Evaluating the Ecotourism Potentials of Naharkhoran Area in Gorgan Using Remote Sensing and Geographic Information System

Delavar Bozorgnia [a], Oladi Jafar[b], Manoochehri Maryam[c]

a *Tourism expert. Cultural heritage, Handicrafts and Tourism organization, Iran.*
b *Faculty member of Natural Resource University, sari, Mazandaran, Iran.*
c *MSc. Of forestry. Natural Resource University, sari, Mazandaran, Iran.*

Abstract

Ecotourism may be defined as voluntary travels to intact natural areas in order to enjoy the natural attractions as well as to get familiar with the culture of local communities. The main factor contributing to inappropriate land uses and natural resource destruction is overaggregation of ecotourists in some specific natural areas such as forests and rangelands; while other parts remain unvisited due to the lack of a proper propagation about those areas. Evaluating the ecotourism potentials of each area would lead to a wider participation of local people in natural resource conservation activities. In order to properly introduce the ecotourism potential areas, at first, we carried out land preparation practices using Geographic Information System (GIS) and Remote Sensing (RS) techniques; then, the maps of height, slope and orientation were produced using the digital elevation model (DEM) of the study area. Afterwards, we overlaid these maps and the ecotourism potential areas were identified on the map. These specified areas were classified into two land uses of mass and alternative ecotourism, with three subclasses (including class1, class2 and an inappropriate class) considered for each land use. To classify the image, the training areas determined on the ground using a GPS device (Ground Positioning System) were transferred on the RS image. Subsequently, the ecotourism potential areas were determined using a hybrid method. At the final phase, these areas were compared with the areas determined on the ecotourism potential map; as a result of this comparison, the overlaid ecotourism potential areas were distinguished on the Geographic information System.

1- Introduction

In recent years, ecotourism sector, as a subset of tourism industry, plays a great role in improving the economy of developed countries and their local people. Moreover, it preserves the natural, bioenvironmental and cultural values of those areas (Journal of Iran and World Tourism, 2000). To determine the potentials of tourism activities for a given area, a comprehensive land use planning via ground surveys, RS and GIS techniques are commonly required. Thus, a meaningful relation can be established among various tourism activities. Although tourism development cannot draw big fundamental capitals as compared with other tourism markets, it can preserve the natural resources involving local people in ecotourism activities (Khosravifard, 2002). The best method to prevent forest destruction is to employ local people for forest preservation purposes (Oladi 2006). Swart & sayman (1997) believed that South Africa Government has to use tourism activities for improving local people lives and job creation.

According to Botkan (2000), not involving local people in ecotourism activities and misdistribution of facilities of Nour forest park led to decrease the vegetation variety and to compress forest's soil compression in NOUR forest park zone. To address these problems, available facilities should be normally distributed through a larger area, local people must be involved in tourism activities and a limited number of visitors must be allowed to use the area at a same time (Sohrabi, 2005). In spite of the ever-increasing numbers of ecotourists visiting Naharkhoran to enjoy the natural attractions of the area, lack of a proper recorded plan for ecotourism potential areas caused some places to be overused while other natural attractions of the area are not even known due to the weak publicizing. In this study, the ecotourism potentials of naharkhoran area were evaluated in order to introduce the new places for ecotourism activities.

2- Materials and Methods

2-1. Materials

2-1-1. Geographical situation

Naharkhoran forest park is located at south-east of Gorgan and in zone-4 on UTM coordination system. The total area is 1641 ha and it is divided into 30 parcels. The study area is wetland zone-85 under the supervision of Gorgan Natural Resource office. In the hottest month of the year (September), the reported temperature is over 35 c̊. The average monthly rainfall is 58.17 mm in Naharkhoran station. The maximum and minimum rainfalls are registered on May (78.89mm) and late July-early august (34.7mm), respectively. Two types of brown forest type and brown soil with Calcite horizon form the soil of the study area. Index tree types of the study area are as follows: Carpinus Betulus, Parotia Persica, Quercus Castanifolia, Acre sp, Alnus sp, Zelkova Carpenifolia and Grassy vegetations such as Ruscus sp, Violet sp, Cartex sp and Ferns. Naharkhoran forest has a mixed, irregular, different aged, two- story structure.

The following materials are used in this study:

a- Digital Topography Map

The digital maps used in this research contained different layers including: topography layer (except for height), road, canal and river layers in the scale of 1:25000. These maps were produced by Mapping Organization of Iran using aerial photographs of 1994.

b- Paper Maps

These maps contained a paper sheet in the scale of 1:25000 with 10 meter internal contours related to Gorgan (6861I (SE)), serie 2 Naharkhoran topographic map. This map encompasses main roads and parcels, soil map of the area available in the forestry plan and maps of vegetation cover percentage and capacity existed in Naharkhoran serie 2 forestry book.

c-GPS (Garmin Model, etrex)
d- Liss 71-44CD040803 images
Liss 71-44CD040803 images in 3 bands with 23m×23m pixels and pan 71-44CO40803 images in one band with pixel size of 6m×6m related to year 2002. The main softwares used in this research were Geomatica 8.1 and Ilwis 3.0 Academic. Arcview (2/.a) software was also used to do further processes.

2-2 Procedures
2-2-1 Ecotourism Potential Map
a.Land shape map

A land shape map was produced by overlaying 3 parameters of slope, height and orientation (Makhdom, 2001). To do this, three maps of slope, height and orientation classes should be already prepared. Then, these maps were overlaid in Ilwiss Academic to produce the land shape map.

b. To produce a map of slope classes

To produce slope maps for natural resource applications (slopes between 0-90 or 0-100%), contour lines were used for topography map. Numbers of slope classes were determined in terms of the purpose, geomorphology situation, tourism land use and map scale.

c.To produce a map of height classes

Contour lines on topography maps demonstrate the height vibrations in the study area. To facilitate the height study process, a map of height classes for the study area was needed. Height classes (from the sea surface) in Naharkhoran area ranges between 250-980m. To produce the map of height classes, at first, a Digital Elevation Model (DEM) of the area was provided using the contour lines of the area. Finally, expected classes were determined for the area based on the given purposes, tourism land use, and map scale; finally, they were analyzed in Ilwiss3.0 Academic and the map of height classes was obtained.
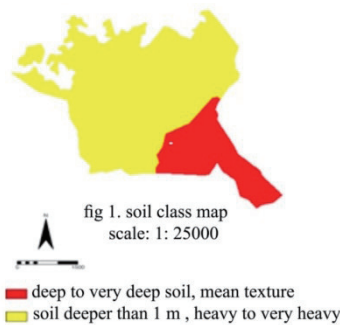
Geographic orientation map

In addition to prepare a geographic orientation map, we used contour line characteristics on topography map and other properties of these maps such as rivers, streams, canals, mane lines, and the relationship between mane and crest. In bioenvironmental potential evaluations, the slopes less than 5% are considered with no geographic orientation, since these slopes can't establish a significant geographic orientation. Thus, to provide the geographic orientation map, 5-9 orientation classes were considered. In the next step, the maps of slope, height and orientation classes were overlaid and a land shape map was produced.

B. Ecotourism map production

The land shape map is overlaid on soil and vegetation maps to produce the ecotourism map of the study area. In other words, both soil and vegetation map should be already provided to be laid over the land shape map in order to produce the ecotourism potential map.
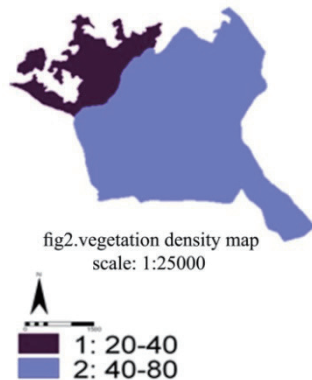
1- Soil map

The map of soil classes was provided using the paper soil map available in the forestry plan. This soil map was scanned and digitized by Ilwiss 3.0 academic. Then, the soil classes of the area were specified in this map (fig.1).

fig 1. soil class map
scale: 1: 25000

■ deep to very deep soil, mean texture
■ soil deeper than 1 m , heavy to very heavy

2- Vegetation cover density

According to Makhdom model, vegetation densities are classified into 3 different classes (0-20, 20-40 and 40-80%). The vegetation density map was produced using forest surveys and the information available in the forestry plan book of study area. Two density classes of vegetation cover were specified in this area as 20-40% and 40-80%. Since the ecotourism map of the study area was prepared and overlaid on road and river layers, the points potential for tourism activities were approximately identified on the map. Then, these points were georeferenced via field surveys. Finally, length, width and height of these points were measured by GPS. (fig.2)

fig2.vegetation density map
scale: 1:25000

■ 1: 20-40
■ 2: 40-80

2-2-2. Remotely sensed image classification

A. Geometric and radiometric correction of satellite images.

Radiometric correction was already performed and no more correction was required. A two dimensional digital map of the area, several determined points on the image and base map (or other image) such as road junctions, violent road curves which are properly distributed, were used ground control points to perform geometric corrections.

B. Image classification

To classify the image, at first, 25 ecotourism potential areas were identified on the ecotourism map and then these

points were controlled on the ground using a GPS device. Near 78% of points measured by GPS corresponded to the points determined on the ecotourism map of Naharkhoran. Then, these points were considered as the training area to classify the total study area. Finally, the earth phenomena having the same spectral reflectance were separated and the image was classified into different categories.

2-2-3. Evaluating the ecotourism potentials of Naharkhoran forest area

While the image was geometrically corrected and classified, the points related to the ecotourism potential areas on the map were identified on the image. Then, the resulted image was studied by a hybrid method (i.e. studying the satellite image and ecotourism potential map associated with simultaneous ground surveys). Among the determined ecotourism potential areas, 4 points having the most ideal characteristics had been selected.

In order to determine the most potential areas for ecotourism land uses and their expansion capacities, some factors were considered as follows: available facilities, site expanse, accessibility, types of ecotourism attractions and climatic conditions of the area. These factors were scored in terms of their significance (Oladi, 2005); for instance, 10 scores were assigned to the factor of available facilities for recreation, lodging, dwelling, health and security services, electric power, water, telephone. Ten scores were given to the factor of site expansion including subcategories of homogeneity, locating at a particular orientation; 8 scores were allocated to the accessibility factors such as road type, parking stations, distance from town, situation of the area or locating along a main road; seven scores were considered to the factor of ecotourism attraction types such as sea, forest, river, monuments, mineral water springs; and finally, 4 scores were given to the climatic conditions including weather, numbers of sunny days, perennial water, height from sea surface.

Each of the above mentioned factors has received a score between zero and the maximum determined score in terms of having particular characteristics. Available facilities in the area were evaluated via field surveys. The best areas for ecotourism activities were determined on the ecotourism potential map and remotely sensed image based on their scores.

3. Results and discussion

3-1. Producing ecologic map in GIS system

Maps of slope, height and orientation classes for Naharkhoran area

Five slope classes were specified on the map of slope clases (table 1). The study area is mainly located at the slope range of 0-25% (classes 1, 2, and 3).

Table1. Slope classification.

classes	Slope percentages
Class 1	0-5
Class2	5-15
Class3	15-25
Class4	25-50
Class5	Over 50

The study area is located at the height of 250-980 m from the sea surface. Table 2 shows the height classes determined for this area. The main part of the study area is located at the height of 400-550m from the sea surface (class 2).

Table2. Height Classification.

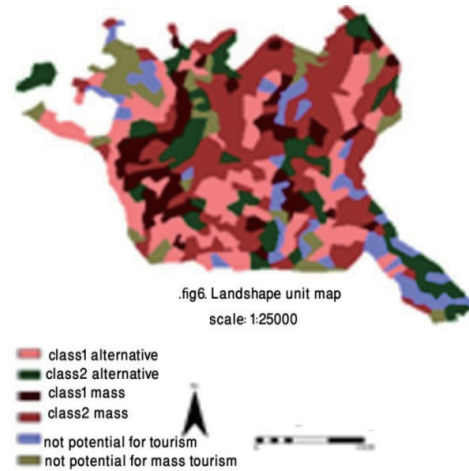| classes	Height from sea surface (m)
Class1	250-400
Class2	400-550
Class3	550-700
Class4	700-970

Since subordinate orientations put no significant effects on ecotourism plans, thus, only 4 main directions are used in these plans; therefore, 4 main orientation classes as well as a flat class have been considered in this study (table 3). According to the orientation map, the study area has a dominant western orientation.

Table3. Geographic orientation classification.

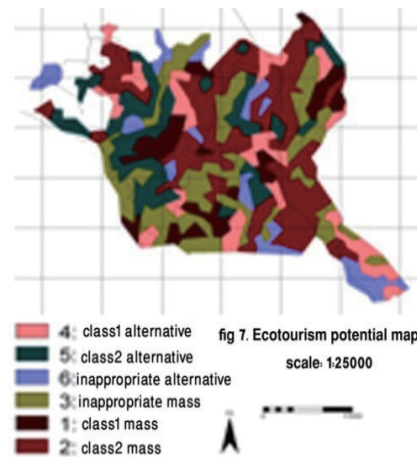| Classes	Geographic orientation
Class1	Flat (without orientation)
Class2	Northern
Class3	Eastern
Class4	Southern
Class5	Western

Landshape map of Naharkhoran area

While the maps of height, slope and orientation were provided for the study area, they were overlaid in an Ilwiss 3.0 Academc to produce the landshape map with 103 codes (table 11). Each color on the landshape map is an indicator of 3 parameters of slope, height and orientation (fig6).

.fig6. Landshape unit map
scale: 1:25000

- class1 alternative
- class2 alternative
- class1 mass
- class2 mass
- not potential for tourism
- not potential for mass tourism

Ecotourism potential map

Ecotourism potential map of the area was produced by overlaying 3 maps of soil, vegetation and landshape unit. Ecotourism potentials of Naharkhoran were evaluated in terms of Makhdom model standards. Results of these evaluations were represented by the ecotourism potential map (fig7).

fig 7. Ecotourism potential map
scale: 1:25000

- 4: class1 alternative
- 5: class2 alternative
- 6: inappropriate alternative
- 3: inappropriate mass
- 1: class1 mass
- 2: class2 mass

3-2. Using RS images for classifications

A 2D digital map of the area and several properly scattered ground control points were used to geometrically correct the image. Geometric correction was performed using minimum distance to mean interpretation method and a first class equation using a Geomatica software. After omission and deletion of 20 GCPs, four of them resulted in a RMS of 0.76 pixels (5.51m) (figs 8,9).
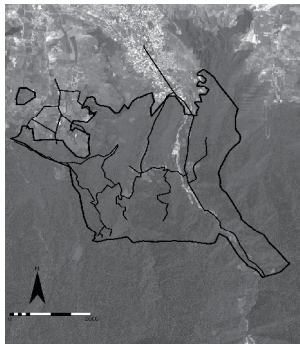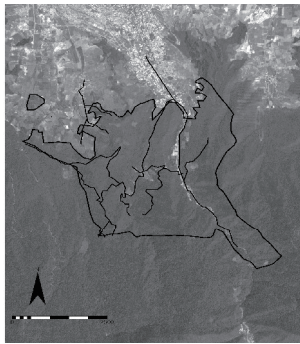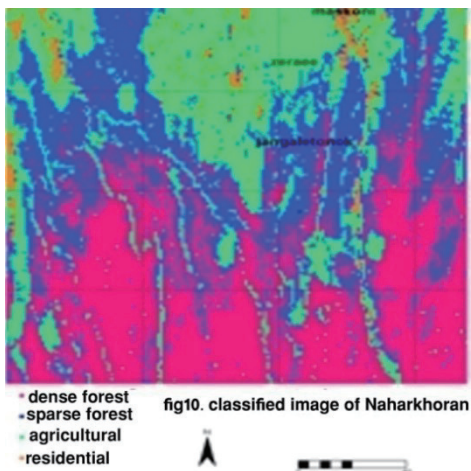
Fig8. Unrectified image of Naharkhoran area

Fig9. Rectified image of Naharkhoran area

In order to classify the image, several training areas had been selected using a GPS device. The image was classified into dense forest, sparse forest, residential area, and agricultural lands (fig10). The dense forest class had revealed the largest class.

dense forest
sparse forest   fig10. classified image of Naharkhoran
agricultural
residential

3-3. scoring the ecotourism potential areas

The ecotourism potential places on the map were identified on the image. Then, the image was postclassified applying a hybrid method (i.e. simultaneous studies on the ecotourism potential map and RS image). Among the appropriate places for ecotourism activities, 4 stations which had the highest scores were selected. In the next step, the area covered by each class was measured using the map scale or by counting the numbers of pixels located at the mass and alternative ecotourism classes with respect to the point that the size of each pixel on the RS image is 6×6m. The results of these measurements were used for evaluating the ecotourism potentials of the region. According to the results of this research, 233.7 ha of 4 studying stations had the potential for mass tourism and 106.8 ha were suitable for alternative ecotourism. Furthermore, Naharkhoran with 45 scores, Alangdare with 42 scores, Toshan with 40 scores and Noroshohada with 39 scores received the highest scores, respectively. The main characteristics of each station were summarized at table 4. Each station has been scored in terms of its characteristics and its ecotourism potentials (table 5).

Results of studying the RS image, ecotourism potential map and ground surveys showed that 1.2 ha of Naharkhoran station has the potential for class1 mass ecotourism and 70 ha of this station is suitable for class2 mass ecotourism; while 18 ha of this area can be used for class1 alternative ecotourism and 2.5 ha had the potential for class2 alternative ecotourism. In the southern part of Naharkhoran station, there was an area of 8.3 ha which has no potential for ecotourism activities. While 50 ha potential for class1 mass ecotourism and 150 ha for class2 mass ecotourism existed in Alangdare station, 30 ha of this area was not suitable for mass ecotourism activities. An area of 50 ha in Alangdare station was potential for class1 alternative ecotourism. The area potential for class2 alternative ecotourism was near 1.5 ha in this station. In Toshan station, 10 ha were potential for class2 mass ecotourism, while no area was proper for class1 mass ecotourism. Three ha of Toshan station potential for class1 alternative ecotourism and 6 ha potential for class2 alternative ecotourism were recognized in Toshan station. As for Noroshohada station, 2 ha were potential for class1 mass ecotourism and the remained 8 ha was appropriate for class1 alternative ecotourism.

4. Conclusion

Naharkhoran forest park, is considered as the main recreation area in Gorgn. This area encompasses health, services and welfare facilities. In order to optimally use the area and preserve the natural environment, a proper management as well as a correct land use selection is required.

Based on the results of scoring the areas in terms of their ecotourism potentials (Oladi, 2005), 4 areas including Naharkhoran with 45 scores, Alangdarre with 42 scores, Toshan with 40 scores and nouroshohada with 39 scores were selected.

Results of ground surveys, and studying the RS image and ecotourism potential map of the study area showed that Naharkhoran station encompassed 1.2 ha appropriate for class I mass ecotourism, 70 ha for class II mass ecotourism, 18 ha for class I alternative tourism and 2.54 ha potential for class II alternative ecotourism. Fifty hectares of Alangdarre station had the required characteristics to be planned for class I mass ecotourism and 150 ha of this station was identified suitable for class II mass ecotourism. This site comprised an area of 50 ha proper for class I alternative ecotourism and 1.5 ha for class II alternative ecotourism. As for Toshan area, we found 10 ha, 3 ha and 6 ha suitable for class II mass ecotourism, class I alternative ecotourism and class II alternative ecotourism, respectively. No area in this site had the required characteristics for class I mass ecotourism. Finally, Nouroshohada station contained 2 ha potential for class I mass ecotourism and 8 ha for class I alternative ecotourism.

The study area has been mostly visited by family groups (86%) and friend- family groups (93%). This study revealed that Naharkhoran area had the potential for various special activities in all seasons such as hiking in forests, climbing the mountains and camping. Since involving local people in ecotourism activities for example as tour guides is proved to be an effective measure to prevent their destructive damages on natural resources (Adbas Salam, 2000), some applicable activities such as establishing local markets to sell local handcrafts, foods and products by people.

References

1- Oladi, J. 2005. Studyinh the situation of Tourism industry in Mazandaran economy and determining the fields for prvate sector investments. World Tourism organization.

2- Oladi, J. 2006. An introduction on ecotourism. First edition. Mazandaran University Publications. Babolsar. P392.

3- Botkan, A. 2000. A study on the effects of ecotourism and human operations on vegetation species. Mazandaran University. P 13.

4- Jokar, A. & Malakshahi, Gh. 2005. Finding the potentials of tourism attractions and classifying an area in terms of tourism potentials by GIS (case study in Haraz region). Proceedings of first national conference on the role of tourism on Mazandaran development. Pp 353-363.

5- Khazaee pool, H. 1996. Finding tourism potentials and designing an equipped forest park site in Safaroud, Ramsar, Msc thesis. Tehran University.

6- Khosravifard, S. 2001. A hint called ecotourism year. Moje sabz,Seasonal Journal , second year. No.7. the first independent environment journal in iran. Pp 3-6.

7- Zobeiri, M.& Majd, A. 2003. An introduction to RS tecknique and its use in natural resourse (satellite data, aerial photographs). Forth edition. Tehran university publication. P 317.

8- Sohrabi Saraj, B. 2005. Estimating the economic value of Abbasabad forest park by a TCM method. Msc thesis. College of natural resources, Mazandaran University.

9- International monthly Journal of Iran and world tourism. 2000.

10- Mejlej poor, Sh. 2001. Evaluating the ecotourism potentials of Vergavij forest park in Noshahr and Chaloos. Msc thesis, College of natural resources, Mazandaran University. P 120.

11- Majnounian, H. 1995. A discussion about parks and recreation areas. Organization of parks and green areas, Tehran. P 251.

12- Makhdom, M. 2001. Land preparation basis. Tehtan university publications. Pp 200-207.

13- Moradi, H. Hedayatizade, Y. Abdollahi, V. 2005. Forest park designing by GIS. Proceedings of the first national conference about the role of tourism industry in Mazandaran development. Pp 461-475.

14- Adbas salam, M. G. Ross, L. C.M. Beveridge, M. 2000. Eco-Tourism to protect the reserve Mangrove forest the Sundarbans and its flora and founa. Anotolia. 11(1): 56-66pp.

15- Banerjee, U. K. Kumari, Smriti. Paul, S, K. Sudhakar, s.2005. Remote Sensing and GIS based ecotourism planning: A case study for western Midnapore, West Bengal, India. Indian Institute of Technology, Kharagpur-721302, India. Pp: 11

16- Berhe,D.1992.Experies with the use of a geographical informaition system to develop coast-effective ecologycally-southland-useplanning, using Etupia as an example , forest Wissenschaftlichf- sentral Blat, 111(1)1-33.

17- Cottrell, S. 2005. Sustainable tourism infrastructure planning: a GIS based approach. Wageningen university, Netherlands. 11pp.

18- Fennll, D. A. 2000. Ecoturism: an introduction, sentral Blat. 326pp.

19- Obadiah Bokenya, J. 2002. Application of GIS in Ecotourism Development Decisions: Evidence from the Pearl of Africa. Reasearch Assistant Natural Resource Economics Programs, West Virginia University Morgantown, WV26506-6108.

20- Swart, Sand Sayman,M. 1997. Legislativ restriction on the tourism industry: a South African perpective. World leisure and recreation 23(1): 24- 30pp.