ASSOCIATION BETWEEN BOTANICAL COMPOSITION AND BIOMASS QUANTITY OF GRASSLANDS AND NIR REFLECTANCE BY USING NDVI

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Abstract

It was aimed to investigate the possible association between botanical composition and biomass quantity and NIR (Near Infra Red) reflectance by using NDVI (Normalised Difference Vegetation Index) derived from remote sensing data. For this purpose, red (0.45-0.52 µm), near infra-red (0.52-0.60 µm) and infra-red (0.63-0.69 µm) spectral bands of the LANDSAT 5 TM satellite images taken in 2005 were used and NDVI was calculated as a ratio between measured reflectivity in the red and NIR portions of the electromagnetic spectrum. The field measurements were also carried out in north eastern part of Turkey in 23 test points during vegetation period to determine botanical composition and fresh biomass quantity. Regression analysis showed that there was a poor relationship between botanical composition and NDVI (R^2=0.22) while a good coefficient of determination was observed between fresh biomass quantity and NDVI (R^2=0.67). It can be concluded that field spectral measurements and satellite derived information can provide a valuable support and information to the evaluation of grasslands.

Key words: Grasslands, remote sensing, NIR, NDVI

INTRODUCTION

Advances in technology have led to the development of active remote sensing systems that have their own energy source and are therefore not limited by the constraints that hinder other types of remote sensing (i.e., aerial and satellite imagery and aerial photographs) [5], [4]. In recent years, estimation of biomass production of pasture using remote-sensing techniques is developing very fast [3]. RS and GIS are being used increasingly as tools to assist in grassland resource inventory and integration of data and as a mechanism for analysis, modelling, and forecasting to support decision-making [2], [1].

A vegetative index is a value that is calculated (or derived) from sets of remotely-sensed data that is used to quantify the vegetative cover on the Earth's surface. Though many vegetative indices exist, the most widely used index is the Normalized Difference Vegetative Index (NDVI). The NDVI, like most other vegetative indices, is calculated as a ratio between measured reflectivity in the red and near infrared portions of the electromagnetic spectrum.

Remote sensing of grasslands at high resolutions using the normalized difference vegetation index (NDVI) is a feasible approach to handling the temporal and spatial variability of biomass for use in management of grazing systems.

MATERIAL AND METHODS

The study area is located in Kars Province, in Eastern Anatolian Region of Turkey, which stretches from 87°46'E to 88°44'E, and from 43°45'N to 45°30'N (Fig. 1). Study area covered provincial boundaries of Kars. The area of Kars province is 918.117 ha. It lies between 260 000-390 000 km East, 4 420 000- 4 530 000 km North according to UTM Geographic Coordinate System. Ardahan province is in the North; Agri in the South; Erzurum in the West and Armenia in the East.

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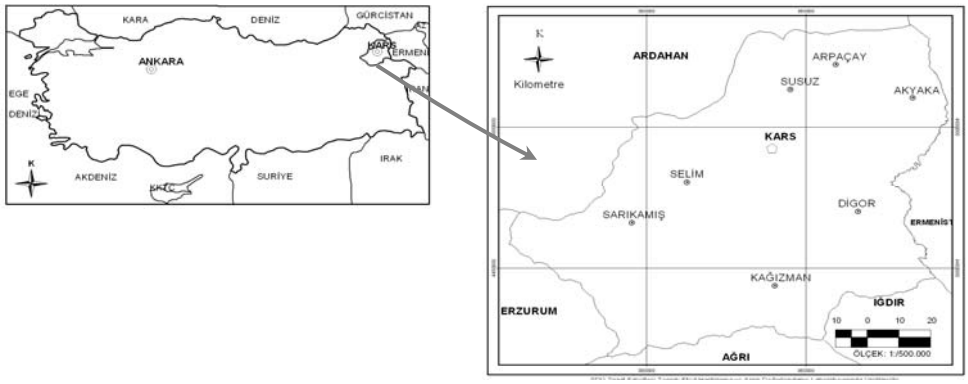

Figure 1 Geographical location of the study area

LANDSAT 5 TM satellite images taken in 2005 were used within the range of red (0.45-0.52 µm), near infra-red (0.52-0.60 µm) and infra-red (0.63-0.69 µm) spectral bands for calculation of NDVI. NDVI was calculated as a ratio between measured reflectivity in the RED and NIR portions of the electromagnetic spectrum, using the following formula:

$$NDVI = (NIR - red) / (NIR + red)$$

The field measurements were also carried out in north eastern part of Turkey in 23 test points during vegetation period to determine botanical composition and fresh biomass quantity. The location of sampling sites were determined in advance using land cover maps derived from the satellite images [6]. Regression Analysis were performed to determine the relationship between botanical composition and biomass quantity and NIR (Near Infra Red) reflectance by using NDVI.

RESULTS AND DISCUSSION

Regression analysis showed that there was a poor relationship between botanical composition and NDVI (R^2=0.22) while a good coefficient of determination was observed between fresh biomass quantity and NDVI (R^2=0.67). The higher coefficient of determination for the regression of NDVI against biomass determined with the direct harvesting method was expected due to the accuracy of direct measurements. It is obvious that the differences in botanical composition of the grassland in test points and grassland management may induce several spectral variations. Botanical composition may differ due to the effect of grazing pressure resulted from specific differences of tolerance, trampling and grazing palatibility. Therefore, it is possible that the results may refer to different compositions and spectral reflectances, which vary for each vegetation type.

CONCLUSION

It can be concluded that field spectral measurements and satellite derived information can provide a valuable support to the evaluation of grasslands. However, the relationship presented here are based only on data collected for a single growth season. Ideally further studies are needed to investigate whether or not seasonal factors affect these relationships.

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