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Application of Remote Sensing in Development of Green Space

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Abstract**—**One of the most important parameters to develop and manage urban areas is appropriate selection of land surface to develop green spaces in these areas. In this study, in order to identify the most appropriate sites and areas cultivated for ornamental species in Jiroft, Landsat Enhanced Thematic Mapper Plus (ETM+) images due to extract the most important effective climatic and adaphic parameters for growth ornamental species were used. After geometric and atmospheric corrections applied, to enhance accuracy of multi spectral (XS) bands, the fusion of Landsat XS bands by IRS-1D panchromatic band (PAN) was performed. After field sampling to evaluate the correlation between different factors in surface soil sampling location and different bands digital number (DN) of ETM+ sensor on the same points, correlation tables formed using the best computational model and the map of physical and chemical parameters of soil was produced. Then the accuracy of them was investigated by using kappa coefficient. Finally, according to produced maps, the best areas for cultivation of recommended species were introduced.

Keywords**—**Locate ornamental species, Remote Sensing, Adaphic parameters, ETM+, Jiroft

I. Introduction

Today, due to the growing of cities area, the development of urban green spaces is one of the serious problems of urban management. In this research, understanding appropriate places to develop parks, walk sometimes and general green space in populous areas are very important matter. In this context, remote sensing (RS) and geographic information systems (GIS) can play an important role in this matter. In addition to study the possibility of different influence parameters and extensive coverage, it can be used to minimize the calculation error. Many studies about application of RS and GIS in urban green space research and vegetation have been done that a number of them are mentioned as follow.

Poushesh, *et.al*, 2007, stating that land surveying of urban green space have enormous costs and also are very time consuming. Therefore, urban green space mapping using satellite images to have a time series and to be careful with high speed and cost is less. In this study, Isfahan in terms of urban area and green space development and increased population and per capita green space during the two years 1923 and 2007 by available maps and satellite images has been studied [7].

Malek Ghasemi, *et.al*, 2005, by using GIS began to review principles of land preparation and development of green space in the forest "Sorkheh-hesaar", Tehran, Iran. In their study, East region of Tehran (Sorkheh-hesaar Forest Park) suitable for forest development was chosen after studies based on green logistics and GIS. Also they could ultimately after base investigation, produce the map of the environmental area. Ecological model of development can be more green space and forest area was extracted with 5 classes [8].

Jalalian, et.al, 2007, to understand the physical limitations and soil morphology at green space development in Isfahan city, illustrated the major problems and limitations of soil in Isfahan as fallow: compaction and density of soil, layers of hard clay, soil depth, percentage of high gravel, layer of hard lime and Knglvmraly, puppets, problem of salinity and sodium chemical limiting factors [3].Abdullahi, 2001, proposed the native species compatible with the dry and semi-dry conditions such as root, hawthorn, shirkhesht, Vamchak, eglantine, wild almond hazel, sumac, ash, walnut, apple and fig for the replacement Most species of native and non-expectation that the relationship between species, aspect and soil must be observant [5].

Jazireie, 2001, stating that the selected species for forest development work and open green space, whether in the field or forest to fill empty areas to compensate for the absence or lack of natural Byy regeneration either native or alien species, placing a very sensitive and difficult be. As a general principle that any work for the forest should be chosen according to environmental conditions is the place in other words must be able climatic and soil conditions and the location and adapted to live agents available to find the compatibility [2]. Nakheii Moghadam, 2007, to review climate parameters as the most important limiting factor in Zabol have shown that a most important factor limiting the development of urban green space in this area has climatic factors. Study climatic parameters limiting urban development and green space due to its direct effect on the yield and quality of human life more than before the city seems to be necessary [9].

Malek Ghasemi, *et.al*, 2005, with the results of land preparation, locate areas suitable for forest development and green space and consequently introduced plant species suitable

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for semi-arid areas based on ecological characteristics. On the other hand GIS due to its ability to analyze information can systematically address the many problems in the development of green spaces and is working forests [8]. Ghelichnia Omrani, 1996, assess the relationship between geomorphologic and vegetation factors based on land preparation in Semnan province and concluded that his study in forestry and forest land user can do is grade 1 [6]. Pour Assad, et.al, 2003, a study with the aim of providing how people's participation in conservation programs, maintenance and development of green space in Tehran has done. Analysis of data obtained showed that 90 percent of respondents very good suggestions for maintaining green space and had its interest to maintain and development of local green space and parks have announced [1].

Due to urban expansion and population increase in recent years in Jiroft, the basic studies to develop this area of green space is very important. Thus adaphic and climatic parameters in this region to identify and introduce best place to develop the most appropriate ornamental species were studied.

II. Materials And Methods

A. The Study Area Location

Jiroft is a city in Kerman province, Iran. It is located 230-kilometres south of the city of Kerman, and 1,375-kilometres south of Tehran and its coordinates are 28° 40' 13" N, 57° 44' 13" E. In the past it was also called Sabzevaran, and on account of its being very fertile land it is famous as Hend-e-Koochak (the little India).Jiroft is located in a vast plain, Halil River, on the southern outskirts of the Barez mountain chain, surrounded by two rivers. The mean elevation of the city is about 650-metres above sea level. Agriculture and Gardening in the valley and plain area in the city had spread. Required water is provided by using the river and deep wells. This region in terms adaphic and climatic conditions, one of the poles is considered agricultural country, so in terms of urban development and population density of green space development in this area is important. In Figure 1, position of Jiroft in Kerman province and the nearby city is shown.

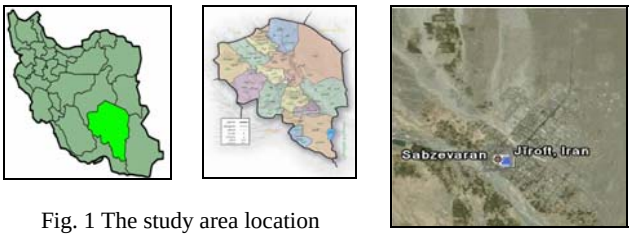


Fig. 1 The study area location

B. Satellite Data

In this study, images of ETM+ sensor of Landsat-7 used for extraction of required maps. These data include 6 reflection band (1 to 5 and 7), two thermal band (band 6) and a PAN band (band 8) that includes two windows 159 and 160 paths information and row 40, (the World Wide System: p160-r40 p159-r40) are located UTM zone #40. This image dates 7 and 14 September 2002 have been obtained.

C. Satellite Data Processing

Geometric Correction

For geometric correction of ETM+ data, the False Color Composite (FCC) images of South East (Zone 40) by 15 meters ground precision was used as reference files. The FCC images provided by Iranian Space Agency (ISA) are used in this study. First, the panchromatic band (band 8) was registered to the FCC files. Then all of the spectral reflection bands except thermal bands by Layer stack command of ERDAS software are gathered in one image file. The registration performance is very good due to same spatial resolution of the both PAN and FCC images that the general Root Mean Square error (RMSe) of this stage equal to 0.41 pixels were calculated. Because large area, 84 control points with appropriate distribution was registered with PAN band. Finally the image re-projects into UTM coordinate system and by using Nearest Neighbor (NN) Resampling method, the georefrenced image with 0.55 RMSe was obtained[13], [15].

Radiometric Correction

In the data received for our study, nothing wrong was found. Therefore don't necessary to radiometric correction for image data.

Atmospheric Correction

Topography of study area is mostly mountainous areas with high slope systems. There are shadow and water areas such as river and dam there. By comparing the histogram of both Jiroft Dam and shadow area, and acceptable water absorption wave at band-7, atmospheric correction was performed. Figure 2, illustrate the rate between the origin coordinate wave spectral band 3 to band-7 is the lowest atmospheric scattering.

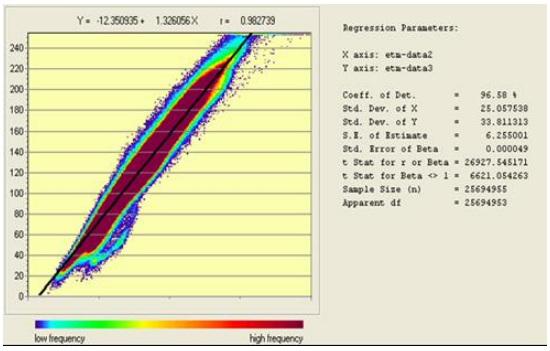


Fig. 2 Regression band 3 and 7 for band 3 correction

Topographic Correction (relief effect)

Topographic correction on the images acquired in mountainous regions has the most effect. In this study, the topography normalized by the ERDAS software's commands and the Sun elevation angle, Azimuth angle of the sun and the

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Digital Elevation Model (DEM) as the correction parameters (Lambert method) on the ETM+ images were applied. The result of applying this correction, changing the minimum and maximum digital number of pixels, the variance remains almost constant and showed a lot of difference.

Image Enhancement

1. Data Fusion of Multispectral and Panchromatic Bands

After data registration, as was mentioned the fusion of panchromatic band and multi spectral reflection bands can be very useful information to the user to provide. Therefore, the merge operator of ERDAS software was used. High resolution PAN band and other bands without thermal them, as a multi spectral band was interred. Data fusion was performed by using the Principal Component Analysis (PCA) method and the nearest neighbor resampling. More analysis of all integration processes on the bands that contain more information than the main bands were performed.

2. Contrast Improvement and the Best Band Selection for FCC Images

After data registration, for diagnosis and classification of complications should they took series processes. First side to better contrasts the three methods of linear stretching, histogram conversion and the saturated linear stretching in IDRISI and ERDAS software was used. In order to determine more clearly and phenomena, the best band combinations with the results obtained from OIF index, respectively. This band combinations that are at least correlation, can be FCC347, FCC754, FCC457, FCC578 and FCC432 cited.

3. Principle Component Analysis and Tasseled Cap of ETM+

PCA analysis as a method of compression for better information on the interpretation of ETM+ data was performed. Examination of the principle components of the table determined the most information about PCA (1) are complications and the diagnosis made of stone such as limestone outcrops and agricultural lands and bare soil lands, especially in the stream were used.

4. Vegetation Indexes

In this study, in order to determine the coverage of pasture, gardens and forest land of different vegetation indices in two EDRISI and ERDAS software was used. However, the Normalized Differential Vegetation Index (NDVI) because covering more information is offer. Therefore, NDVI index for the isolation of dense gardens and forest coatings were used. But, for weaker and Coating spread of such coatings pasture, Perpendicular Vegetation index (PVI) was also help. This index data bands in addition to red (RED) and near infrared (NIR) requires information line is also the soil. To obtain this information from two band correlation mentioned and Mask soil diagnosis by the spread of better coverage was used.

Determine the Shape Land Surfaces Sampling Units

Ecologic, Geomorphologic and interpretation of processed satellite imagery units was considered to determine the land unit forms for surface sampling and study of selected region. This interpretation of the processed satellite imagery because closing to the earth and accuracy of the considered phenomena and allowing for sampling and determine physical and chemical properties of soil were used.

Soil Data

The purpose of this section to collect data and soil parameters are. Therefore, the determination of homogeneous regions, the distribution of sampling points in the area was suitable. The most important point at this stage be close to harvest time, sampling time satellite is

Sampling method that was used in this study classified random sampling method is so selective distribution points in homogeneous units are completely random. Soil samples had 0 to 20 cm depth and the required information of samples was recorded.

Physical and Chemical Analysis of Soil

To laboratory analysis, samples perception after primary processing and drying in free air, passed from 2 ml riddle and then compute the physical and chemical characteristics was conducted the following:

a. Physical characteristics of soil

Soil texture: For determining soil texture according to Stoke's law, Hydrometric method was used [11], [10], and [15].

b. Chemical characteristics of soil

Measuring PH: The PH value of mud samples saturated was measured by "PH meter" (model E588).

Electrical conductivity: To assess soil salinity, the total amounts of mineral soil solution were measured. Measured electrical conductivity of soil saturation extract one of the fastest and yet most accurate methods to determine the total soluble salts in soil. For measuring the electrical conductivity of saturation extract conductivity gauge device was used.

Lime measuring: Titration method to measure lime was, in this method to solve calcium sulfuric acid (0.5 normal) was used and then titration was performed with 0.25.

Sodium Absorption Ratio (SAR) measuring: First, sodium was measured by photometer, then the values of Mg and Ca were determined using Versyn and the following relationship, SAR rate was achieved:

$$SAR = \frac{Na}{\sqrt{Ca + Mg/2}}$$

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III. Experimental Results

In order to locate the best and adaptable tree and shrub species to develop green space in Jiroft, Iran, ETM+ Images of 2002 were used. After incorporating their data and geometric correction, atmospheric correction also took. In order to increase the accuracy of produced maps, by using PAN band from IRS-1D satellite image acquired at 2005, spatial resolution of image from 30 meters increased to 5 meters. Considering the limited surface area and the microclimate study area, determined study area, with climate is uniqueness. Therefore, locate the appropriate species for landscape soil chemical and physical parameters were studied. The results of these studies are such as the following:

A. Statistical Analysis of Soil Variables

In this study to evaluate the correlation between different factors in surface soil samples and Digital Number (DN) of ETM+ bands in the same points, correlation tables were formed. For this purpose, surface soil samples have been tested as a dependent variable and satellite images as independent variable was considered. Table 1, shows the correlation coefficients for these variables.

TABLE I
THE CORRELATION COEFFICIENTS OF SAMPLING SITES' DN WITH SOIL SURFACE PARAMETERS (0 - 10 CM)

parameter	ETM^+1	ETM^+2	ETM^+3	ETM^+4	ETM^+5	ETM^+7
SAR	0.12	0.04	0.11	0.042	0.05	-0.08
PH	0.21*	0.23*	-0.26	-0.46**	0.28	0.25**
ECe	-0.430	0.14	-0.02	0.32**	-0.12	-0.32*
Lime	0.023	0.08	-0.12	0.19	-0.05	-0.01
Gravel & Stone	0.048	0.19	0.18	-0.47**	-0.05	-0.02
Silt	0.02	0.31*	0.25*	0.42**	0.12*	0.17
Sand	0.12	0.17	-0.14	0.58**	-0.01	0.17
Clay	-0.17	0.28	-0.023	0.56**	-0.04	-0.21*

** 99% significant level * 95% significant level

B. Mapping of physical and chemical soil parameters

1. Acidity Map (PH) of Soil:

To mapping the surface PH, the relationship between PH of samples and digital images of satellite were studied by regression models. PH of samples was considered as dependent variable and the main band ETM+ as an independent variable. Using multivariate regression models the best model was selected with high R2. PH on the classification parameter likely used the maximum values PH and soil samples in 3 classes, including "PH> 8", "8 <PH <8.5" and "PH> 8.5" respectively. Figure -3 shows PH map of the study area.

To determine the accuracy and the precision of PH map, 34 control points were used that illustrated high kappa accuracy equal to 84%. As we will see a high proportion of the region is with PH <8.

2. Map of Surface Soil Bases (SAR map)

SAR mapping of soil to the region, the combination of various independent and dependent variables were used. Unfortunately, the computational models were with low R2. Therefore, the correlation coefficients were used in order to obtain the best band SAR map. Considering Table 1, ETM+3 have the highest correlation. SAR mapping performed by Maximum Likelihood Classification (MLC) as a statistical method and by using sampling points as training sites, the SAR map were prepared in 5 classes (Figure 4). 87% Kappa coefficient showed the high accuracy of produced SAR map and the highest accuracy belong to class 1 <SAR <2.

3. Percentage of Gravel and Stone Surface Soil

In order to estimate percentage of stone and gravel in the field study, the 1 × 1 m plots inside 10 × 10 m plots were used. Investigation of DN of images and normalized ground sampling data files and different composition of them don't led to a model of reliable and high precision. Consequently, the fourth band of ETM+ was used for mapping soil gravel. Finally, gravel and stone map of surface soil with 85% accuracy were obtained (Figure 5).

As can be seen the north area of Jiroft due to geomorphology status is a high percentage of gravel and stone and gradually declined toward the city center.

4. Limestone Map

In order to surface limestone mapping, the relationship between the lime of surface samples and digital satellite images were studied by using regression models. Finally, due to the low accuracy of the extracted model, fourth band of ETM+ was used to extraction of lime map. The accuracy of produced maps using kappa coefficient is 81%. As shown in figure 6, a few percent of all area in the west region of the city are high limestone.

5. Soil Texture Map

Due to high correlation with the soil data and fourth band of ETM+, by using the training sites included the soil samples soil texture classification was done with 9 classes. To determine the accuracy of obtained map (Figure 7), values of 34 field samples that measured in soil science laboratory compared with map data respectively and matrix error was formed. So that the highest accuracy class "Silty Loam" is

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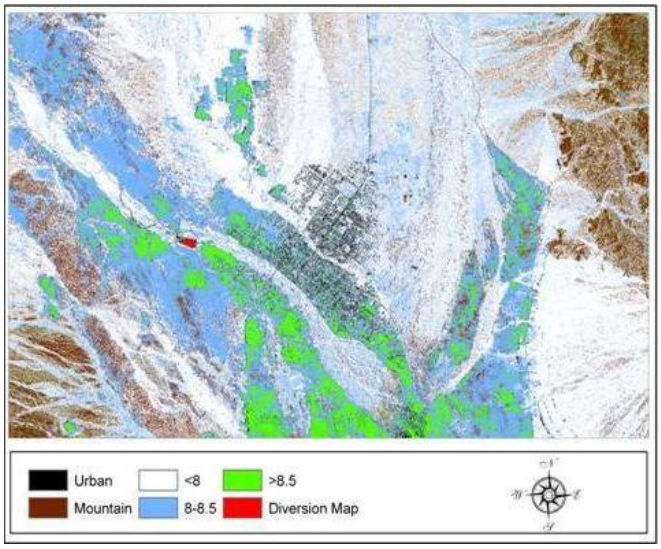


Fig. 3 The acidity map (PH) of soil of study area

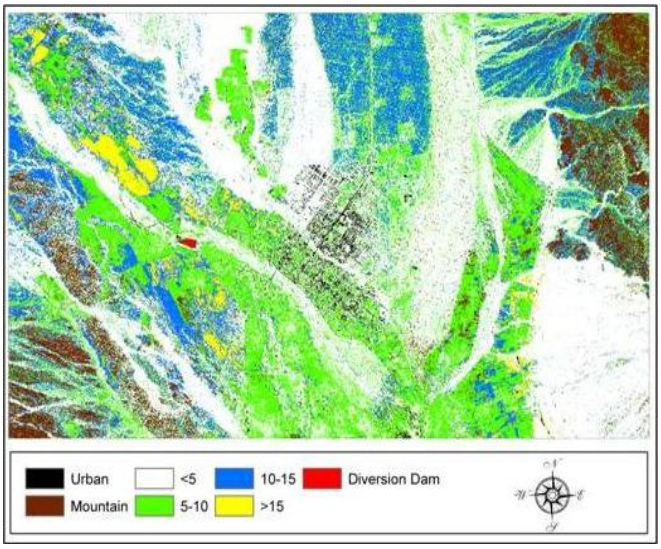


Fig. 6 The limestone map of study area

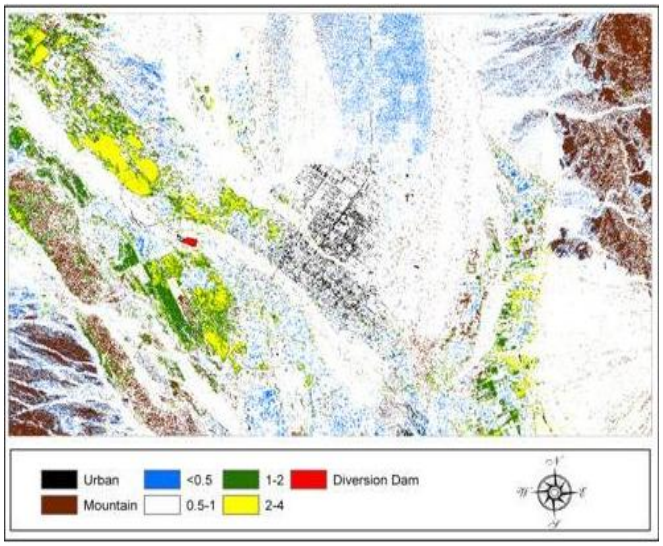


Fig. 4 The SAR map of study area

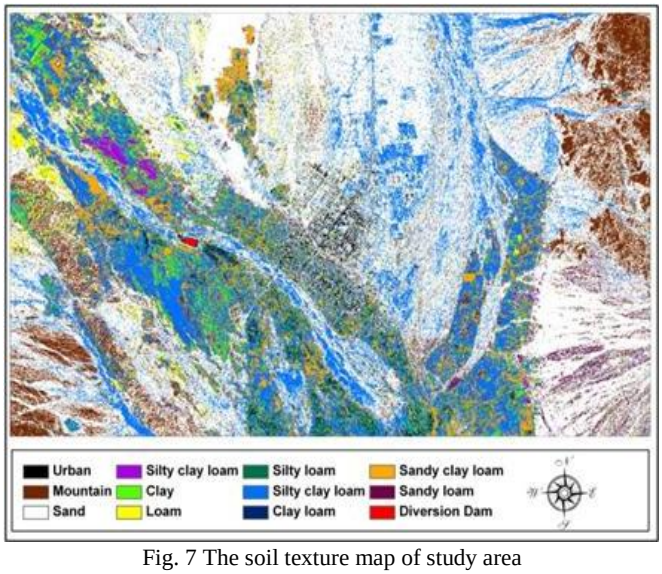


Fig. 7 The soil texture map of study area

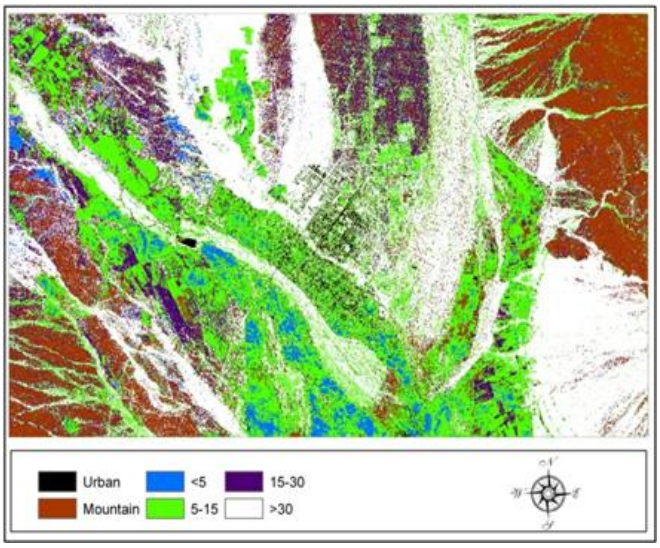


Fig. 5 The gravel and stone map of surface soil in study area

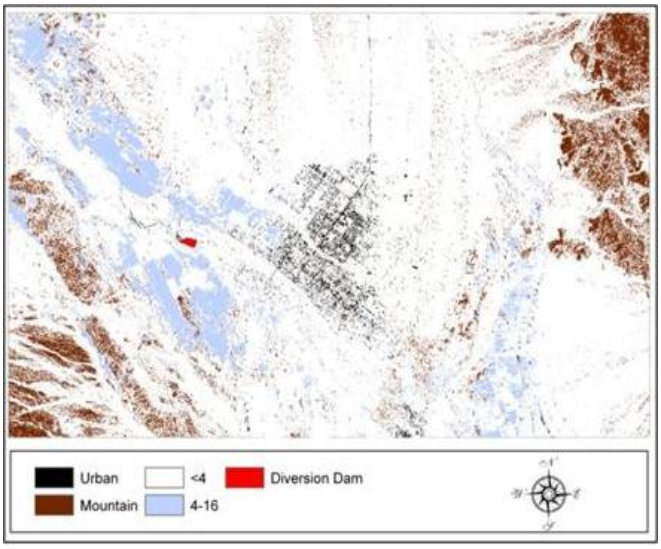


Fig. 8 The soil salinity map of the study area

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equivalent to 92 % and 73 % equivalent to map the overall kappa was determined.

As can be seen north of the city texture is coarse and gradually towards the south of the city of fine grain texture that can be replaced.

6. *Soil Salinity Map*

For mapping surface soil salinity, were trying to regression relationships between ECe data and satellite digital images may be used. In this equation Soil ECe as a dependent variable, ETM+ data as an independent variable was considered. Considering the high correlation between perception ECe data with fourth band of ETM+, by using MLC, the classification map took with 3 classes. Map accuracy using Kappa coefficient is 78%. Figure 8 shows the map of soil salinity from the above method.

As you can deduce, because a high proportion of drainage area above the slope being, soil salinity (ECe) is low and only percentage area of agricultural lands in place with 4 <ECe <16 dS/m.

In addition to layers of soil parameters and the review in terms of regional climatic parameters such as temperature and absolute minimum and maximum annual average temperature and average annual precipitation parameters, studies of underground water was performed. In this region due to the location of Jiroft in plain area of Barez mountain chain and having a kidney stone texture in this area, ground water levels and depth in this area suitable for irrigation are different species of tree. Finally, ornamental species and habitats which are coarse soil the computational parameters, as part of the North City best place for growing tree species and shrub was introduced to create the park. Center City and South West and appropriate habitat for various species such as cypress, eucalyptus, pine (spatially: Tehran pine), nigra and development of urban green space can be shown in Figure 9.

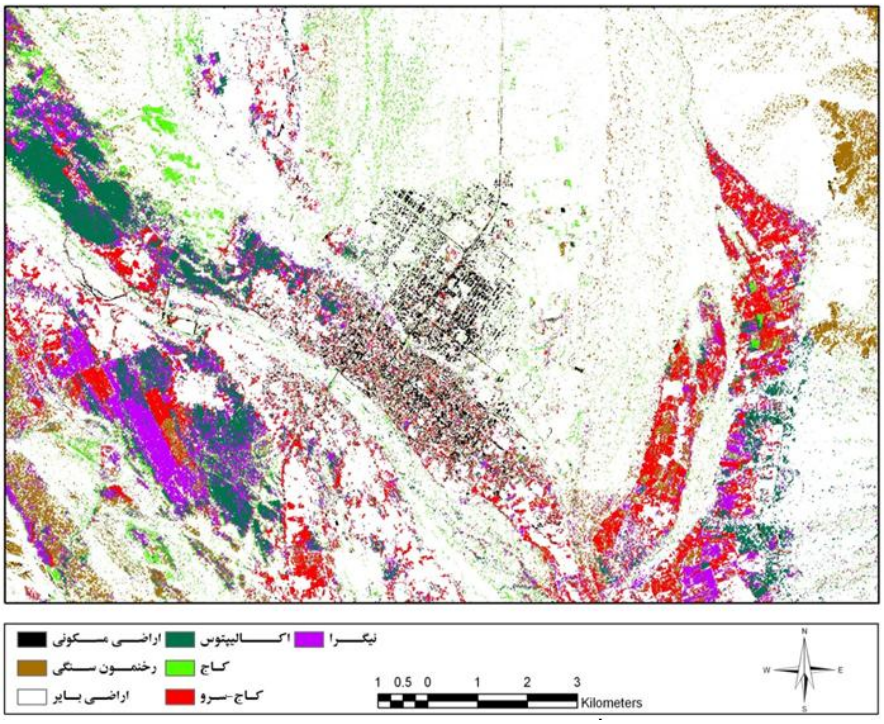


Fig. 9 The map of site location of various tree species

IV. Conclusion

According to produced map of the different climatic and adaphic parameters, Jiroft city have the potential of ornamental species growth. Also the potential of this region are very suitable for recreational development and tourism. Foothills lands those are close to Jiroft considered. The slope and soil texture of these regions can be used for forest species tillage to development the forest park by spreading the natural freshet water. Halil River and the River "Shour" coasts as the results showed were very high potential to develop park and recreational species cultivating ornamental tree and shrub. Therefore, by proper planning and providing executive field, we can increase the area of green space in Jiroft with the urban growth of 21% to 68%.

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