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Investigation of forest area and density changes in Middle Zagros using aerial photos interpretation and GIS in the various distances of the village (a case study: Kakareza region, Lorestan province)

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Abstract

This study located in the Oak trees coppice of kakareza situated on 45th kilometers on the way to Aleshtar from northeast of Khorramabad at the middle area of zagros. In this study cognitional changes (area and accumulation) in various distances from the village of these forests is studied via pictures taken from the air image in (1:55000) and in 1997 (1:40000). For this purpose, geometric corrections are done as the movement correction issued from ups and downs on the pictures taken in the air is performed, then the forest frontier localities are fixed through sight inter pretation and thickness layers of canopy was appointed in a dotted network with the width of 2 millimeters. The frontier line of separated layers is drawn in ArcView software in the form of closed polygons and the area of these polygons are measured separately. Then any changes in area of these polygons in every stage of photographs are compared through software and the layer changes of the thickness of canopy are provided. Then, distance from village maps divided the three classes (0-300 m, 300-600 m and 600-900 m) in two period in Arcview software and from combining each of these maps with density map in the years 1955 and 1997, the forest changes were found in different classes of distance of the village. Results shows that the bulk density of the forest in classes of dense (F 1) and semi-dense (F 2) is with most of the area at a distance away from the village and the lowest area in a distance nearby village. But the class of sparse density (F 3) is with most of the area at a distance nearby the village and the lowest area in a distance away from the village.

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Introduction

Forest resources are important and vital resources of every country and sequence of these resources in different climatic and human courses has been much important for prospective planning. West oak forests on Zagros Mountains have been very important in terms of area, environmental problems and water and soil resources conservation. The forest has lost its productivity due to economic and social factors and lack of integrated management and this trend has thrown the regions forests into jeopardy. The role of Zagros forests is obvious for everyone since, 40% of Iran surface water is flowing in Zagros area it is the water supply of several rivers in Iran, and the residents living in the area is possible by water supply from the mentioned watershed (Ghazanfari *et al.* 2004).

Middle Zagros has forests with high biodiversity, so, climate diversity, soil vegetative cover, physiographic conditions and latitude and longitude difference have caused specific ecosystem conditions and this diversity. Lorestan province is a mountainous region and 60% of its area has a slope higher than 12% and whole the region has been located in Karkhe and Dez basin and has various forests. Total area of the province forests is 885000 ha. Considering that, this region has an important role in long-term social, economic and environmental goals of the country and on the other hand, with regard to current conventional utilization of the forests and population growth, the forests area and density have been changed so, having knowledge about destruction rate, increasing or decreasing of the forests area and density seem to be necessary for long-term planning which become possible in this study (Pourreza *et al.* 2008).

Manteghi and Sammak (2000) investigated the possibility of announcing of updated statistics of northern forests area using aerial photos of year 1994. They also assessed the resulted changes compared with statistics of previous years.

Tavakoli (1996) and Delafkaran (2002) studied the trend of qualitative and quantitative changes of northern Zagros forests. In this study, description of different land types in terms of quantitative (determining the percentage of each land type) also description of forest lands type in terms of qualitative (determining the percentage of different forest degrees in terms of density) using aerial photos of the years 1955, 1968 and 1990 over the time. Pirbavaqar (2005) investigated the forest area variations related to topographic factors and regions built by human using forest digital maps in state 2D which had been extracted from aerial photos of the years 11967 and 1994. Rafieian (2003) studied the variations of northern forests area between years 1994-2001 using sensor images ETM$^+$. He ultimately achieved a map with acceptable overall accuracy. Dunber (2004) worked on regional forest cover variations of Kanzas, America during 1941 to 2002. Five stages black and white aerial photos related to 1941 to 1991 and one color infrared aerial photograph related to year 2002 were used to carry out this work.

The aim of this study is an investigation of forest area and density changes in Middle Zagros (lorestan province, Kakareza region) by using aerial photos interpretation and GIS in the various distances of the village.

Materials and methods

Study area

Kakareza forests have been located in 45 km far from eastern north of Khoramabad city and between longitudes 48° 15' and 48° 20' and latitudes 33° 40' and 33° 44'. The maximum elevation from sea level is 2800 m and its minimum is 1400 m. Therefore, an area about 3000 ha in the west part of the region was restricted by GPS. The study area has been located on Chekriz slope. Forest cover of the region includes *Quercus brantia* var.persic, *Crataegus aronia, Acer cinerascens, Pyrus syriaca, Pistacia atlantica, Cerasus microcarpa, Cotoneaster* sp., *Amygdalus* sp., etc. Dominant type of the region is *Quercus brantia* var.persic (multi-purpose forestry plan of Kakareza, 2004).

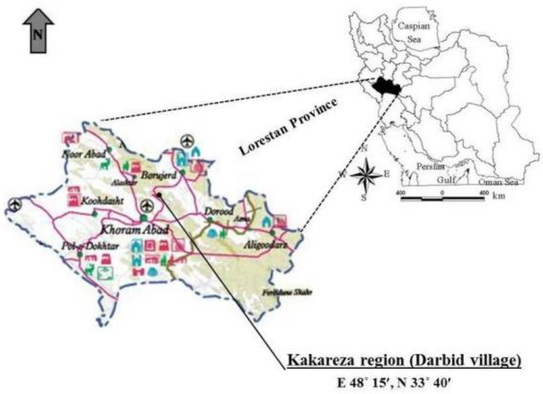

Fig. 1. location study area in the Kakareza region, Lorestan province.

Used data

Paper maps with scale of 1:50000 and digital maps as 2D and 3D with scale of 1:25000 which have been produced from mapping organization of Iran.

Aerial photos of the region of year 1955 with scale of 1:55000, Aerial photos of the region of year 1968 with scale of 1:20000 and Aerial photos of the region of year 1997 with scale 1:40000. The photos of year 1955 were produced from Armed Forces Geographical Organization and the rest of photos were produced from mapping organization of Iran.

Ground statistics were collected by systematic-random method with network dimensions of 500*1000 and square plots of 100*100 and 60 plots were taken from the whole the region.

Information about herbaceous ground cover, soil and land of the region (texture, tone, color and grain size) which were obtained field sampling and experimental analysis.

Research methodology

Forest map derivation from aerial photographs

Firstly, positive film scan was produced from aerial photos of year 1997 to do required geometric corrections. Then, corrected image of the region was extracted from PCI9.1 software by entering some information including camera type, focal distance, Image marginal points, flying height, ground control points (GCP), elevation digital model, etc. Since aerial photos of the years 1955 and 1968 did not have all the required information to do geometric corrections by mentioned method, so, these photos were corrected by approximate correction method using a referenced photo (aerial photo of year 1997). In this method, relationships between the points of referenced photo (X, Y) and non-referenced (X', Y') were determined using two polynomial functions then, corrections of the photo are carried out by adapting the considered image and base image. Now, the considered image coordinates are found using spatial coordinates of the nearest pixel in geo-referenced image (Hajarian, 2005). Then, obtained area and density between two series of aerial photos of the years 1955 and 1997 were compared.Then, the prepared distance of the village maps in three classes (0-300 m, 300-600 m and 600-900 m) to two period in Arcview software and from combining each of these maps with density map in the years 1995 and 1997, the forest changes were found in different classes of distance of the village.

Area calculation

Forest lands were determined on aerial photos with scale of 1:40000 and 1:55000 by visual interpretation. Then, the lands were divided to separated polygons, and area calculation was carried out in ArcView software for each determined units separately. Therefore, the area of each polygon which has different densities (F1, F2, and F3) was calculated during the two periods. Also, determination of area variations during the period easily becomes possible through this method.

Determination of canopy density

Optical method was used to determine canopy density. For this purpose, dotted network was created on considered areas in which forest masses was closed. Considering that, high accuracy is needed in density determination, also with regard to small forest messes in these regions; dimensions of dotted network were considered 2mm by 2mm. For this purpose, the network was designed in PCI software and was placed on considered regions. The existent points on the polygon were counted after creating and transferring the dotted network to the photo. Also the points located on forest masses were counted. In this stage, if more than half of a point was on the border, so the point was counted as well as the points which were as middle on the region and outside the region. After counting all the points, forest mass density was determined considering proportion and fit between existing points in the forest mass and polygons points.

Determination of area and canopy density variations in the various distances of the village.

After determining the forest polygons and each polygon area (in ArcView software), all polygons areas were summed separately in each region and period to obtain a value as the region area in considered year. This trend was conducted for each series of the photos as well as determination of area in each considered year. Then, the prepared distance of the village maps in three classes (0-300 m, 300-600 m and 600-900 m) to two period in Arcview software and from combining each of these maps with density map in the years 1955 and 1997, the forest changes were found in different classes of distance of the village.

Results

Investigating the area of density classes in the various distances of the village *in Kakareza region using aerial photos of year 1955 (scale of 1:55000).*

According to the conducted study in the region using aerial photos with scale of 1:55000, it was found that the bulk density of the forest in classes of dense F1 (density higher than 50%) and semi-dense F2 (density of 25-50%) is with most of the area at a distance away from the village (600-900m) and the lowest area in a distance nearby village (0-300m). But the class of sparse density F3 (density of 5-25%) is with most of the area at a distance nearby the village (0-300m) and the lowest area in a distance away from the village (600-900m). (Table 1, Figure 2 and 3).

Table 1. Area of density classes in the various distances of the village in Kakareza region in 1955 (scale of 1:55000).

distance of the village (m)	Area of density classes (ha)		
	(density higher than 50%) F1	(density of 25-50%) F2	(density of 5-25%) F3
(0-300)	15	100	143
(300-600)	40	131	112
(600-900)	54	164	94

Table 2. Area of density classes in the various distances of the village in Kakareza region in 1997 (scale of 1:55000).

distance of the village (m)	Area of density classes (ha)		
	(density higher than 50%) F1	(density of 25-50%) F2	(density of 5-25%) F3
(0-300)	14	96	147
(300-600)	39	127	124
(600-900)	51	168	101

Investigating the area of density classes in the various distances of the village *in Kakareza region using aerial photos of year 1997 (scale of 1:55000).*

According to the conducted study in the region using aerial photos with scale of 1:55000, it was found that the bulk density of the forest in classes of dense F1 (density higher than 50%) and semi-dense F2(density of 25-50%) is with most of the area at a distance away from the village (600-900m) and the lowest area in a distance nearby village (0-300m). But the class of sparse density F3 (density of 5-25%) is with most of the area at a distance nearby the village (0-300m) and the lowest area in a distance away from the village (600-900m). (Table 2, Figure 3 and 4).

Discussion and conclusion

For investigating the canopy variations in aerial photos of different periods that the photos needs fitting to determine change location, geo-referencing the photos is not possible for all the photos due to lack of required geometric information (Hajarian, 2005). Therefore, approximate correction method using a base image by selecting or creating a geo-referenced image is recommended for such investigations. An advantage of this method is fully consistent images. Combining the capabilities and facilities of various image editor and classifier software along with using visual interpretation techniques would have the best result to classify the considered phenomenon in aerial photos properly, and relying on a specific approach or software will decrease classifications results quality due to their limits (Sadeghi. 2005).

In this study considering intact diapositive of year 1955, the photos of this year were used but, the photos of year 1968 were eliminated due to low quality. In a similar study (Hajarian, 2005) also, aerial photos of year 1955 were eliminated because of low quality and aerial photos of the years 1967 and 1994 were investigated.

Combined interpretation (visual-visual) method was distinguished as proper method to determine land border and forest types. Rafieian (2003) and Sadeghi (2005) introduced combined and visual interpretation method to separate forest borders and types.

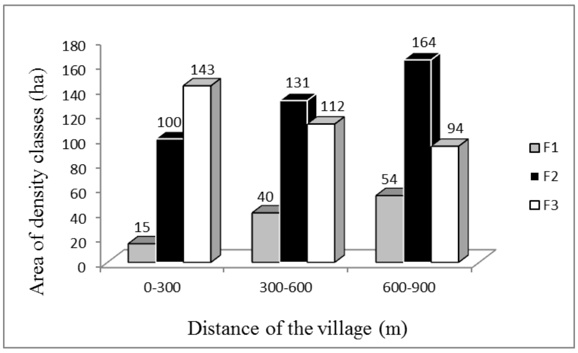

Fig. 2. Area of density classes in the various distances of the village in Kakareza region in 1955.

As Sachas (1998) explained, if it is possible to separate vegetative cover type in aerial photos, this data is a suitable source to investigate variations in land scape level. This case was approved in this study.

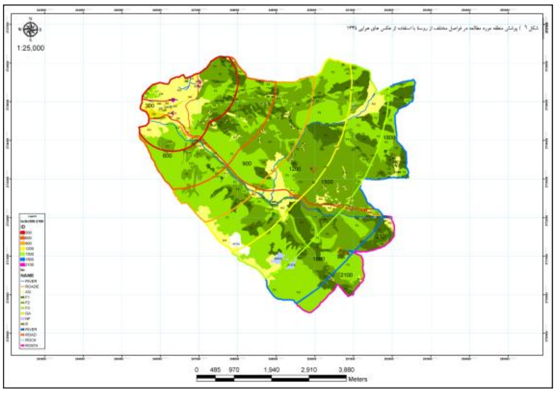

Fig. 3. Study area coverage in the various distances of the village using aerial photos of year 1955.

Results of the years 1955 and 1997 show that, the bulk density of the forest in classes of dense F1 (density higher than 50%) and semi-dense F2(density of 25-50%) is with most of the area at a distance away from the village (600-900m) and the lowest area in a distance nearby village (0-300m). But the class of sparse density F3 (density of 5-25%) is with most of the area at a distance nearby the village (0-300m) and the lowest area in a distance away from the village (600-900m). Overall results showed that by increase the distance from village the forest density is increase, but by increase the altitude the forest density reduced, because the slope and physiographical condition is harder. In the base of this study suggested the conservation forest planning focused on the nearest of village. Therefore, prevention of livestock grazing and irregular tree cutting in the degraded forest stands can be suggested as a suitable approach for natural restoration and increasing forest density.

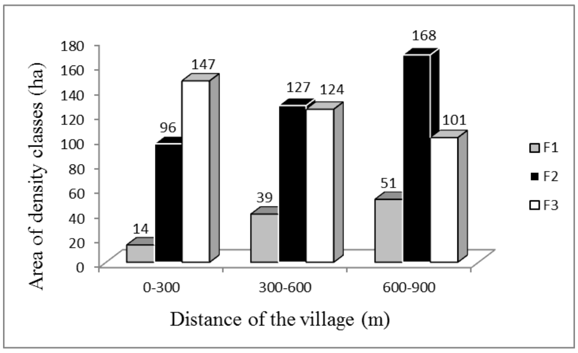

Fig. 4. Area of density classes in the various distances of the village in Kakareza region in 1997.

Suggestions

Geometric correction of displacement due to topography should be done in order to investigate aerial photos and to derive their information.

Accuracy of manual and digital data derivation from aerial photos should be compared by conducting an investigation.

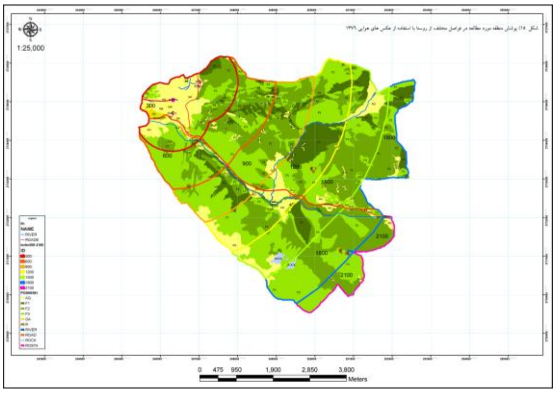

Fig. 4. Study area coverage in the various distances of the village using aerial photos of year 1955.

Most critical factors in reducing the forest area should be found by conducting an investigation and then should be used in development of macro-management strategies.

To implement periodic monitoring plans in order to produce accurate and updated data of the region forests status.

In order to indicate forest cover variations in these regions, combination of derived data from aerial photos and derivable data from satellite images should be used.

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