

Mapping and Assessment of Land Use/ Land Cover Using Remote Sensing and GIS. Case study: Potential Area for Dates Palm in Al-Qassim Region, Central Saudi Arabia

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Abstract- Mapping of land use/land cover classes is important task to conserve natural resources and to put suitable management practices. Remote sensing techniques provide promising possibilities to map land use/land cover classes since remotely sensed data covers a large area with periodic synoptic view.

The Kingdom of Saudi Arabia contributed significantly to world date production. The Qassim region of central Saudi Arabia is considered as one of most famous producing area locally, regionally and internationally.

In this study Enhanced thematic satellite scene of path 168 and row 43 acquired on 28.08.1999 was used. Unsupervised classification approach was used. Three major land use/land cover classes were determined viz hilly area (1232566.06 ha), vegetated land (1663389.88 ha) and sand dunes (470068.08 ha). The vegetated land constitutes the first class, mainly the Wadis, and it is mainly devoted to dates production. Hilly unproductive areas constitute the second class. Finally, it is obvious that sand dunes cover a large proportion of the study area.

It is worth to mention that sand dunes surround the vegetated land, which in turn will lead to the loss of some of the productive lands through sand encroachment. This fact necessitates the adoption of suitable management practices to retard and, if possible, to stop sand encroachment.

Index Terms- Remote Sensing, Land use/Land cover, Saudi Arabia

I. INTRODUCTION

Remote sensing is becoming increasingly important for mapping land use and land cover due to specific characteristics of remotely sensed data e.g. large area coverage, good spatial resolution, accessibility to remote areas and faster interpretation with higher degree of objectivity and reproducibility. There are two broad types of image classification methods; namely, supervised and unsupervised classifications. In supervised classification approach, training samples for information classes are selected with aid of ground truth points and then are used to train the classifier, where in unsupervised classification approach the classifier determines dependently the

spectral classes with the image and finally the image analyst determines the related information classes to these spectral classes. However, combined hybrid (supervised and unsupervised) classification approach is also used for land use and land cover classification (Sabins, 1996, Dafalla and Csaplovics, 2005).

The difficulties concerning land use / land cover classification by means of remote sensing in arid and semi-arid regions are well known. Since vegetation-soil-patterns in arid and semi-arid zones are characterized by a sparse distribution of non-photo synthesising vegetation (NPV) its spectral behaviour interferes with spectral signatures of bare soil patterns (Schmidt and Karnieli, 2000, Khiry et. al., 2006). Moreover, the spatial heterogeneity at pixel level strongly affects systematic separation between dominant land uses. Therefore, many studies have recommended subpixel unmixing analysis as a suitable method to overcome such constrains (Elmore, *et al.*, 2000), but still there are many difficulties to be overcome such as unavailability of spectral libraries for dominant plant species and soil types.

Mapping of land use/land cover classes is an important task to conserve natural resources and to recommend suitable management practices. Remote sensing techniques provide promising possibilities to map land use/land cover classes since remotely sensed data cover a large area with periodic synoptic view. The goal of this study is to determine the major land use/land cover classes in this arid zone of Saudi Arabia by using remote sensing techniques with more emphasis on the effect of sand encroachment on date palm production.

STUDY AR METHODOLOGY

II. METHODOLOGY

III. EA

The Kingdom of Saudi Arabia contributes significantly to world dates production. Date Palm constitutes about 90% of the cultivated land (Shahean, 1990). The average dates production is in the range of 600-650 tons/acre (Al-Suliem, 2003). The study

area, Qassim Region of Central Saudi Arabia, is considered as one of the most famous dates producing area locally, regionally and internationally. The region is known to be the alimantal basket of the country because of its agricultural assets. Al-Qassim (26° 18' N, 43° 58' E) has a land height of 600-750 m

above sea level generally gliding from west to east. The climate is a typical desert climate with cold rainy winter and hot summer with low relative humidity (http://en.wikipedia.org/wiki/al_Qasim).

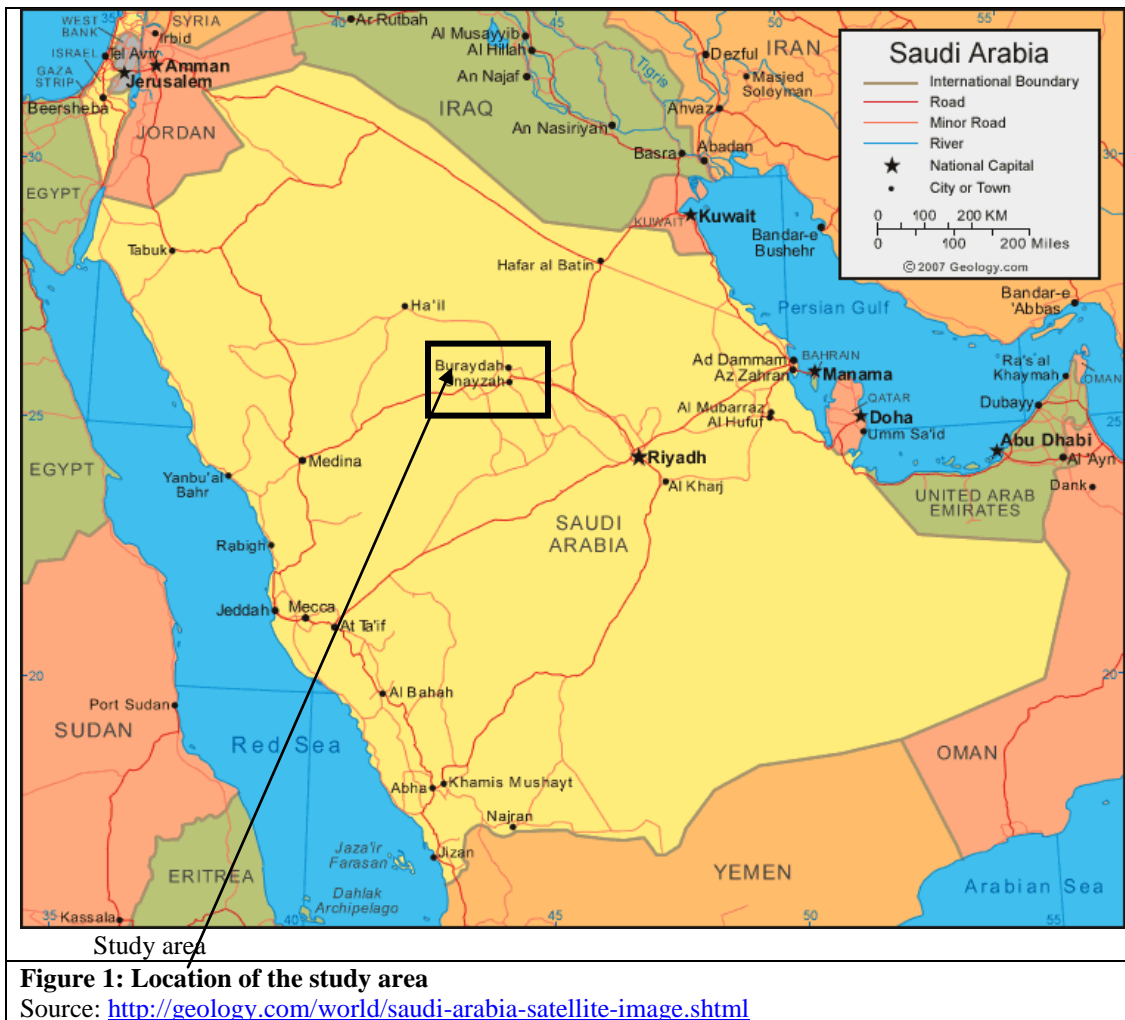


Figure 1: Location of the study area

Source: <http://geology.com/world/saudi-arabia-satellite-image.shtml>

IV. METHODOLOGY

In this study geometrically and radiometrically corrected Enhanced Thematic Mapper Plus (ETM+) scene of path 168 and row 43 acquired on 28/08/1999 was used. The image was freely downloaded from Global Land Cover Facility (<http://glcf.umiacs.umd.edu/data/>). Visible bands 1, 2, in addition to near infrared band 4, 5, 7 were stacked to form false composite

image (fig. 2). Visual interpretation was carried out to determine the major apparent land use/land cover patterns. Three patterns, hilly area, *Wadi* vegetation and sand dunes, were recognized and then used as inputs during the process of unsupervised classification.

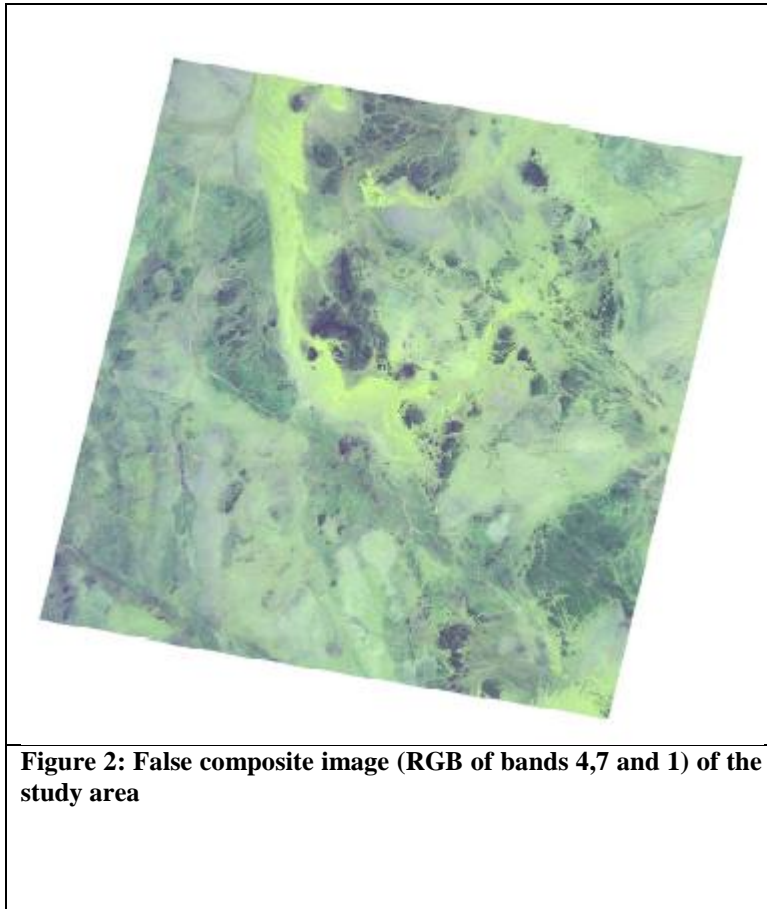


Figure 2: False composite image (RGB of bands 4,7 and 1) of the study area

V. RESULTS

Figure (3) and Table (1) showed that three major land use/land cover classes were determined viz hilly area (1232566.06 ha), vegetated land (1663389.88 ha) and sand dunes (470068.08 ha). The vegetated land constitutes the first class, mainly the *Wadis*, and it is mainly devoted to dates production. Hilly unproductive areas constitute the second class. Finally, it is

obvious that sand dunes cover a large proportion of the study area.

It is worth to mention that sand dunes surround the vegetated land, which in turn will eventually lead to the loss of some of the productive lands through sand encroachment. This fact necessitates the adoption of suitable management practices to retard and, if possible, to stop sand encroachment through sand dunes fixation, establishment of shelter belt and wind breakers.

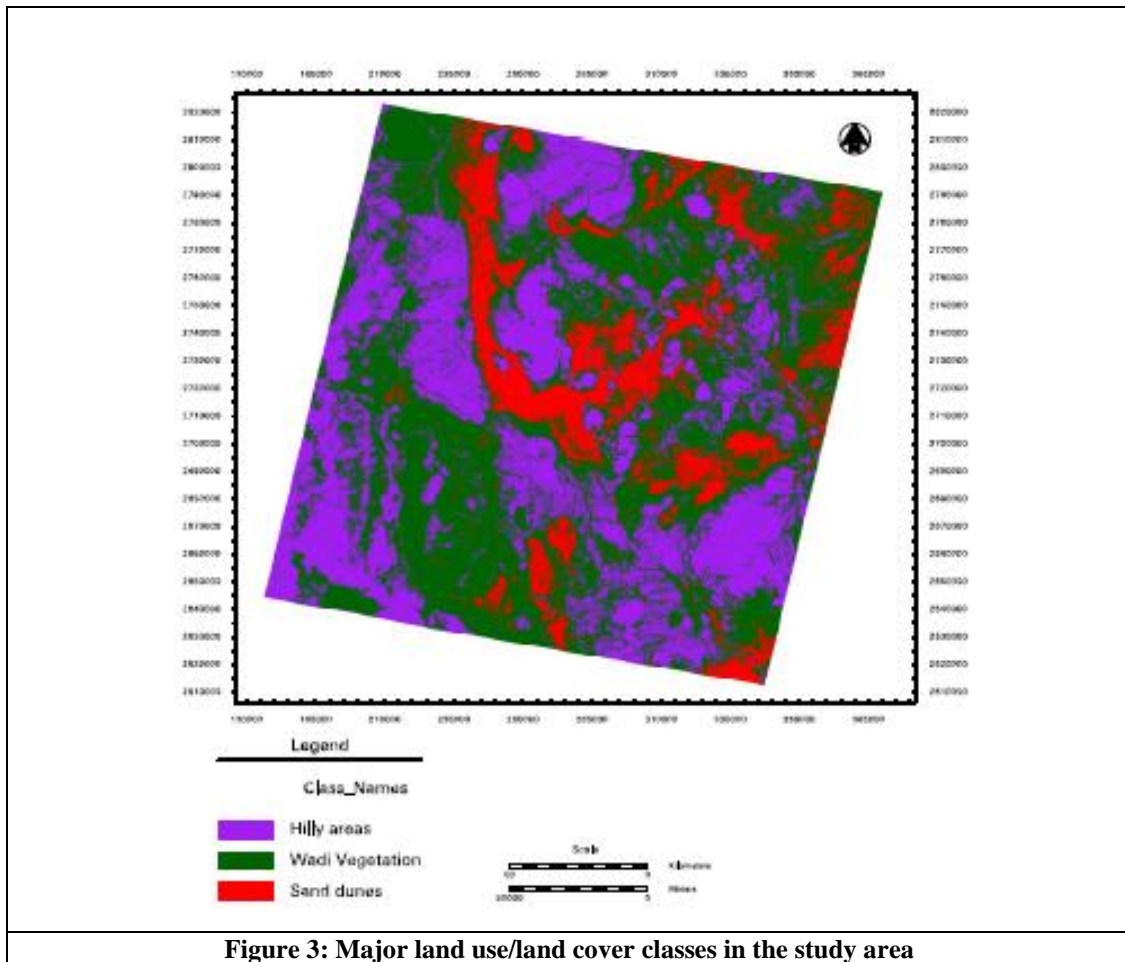


Table 1: Areas and percentages of the major land use/land cover classes in the study area

Class name	Area (ha)	%
Wadi Vegetation	1663389.88	49.42
Hilly areas	1232566.06	36.62
Sand dunes	470068.08	13.97

VI. CONCLUSION AND RECOMMENDATION

This study ends up with the following conclusions:

1. Remote sensing techniques can be used efficiently as time- and cost-efficient tool in land use/land cover mapping and assessment.
2. The Wadi vegetation covers the large portion of Al-Qassim region.
3. Sand dunes threaten the wadi vegetation in the Al-Qassim region.

This study stipulates the following recommendation:

1. Use of remotely sensed data and remote sensing techniques in monitoring natural resources in the regions, Saudi Arabia has many advantages, since the Kingdom had launched its satellite and host a receiving station for the American land resource observation satellites.

2. Adoption of sand dunes fixation ranging from sand dunes fixation to establishment of wind breakers.
3. Encourage of in depth detailed studies related to simulation of future changes in the land use/land cover in the region.

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