

Classification and Spatial Analysis of Land Use Classes and the Factors Influencing them in Lorestan Province (West Iran)

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Abstract

Man's life depends on the natural resources on the earth. Lack of knowledge on land cover leads to lack of optimization along with inefficient land use. This results in geographical environment changes, ruins and destruction. The most important way to gain knowledge of land cover is generation of land cover and land use maps.

The purpose of the present research is to generate the map of land use classification for Lorestan province in west of Iran as well as analyzing its classes along with considering influential factors on it. The investigator applied LANDSAT ETM digital images processing method and classification algorithm to generate the land use map.

The prepared map indicates the status quo of land use in Lorestan province. Recognizance of this will help the planners in the prospective issues relating to land use. These maps can also be used as a spatial data base layer in the prospective geographical and environmental researches.

Introduction

Man's life relies heavily on the ground resources in which the major part is related to land resources. Due to the limited land resources and the increasing population, knowledge on Earth resources is of great importance.

Lack of access to the exact information on the natural resources will lead to endangering the life of next generation. One of the most significant ways of planning the utilization of the land resources is to generate the land cover and land use maps.

In the present research, the investigators have primarily generated land use map of

Lorestan Province while using ETM images of LANDSAT 7 on the scale of 1:100,000 in order to acquire information of land cover to facilitate land use planning.

The land cover status and geographical distribution of land utilization are very significant in order to cause modification in the regional managers and planners' decision making on the land cover.

Lorestan is located between 23° 39' 12" and 24° 22' 44" of northern latitude and 46° 50' 14" and 50° 01' 21" of Eastern longitude. Because of possessing potential natural and human resources, the province is considered as a crucial part of Iran. The

province can be noted as a strategic part of Iran because of its natural and human potentials. Thus, the first step namely land cover study and land use mapping can pave the way for making strategies to develop the area.

The background of study

Use of aerial photographs and satellite images for land use mapping dates back to a long time. Leo et al (1975) generated the land use of north of China by using the MSS data of Landsat on the scale of 1:600,000. Mohajer Shojaie (1982) evaluated for the first time resources and land potentials of Lorestan province manually by using land data. Prakash & R.P. Gupta (1998) generated the land use map and analysed the changed in land use of the coal mine of Jharia area in India by using Landsat and IRS data. Karami et al (2004) in a research entitled "Land use planning by using remote sensing and GIS, a case study in Khorramabad" generated a database on DEM, slope, geology, NDVI and soil maps. Using this database he generated the land use of the area. His methodology was based on overlapping, buffering multifactor evaluation by means of CRITIC weighing method. Ghiasvand (2005) generated the land use map of Lorestan province to implement a comprehensive development plan.

Data Base

The data accessed in the research are as follows

- Multi-Spectral ETM + Satellite Images of 2000-2001 (Fig. 1...Page 49).
- Topographic maps on the scale of 1:50,000 to generate DEM
- Geological maps to contribute to determine the land potentials.
- Coordination of detectable ground control points linked to different classes of land use were taken from GPS.

Methodology

To process and analyse the above-mentioned data and to generate the land use map, the investigators applied ER-MAPPER (Ver. 6.1), EASE/SPACE (Ver. 6.1), ERDAS imagine (Ver. 8.3) Arc View (Ver. 3.2a), Arc/Info (Ver. 3.4.2), IDRISI (Ver. 2) softwares.

The initial step in using the satellite images is pre-processing operations on the images. A digital satellite image possesses some defects and errors due to Earth motion, rough areas, geometrical satellite position in the space, and the disharmonious functions of electronic and optical devices installed in measuring gauges and also atmospheric impact during imaging. Hence, the primary visual and images detection from the monitor showed that the rate of defects and errors are low.

Owing to the factors determining the errors in the satellite images and also the necessary precision, ground control points methods were used for the geometric correction of satellite images.

In this method, image corrections are done by means of polynomial equation with various ratios indicating the relationship of image coordination system with ground coordination points.

Polynomial equations indicate the relationship of image coordinate system with ground coordinate (lat-long) system. The link between two systems is determined by using the control points which contribute to determining the rest coordinate points.

Parallel with the system, all topographic maps 1:50,000 of area were digitized to choose the ground points. Consequently, control points from the above maps, which were pre-geo coded, were extracted by means of image to image registration. It was endeavored to choose some points from all parts of images to influence a homogenous geometric correction equation on the entire images. Totally, 27 control points were selected and then all images related to the area under study were geometrically corrected by using the first degree polynomial equation. To solve the polynomial equation, the matrix method was used. In this regard, the least squared method was used to determine the ratio of polynomial equation since the applied points for geometric correction were more than the necessary points.

In order to do re-sampling on the degrees of brightness, it was necessary to determine the degrees value of image brightness by the interpolation system. Since the interrelated pixel would not overlap each other exactly. The nearest neighbour interpolation method

was selected. In this method, the degree of brightness in the nearest pixel is applied to detect the amount of degrees of pixel in the images.

Applying the method leads to correction in the degree of brightness resulting in less modification. In other words, using the method ends in keeping the primary information in the images better. On the other hand, the method can be interpreted as to spatial auto correlation.

It is worth noting that geometric correction and homo-coordination of digital satellite images are used by the nearest neighbour interpolation method for re-sampling images.

Accuracy Assessment of Geometric Precision

The operation related to calculating the precision was performed on Lorestan province satellite image by the ER-MAPPER soft ware.

The entire calculated error for Lorestan province was 0.61 on the basis of 27 control prints. In the whole procedure, the control points with errors above one pixel (30 meters) were omitted from the process of geometric corrections on Lorestan province images.

It is necessary that image contrast would have a high quality to interpret, and to recognize Land use classes and the features on the images along with choosing the precise control points. Thus, the methods

of digital images processing were used for image enhancement and stretching and image contrast, before choosing the control points interpretation operation and recognizing the Land use classes and features. In this regard, linear contrast stretch, histogram equalization, stepwise, logarithmic and exponential was applied for intensification of image contrast.

Results: Spatial analysis of land use classes

Agricultural Class [A1, A2, A3, AO, O]

In this region, the farm land comprises of irrigated farming land, dry farming land and the orchards. Geographical distribution of agricultural farms follows the topographic status (Fig. 2...Page 49). and elevation in Lorestan Province. The irrigation farming land is generally located in mid-mountainous region and the dry farming land is found along the hill sides. Besides the dry farming land is combined with pastures. The arboreal complexes are mostly located in valleys. The extent of this class is estimated at 6372.66 sq km. Spatial distribution of the farming land in Lorestan province is specified on the map (Table 1 & Fig. 4...Page 51).

Pasture Class [R1, R2, R3 & AR]

Pasture lands are divided into two main types following the topographic stands in Lorestan Province: (i) Pasture lands compatible with hills and plains, which are

observed combined with dry farming lands, (ii) Mountainous pasture lands which are located in lower elevation than mountainous forests and arboreal pasture lands. The extent of this class is estimated at 1113.86 sq km. Spatial distribution of the pastures class in Lorestan Province is specified on the map (Table 1 & Fig. 4).

Mountainous Forests Class [F1, F2, F3] (Fig. 3...Page 50).

Rainfall condition and topographic status are the most important factors in the growth of the mountainous forests in Lorestan Province. Mountainous forests in this area are divided into two types. (i) thick covered forests (F1) and (ii) semi-thick covered forests (F2). Arboreal pastures (F3 or R1) are located in lower height than the mountainous forests, in the classification of satellite images in the area. The GIS environment coupled with the elevation data clearly bring out the relation of altitude and the forest cover. The first rank forests are located at the highest elevation in the province and they also coincide with the high rainfall regions. The second rank and third rank forests are located at moderate and low elevations. The extent of the first rank forests, the second ones and the arboreal pastures are estimated at 1585.32, 2350.49 and 7460.21 sq km respectively. Spatial distribution of the mountainous forests in Lorestan province is specified on the map (Table 1 & Fig. 4).

Wet lands with Thick Vegetation Class [W1D1, W1D2]

The class includes wet lands, marshlands and reeds together with having total extent of 15.12 sq km (Table 1 & Fig. 4).

Stone Outcrop Class [OC]

The area lacks the vegetation and is seen as exposed rocks. Stone outcrop class is compatible with sharp slope or the areas that do not have suitable bed for engendering soil for the growth of plants, bushes and trees. The class is often observed in the southern and western parts of the Province. Despite the suitable rainfall, the existence of naked lands can be attributed to mountainous slope areas (stone outcrop). The class extent is estimated at 1735.04 sq km. (Fig. 4).

The Classes of Urban and Rural Areas, Industry and Installation [U1, U2, U3]

These classes are among those that indicate the trend in spatial changes which is more rapid than the other classes.

The population boom, the horizontal expansion of the cities, establishing the new towns, transforming the villages to cities along with the development of industrial centres are considered as the most important reasons for rapid spatial changes of classes. Nine urban areas which are mainly located in plain and at the foot of mountain are specified on images. The rural areas are also formed throughout the province factories and industrial installations are in the

outskirts of cities. The extent of both urban and rural areas is estimated at 116.33 sq km and the industrial areas are estimated at 5.32 sq km. The spatial distribution of classes is specified on the map (Table 1 & Fig. 4).

The Class of River Network [RN]

This class includes permanent rivers, seasonal and temporal rivers. The hydrographic network of this region is affected by rainfall and topographic status to a large extent. The extent of this class is estimated at 40.03 sq km. The spatial distribution of the class is specified on the map (Table 1 & Fig.4).

The Class of Natural and Artificial Water bodies [W1, W2]

Gahar Lake is the only natural water body in Lorestan Province. The lake is located in the Oshtorankoo Mountain heights in north-eastern part of the province.

The rest of the water bodies mostly include fish raising pools located mainly in the northern part of the province. The extent of each natural and unnatural water area is 1.64 and 2.66 sq km respectively. The spatial distribution of class is specified on the map (Table 1 & Fig. 4).

The Snow-covered class [SN]

Referring to imaging date and the mountainous areas, it is observed that the snow-covered class is compatible with the elevated peaks e.g., Oshtorankoo. The extent is 40.59 sq km. The spatial

distribution of class is specified on the map (Table 1 & Fig. 4)

The Cloud-Covered Class [CL]

Referring to the imaging date, it should be noted that there is significant covering of this class in Lorestan Province which is estimated to be 0.365 sq km.

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Appendices

Table 1: Land use classes in Lorestan province

	Usage	Code	Abbreviation	Area(km ²)
1	Under cultivation lands	20	A1	1349.4249
2	Harvested lands	21	A2	3640.2156
3	Fallow lands	29	A3	567.2565
4	Combination of agricultural lands & orchard	23	AO	735.4017
5	Arboreal complexes	22	O	80.3574
6	Pasture degree 1	14	R1	3449.1276
7	Pasture degree 2	13	R2	3729.159
8	Pasture degree 3	12	R3	3067.5555
9	Combination of agricultural & pasture lands	31	AR	868.0221
10	Forest degree 1	19	F1	1585.3239
11	Forest degree 2	18	F2	2350.9395
12	Forest degree 3	17	F3	4760.2107
13	Wet lands with vegetation	28	W1D1	6.9246
14	Wet lands with thick vegetation	30	W1D2	8.199
15	Stone outcrop	1	OC	1735.0353
16	Urban areas	15	U1	86.3775
17	Rural areas	24	U2	29.9538
18	Industrial areas	16	U3	5.3226
19	River Network	2	RN	40.0275
20	Natural water bodies	26	W1	1.6416
21	Unnatural water bodies	27	W2	2.6595
22	Snowy lands	25	SN	40.5936
			TOTAL	28157.7294

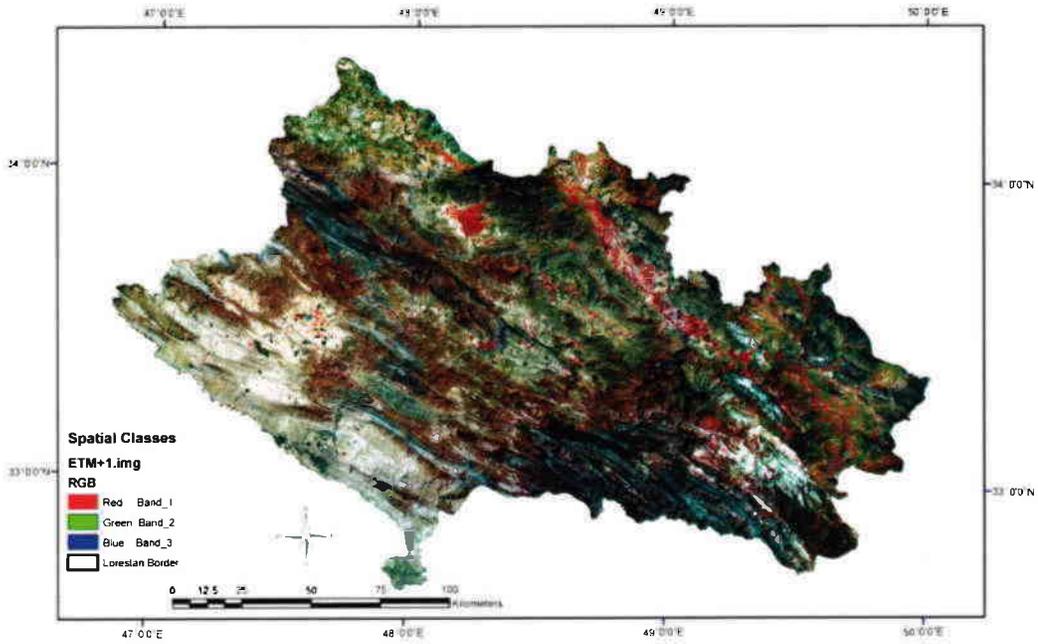


Fig. 1: Landsat ETM+ Satellite image of Lorestan Province

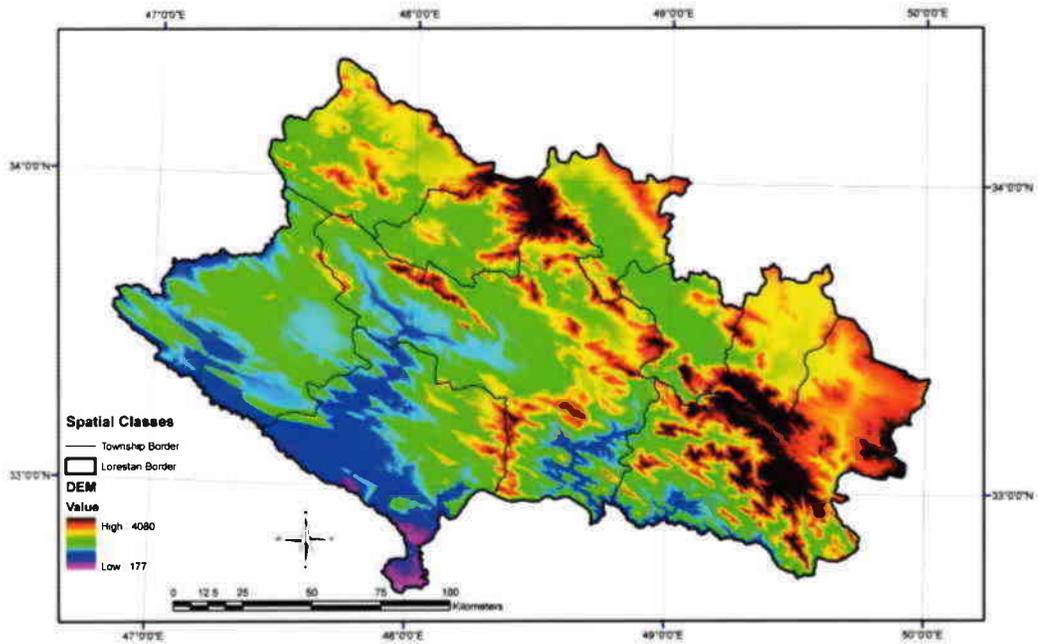


Fig. 2: Digital Elevation Model of Lorestan province

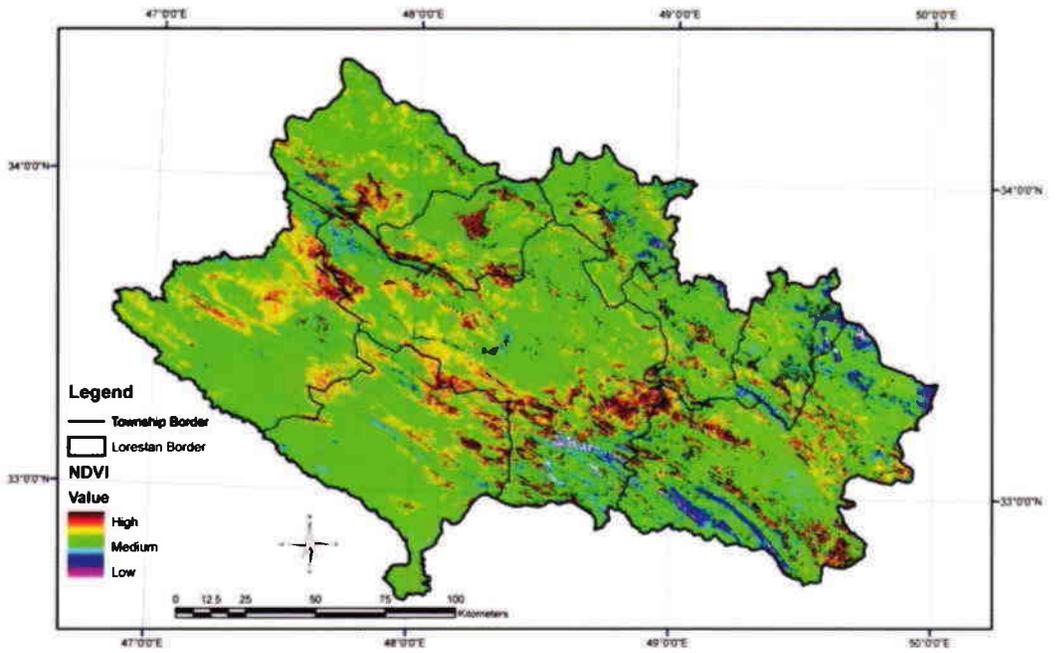


Fig. 3: Lorestan province NDVI

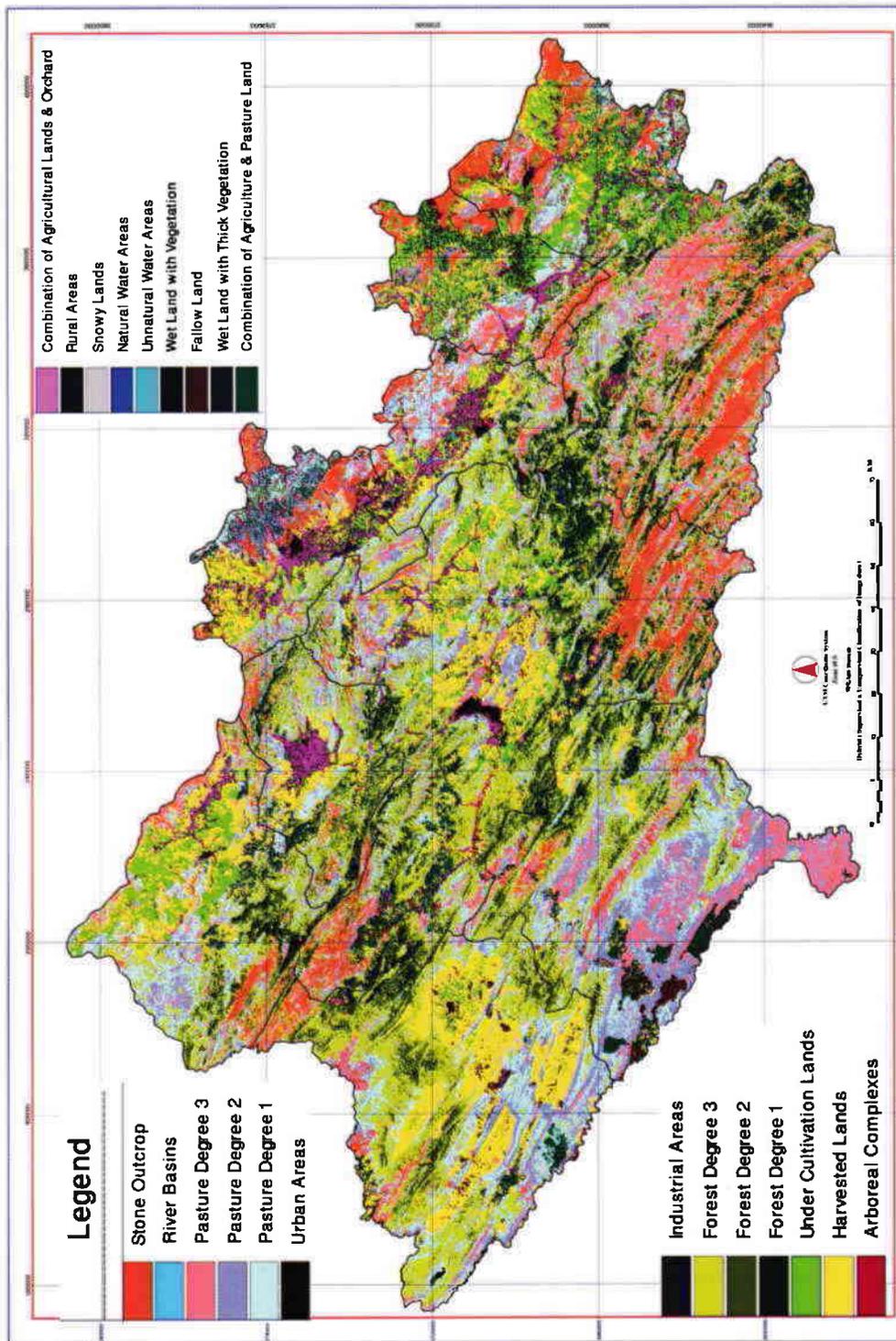


Fig. 1. Land use map of Lorestan