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Study of Remote Sensing and Satellite Images Ability in Preparing Agricultural Land Use Map (ALUM)

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***Abstract*—**In this research the Preparation of Land use map of scanner LISS III satellite data, belonging to the IRS in the Aghche region in Isfahan province, is studied carefully. For this purpose, the IRS satellite images of August 2008 and various land preparation uses in region including rangelands, irrigation farming, dry farming, gardens and urban areas were separated and identified. Therefore, the GPS and Erdas Imaging software were used and three methods of Maximum Likelihood, Mahalanobis Distance and Minimum Distance were analyzed. In each of these methods, matrix error and Kappa index were calculated and accuracy of each method, based on percentages: 53.13, 56.64 and 48.44, were obtained respectively. Considering the low accuracy of these methods in separation of land preparation use, the visual interpretation of the map was used. Finally, regional visits of 150 points were noted at random and no error was observed. It shows that the map prepared by visual interpretation is in high accuracy. Although the probable errors due to visual interpretation and geometric correction might happen but the desired accuracy of the map which is more than 85 percent is reliable.

***Keywords*—**Land use map, Aghche Region, Erdas Imagine, satellite images

I. INTRODUCTION

LAND use ,including different types of exploitation of the earth and one of the main preconditions for optimum use of land and knowing land use patterns, changes are in duration of time .So land use describes the kind of human exploitation on a piece of land for one or more purposes. So far, awareness of type and range of agricultural and gardening uses and the potential and ability of each culture in rural areas to human food supply were important and in Agriculture planning were considered [1]. The investigation of spatial distribution of land use and their changes for management planning and monitoring processes in regional, local, and national scales is necessary. This information in addition to make land use aspects understanding better, it also plays an important role in formulating policies and programs needed for development . Nowadays there are different methods and data to make clear the changes of a region over time. The use of satellite data because of their specific features, such as: broad vision, integrity, using different parts of the electromagnetic energy spectrum to enter the specification of phenomena, the short return period, the possibility of using the hardware and software, cheep, quick cheek and prepare the regional monitoring in past and present is specially referred in the world.

As the ability of satellite data, is preparing the land use and the land cover in the past and present, so the remote sensing and geographical information system can be used together [2].

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II. MATERIALS AND METHOD

A. Study area

The area which is studied is a part of Aghche watershed with an area of 1970 hectares, located in the suburb of Feraydan in Isfahan province. The average annual precipitation is 85.417 mm and the average annual temperature is 5. 9° C. The climate of the region according to Domartan method is semi-dry and Amberje method is semi-wet cold. Fig. 1 shows the position of area to Isfahan province & the country.

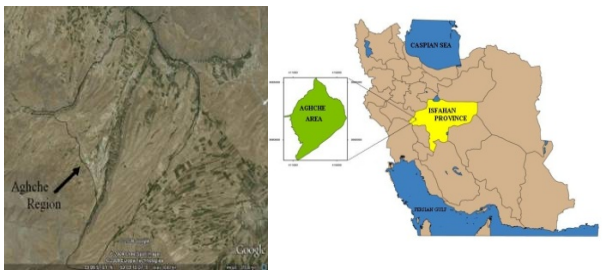

Fig. 1 Position of the region to Isfahan province and Iran.

For this research the scanner LISS III satellite belonging to the IRS is studied. Therefore, the satellite data were prepared in August 2008. To produce the land use map, first it's necessary to ready the following satellite data:

B. Atmospheric correction

Because of suspended particles and gases in the air, the reflection of various objects will be absorbed or scattered. So the real reflection is not shown and possibly should be modified. For atmospheric correction, the terrains which are both in the visible and the non-visible band in zero or near zero are used. Shadow and water are the terrains that will be used. Atmospheric effect on the long wavelength bands is very limit and of almost zero [3].Therefore, in this study correction compared with data infrared bands with long

wavelength and visible data band in some pixels which have water, was done. The DN of different surface terrains, converted to the real value and the atmospheric effect in the size of image terrains reflection were removed.

C. Geometric correction

The first and raw images of satellite data in different reasons, such as Earth's rotation, change in satellite altitude, have the wrong geometry and they are not used with other satellite data and compared with each other [4]. So to be able to process and interpret the satellite data, it's necessary that this image return to its real geographic position.

III. RESULTS

A. Preparing the land use map by use of Maximum Likelihood method

This method is one of the best methods of remote sensing classified data [5]. By using this method, 4 different land uses in region were separated; the results are shown in Fig. 2. Table 4 shows the area of each different land use in the studied region. The Results of overall accuracy and Kappa Maximum Likelihood method are 53.13% and 0.2780, respectively.

TABLE I
RESULTS OF ERROR MATRIX BY MAXIMUM LIKELIHOOD METHOD

conditional Kappa	User's Accuracy	total	Reference Data: Dry Farming	Garden	Rangeland	Irrigation Farming		classified data done by user
0.3133	%54.13	109	2	0	48	59	Irrigation Farming	
0.3071	%65.63	96	26	0	63	7	Rangelands	
0.1568	%16.67	18	0	3	3	12	Garden	
0.2135	%33.33	33	11	0	15	7	Dry Farming	
		256	39	3	129	58		total
			%28.2		%48.8			Producer's
			1	%100	4	%69.41		Accuracy

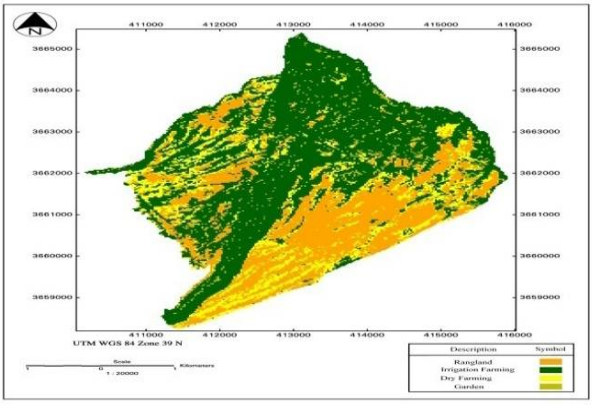

Fig. 2 land use Map prepared by Maximum Likelihood method

B. Images classification

As presented before, in visit of area, five types of land use were selected. To prepare the land use map from LISS III scanner, first the control classified method in preparing land use map was selected [6] [7] [8] [9]. So the data obtained in the visit of the area (partial mapping of each land use) was used. The data in ERDAS IMAGINE software was used as AOI (Area of Interest) and the land use map by theme and in three methods of classification-Maximum LikeLihood, Mahalanobis Distance and Minimum Distance- was prepared. Due to lack of urban area development and to avoid classification error, the urban areas were not considered in this classification. Finally, results from each method were reviewed separately and then the amount of each method and map accuracy and were evaluated. To determine the accuracy of the map, in fact, it will be clear that the map from Classification extent compatible with the realities of the earth. Value and usability of each prepared map depends on the degree of its accuracy. Very common and standard method for determining the accuracy of classified maps is the use of the error matrix.

C.Preparing the land use map by use of Minimum Distance method

The Results of overall accuracy and Kappa Minimum Distance method are 48.44% and 0.2284, respectively.

TABLE II
RESULTS OF ERROR MATRIX BY MINIMUM DISTANCE METHOD

			Reference Data					
conditional Kappa	User's Accuracy	total	Dry Farming	Garden	Rangeland	Irrigation Farming		
0.4321	%62.07	58	0	1	21	36	Irrigation Farming	classified data done by user
0.3406	%67.29	107	25	0	72	10	Rangelands	
0.1231	%13.33	15	0	2	0	13	Garden	
0.0373	%18.42	76	14	0	36	26	Dry Farming	
		256	39	3	126	85		total
			%35.90	%66.67	%55.81	%42.35		Producer's Accuracy

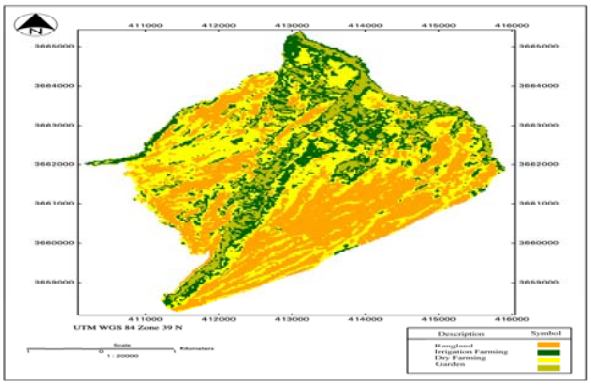

Fig. 3 Land use Map prepared by Minimum Distance method

D.Preparing the land use map by use of Mahalanobis Distance method

The Results of overall accuracy and Kappa Mahalanobis Distance method are 56.64% and 0.3021, respectively.

TABLE III
RESULTS OF ERROR MATRIX BY MAHALANOBIS DISTANCE METHOD

			Reference Data					
conditional Kappa	User's Accuracy	total	Dry Farming	Garden	Rangeland	Irrigation Farming		
0.3099	%53.90	141	5	3	57	76	Irrigation Farming	classified data done by user
0.3138	%65.96	94	26	0	62	6	Rangelands	
-0.0119	%0	3	1	0	1	1	Garden	
0.2791	%38.89	18	7	0	9	2	Dry Farming	
		256	39	3	129	85		total
			%89.41	%48.06	%0	%17.95		Producer's Accuracy

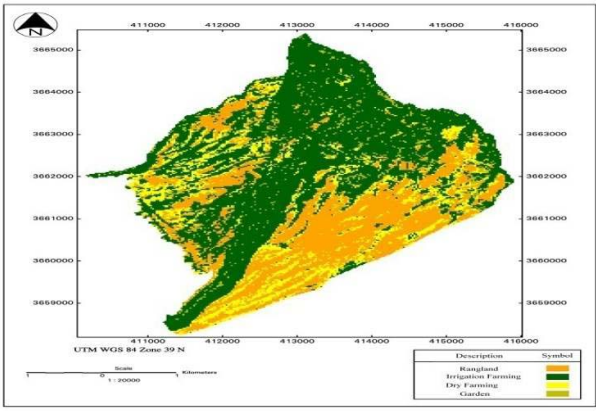

Fig. 4 Land use Map prepared by Mahalanobis Distance method

In this research to evaluate the accuracy of: statistical parameters such as error matrix, overall accuracy and classified coefficient Kappa for each map were extracted [2]. To obtain accuracy of any of these methods first by ERDAS IMAGINE software randomly with ACCURACY ASSESSMENT command, 256 points in the region (except urban) was determined and the characteristics of this points were noted. Then each of these points was studied by GPS and the type of land use of every point was noted. Finally, by ERDAS IMAGINE software and ACCURACY ASSESSMENT command, error matrix and Kappa for each three methods for preparing land use map were used [10].

E. Correcting the prepared map

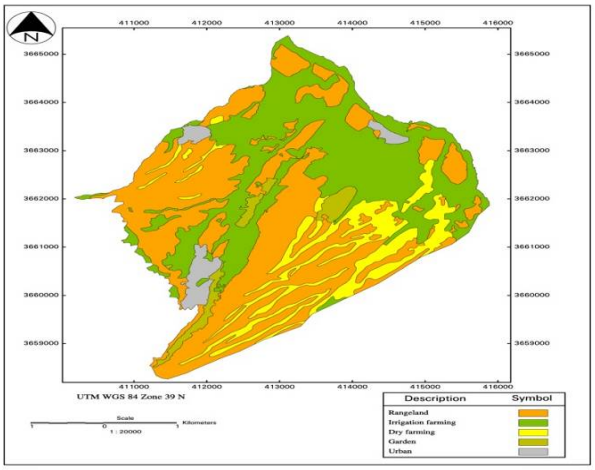

Fig. 5 The final Map of the land use region

TABLE IV
AREA OF EACH DIFFERENT LAND USE IN REGION

Land use type	Area (hectares)
Irrigation Farming	699.7975
Rangelands	902.8175
Garden	61.11
Dry farming	243.8525
Urban	62.312
Total	1969.89

Regard to low accuracy of the three above methods to separate land uses, the visual interpretation of image to prepare land use map was used [2]. In order to interpret the images, first the studied area was visited, and by asking question from native people and the knowledge obtained from the region, five types of land use including: Rangelands, Irrigation farming, Dry farming, Gardens and Urban were selected. After identifying the land uses, images were interpreted by stereoscope and the border of each land use was put on transparence to every image. For geometric correction of images, on specific terrains of each image were determined and noted. Then each of these images was scanned. After that each one in the ERDAS IMAGINE software with a numeral topographic map of region and with the help of marked terrains and camera specification including center distance and features of fidoshal filming camera were geometrically corrected. Then the border of each land use in image, became numeral this software and because connecting these borders together the land use image was prepared. Finally, the region was revisited and in 150 points randomly the terrains were noted and not any errors observed. It shows that the prepared map from visual interpretation is in high accuracy. Although regarding to visual interpretation and geometric correction error, it cannot be said that the prepared map is out of error, but this map can be certainly in a good accuracy which is more than 85 percent [11].

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