Studying Bio-Environmental Potentials of Kusalan Area, Based on IUCN criterions, using RS and GIS technologies

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Abstract

Kusalan habitat is located on a northwest-southeast mountain with an intensive topography near the Sarvabad town in the west of Kurdistan. This habitat encompasses a set of unique bioenvironmental phenomenon (such as *Quercus* forests and dense ranges) as well as three permanent rivers and numerous springs. So far, there was no study on the bioenvironmental habitat potentials. This persuaded us to conduct a research on the bioenvironmental potentials of the region, to protect the area, according to IUCN criterions. Field surveys, remote sensing and geographic Information System (GIS) were used to identify and analyze the ecological, social and economical resources of the study area. Hybrid method was also employed using digital classification of 10m SPOT5 image of 2005 and field data as visual interpretation. Applying this method, the potential resources were identified. Then the maps of land forms, Hydrology, soil, vegetation, wildlife habitat, ecological potentials, current applications and the conventional boundaries were provided. In the next stage, bioenvironmental units were determined through applying GIS analysis along with gathering the maps and overlaying them. Zoning of the bioenvironmental resources was performed on the basis of IUCN definitions. The results of this study demonstrated that the study area involves 224 of flora species and 195 of fauna species as well as 5 main zones including: 29% secure zone, 40.75% protection zone, 13.7% alternative recreation zone, 3.21% mass recreation zone and 0.14% cultural and historical zone and 13.2% reconstructing zone along with the many scientific and training values and a unique wild natural landscape. Thus, Kusalan habitat is worth to be introduced as a national park (II) and to be considered as one of the four national protected areas in Iran. According to the results of this research, the GIS and RS can be used for identifying inaccessible bioenvironmental resources with an intensive topography and providing their maps with the aim of protecting the area, based on IUCN criterions.

1- Introduction

Establishing protected areas is considered as a conscious attempt to support the last remainders of a biodiversity which preserved their natural properties in the current instable developing process. Applying scientific principles to study the bioenvironmental potentials and evaluating the ecological potentials determines the land use type and the natural potential (ecological potential) (makhdom, 1999). These studies has been already conducted in traditional ways by using the ground data collection, however, this method was an expensive, time consuming method and in some cases difficult to access. To address this problem, remote sensed images are used to study the natural resources, forests, ranges, wild life, erosion and other bioenvironmental factors (chaderi l996). Consequently, studying the ecological potentials of western habitats of Mazandaran, involving forests, ranges, apparent animal types such as some kinds of Mammals, birds, reptilian, etc. seems very necessary.

2- Materials and Methods

Ecological resources include biological and physical sources, each of them involving different parameters. In general, 3 methods of identifying ecological sources include:

1- Inventory and sampling

2-Automatic visual interpretation of aerial photographs, remotely sensed images and topographic maps

3- Geographic information system (Makhdom, 1999).

At first, a supervised digital classification method was applied using a maximum likelihood classifier. To do this, seven groups of training samples were selected as a model of spectral reflectance for different phenomena in the study area (including water, Gardens, planted crops, unplanted crops, forests, pastures, rocky lands and manufactured areas) based on the ground survey data.

The resulted map has a total accuracy of 57.4% and a kapa coefficient of 72.3%. Then, a visual classification method was applied. To do this classification, the raster map was transferred to a vector one. In the next step, the obtained map was laid on SPOT 5 panchromatic image. Then, it was interpreted, reviewed and edited using ground data in an Arc view 3.2 environment. The resulted map had a total accuracy of 65.15% and a kapa coefficient of 78.65%. This matter indicates the high capability of spot5 data associated with using a hybrid classification method to provide maps of the mountainous and non accessible areas. Ecological resources include:

2-1 Physical sources: Due to lack of a meteorological station in the study area, we used Synoptic station of Marivan and Paveh which are located near Kusalan. Rivers and Brooklets were extracted from topographic maps and remote sensed images. Then, they were digitized. The registered points were transferred to GIS in order to identify the existing springs. Ground samples and geographic characteristics of springs obtained by GPS system were used. In the next stage, hydrographic maps of the Kusalan area were also provided.

2-2 Land Shape maps: To assess the parameters forming the land shape (height classes, slope classes and five main geographic directions) and to prepare the necessary maps, four sheets of topographic maps at the scale of 1:50000 of year 1997 were used. Finally, the land shape maps were obtained by overlaying the map layers of height, slope and geographic direction.

2-3 Biological Resources

2-3-1 Plants: The extinction rates of plants in the study area were measured after careful frequent ground checking at different phonological stages of plant growth by collecting vegetation samples.

2-3-2 Animals: The information about the animals in the study area was collected by the wildlife habitat experts. To prepare the wildlife scattering map, the animal species index was determined. Then, habitat location was registered by GPS device and spatial data was transferred to GIS environment. The vector map of wildlife habitat was obtained through the hybrid interpretation of remotely sensed images.

2-3-3 Land shape: Since the land shape is a qualitative factor, remotely sensed images and a topographic map of 1:50000 associated with the field data were used to identify the scenery of Kusalan area.

2-4 Socio-economical studies

Conventional boundary map was prepared via hybrid interpretation of SPOT5 images and ground surveys with local people.

2-4-1 Evaluating the Bioenvironmental Potentials: The following processes are used in all methods of evaluating the bioenvironmental potentials:
1- Ecologic resources identification
2- Socio-economic data collection
3- Ecologic data collection and analysis
4- Evaluating the ecological potential for each unit, then comparing them with the ecological properties of each unit in the model
5- Zoning
6- Providing the land use potentials in terms of the global criteria

3- Results

The results of bioenvironmental resource identification (ecologic and socio-economic resources) are as follows:

3-1 Ecologic resource

3-1-1 Physical resources: Results of studying the physical resources show:

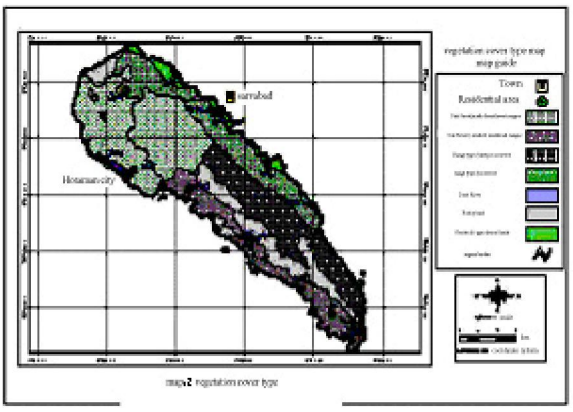
3-1-2 Climate: The Combination of climatic conditions in Marivan and Paveh stations, and the average of climatic parameters show the cold wet climate of Kusalan area.

3-1-3 Hydrology: There are abundant steep slope brooklets and springs in Kusalan habitat which all of them ends to Sirvan River. The main springs of Kusalan include: Hooseian, Lar, Odele, Hevar, Hevar Heye Shour.

3-1-4 Land shape: According the obtained results, there are many mountains and elevations with crest or round tops in the cornice or precipices shapes. The walls of valleys often have a steep or moderate slope, ending to bottom-line of brooklets. Direction of brooklets is mainly observed in linear form having a low width and a V shape profile view. The studies on topographic factors demonstrated the mountainous high altitude topography of Kusalan. Based on table 1 and map2, height variation range is 1800m and the main height classes are 1200-1800m in 40% of the study area. 27% of the area is covered with 2000-2500m classes which are suitable for protection according to evaluation models. Table 1 shows the percentage and area of each slope class. Distribution of classes is heterogeneous and the permanent predominant slope class is 30-60%. The slope above 60% covers 1/3 of the study area. Based on the results of this study, the area for the classes is north orientation (28/8%), west orientation (25/6%), east orientation (25/1%), and south orientation (20/2%). Due to the uniformity of area distribution of the main orientations, the summer and winter time is proper for wildlife, so, animals won't migrate to the neighbor habitats. Land shape was determined by resultant of 3 physiographic factors of slope, height, orientation. As the result, 509 small ecosystems are obtained from Kusalan big ecosystem.

Table1 : height classes

Area (%)	Area (ha)	Height from sea level(m)	Height class
17.4	4474.98	800-1200	1
40.6	10457.55	1200-1800	2
14	3652.2	1800-2000	3
26.9	6927.93	2000-2500	4
1	251.73	Over 2500	5



3-2 Biological resources

3-2-1 Plants: 224 plant species were identified using field data and through a process of plant collection and identification in

Kusalan. These identified species include: 78% forbs, 13% grasses, 8% trees and bushes and 1 % brushes. Figures 3-5 demonstrates the natural resource preservation value in Kusalan area. 30 species among these 224 species are exposed to extinction threats.

Figure 3: oak forests

Figure3: image1) ***Medicago radiate***, 2) ***Rheum Ribes***, 3) Down Tullip

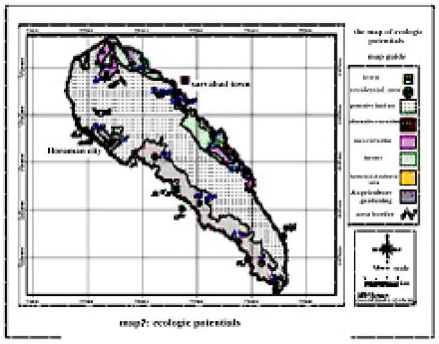
Figure4:images1: ***Alkana sp***,2: ***prangos sp***,3: Avena Sativa ,4: ***Bromus tectorum***

3-2-2 Animals: According to the studies, there are 23 species of mammals in Kusalan habitat. The most outstanding of them are: Canis lupus, canis aureus, vulpes, Ursus, Mustela nivalis, Meles, Vormela peregusna, Lutra, Felis catus, Lynx, Felidae, all of them belongs to Carnivora family.
Five families and subfamilies of Rodents observed in this habitat, including: Sciuridae, Criceinae, Gerbilinae, Muridae, Hystrigidae.

Figure 6: *Capra aegagrus*

3-3 evaluating the ecological potentials

This area was prepared for evaluation via ecologic resource identification, data collection and analysis. The evaluation was in terms of the ecologic resources (land shape, soil, vegetation cover, wildlife scattering, and other physical resources) playing a role in ecologic models and it was conducted through a multi-factor method according to an ecologic model. Six types of land use were determined for the study area involving preservation, mass recreation, alternative recreation, forestry, gardening and agriculture (map7).



map7: ecologic potentials

3-4 Historical and cultural events

a) Horaman ancient village: Horaman ancient village located at the study area has a unique view. This village has a pyramidal shape with echelon construction and an ancient castle is located at top of this village.

Figure 8: Horaman valley

b) Pirshalizar ceremony

This ceremony is annually held at the wedding anniversary of Pirshalizar. He was the most well-known philosopher of that area. This ceremony is held in eight days and people spend a great time together.

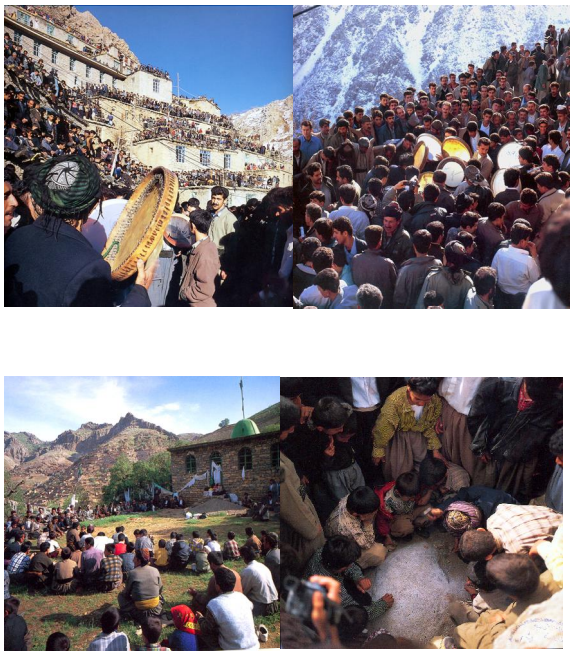


Figure9: Pirshalizar Ceremony

3-5 Zoning

Zoning was based on the ecological and socio-economical factors. The results obtained by combining and overlaying the maps of ecological potentials and conventional boundary, reveal 12978 biological units in Kusalan area. Combining the uniform units, we obtained 6 main zones: 1- safe zone, 2- protected zone, 3- mass recreation, 4- alternative recreation, and 5- cultural and historical zone, 6- reconstruction zone.
Area of each zone and its ratio to the total area were measured. Zone 1(safe zone) covering 29% of the study area is extended over the eastern and western ranges of Doab River. Some parts of this zone are observed in southern range with a slope over 60%. The vegetation cover has a low density in this zone. Rocks are the main coverage of the area.
Some other factors such as some threatened species of goat (main habitat) and Ursus have also affected on the selection of this zone. Zone 2 (preservation zone) with an area of 40/7% surrounds zone 1. This zone involves some parts of forests in the north and north-east ranges. Lynx habitat can be observed in this zone. 13/7% of the study area pertains to alternative recreation (zone 3), mainly observed in south ranges of Sirvan Permanent River and north ranges of Shahoo Mountain. Zone 4 (mass recreation) is located at north ranges with an area of about 3/21%. This zone was chosen because of the asphalt road of Marivan-Sanandaj and also the gravel rural road of Bahramabad –Bandol. Historical town of Horaman with special customs for holding Pirshaliar ceremony is selected as zone 5 (cultural and historical zone). The reconstructive zone is 13/2%. Totally, 70/7% of the study area has the potentiality to be preserved. In continue, the final zoning was done with regard to their natural condition, wetland shape and their combination with the conventional boundary map. According to the results of zoning, 29% of the study area pertains to zone 1 and 40/7% is considered as zone 2. In total, 70% of the study area has the potentiality to be preserved. About 17% of the study area (zones 3&4) has recreative potentiality. 14% of zone 5 and the rest 13/2% are considered as zone 6 or the reconstructive area.

4- Conclusion

Results of this study indicate the high potentiality of study area (Kusalan) to be a national park and receive the IUCN criteria. In this study, it is also verified that the biological potentials of an area or a natural habitat can be studied using data extracted from SPOT5 remotely sensed images (panchromatic 10 m images) via optical interpretation and supervised digital classification (hybrid method) and based on the global criteria (IUCN) to establish protected areas. It is also emphasized on using GIS to save and analyze the special data and also on providing proper outputs (maps, tables, etc.) as a significant and applicable method.

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