

Greenrey(Green Space) Percentage Estimation Using Band Ratio, NDVI From Landsat Enhanced Thematic Mapper(ETM)-2002 & An Application Of Geographic Information System(GIS) Techniques, Dezful-Andimeshk, Khuzestan South-West Iran

Saied Pirasteh ⁽¹⁾ Syed Ahmad Ali ⁽²⁾ Heshmi Jamil Hussain ⁽³⁾

Contact [Email: moshaver1380@yahoo.co.uk](mailto:moshaver1380@yahoo.co.uk)

1- Faculty of Engineering, Islamic Azad University of Dezful, Dezful-Iran

2-Department of Geology, Aligarh Muslim University, Aligarh, India, saaligeology@yahoo.com

3-Forest Research Institute, Dehradun, India,

Email:hishmijamil@rediffmail.com

Abstract Landsat-7 ETM was used to derive the greenery for the Oct-2002 in the Dezful-Andimeshk, Khuzestan, southwest Iran. Dezful and Andimeshk are very hot cities in summer and dry winter with about +1 degree centigrade. Urbanization was correlated with increasing needed of the land for settlement and it caused one of decreasing amount of greenery. In other hand decreasing of greenery makes human who stay in these area loose their comfortability. Greenery has an important role as an indicator of environmental condition in the urban areas. The percentage of the greenery was estimate and evaluated by the remote sensing methods like Band Ratio, NDVI, supervised classification and post classification . Function of vegetation in urban areas strongly controls urban air pollution, thermal environment and influence urban microclimate. Quantitative analysis about green space in Dezful-Andimeshk and its suburbs are necessary for evaluate environmental condition in greenery aspect, application of image data analysis, and GIS are effective for the area like Dezful-Andimeshk of the present research.

Percentage obtained of greenery in selected area indicated shortage of green spaces in both the cities namely Dezful-Andimeshk from the study area. However, this study reveals that how satellite data beside GIS techniques approach eases data archiving and map.

Keywords Dezful-Andimeshk' Khuzestan' Band Ratio' NDVI, GIS

Introduction

During the past millennium, human, have taken an increasingly large role in the modification of the global environment. With increasing numbers and developing technologies, man has emerged as the major most powerful, and universal instrument of environmental change in the biosphere today. Both globally and in the Iran land cover today is altered primarily by direct human use. Greenery percentage prediction has become a central component in current strategies for the Dezful-Andimeshk area. Viewing the Earth from space has become essential to comprehend the cumulative influence of human activities and its natural resourcebase. Over the past two decades, data from Earth Sensing Satellites(ESS) has become important in different aspect such as monitoring, mapping , infrastructure and environmental green open space studies. Remote Sensing and GIS are providing new tools for advanced natural resources evaluation, mapping and prediction of the greenery percentage in the study area. Several studies have been established good correlation vegetation indeces and grain yield using single data (Colwell, 1979, Barnett & Thompson, 1982, 1983, Parihar et al 1987, Alinda Medrial et al, 2001 & R. Singh et al, 2002) and remotely sensed data.

Dezful city covers around 5289.166 hectares which about 1953.876 hectares of the area are urban. Andimeshk city also covers around 1544.818 hectares and 1133.820 hectares of the total area are urban. Dezful- Andimeshk cities are connected by the road and that is about 7 km.

Image processing techniques employed in this study were conducted using ER-Mapper and Environmental Visualization Images (ENVI)softwares. Both the softwares are raster based software package with advanced vector capabilities. The False Color Composit (FCC) image bands 7-4-2, Band Ratio and Normalizes Difference Vegetation Index (NDVI) images were produced using ENVI software. These two images were classified and dirtely converted

from raster to vector using ENVI software then exported to Arcview software of the GIS environment for the creation of map, ability for the query, editing, saving and additional GIS analysis.

This research was conducted to analyze green open space condition in Dezful-Andimeshk area using Landsat-7 ETM (Fig.2), and GIS data sets as tools of analysis.

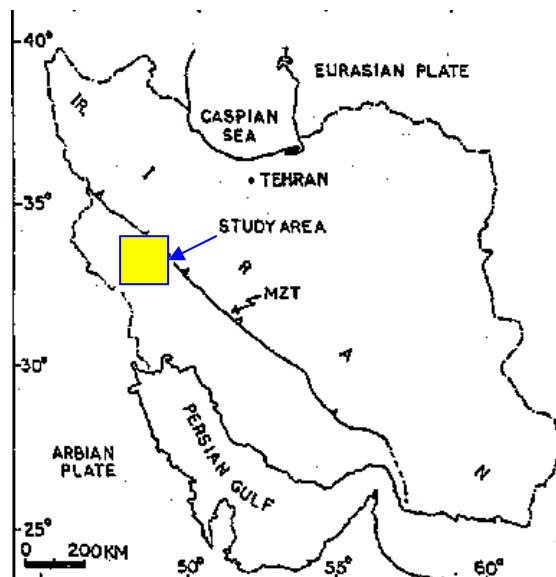


Fig.1) Study area, Dezful-Andimeshk, SW-Iran

Study Area

The Dezful-Andimeshk cities are administratively belong to the Khuzestan province. The study area (Fig.1) located in south-west of Iran. The selected portion of the Landsat-7 ETM-2002 FCC (7-4-2) image (Fig.2) of the study area ranges between 248049.250 to 260846.250 E and 3597284.750 to 3581808.750N with respect to Universal Transverse Mercator (UTM). Dezful-Andimeshk are two hot cities of Iran. The temperature in summer normally falls between +46 to +54 degrees centigrade and having a dry winter with +1 to +5 degrees centigrade. Dez dam is situated in north-east (about 20km)of the Dezful-Andimeshk cities. The Karkheh dam also is constructed in north-west(about 30km) of the Dezful-Andimeshk cities. The dams were constructed for the prevention of the flood and generation of electricity power, and agricultural purposes. Dez river crossing the Dezful-Andimeshk cities and it makes Dezful city very interesting while the ground truth data indicated deficit of the green space which may affect on the present environment.

Dezful

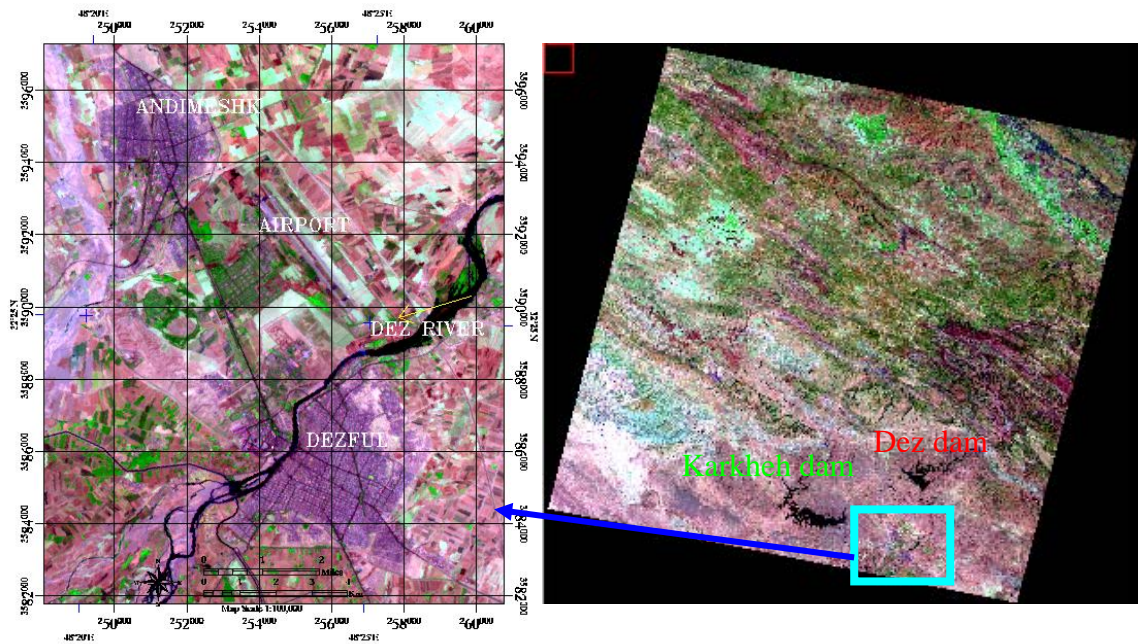


Fig.2) Landsat satellite ETM data, 2002, FCC 7-4-2, Dezful-Andimeshk, Khuzestan, SW Iran

Materials & Methodology

Materials

Remote Sensing data set was collected from Iranian Remote Sensing Center (IRSC). Portion of the Landsat-7 ETM-2002 data was chosen as a tool of analysis. The image satellite data was geometrically corrected in ER-Mapper software. Topography data and land use map of 1:25000 scales, which's use for geometric correction process and were sourced for the background and calibrated to the digital data. Global Positioning System (GPS) was used during the ground truth control to increase the accuracy of the obtained data from digital data. ENVI software (Evaluation Copy) was used to develop FCC, Band Ratio and NDVI images. The ENVI software allows for the Digital Image Processing (DIP) like enhancements, filtering and classification were applied on the Landsat ETM image. The data analysis were converted to the Arcview software of the GIS environment for further analyses and creation databank system, query ability and producing map.

Methodology

Geometric Correction

Theoretically, geometric correction is undertaken to avoid geometric distortion from a distorted image, and achieved by establishing the relationship between the image coordinate system and the geographic coordinate system using calibration data of the sensor, measured data of position and attitude, Ground Control Point (GCP) (using GPS). Geometric correction process should done represents for all sides of the Landsat ETM image dated 2002, and not enough GCP points could give a bad result. UTM information from landuse and topographic 1:25000 scale, maps used for references on geometric correction process. This above process was done in ER-Mapper software 6.1 versions.

Enhancement and Filtering

Basically enhancement process is applied to enhance objects in the image. Linear 2% enhancement was applied to the images using ENVI software. Filtering process was also used to make sharpen the objects in the images. This process was done with the help of ENVI software.

Greenery Percentage

Vegetation indexes are combination of different spectral responses from the surface layer, which commonly used in remote sensing studies (Alinda Medrial et al, 2001). It is usually using for identify and address the status of the vegetation. Many studies have been done regarding the spectral response from vegetated and non vegetated area in visible, near infrared and middle infrared regions of the electro-magnetic spectrum. The accuracy of estimation the percentage of vegetation from image data are influenced by atmospheric condition (Alinda Medrial et al, 2001), soil brightness, leaf inclination, leaf optical properties and vegetation density. The behavior of the vegetation to reflect, absorb and transmission the incident radiation is considered relatively even whatever the crop considered. It is recognized that almost 90% of the spectral information remotely collected from a vegetation cover belongs to the red and near infrared bands (Alinda Medrial et al, 2001). These bands represents a significant fraction of solar irradiance, and high change of reflection rate between red and near infrared is indication that characterizes the spectral response of vegetation.

The existence of urban vegetation in Dezful-Andimeshk area for about 6833.984 hectares was measured using Band Ratio, NDVI, and supervised classification. The parallelepiped was carried out for the supervised calssifications and then post classification such as sieve was done. The sieve function searches the eight neighbor region around a pixel rather than the four-neighbor region for continues blubs. The four-neighbor region around a pixel consists of two adjacent horizontal and two adjacent vertical neighbors. The eight neighbor region around a pixel consists of all the immediately adjacent pixel (www.researchsystem.com/envi).

Band Ratio= Band 7/ Band1, Band 4/Band2

NDVI= $\frac{NIR - R}{NIR + R}$

Where ETM band 1,2,3 and 4 corresponds to B (blue), G (green), R (red) and NIR (near infrared) respectively.

Spatial analyses from the supervised classifications and post classification using Band Ratio and NDVI methods were finally converted to the vectors and shape file(GIS formats). During the conversion of raster to vector the topology was built for the layers which were defined during the supervised classification procedure by Region Of Interest (ROI) in ENVI software. The image processing chain for the proposed method is shown in [figure 3](#).

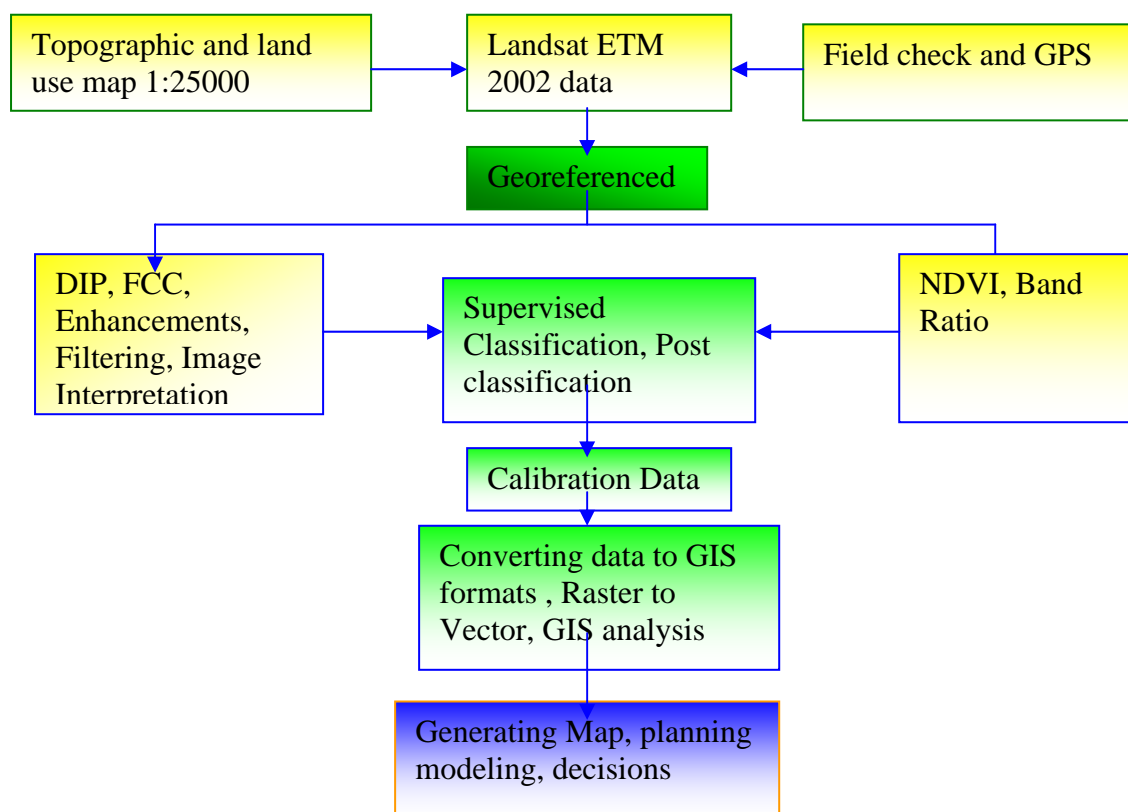


Fig.3) The steps of the greenery estimation percentage using digital data

Results

The calibration of the remotely sensed data with the field check showed that high values of Band Ratio and NDVI has a correlation with percentage of green coverage, especially for tree coverage. The correlation and linking of Band Ratio and NDVI images using ENVI software, indicate that the brightness in the pixel from NDVI image is related to the high values pixel from the Band Ratio FCC 7/1-4/2-2 image. This result was calibrated to the field check and it has been seen that the healthy, high trees and large density vegetation have remarked as lighter tones in NDVI and high pixel value in Band Ratio FCC image. The total greenery(trees+grass) for the present study area indicated that there is trend of increasing of Band Ratio and NDVI values as same as increasing of total greenery percentage.

About 1406.4117 hectares (20.5716%) green coverages (Fig.4) are evaluated from the total study area for Dezful-Andimeshk cities which is documented not sufficient coverages for the environment. The ground data calibrated to the spatial data have shown that the distribution of the green coverages (Fig.4) in both the Dezful as well as Andimeshk cities is not well defined and the green spaces are concentrated in between the Dezful-Andimeshk highway or around both the cities while the present condition can not be played as an important role for the environment especially during hot climate as well as in psychology of the people in respect to entertainment. This study represents that about 73.4280 hectares (3.75%) and 45.3240 hectares (3.9973%) of the urban is covered by green space respectively from Dezful and Andimeshk cities.

We also show how GIS approach eases data archiving, map generation and also provides interpretational possibilities not available with more traditional procedures (Pirasteh et al., 2002).

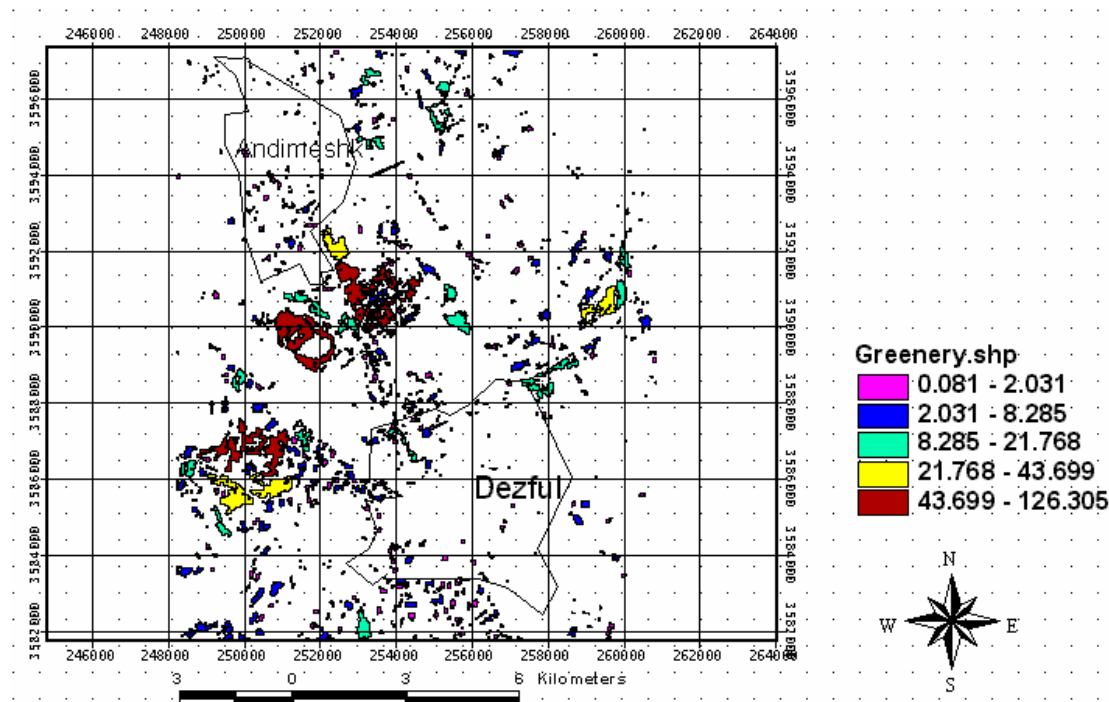


Fig.4) Green spaces map of the Dezful-Andimeshk ,SW Iran

Conclusion and Recommendations

Conclusion

This research was conducted to analyze greenery condition in Dezful-Andimeshk area using remote sensing and GIS techniques as tools of analysis. This research showed that there is a correlation between Vegetation Index and percentage of greenery. This index more effective use at massive vegetation and trees than ground cover such as grass.

The correlation of the Band Ratio and NDVI images indicated that the high Band Ratio and NDVI values identify pixels cover by substantial portions of healthy vegetation, and as a result of trees surface layer reflectance. Function of vegetation in urban areas strongly controls urban air pollution, thermal environment and influence urban microclimate.

Recommendations

It seems that the Dezful-Andimeshk cities need more attention for the growing green spaces, since the two main dams and other natural resources like the Dez river crossing them and holding good situation for the improvement of the greenery and environment. It also seems that growing the green spaces in the present study since facing hot climate in atleast 6 months of a year, has an important role to the thermal environmental aspects.

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