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Feasibility study on ecotourism potential areas using remote sensing and geographic information system (case study: abbasabad forest area, veresk, iran)

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ABSTRACT

Ecotourism as the most attractive subset of the tourism industry can contribute to natural resource conservation and local development. Although great numbers of people annually visit Abbasabad area, in Veresk, Mazandaran, to enjoy its brilliant landscape and moderate ecologic condition, there is no applicable plan for many natural attractive zones in this area. As a result, some specific well known areas are threatened by being overused while other unknown or less familiar ones remain unvisited. Therefore, proper comprehensive ecotourism plans are required to prevent overusing most widely known forests as well as new integrated plans are needed for introducing unknown potential areas to people. In this research, a feasibility study was conducted to identify potential ecotourism zones within the study area, and then applicable strategies were suggested for optimal exploitation of the area. Both Geographic Information System and Remote Sensing techniques accelerated our research process, enhanced accuracy and reduced the expenses of this study. In addition, the map of the slope, height and aspect were produced using a topographic map in an ARCVIEW environment. These three maps were overlaid to provide the Land shape map of the study area. To make an accurate decision about the most appropriate ecotourism land use, two maps of soil and vegetation cover were overlaid to produce an environmental unit map. The ecotourism potential map was obtained by measuring the available bio-environmental units on this map based on our predetermined factors in this study. The largest part of the area was identified suitable for class I alternative ecotourism. Moreover, two villages of Abbasabad and Bezmilesh made the study area appropriate for establishing an ecotourism village. According to the results of this study, Abbasabad Veresk forest area was proved to be appropriate to construct a natural forest park.

Keywords: *Ecotourism, feasibility study, Geographic Information System (GIS), Remote Sensing (RS).*

INTRODUCTION

Travelling and recreation activities are considered as essential activities to fill people's free times in the most optimum way. Psychological studies on human social life indicated the necessity of finding a desired way to spend free time and change their routine lives. Identification, classification and introduction of ecotourism attractions, as the very exclusive capital of a country, are significantly important in developing a country. Nowadays, the ecotourism industry plays a key role in national economy, job creation and environmental conservation of developed countries (Ramzani Gouraei, 2003). Nevertheless, illogical exploitations of natural resources impose irreversible damages on the natural environment. To eliminate this problem, natural resources have to be exploited based on their productivity potentials. Ecologic potential evaluation might be an effective measure to prevent these damages.

Alejandrino, 2001, prepared a land use map and a natural resource map for 1.3 ha of Aklan area in Philippines. The areas with least height and slope degrees showed the highest potential for mass ecotourism land use and the remaining parts of the area located in lower heights and slopes were potential for alternative ecotourism.

Sinun *et al*, 2002, evaluated the ecotourism potentials of Malya Wetland in Taiwan and provided a land shape unit map for the area. They divided the study

area into four zones. The northern and southern parts of the area were entirely potential for ecotourism activities. These areas were classified into 12 botanic zones.

Jolankai (2004) in a similar study on Tysez River basin located in Hungary, Romania, provided an ecotourism plan by identifying the potentials of the area using a Geographic Information System (GIS). Then, he prepared an ecotourism potential map which showed the appropriateness of the area for each ecotourism land use considering its vegetation cover type. Finally, he suggested various ecotourism activities for the study area.

Adbas Salam *et al* (2000) used GIS and RS for their study on the forest resource conservation in Mangrove, Sundarbans. The study was aimed at demonstrating the advantages of ecotourism development including international trade growth, more regional cooperation and entrepreneurship. As for environmental conservation purposes, GIS enables us to indentify and control the negative effects of human activities on natural resources. For instance, it could be effective in providing the spatial map of studying natural resources using GIS to indentify the sensitive and threatened areas. Then, we can employ local hunters as tour guides to lead tourists into unthreatened areas recognizable on the map.

According to the results of Berhe (1992), studies in Arsy Province, Ethiopia applying GIS in land use and design purposes resulted in obtaining a higher compatibility between the proposed land use type and dominant ecologic condition of each area. Motevalli (2003) assessed the impacts of ecotourism on development of Baladeh area located in Nour, Mazandaran. He asserted that the ecotourism industry has a significant effect on developing an area. One of the development strategies is to attract tourists to visit those areas. To do this, it is necessary to identify the available and potential ecotourism facilities in the area, then, the most appropriate land use can be planned for each area.

In a study on Guillan province, Iran, Ramzani Gouraei (2003) expressed that due to some reasons such as scarcity of agricultural soils and limitations of industrialization in this province, it is important to pay more attention to the ecotourism industry aimed at creating new jobs, eliminating poverty and preventing natural resource destruction. In this study, the areas with ecotourism potentials were identified in Guillan Province to provide the map of ecotourism potential distribution. The local and spatial situations of available ecotourism potentials in Guillan Province were determined and presented as large scale maps and slides using Geographic Information System.

Moradi *et al* (2005) studied the planning of a forest park in Bineshki area located within Noshahr protected district using GIS. To do this, the appropriate landuse determined for the area was ranked in terms of preference into mass or alternative categories. A registered standard plan associated with proper management is required for preventing natural resource destruction by ecotourism activities. Therefore, it is essential to use organized tourism strategies and standard methods, consider moral principles and provide adequate facilities.

Annually, a large number of tourists visit Abbasabad forest area to enjoy its fantastic ecotourism attractions. Unfortunately, many natural attractions of this area have remained unvisited due to lack of a proper ecotourism plan for those areas; therefore, people are not perfectly informed about them. As a result, worthy ecologic potentials of some given areas are seriously threatened by being overused. In order to prevent natural resource damage, a comprehensive ecotourism plan in harmony with the specific ecologic condition of each area is required. This plan should be well designed to protect the natural bio environmental values of Abbasabad forest area. In this study, the ecotourism potentials of the region were evaluated to: (a) establish a meaningful relation among various ecotourism activities using RS data, (b) identify the potential areas to establish and develop a forest park, and (c) put the provided plan in a GIS data station to better introduce the attractions.

MATERIALS and METHODS

Study Area

The study area in Mazandaran Province encompasses an area of 27073 km^2 within wetland district no. 61, in the northern part of central Alborz along the Caspian seashore. This area is located between

north latitude of 35º 53' 38"- 35º 56' 40" and east longitude of 52º 54' 02"- 52 º 59' 03" at the altitude of 1220 m above the sea level up to 3280m in the southern part. The maximum rainfall in this area occurs in late summer and autumn. The driest months of the year extend from late spring to early summer. The average maximum and minimum temperatures are 20.4 ºC and 1.8 ºC, respectively. The coldest months in the area are December, January, February and March. The area experiences approximately 118 icy days and 158.6 sunny days a year. Average annual humidity measured for the area was 64%. Index tree types in the area include: Thyme, Astragalus, East Beech, Juniper and Gall Apple.

These forests consist of irregular uneven aged and merged double story structures. The main animal types living in this area are brown bears, tigers, fox, wolves, wild pigs, hedgehogs, pheasants, eagles, partridges, pigeons, sparrows, hawks, hoopoes, dull yellow partridges as well as some kinds of reptilians such as python and mountain snakes.

Data

1.3D digital maps (containing length, height and width)

Digital maps on a scale of 1:25000 contained different layers such as contour lines, roads and hydrology with 10 m intervals between Veresk contour lines.

2- Paper maps

These maps included a paper sheet on a scale of 1:50000 with 50 m intervals between contour lines, soil and vegetation maps and topography maps of the area.

3- pan69-45B090526 image (2002) in one band with 6m pixel sizes and a TM image.

4- Geomatica 8.1 and ArcVIEW (2/.a) software as well as Ilwis 3.0 Academic to perform some of the subsidiary operations.

5- Etrex Garmine GPS

Methods

Natural phenomena on the ground surface form the land shape of an area. Digital topography maps on a scale of 1:25000 were used to produce a land shape unit map. To do this, the maps of slope, height and aspect classes were separately prepared and overlaid to produce the land shape unit map.

Slope maps were produced to reduce intense slope variations and to facilitate reading them on topography map. This map may be used to prepare a land shape unit map. Numbers of slope classes and their variations directly depended upon several factors including: research goals, geomorphological situation and land shape of the area, map scale and expected land use on field surveys and planning operations (Makhdom, 2001). Table 1 shows the most common and acceptable slope classification to evaluate the ecotourism potentials of Abbasabad Veresk area.

Table 1. slope classes in the study area.

Class	Slope degree
1	0-5
2	5-15
3	15-25
4	25-50
5	Over 50

While the curve contour lines are mixed and indistinct, it is time consuming and requires high percent of accuracy to observe height variations on these lines. The first step for preparing a height map is to determine the expected variations and number of classes.

The characteristics of contour lines on topographic maps are provided to clarify the aspects related to specific areas which can be used in preparing the land shape unit map. As for environmental potential applications, slopes equal or less than 5% and with no aspects are considered as flat areas. Five to nine geographic aspect classes were identified in these maps. Then, the geographic aspect map was classified based on the available ecologic model (table2).

Table 2. Geographic aspect classes

Classes	**geographic aspect**
1	Flat (without aspect)
2	North
3	East
4	South
5	West

Land shape map

The land shape map of an area is constituted of its natural ground units undergoing an evolutionary history of changes due to climatic conditions, erosion

and sedimentation processes. A topographic map is required to produce a land shape unit map. To do this, at first, three maps of height, slope and aspect classes were separately prepared. Then, these maps were overlaid to produce a land shape unit map.

Soil map classification

Followed by digitizing the soil map of Abbasabad, this map was classified using Arc VIEW software based on the factors mentioned on table 3.

Table 3. soil classes

Classes	Characteristics
1	*Often bare soils or rarely covered by vegetations. Stone rocks. The main vegetation cover include bush.*
2	*High uplands with steep slopes, bare soil with sparse trees, maximum soil depth of 5m. Considered as protected areas due to their steep slopes and rocky structure.*
3	*High mountains mainly composed of hard black lime. Moderate to intense slope, relatively deep soil with L- (c-L) texture, brush and shrub coverage. Available soil types include forest brown soil.*
4	*Low slope heights, deep soils without gravel. Brown soil with calcite horizon, lime rocks, moderate penetrability, L – (C-L) texture.*
5	*Relatively high forest altitudes. Moderate to intense slope, sandstone and shale origin, deep matured soil with gravel content, (sa-L) - L texture, forest brown acidified soil. Chestnut and beech coverage.*
6	*Forest uplands with shale- sandstone origin, low slope, deep matured soil, (C-L) - L texture, rinsed brown soil, chestnut and beech coverage.*

Vegetation density map classification

Vegetation map of the area obtained via a culturing plan was digitized using an ARCVIEW system. Then, it was classified based on the factors mentioned in table 4.

Table 4. vegetation density classification

Classes	Characteristics
1	sparse
2	Dense beech
3	Semi dense, protected
4	Semi dense shrubbery
5	Dense chestnut
6	Dense chestnut and others
7	bare area

Ecotourism map of the area

Since the digital elevation model of the area was provided using a digital 1:25000 topographic map, three maps of slope, height and aspect classes were prepared based on the Makhdom tourism classification model. Afterwards, a Land shape unit map was produced by overlaying height, slope and aspect maps in an ARCVIEW environment. A primary land use map was provided by assessing the map units based on their slope, height and aspect characteristics to determine an ecotourism land use type for each unit. In progress, soil and vegetation cover maps were overlaid on the land shape unit map to produce the environmental unit map. Finally, ecotourism potentials of the study area were evaluated on this map using the Makhdom ecotourism model.

2- Satellite imagery

The remotely sensed image which was already prepared for the study area was classified. To do this, an IRS-PAN image of the area was optically interpreted. This image was geometrically corrected using a corrected TM image. Ground control points (GCPs) encompass some distinct points which are clearly recognizable both on the ground and image (Figs 1 and 2). A TM image was classified by selecting training samples on this image.

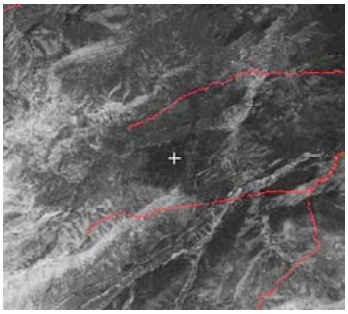

Fig1. Uncorrected RS image

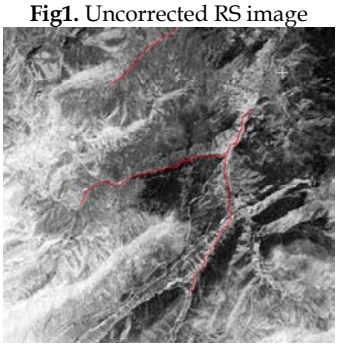

Fig2. Corrected RS image

3- Overlaying the land shape unit map on soil and vegetation maps

Two maps of vegetation cover and soil classes were overlaid on land shape unit map to produce an ecotourism potential map.

Ecotourism potential evaluation in the study area

Class I mass ecotourism

The required characteristics to make an area suitable for class I mass ecotourism land use are as follows: 1- slope: 0-5%; 2- aspect: east-west; 3- soil: high uplands, deep or relatively deep matured soil, L – (C-L) soil texture with moderate to good penetrability; 4- height: 1200-1600m; 5- vegetation cover: oak forests, mixed oak forests, beech forest, forests of Medlar and pear trees and, etc., agricultural lands; 6- vegetation cover density: 40-80%. Our study area didn't encompass the above mentioned characteristics; on the other hand, the area didn't have the adequate spatial expansion to conduct an ecotourism plan.

Class II mass ecotourism

An area needs the following characteristics to be planned for class II mass ecotourism land use: 1- slope: 5-15%; 2- aspect: flat, west and north; 3- soil: high to relatively high uplands, deep to relatively deep matured soil, L- (C-L) texture with moderate to good penetrability; 4- vegetation density: 20-40%. Natural conditions of beech sites are appropriate to be planned for class II mass ecotourism land use.

Class I alternative ecotourism land use

This land use requires several characteristics including: slopes between 0-25%; soil of relatively high to high uplands, approximately deep to deep matured soil with (C-L) - L texture having a moderate to good penetrability (soil type in this land use is important for road construction). Height and vegetation cover density are not very important for this land use. Based on our findings, waterfall zone was appropriate for class I alternative ecotourism.

Class II alternative ecotourism land use

This land use type needs a slope of 25-50% and a soil type similar to that of class I alternative tourism. No limitations exist for parameters of height and vegetation cover density.

Inappropriate class

Slopes over 50%, the same soil type as class I and II alternative ecotourism, no limits for height and vegetation cover density. Slopes of more than 50% were rarely available in our study area.

RESULTS

The required maps to determine the land shape unit of the area were prepared. Slope map was provided for the area using ARCVIEW GIS software and DEM of the studying area which had been produced from a 1:25000 digital topographic map.

As it is shown in fig. 1, a slope map was provided with 5 slope classes (table 1). According to this map, a large part of the area is located at slopes between 15-25%. Thus, it could be used for all types of alternative ecotourism (fig.3).

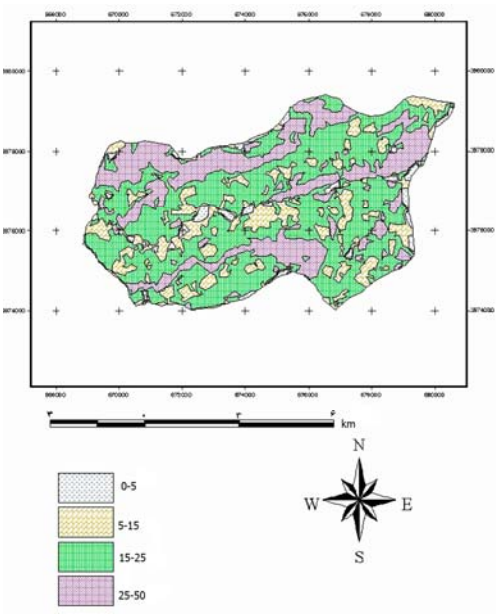

Fig 3. Slope map of Abbasabad

Generally 5-9 geographic aspect classes can be used in aspect map classification (Manoochehri, 2006). Based on the 3D map derived from the digital elevation model of the area, four main aspects as well as a flat class were identified in the study area. Based on this map and Makhdom model, Veresk region had the specified conditions such as those located as good aspects for ecotourism activities (fig. 4). Followed by preparing the DEM of the area, height classification was performed based on the factors and criteria mentioned in the procedure section.

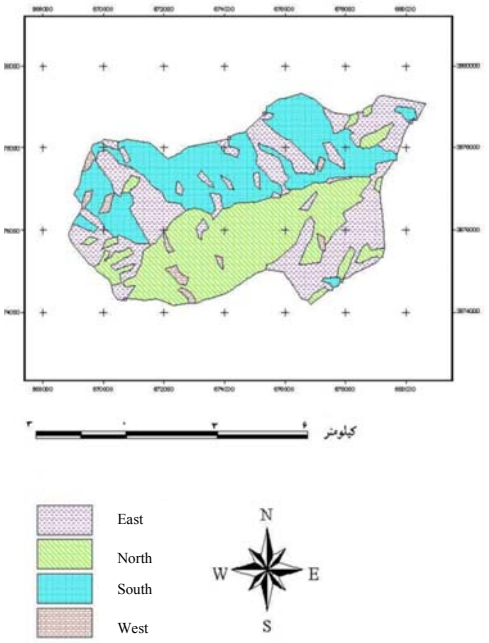

Fig 4. Aspect map of Abbasabad

RS image classification

In this study a pan69-45B040526 with small pixel size and high resolution was used for optical studies. In addition, a TM image was applied for PAN image classification and correction.

RS image classification

In the next phase of this study, the corrected image was digitally classified using maximum likelihood method (fig.5). To do this, some training areas were selected by GPS among various available phenomena of the area. Then, the image was divided into different classes considering these training samples. Four classes including dense forest, sparse forest, mountainous area and residential area were specified in this study.

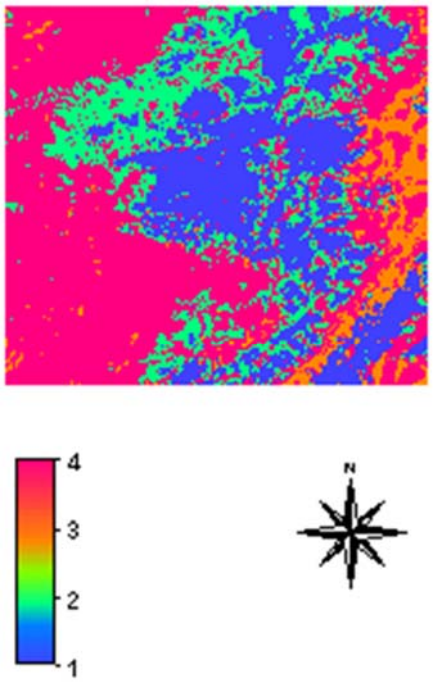

Fig 5. The classified image of Abbasabad

Discussion

The output of this study was represented as an ecotourism potential map (fig.6). As it can be observed in the slope map of the area, the main part of the area is located at a slope range between 15-25˚ which is appropriate for all alternative ecotourism activities. According to the aspect map shown in fig. 2, the dominant part of the area involved north and south aspects. The protected areas in which cutting the trees was legally prevented, could be used for alternative ecotourism activities under particular supervised conservation measures. The soil map of the area shows some parts of the study area inappropriate for ecotourism uses due to the soil types and depths.

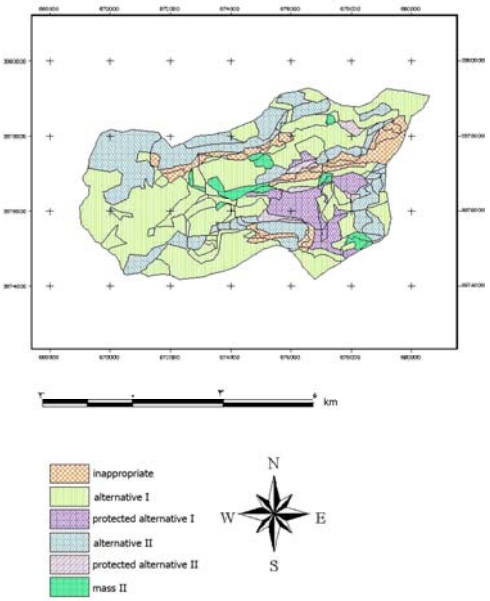

Fig 6. Ecotourism potential map of Abbasabad

Results of evaluating the ecotourism potential map are as follows:

1- No areas were suitable for class I mass ecotourism
2- Few areas had the potentials to be planned for class II mass ecotourism.
3- Vast surfaces of the study area were identified as appropriate areas for classes I and II of alternative ecotourism.
4- The areas not potential for alternative ecotourism classes were classified as protected areas.

Based on our findings, a dominant part of the area can be used for ecotourism activities; however, just the areas located near roads are currently used. Moreover, there are many villages along these roads which can be socio-economically developed via conducting ecotourism plans. Establishing some tourism cooperation and developing tourism activities such as bee culture, salmon culture, horse riding clubs, hunting associated with other ecotourism development activities would result in more job creations and income earnings for local people. Classified RS image evaluation showed that nearly half of forests located in the study area were dense forests and the remaining parts were destructed sparse forests. One of the main purposes of this study was to reclaim these destructed sparse forests by providing new proper ecotourism plans.

Based on the results of our study, the following suggestions can be made for Veresk area:

1-To pave the available roads.
2-To canalize the urbanized water.
3-To establish health services.
4-To install ash cans in determined intervals.
5-To install guiding signs for visitors.
6-To put light lamps along roads.
7-To place medical centers in the area.

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امکان سنجی مناطق مستعد طرحهای طبیعت گردی با استفاده از RS و GIS
مطالعه موردی: منطقه جنگلی عباس آباد ورسک

ج. اولادی، ف. طاهری اطاقسرا

چکیده

توریسم طبیعت گرا از سالمترین و پرجاذبه ترین بخش صنعت گردشگری محسوب می گردد که در صورت مدیریت و هدایت صحیح می تواند به حفظ طبیعت و عمران ناحیه ای کمک نماید. لذا، احداث و توسعه پارک جنگلی وتفرجگاههای طبیعی برای جذب گردشگران، تمدد اعصاب، گذران اوقات فراغت، حفاظت از منابع وذخایر و ایجاد درآمد بیش از پیش احساس می شود. منطقه جنگلی عباس آباد ورسک مازندران با توجه به طبیعت وچشم اندازهای بسیار زیبا و باشرایط اکولوژیکی مناسبی که دارد سالانه پذیرای طبیعت گردان زیادی است. ولی، متاسفانه به دلیل فقدان طرح طبیعت گردی مناسب و نداشتن برنامه ای اساسی برای بسیاری از منا طق دارای جاذبه گردشگری و تراکم بیش از حد طبیعت گردان در یک منطقه خاص واستفاده بیش از توان اکولوژیکی منطقه باعث تهدید این منابع با ارزش گشته اند. با برنامه ریزی درست و مدون وارائه طرحهای طبیعت گردی مناسب میتوان از طرفی به حفاظت بهتر محیط های جنگلی مورد استفاده فعلی پرداخته و از طرف دیگر برای مناطق مستعد، طرحهای نوین طبیعت گردی همگام با توسعه پایدار ارائه داد. این تحقیق با ارائه طرحی به امکان سنجی مناطق مستعد طرحهای طبیعت گردی پرداخته و با شناسایی مناطق مستعد و ارائه راهکارهای اجرایی مناسب جهت بهره وری بهینه از این مناطق نموده است. در تحقیق فوق از فن آوریهای GIS , RS به عنوان دو ابزار کارآمد در جهت تسریع روند کار ، کاهش هزینه ها و دقت بیشتر در کار استفاده شده است، بدین ترتیب ابتدا نقشه های طبقات شیب، جهت و ارتفاع از نقشه توپوگرافی در محیط ARC VIEW تهیه شد، سپس با تلفیق آنها نقشه شکل زمین بدست آمد . در این مرحله با توجه به مدل طبیعت گردی مورد استفاده اقدام به ارزیابی اولیه از توان طبیعت گردی منطقه گردید. برای تصمیم گیری دقیق تر و همه جانبه برای کاربری طبیعت گردی، نقشه طبقات خاک و پوشش گیاهی منطقه نیز با نقشه شکل زمین تلفیق شده و نقشه واحد های زیست محیطی تهیه گردید، با توجه به فاکتور های مورد استفاده تعداد واحدهای زیست محیطی تشکیل شده بر روی نقشه مورد ارزیابی قرار گرفتند، در نتیجه نقشه توان تفرجی منطقه بدست آمد. از نرم افزار RS جهت تصحیح تصویر ماهواره ای منطقه، طبقه بندی تصویر ماهواره ای، مطالعات بصری روی منطقه و برقراری ارتباط معنی دار بین انواع فعالیتهای طبیعت گردی مورد برنامه ریزی در منطقه استفاده شد. با توجه به نتایج حاصل از نقشه ها و تصاویر منطقه و با توجه به پر شیب بودن منطقه نتیجه گیری شد که نواحی دارای توان تفرجی کلاس I متمرکز در منطقه وجود ندارد، تفرج کلاس I گسترده بیشترین سطح منطقه را بخود اختصاص داده است و همچنین وجود دو روستای ییلاقی عباس آباد و بزمی لش در منطقه امکان ایجاد دهکده های طبیعت گردی را فراهم ساخته است. لذا، با توجه به نتایج منطقه عباس آباد ورسک جهت برنامه ریزی پارک طبیعت بسیار مناسب است.