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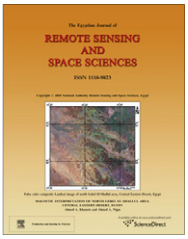

Monitoring of agricultural area trend in Tabuk region – Saudi Arabia using Landsat TM and SPOT data

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Abstract The main objective of this study is to monitor and assess the agricultural land use changes through the period from 1988 to 2008 using the Landsat TM 5 and SPOT 5 imagery along with laboratory and field works. The analysis of the classified satellite images indicated a considerable increase in the spatial extents of the agricultural land use. The spatial extents of the agricultural areas have increased by 10% during the period from 1988 to 2008. This increase had basically occurred on the expense of the bare soils. The results of this research imply the possibility of using the multi-temporal satellite data for understanding the interchange of the agricultural land use with the surrounding bare areas for the purpose of modeling the potential environmental changes in the future in one of the most important agricultural area in Saudi Arabia.

1. Introduction

The integration of remote sensing and field measurements represents a valuable source of information for monitoring the environmental changes and the development planning (Geotz et al., 2003). Identification and analysis of landscape change are considered key components for studying the environmental consequences of the change (Sohi, 1999). From this perspective, the assessment of land resources such as agriculture land use has been considered reliable information on resource conditions and the effects of different resource use patterns (Amissah-Arthur et al., 2000). However, acquiring this information at appropriate temporal and spatial scales is a challenge in most of the cases.

Remote sensing techniques can be used for monitoring the agricultural land use change such as spatial locations, spatial extents, and spatial cropping pattern. It represents a potential effective approach for studying the different factors controlling the agricultural change. Satellite imageries are a potential source of information that enables studying vast areas with the same observational parameters, and achieves a regional perspective that is difficult to be obtained from conventional ground survey only (Qari et al., 1999). In addition, satellite imageries can be utilized for effective management of

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agricultural resources (Gatsis et al., 2005; Phoompanich et al., 2005) and defining and analyzing the trend of the agricultural changes over the past two decades in the study area.

Many studies were conducted using remotely sensed data and correlated with fieldwork assessment for monitoring the trends of the environmental changes in areas under the arid climates. Al-Harbi (2003) used the Landsat TM data to apply Ratio Vegetation Index (RVI) for monitoring the agricultural expansion in the eastern part of Tabuk area. Merging two RVI images to produce a RVI image that indicated three modes of agricultural changes as decrease, increase, and no change. Phoompanich et al. (2005) applied multi-temporal radar satellite data (SAR) for monitoring the current agricultural production along with planning the future expansion. Mya (2007) utilized various remote sensing techniques and Geographic Information Systems (GIS) for detecting the trend of the environmental changes in Indonesia. The elements of changes were noted as pollution, urban growth, and change the use of natural resources. Rouchdi et al. (2008) assessed irrigated crop lands in the south part of Morocco throughout using SPOT 4 XS images. The study based on the application of supervised classification maximum of likelihood algorithm, which help in detecting the shape and size of agricultural land. Guo et al. (2007) used remotely sensed data and GIS for obtaining agricultural information in a selected area of China. The study was based on the supervised classification for two selected images which were displayed within GIS for agricultural land use change detection. Gatsis et al. (2005) used SPOT 1–2 images for monitoring and mapping land cover and land use in a selected area of Greece. The study adopted supervised classification to classify land cover and land use, with emphasis on deforestation and desertification indicators. Amissah-Arthur et al. (2000) applied the integration method of satellite data, biophysical and socio-economic information data to assess farm land dynamics and land degradation on Sahelian landscapes. The authors used the supervised classification applying the maximum likelihood algorithm for mapping the farmland and degraded areas. Zhang and Yan (1999) compared between the radar data and other remote sensing data resulting in a conclusion that radar data has the advantage of collecting agricultural data especially the status of crop growing under cloudy condition. The objectives of the present research are to monitor the major agricultural changes, indicate the size and the shape of differences, and assess the reasons of that agricultural change. The produced maps as a result of monitoring the agricultural land use with the aid of remote sensing data will provide the Saudi Arabia government with adequate information about the rate of land cover conversion, in order to establish a reform policy of land cover and land use in Tabuk area, Saudi Arabia.

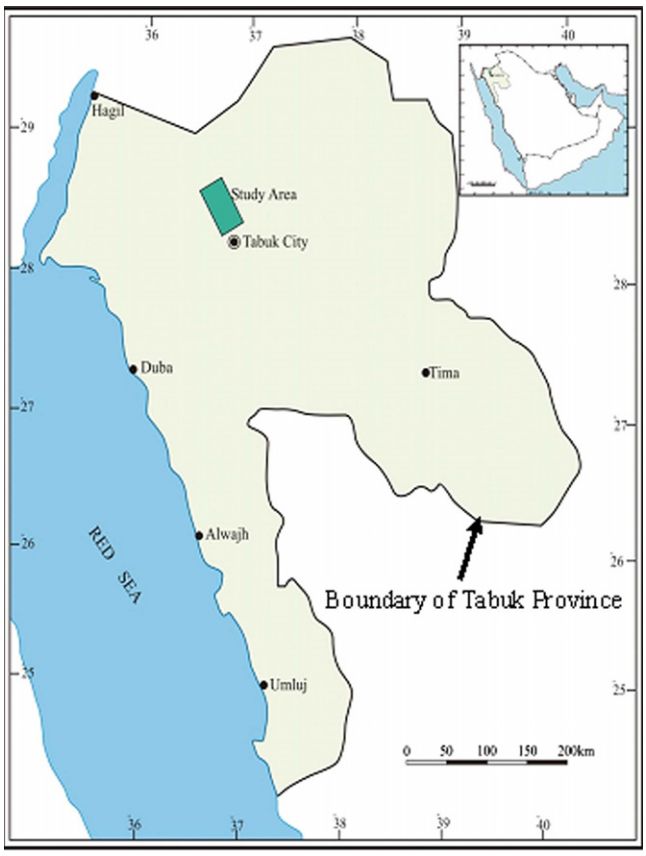

Figure 1 Location map of the study area assigned on the geographic map of Tabuk Province (Saudi Ministry of Petroleum and Resources, 2002).

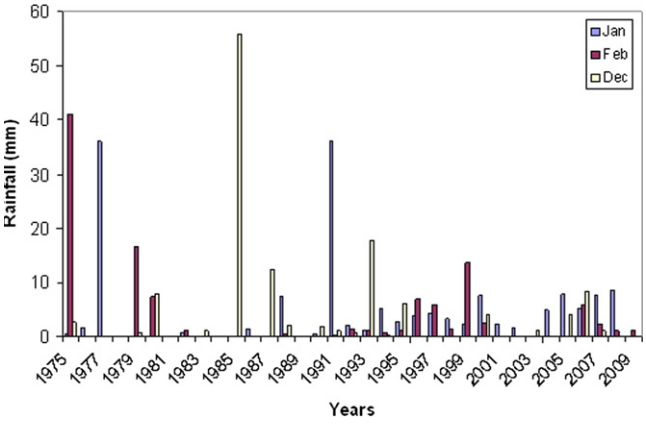

Figure 2 Annual rainfall in the study area (Tabuk Meteorological Station, 2009).

2. The study area

Tabuk region is one of the largest regions in Saudi Arabia which covers an area of 139,000 km^2, and corresponds to about 7% of the country's total area. The agricultural area of investigation is located in the north of Tabuk city and roughly is extended from latitudes 28° 28′ to 28° 40′ N and longitudes from 36° 06′ to 36° 29′ E (Fig. 1). The area of interest occupies 543.4 km^2. This area is dominated by rock structures of Tertiary Era. The Quaternary formations comprise alluvial deposits of silt and gravels while the mountainous areas are dissected by many internal valleys.

According to Tabuk Meteorological Station (Meteorological Station, 2009), the summer season is hot where the average temperature is 40 °C. The winter season extends from December to March with low temperatures that sometimes