ASSESSMENT OF LAND USE CHANGES IN DIRAB REGION OF SAUDI ARABIA USING REMOTELY SENSED IMAGERIES

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ABSTRACT

Knowledge of land use (LU) changes is important for many planning and management activities. It is thought to be an essential element for modeling and understanding of major land forms, especially in arid regions like Saudi Arabia. This study was aimed at assessing the temporal changes in land use pattern in Dirab region, Riyadh, Saudi Arabia using Landsat TM/ETM+ data. Cloud free single date images for the years 1990, 2000 and 2010 were corrected radio-metrically (Top of Atmosphere) using sun elevation correction and earth-sun distance techniques. Radiative transfer equation was used to compute the at-sensor radiance (Lrad) to surface radiance (i.e. absolute radiance value) ratio. The ratio was determined by applying the pre-launch calibration constants of TM and ETM+, followed by corrections for spectral emissivity according to the nature of land use. Supervised and unsupervised classification techniques were both applied to assess the LU class according to USGS level – I classification scheme using Erdas Imagine Professional software. The Supervised classification was carried out using the maximum likelihood method with the aid of ground truth data obtained from the field. However, the unsupervised classification was conducted by the use of algorithms that examined the unknown pixels in an image and aggregated them, based on natural groupings or clusters presented in the image value, into a number of classes. The overall accuracy and the error matrix with Kappa coefficients are presented in the paper, along with a change detection matrix of the study area.

Keywords: Precision agriculture, land use, remote sensing, temporal changes, imageries, Saudi Arabia.

INTRODUCTION

Precision agriculture seeks to identify, analyze and manage spatial and temporal variability. Land use mapping is a tool to observe spatial association between land use practice and developmental activities. It also provides solutions for sustainable use of natural resources including water, soil and nutrients.

The main goal of this study was to determine land use changes during the period between the years 1990 and 2010, and generate Land use classification maps of Dirab region, Saudi Arabia, using TM and ETM+ satellite images.

MATERIALS AND METHODS

Geo-corrected cloud free Landsat TM (166/43, date of pass: 07/09/1990) and ETM+ (166/43, date of pass: 02/09/2000) imageries were downloaded from GLFC and USGS (165/43, date of pass: 07/09/2010). Images were radio-metrically (Top of Atmosphere) corrected by applying sun elevation correction and earth-sun distance techniques. Radiative transfer equation was used to compute the at-sensor radiance (Lrad) to surface radiance ratio (i.e. absolute radiance value) utilizing pre-launch calibration constants of TM and ETM+ (Todd et al., 2006). Both of unsupervised and supervised classification techniques were applied to prepare LU maps (agricultural, built-up and barren lands) according to USGS level – I classification scheme. These maps were used for change detection using Erdas Imagine Professional software program, where image differencing technique, (Lu et al., 2004) was implemented. A total of 60 samples were randomly chosen for accuracy assessment. Three measures of accuracy; namely overall accuracy, error matrix and Kappa coefficient were studied.

RESULTS AND DISCUSSION

Results of temporal variability in land use pattern revealed that, in the year 1990, the area under agriculture formed 3.16% out of the total study area. This area under agriculture was found to increase 5.46% in the year 2000 and decrease to 3.86% in the year 2010. The built-up area, however, was shown to increase from 6.13% in 1990 to 7.0% in 2000 and to 9.02% in 2010. For the supervised classification, the values of Kappa coefficient were 0.7452, 0.7555 and 0.7524, for the years 1990, 2000 and 2010, respectively. However, these values for the unsupervised classification were 0.6667, 0.6861 and 0.6519 for the years 1990, 2000 and 2010, respectively. Change detection was determined using error matrix. For supervised classification, the overall accuracy for images of 1990, 2000 and 2010 was 77.78, 75.62 and 77.92 per cent, respectively. However, for unsupervised classification, the accuracy reached 64.58, 62.68 and 62.12 per cent, for 1990, 2000 and 2010 images, respectively.

CONCLUSION

Land use mapping was proven to provide detailed information for assessing land use dynamics. Results of the study indicated differences in accuracies between the two classification methods (supervised and unsupervised). Supervised classification method was found to be more accurate than the unsupervised classification.

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