.51 | 19.30     | 19.88  | 36.51     | 25.84  | 47.45     | 3     | 3     |
The table (3) showed that the values of the NDVI was closer to No. 1 in 2005 in Image 1, and followed by 2007 image, the highest value of NDVI was in 2005 for Kalakji (0.346) in Image 2 and that goes with the field induction that show the location were planted by okra crop and soil mostly had a good characteristics that help to keep the in a good vegetation cover and this is consistent with what stated in the FAO, (1998). VI for the year 2010 which is much higher than most of the study area for the all images, while the lowest value was in Shallalat inside Image 2 due to lack of vegetation cover and the exploitation of the region as a graze land recently. SAVI values ranged between (0.05 - 11), and the highest value was in Image 1 in 2010, also noted SAVI had a values for vegetation cover higher than the values of NDVI and the reason for this is to calculate reflectivity of the soil in addition to the vegetation and that making them the highest values according to Huete, (1988).

![Unsupervised Classification for first region for the three years by Erdas 9.2](image)

**Figure (2)** Unsupervised Classification for first region for the three years by Erdas 9.2
Figure (3) Unsupervised Classification for second region for the three years by Erdas 9.2

Table (4) the values of vegetation indices for the study area

|       | Image 2 | Image 1 |
|-------|---------|---------|
| 2010  | 0.094   | 0.140   |
| 2007  | 0.420   | 0.346   |
| 2005  | 0.346   | 0.172   |
| 2010  | 0.150   | 0.192   |
| 2007  | 0.042   | 0.094   |
| 2010  | 0.37    | 0.27    |
| 2007  | 0.14    | 0.09    |
| 2005  | 0.25    | 0.11    |
| 2010  | 0.11    | 0.05    |
| 2007  | 0.26    | SAVI    |
| 2005  | 0.12    | SAVI    |
| 2010  | 0.45    | SAVI    |
| 2007  | 0.11    | SAVI    |
| 2005  | 0.11    | SAVI    |

References

[1] Hathout, S., (2002) “The Use of GIS for Monitoring and Predicting Urban Growth in East and West St Paul, Winnipeg, Manitoba, Canada”, J. Environ. Manag, 66, 229–238.
[2] Huete, A. R. (1988). A soil adjusted vegetation index (SAVI). Remote Sensing of Environment. Vol. 25, No. 3, pp.295-310.
[3] Jensen, J.R. (1996). “Introductory digital processing”: A remote sensing perspective (2n edition). Upper Saddle River, NJ: Prentice-Hall.
[4] John, W. R., Haas, R. H., Schell, J. A. and Deering, D. W. (1973). Monitoring the vernal advancement and retrogradation (Green Wave Effect) of natural Lambin, E.F., M.D.A.
[5] Lillesand, T. M. and Keifer, R. W. (1987). Remote sensing image interpretation. 2nd ed., Johen Wiley and Sons Co. New York. p 721.
[6] Meyer, W. B., and B.L. Turner, (1991) “Changes in Land-use and Land-cover: A Global Perspective”, Cambridge University Press.