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Environmental evaluation for ecotourism development using GIS in Arasbaran area, Iran

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Abstract. This research was conducted to find the best sites for ecotourism development through ecosystem and ecological approaches using GIS in Arasbaran area, Iran. For this purpose, the collected data was quantified and became dimensionless. Thereafter, limitation layers were applied to the map in each approach based on Boolean Logic. Regarding to consistency matrices and acceptable error level and using Analytical Hierarchy Process (AHP) principles and Group Decision System Support (GDSS), criteria weights were figured out in each approach. Finally, Simple Additive Weighting (SAW) method was used for criteria weighting. The results were sorted in four groups from high to low ecotourism preferences and then consequences were represented in one complex map and matrix. The complex map outcomes were confirmed by matrix diameter selection. Based on the results, the most overlap was observed in the lowest ecotourism preference in each approach. It seems that there was more accuracy in quantifying criteria in ecosystemic approach. Because the ecosystem evaluation based on biocenose factors less than biotope ones, but in landscape ecology approach it is vice versa. The results showed 4985.12 ha appropriate areas out of 54872.3 ha for ecotourism development in the study area.

Keywords: Environmental evaluation, GIS, Ecology, Ecotourism, Arasbaran.

1. Introduction

Landscape ecology is the scientific bases of evaluation planning, land and landscape reclamation and conservation management in many branches of geography and ecological sciences (15). Landscape is a heterogeneous part of land which includes a selection of action and reaction between biocenose and biotope which are repeated similarly at the entire land (11). Landscape includes three mechanisms, geomorphology in the long term, creature settlement patterns and chaos inside the ecosystems. Landscape ecology can be defined by structure-function methods and effective changes on patches and corridors inside the matrix which describes elements and their relations between them and at last, includes management methods such as Tensor model, Sensitivity model, etc. Hans (1992) demonstrated relationships between zones and ecotons in landscape and functional role of ecotons on the point of energy current, matter, animal scattering, which these comparisons are categorized in categories such as ecotons contents and types, life varieties of ecotons, ecology progresses and some researches about marginal mountains, marine and climate zones.

Using controlled conservation parameters in environmental zones and assessing potential of these zones, with landscape ecological methods, Pamela *et al* (2001) nominated the best ecotourism sites, entertainment sites, seasonal hotels, markets, transportation, agricultural, cultural and ancient sites. Environmental evaluation necessity relied on qualitative and quantitative modeling for ecotourism development is unavoidable and on the point of economical aims, it is better to apply quantitative relied on

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evaluation factors such as slope and topology and regarding to land conditions usually led to acceptable results (13).

Landscape management using GIS and other different assessing factors such as slope, earth shape and regarding to land conditions is usually led to acceptable results. The first theory method of environmental assessing in Iran is brought up by a French Consulting Engineering Corporation (CSET) through 1960's. Land use expressions were proponed for the first time in Iran by this corporation and the evaluating method was based on ecosystem approach and global scope. Makhdom and Darvishsefat (2004) declared environmental evaluation using GIS and RS and gave lots of real applications of this method. Many projects were done about ecosystem evaluation methods in Iran by Iranian Academic Institutes and French Consulting Engineering Corporation during last decade. All of these projects are based on power assessing with an ecosystem approach, but present paper presents environment evaluation based on ecosystem and ecology, for first time in Iran.

Arasbaran is one of the five main germinating zones of Iran, where is located in Azarbayejan-e-Sharqi and Ardebil provinces. This zone is one of the best places to develop ecotourism due to having particular charactristics. This zone has special crowded trees in mountainous sites. North border of this zone is included Aras river and it is named as north Arasbaran basin. The length of Aras river in this zone is about 212.5 km and its stream is west to east. The headspring of Aras river is divided between Iran (12%), Turkey (34%), Armanestan and Azarbayejan republic (54%) The hydrological state of the case study includes Kalibar Chay river as one of the main sources of Aras river. Its coordinates are 41° 56'E to 47° 14′ E and 38° 48'N to 39° 01'N. (3). Historical and cultural buildings like Babak Khoramdin ancient castle are the main factors of tourist attraction to this zone. Land evaluation on this zone is essential, ecosystem and historical attractiveness in view point of making a particular ecotourism site for ecotourism development, to decreasing the natural resources destruction rate. There is not any case of parallel environmental assessing in Iran and so, this research was carried out for ecotourism development in Arasbaran region.

2. Material and methods

2.1. Used matters in research

Topography and case study zone maps were provided by Iranian Geographical Organization of armed forces and Jaame Iran Consulting Engineering Corporation, based of other maps. Landsat7 satellite ETM+ sensed data was used to produce the accurate maps and then data was processed by ILWIS and ArcGis9.2software. Finally the data was geo referenced by GPS and control points were specified.

2.2. Research method

Two parallel methods were done simultaneously including ecosystemic and the landscape ecology approaches.

2.3. Ecosystem approach

First of all, elevation, aspect, and slope maps were provided, then land form unit maps were produced and finally stone, soil, land use and plant maps were overlapped on the land form unit maps (1,4,5,6,7,8,9). Afterwards, limitation layers based on Boolean logic were applied on them and at last environmental unit map prepared.

2.4. Landscape ecology approach

Fragmentation map was created using roads, counties, plant cover and land use maps and then patches, corridors and matrixes were produced (1, 10, 11, 12, 15). After extracting necessary data for each approach, effective factors were quantified and became dimensionless for ecotourism development (1,2,4). After processing data and maps and changing them to homogenous units, limitation layers affected on them. It is important to notice that limitation layers and their functions are the same as limitation layers in ecosystem approach. (4,6,12). Based on this action, lands where have elevation upper than 2000 m, 30% slope, weak drainage soil and clay texture and as well urban land use with the area upper to 10 km^2, sensitive settlement and locations under forecasting where were not suitable for ecotourism, were omitted from total case study zone. Effective criteria became exactitude by AHP and then weighting of each criterion was specified by

simple linear weighting model. Finally, filtering was done by limitation layers. Issues of ecotourism development in four groups were sorted from the highest preference to the lowest. Final data was showed as a complex map and the highest ecotourism preference targets for both approaches were presented by a square matrix. (Fig.1).

3. Results and discussion

Environmental units map in ecosystemic approach and fragmentation map in landscape ecology approach include 11368 and 1750 polygons, respectively. After applying limitation layers 81 and 303, polygons were remained in landscape ecology and ecosystemic approaches, respectively. Ultimately, using AHP and SAW, polygons weights were specified and multiplied in relevant polygons. The error rate in AHP for criteria weights was 0.09 which was lower than 0.1 and was acceptable. So, obtained results were categorized as below:

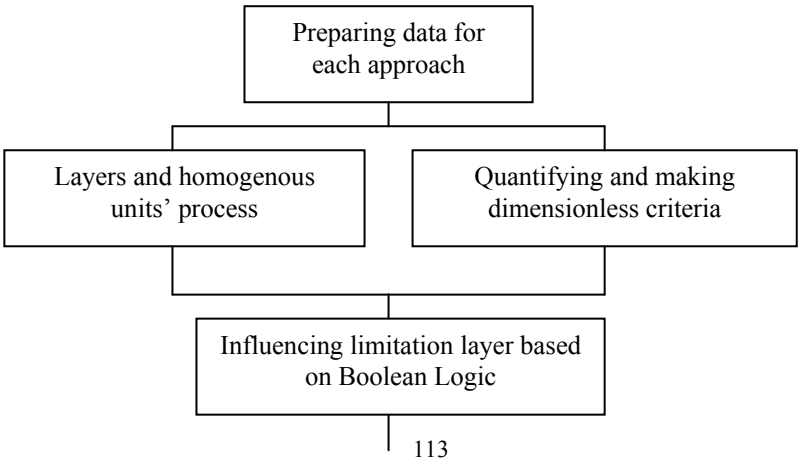
1. First group: the highest preference regions for ecotourism development in each approach.
2. Second group: the high preference regions for ecotourism development
3. Third group: the average preference regions for ecotourism development
4. Fourth group: the weak preference regions for ecotourism development

Thereafter, a 4×4 square matrix was made based on the above categories, so that the matrix diameter represented the best preference regions for ecotourism development. (Table.1).

Regarding to the matrix, 4985.12 ha out of entire study area (54872.3 ha) was recognized appropriate for ecotourism development in each approach (fig .2). The most joint area was in the fourth group on the matrix diameter which had the weakest preference and the least joint area was in the second group on the matrix diameter which had the high preference. The matrix data confirmed the final combined maps information. Although, the limiting layer was the same in each approach, considering different parts of area (different aims) caused the least joints in middle preferences (second and third groups) and the most joints in the first and fourth groups. The most joint area among was third group with landscape ecology approach and the fourth group with ecosystemic approach which included 63% of entire preferred area for ecotourism development.

Table (1): obtained matrix based on four groups considering preferences in each approach for ecotourism development. (Areas in hectares)

Landscape ecology approach / Ecosystem approach	First group	Second group	Third group	Fourth group
First group	**885407.15**	2977305.152	0	0
Second group	49899305.96	**5147.158.54**	0	0
Third group	0	597475.11	**136511.93**	09848191.15
Fourth group	0	44860969.35	742466.3166	**588218.19**



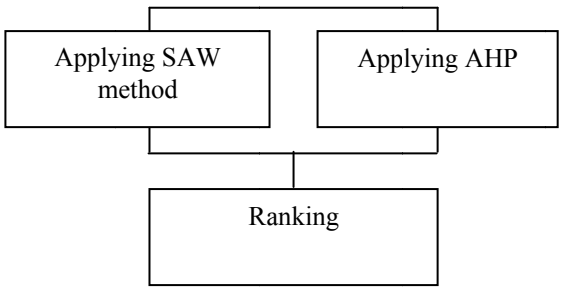


Figure .1: Preparing required data for each approach

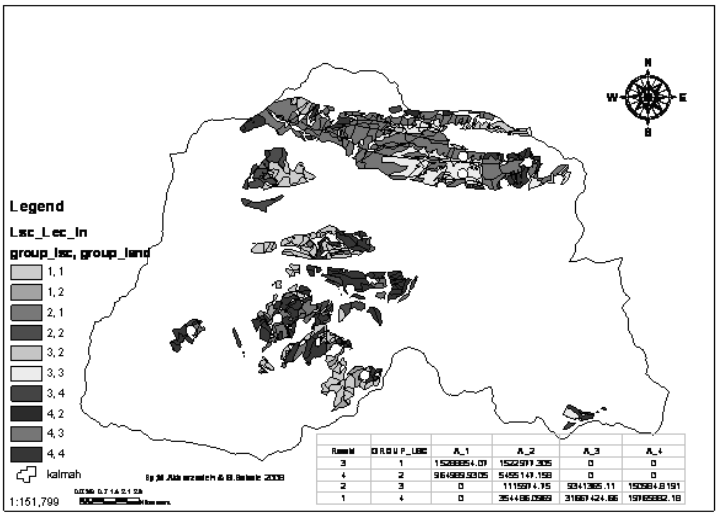


Figure .2: Obtained map based on sorting appropriate groups for ecotourism development

considering the preferences in each approach

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