

CHANGE DETECTION OF URBAN AREAS IN THE ARDABIL PROVINCE DURING THE LAST 5 DECADES USING AERIAL PHOTOGRAPHY AND LANDSAT IMAGES

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ABSTRACT: Population in Iran is growing very fast. Ardabil province is a new established province and under these circumstances, agricultural and natural areas changing to residential and industrial areas. This study aimed to evaluate the amount of change in urbanized areas during the last 5 decades using Landsat ETM+, 1:55000 aerial photos and 1:50000 topographic maps. Results showed: 1) during the last 50 years, in all cities about 3.6 to 12.8 times the area of the cities have been increased. 2) By considering the historical documents and elderly people views, it was recognized that the most of the changes were happened from the altering of agricultural land uses to the urban and industrial areas. Moreover, it should be noted that these changes were more accelerated after becoming Ardabil as an independent province in 1994. Furthermore, the used Landsat image was acquired in 2002 and in recent 9 years some agricultural lands have also changed to the city and industrial areas, which were not included in this study. In continue of this study, by the selection of more precise temporal images the amount of changes will be calculated more accurately. By the continue of this change and by including industrial suburbs and distributed factories on the Ardabil plains, changing agricultural land uses to the city and industrial areas causes growing more concerns from the environmental and agricultural products perspectives.

1. INTRODUCTION

Urban growth has long been considered a sign of regional economic vitality (Yuan et al. 2005). However, its benefits are increasingly balanced against ecosystem impacts, including degradation of air and water quality and loss of farmland and forests, and socioeconomic effects of economic disparities, social fragmentation and infrastructure costs (Squires, 2002; Schrank and Lomax, 2004; Yuan et al. 2005). While urban area decision makers are in constant need of current geospatial information on patterns and trends in land use, relatively little research has investigated the potential of satellite data for monitoring land use in urban areas. However, the recent work, for example, of Yang (2002), Alberti et al. (2004), Goetz et al. (2004), and Yang et al. (2005) has shown that satellite remote sensing has the potential to provide accurate and timely geospatial information describing changes in land use of urban regions. Although land use changes can be monitored by traditional inventories and surveys, satellite remote sensing provides greater amounts of information on the geographic distribution of land use and changes, along with advantages of cost and time savings for regional size areas. Importantly, remotely sensed imagery provides an efficient means of obtaining information on temporal trends and spatial distribution of urban areas needed for understanding, modeling, and projecting land change (Elvidge et al. 2004; Yuan et al. 2005).

Land use changes, especially the change of agricultural land use to urban area, are the most concern in the fertilized plains, not only in Ardabil province, but also in throughout the world (Makhdoom, 2008). Nine main urban areas in Ardabil province is distributed on the fertile plains, which are growing very fast. For example, the Ardabil plain is one of the major centers of potato cultivation in Iran (about 18 percent of total potato products). The main reasons for these growth and changes are mainly due to population growth and increasing urbanization trend and migration from rural areas to urban areas. The aim of this study was to detect the location and amount of change in the main urban areas of Ardabil province using aerial photographs, and Landsat imagery during last five decades.

2. STUDY AREA

This study was conducted at Ardabil province that is located in North West of Iran ($48^{\circ} 15' 20''$ E to $48^{\circ} 20' 20''$ and $38^{\circ} 13' 20''$ N to $38^{\circ} 17' 20''$) (Figures 1 & 2). The locations of urban areas are presented in Figure 2. From 18 urban areas, 9 main urban areas were selected for this study which is presented in Figure 2.

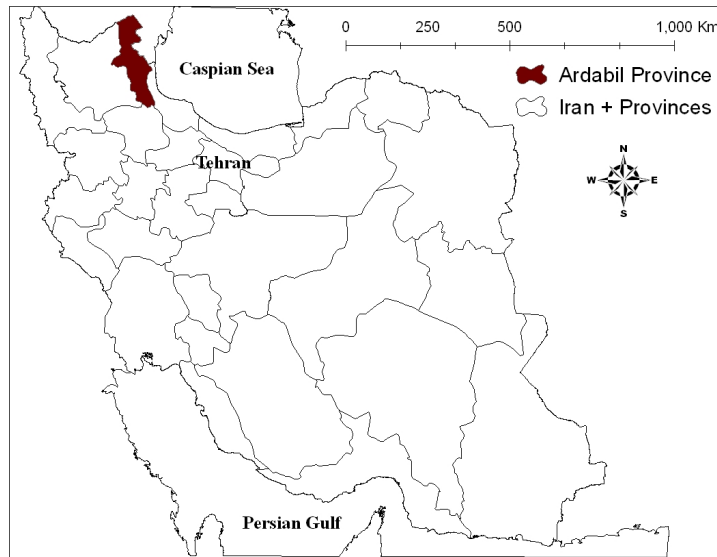


Figure 1. Study location in Iran and Ardabil province

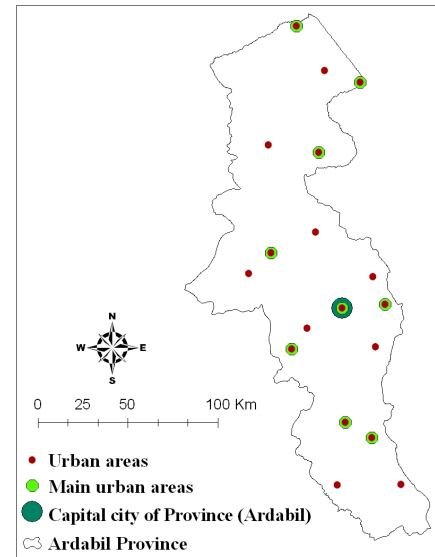


Figure 2. Distribution of urban areas and 9 main urban areas, which were selected for this study

3. METHODS

The © aerial photographs (1950s) and © Landsat copyright 2004 (the available image/ 2002/7/29) was selected based on cloud and snow free for this study. Obtained aerial photographs and images have been registered to the UTM map projection with a datum of the WGS84. However, according to the collected Ground Control Points (GCP) and other GIS layers such as registered topographic maps, acquired images were still required to be rectified by affine transformation model to the WGS84 to align accurately with the GIS layers and collected GPS points. The study area is located in two zones (38 & 39). In aerial photographs and image rectification Root Mean Square (RMS) errors of 14 to 25 points selected from 50 GCP (for three data series) were less than 2 pixels and total RMS was 1.50 pixels.

As this study was part of the digital image processing, therefore, image preprocessing stages, including atmospheric, geometric and radiometric corrections, topographic normalization and image enhancements, were conducted before image utilization (Chavez 1996; Furby et al. 1996; Lillesand and Kiefer, 2000; Chander and Markham 2003). The boundaries of the selected images were derived and areas were calculated and compared on the 9 main urban areas of study area. Accuracy assessments of the derived boundaries was undertaken using confusion matrices and Kappa statistics (Congalton and Green, 1999). The accuracy of the classified image was assessed using field data collected in the study area. Producer and user accuracies for each class were calculated along with the overall accuracies and Kappa statistics.

4. RESULTS AND DISSCUSION

Figure 3 shows maps of 9 main cities of Ardabil province in three decades namely 1950s, 1980s and 2000s and the amount of change in each city at three decades are also presented in Table 1. The amounts of urban area are presented and the percentage of expansion from 1950s to 1980s, 1980s to 2000s and finally 1950s to 2000s are also presented in Table 1. As can be seen from figure and table, there are considerable increase of the area of each city. According to table Khalkhal County has been increased by almost 12.8, Nir 8.9, Ardabil 6.2, Bilesouar 6, Meshkin 5.7, Namin 4.1, Germe 4, Aslandouz 3.8 and Sarien 3.6 times during the last 50 years. This development may be beneficial in terms of urban planning but in relation to environmental and agricultural production problems causes more concerns and if this trend continues in future years, according to population growth and urbanization, we will see more conversions in this province and in other words, with a similar trend in the future we will lose agricultural land for cultivation and beside that we will see the problems of large cities and metropolitan cities, including environmental pollution in these main cites according to this process of expansion.

By considering the historical documents and elderly people views, it was recognized that the most of the changes were happened from the altering of agricultural land uses to the urban and industrial areas. Moreover, it

should be noted that these changes were more accelerated after becoming Ardabil as an independent province in 1994. Furthermore, the used Landsat image was acquired in 2002 and in recent 9 years some agricultural lands have also changed to the city and industrial areas, which were not included in this study. In continue of this study, by the selection of more precise temporal images the amount of changes will be calculated more accurately. By the continue of this change and by including industrial suburbs and distributed factories on the Ardabil plains, changing agricultural land uses to the city and industrial areas causes growing more concerns from the environmental and agricultural products perspectives.

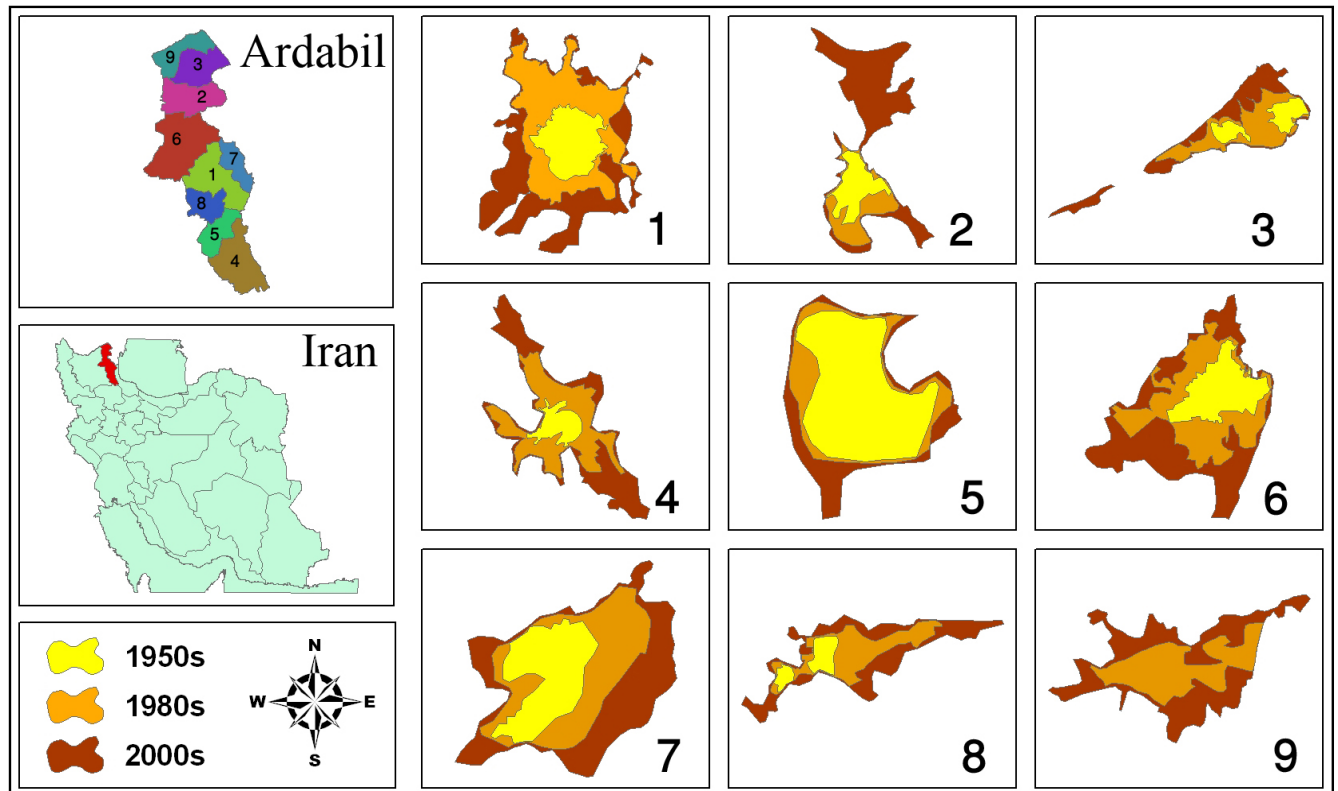


Figure 1. Changed and developed urbanized and industrialized areas in main cities of Ardabil province (1=Ardabil, the capital city of province; 2= Germi Moghan; 3= Bilesouar Moghan; 4=Khalkhal; 5=Nir; 6=Meshkin-shahr; 7= Namin; 8=Saraein; 9=Aslandoz)

Table 1. Nine main cities and areas at three decades and rate of change from 1950s to 1980s and from 1980s to 2000s

Decades	Ardabil	Meshkin	Bilesouar	Khalkhal	Germi	Namin	Sarien	Nir	Aslandoz
1950s	790	169	108	48	84	52	31	12	18
1980s	2715	442	347	278	154	126	64	45	33
2000s	4870	965	654	615	337	214	112	107	68
1950-1980 %	344	262	321	579	183	242	206	375	183
1980-2000%	179	218	188	221	219	170	175	238	206
1950-2000s%	616	571	606	1281	401	412	361	892	378

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