ISFOR 2017 International Symposium on New Horizons in Forestry
18-20 October 2017 | Isparta - Turkey
Oral presentation

Identifying potential sites for ecotourism in Burdur Province using GIS & AHP

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Abstract: The aim of this study is to identify and assess the natural resources having tourism potential to be developed in Burdur province. In this study, characteristics of the land ecosystems; landscape, wildlife, topography, accessibility identified as indicators of suitability. The evaluating process for ecotourism site conducted based on chosen criterias; land use/cover, reservation/protection, elevation, slope and distance from roads. GIS and AHP was used for the analysis and calculations required in regard with these parameters to identify the potential ecotourism sites in Burdur province. As a result of the study, ideal areas for ecotourism usage are defined and the land suitability map for ecotourism was created. Based from the suitability map ecotourism potential areas was classified as highly suitable (S1), moderately suitable (S2), marginally suitable (S3) and not suitable (N) for ecotourism. Highly suitable areas (S1) can be used for education as well as conservation. Moderately suitable areas (S2) can be developed as ecotourism destination by facilitating proper ecotourism infrastructure and services. Marginally suitable areas (S3) are the most appropriate areas for development. And not suitable (N) areas are currently not suitable for ecotourism, including areas with several effects of development and degraded environment. The proposed methodology has been useful in identifying ecotourism regions by associating important criteria with the province's real resources. And the findings of this research can be useful for ecotourism resource utilization and development of tourism facilities in Burdur province.
Keywords: Site suitability evaluation, Ecotourism, GIS, AHP, Burdur

1. Introduction

Ecotourism emerged as an alternative form of tourism in the 1990s to mitigate the faults of conventional (mass) tourism in meeting the needs of sustainable development (Leksakundilok, 2006). Ecotourism is the most pervasive tourisms of all and it plays important role in various countries differently. Ecotourism was first proposed in 1983 by Ceballos-Lascurain, a special consultant of the International Union for Conservation of Nature and Natural Resources (Hummel, 1994).

According to Lascurain, the tourism boom is to study, admire, appreciate and enjoy the natural landscape and observe the flora, fauna, cultural features and find local communities in the past and present times (Niyazmand, 2004).

Ecotourism is now defined as "responsible travel to natural areas that conserves the environment, sustains the well-being of the local people, and involves interpretation and education" by The International Ecotourism Society (TIES, 2015).

Generally, Ecotourism is responsible to travel to natural areas that its aim is to protect the environment and improve the quality of life for local people. Ecotourism creates minimal damage to nature and culture of the region. Ecotourism has a strong correlation with sustainable tourism (Prabhu et al., 1999). Ecotourism makes a social relation between people of various communities. It can increase social interactions among nations and present different cultures and religions and cause to world peace (Babapour, 2001). However, ecotourism can be classified as a possible threat to ecosystems because ecotourism attractions are based on fragile ecological relations (OK, 2006).

Ecotourism's perceived potential as an effective tool for sustainable development is the main reason why developing countries are now embracing it in their economic development and conservation strategies (Rahman, 2010). Ideally, ecotourism should satisfy several criteria such as conservation of biological and cultural diversity through ecosystem protection promotion of sustainable use of biodiversity with minimal impact on the environment being a primary concern (Ryngnga, 2008). This can be judged with the help of criteria and indicators approach, which is basically a concept of sustainable ecotourism management developed in a set of principles, criteria and indicators (Prabhu et al., 1999). A multi-criteria approach can thus be adopted based on application of relative weights to each criterion in a GIS environment (Wanyonyi et al., 2016).

Strategic planning to develop ecotourism area is not measured in terms of the landscape only, but many factors should be considered such as topography, climate area, soil type and many more. This planning can be overcome by using a method in which the existence of AHP technique with the help of GIS (Mohd Ujang, 2016).

To identify potential sites for ecotourism, it is necessary to first evaluate the land ecological suitability for ecotourism. In other words, identifying suitable sites for ecotourism is the first important step to ensure their roles and functions (Kalogirou, 2002; Malczewshi, 2004; Gillenwater et al., 2006).

2. Study area

The area chosen for this current research is specially focused on the land ecosystems of Burdur Province in Turkey.

Burdur is located between 36-53 and 37-50 northern latitudes and between 29-24 and 30-53 eastern longitudes in South-Western Anatolia, also called Turkish Lakeland, in Western Mediterranean Region.

The land area of Burdur is 6.840 square kilometers and covers 0.88 percent of the country's land area. The average height is 1.000 meters (Anonymous, 2012).

Burdur is composed of 11 districts, 183 villages and 14 municipalities (TODAİE, 2016). Burdur is located in southwest Anatolia, surrounded by Antalya in the east and south, Denizli in the west, Muğla in the south, Afyon and Isparta in the north (Figure 1).

Figure 1. Location map of the study area

3. Materials and methods

3.1. Materials

This study focuses on land suitability evaluation of ecotourism in Burdur using GIS and AHP techniques. Data used in this study were assembled from a variety of sources (Table 1).

Firstly, the primary data from the field survey were collected through interviews and questionnaires answered by 20 experts in the related fields of study for identifying factors that are important for ecotourism in Burdur province.

Secondary data were gathered from land use-land cover map 2012 and topography map of the study region. In addition, national institutions are also contacted for the collection of necessary information and literatures. The thematic maps were prepared and edited. Then they overlaid with weighted sum method in the suitability analysis of ecotourism using ArcGIS 10 software of ESRI.

Table 1. List of data and their original sources

Data	Scale	Source
Land Used/Cover Map	1:100.000	Corine Land Cover-2012
Protected Areas	1:50.000	Thematic map Published map-General Directorate Of Forestry-2017
DEM (View-shed Map)	1:50.000	U.S. Geological Survey (USGS)
Road Map	1:50.000	Thematic map Published Map-General Directorate Of High Ways-2016

3.2. Methods

This study demonstrates a methodology for identifying potential ecotourism sites using GIS and AHP techniques as case study of Burdur Province, Turkey. The AHP weights calculated using Microsoft Excel and ArcGIS 10 software which were used in the suitability map producing process. The work flow to produce land suitability map for ecotourism are; finding suitable factors to be used in the analysis, assigning factor priority, class weight (rating) to the parameters involved and generating land suitability map of ecotourism.

In this process, experts' opinions were asked to calculate the relative importance of factors involved. The AHP is one of the most extended Multi-Criteria Decision Making (MCDM) techniques. This method provides a structural basis for qualifying the comparison of decision elements and criteria in a pair wise technique (Bunruamkaew, 2012).

The decision of factors : landscape/naturalness (land use/cover), wildlife (reservation/protection), topography (elevation, slope) and accessibility (distance from roads).

First, the AHP method was applied to determine the relative importance of all selected criteria. Each criterion received a weight and a score which represented its relative importance in the suitability evaluation. The total score for suitability is achieved by multiplying criterion score with its appropriate weight. At the next stage, spatial data of the factors as a set of GIS layers were overlaid together for final suitability using weighted sum method. Then in raster-based format suitability map reclassified into 4 classes. At the end, the suitability map for ecotourism development is generated. In the suitability map the degree of suitability of each factor classified as Highly suitable (S1), Moderately suitable (S2), Marginally suitable (S3) and Not suitable (N).

3.3. Determination of factors and classifications

This study identifies the following factors as indicators of suitability within the land ecosystems of Burdur Province. Factors; landscape/naturalness, wildlife, topography and accessibility.

The evaluation for ecotourism sites was conducted based on the chosen criteria : land use/cover, reservation/protection, elevation, slope, distance from roads and settlement size (Table 2).

Table 2. Factors and criteria in land suitability analysis for ecotourism

Ecotourism Requirement			Factor Suitability Rating			
Factors	Criteria	Unit	High Potential (P1)	Moderate Potential (P2)	Low Potential (P3)	No Potential (N)
Landscape	Land use/ cover	class	High	Moderate	Low	Not
Wildlife	Reservation/ Protection	protected areas class	High	Moderate	Low	Not
Topography	Elevation	meter	>1581	1083-1581 m	475-1083 m	<475
	Slope	percentage	0-5 %	5-25 %	25-35 %	>35 %
Accessibility	Distance from roads	kilometer	Areas outside of any buffers around all roads	Areas within 2 km buffer around third main roads	Areas within 5 km buffer around second main roads	Areas within 10 km buffer around major roads

3.4. Classification of criteria maps

There are 5 criteria in the table which are incorporated for suitability analysis for ecotourism. The related factors and criteria in table were created and kept as GIS layers. The data of all the selected criteria maps shown in table are created and evaluated separately.

a) Landscape

- Land use/ cover

Land use map reclassified from Corine map 2012 into 10 classes of land use/ cover according to bio-physical vegetation characteristics of ecotourism potential resources as seen in Table 3.

These are forest, orchard, water body, plantation, crop land, farm land, urban and built-up land, degraded forest, grassland and mine.

Table 3. Land use/ cover classification for ecotourism potential resources (Banerjee U.K. et al., n.d.).

LULC Type	LULC Suitability
Forest	Highly importance for ecotourism, can serve as major ecotourism attraction, area need to be conserved.
Orchard	Highly importance for agro-tourism can serve as main ecotourism attraction.
Water body	Active recreation as boating, parks and natural zoological parks.
Plantation	Should be properly monitored and protected from any encroachment.
Crop land and Farm land infrastructure	Area under agriculture and farm should not be converted to other schemes. Any infrastructure development should be restricted.
Grassland	Suitable for recreational activities, area need to be conserved.
Urban and built-up land	Suitable for eco-tourist infrastructure development
Degraded forest	Need to be managed, properly with possibilities of new plantations. Important from point of view of medicinal plantations and agro-forestry scheme.
Mine	Active or abandoned mines no importance for ecotourism.

Therefore forest areas are ranked as Highly potential (P1); orchard and water body areas are ranked as Moderately potential (P2); plantation, crop and farm lands, grass lands are ranked as Low potential (P3); urban and built-up land, degraded forest, mine areas are ranked as No potential (N). The result of the reclassified land use/cover map is shown in Figure 2.

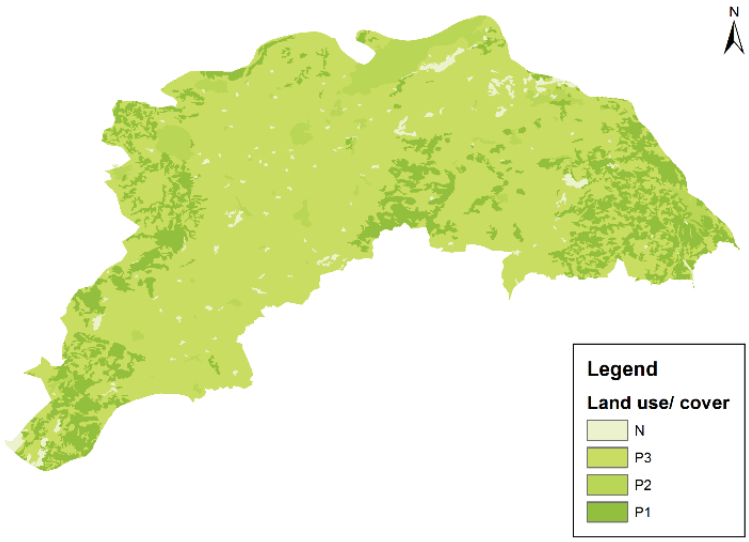

Figure 2. Land use/cover map

b) Wildlife

- Reservation/ Protection

The reservation-protection factor was classified by the type of protected areas which are suitable for habitat and wildlife abundance with regards to wildlife reserve, rare species and newly found species.

(Bunruamkaew, 2012). Protected Areas were known from the Burdur Province Protected Areas Map published by General Directorate of Forestry. From the map areas added to map as polygon feature data and new reservation/ protection map formed in ArcGis.

In this study, Wildlife Protection and Improvement Areas and Non Hunting Areas are ranked as Highly potential for habitat (P1); Wet Land and Nature Park areas are ranked as Moderately potential for habitat (P2); and Non Forest Reserve areas are ranked as Low potential for habitat (P3). On the other hand, the areas outside of these areas are ranked as No potential for habitat (N). The result of the reclassified reservation/ protection map is shown in Figure 3.

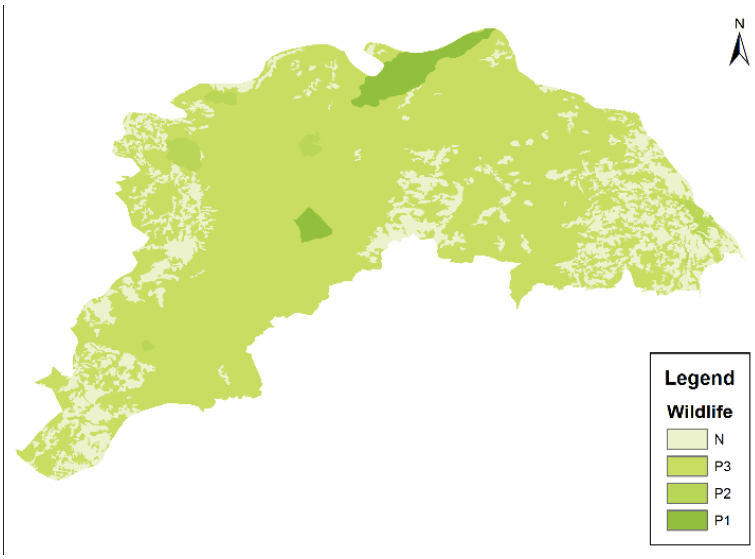

Figure 3. Reservation-protection map

c) Topography

- Elevation

In this study, elevation factor was generated from a Digital Elevation Model (DEM). The elevation classes are evaluated based on the basis of attractiveness in landscape or the topographic attractiveness for tourism significant feature (Geremew and Hailemeriam, 2015).

The elevation was reclassified based on altitude using natural breaks (jenks) technique into four classes and new values N, P3, P2, P1 were given to elevation ranges. The classes are; (<475 m) No potential (N); (475-1083 m) Low potential (P3); from (1083-1581 m) Moderate potential (P2); from (>1581 m) High potential (P1). The result of the reclassified elevation map is shown in Figure 4.

- Slope

In this study, slope factor was generated from a Digital Elevation Model (DEM). Slope of the terrain surface can be explained by degree or percent for change of slope. In this part, the reclassified slope map was given from the percentage measurement unit for ecotourism requirement.

The slope was reclassified into four classes as described by Jangpradit (2007) and new values N, P3, P2, P1 were given to slope ranges. The classes are; over (>35 %) No potential (N); from (25-35 %) Low potential (P3); from (5-25 %) Moderate potential (P2); from (0-5 %) High potential (P1). The result of the reclassified elevation map is shown in Figure 5.

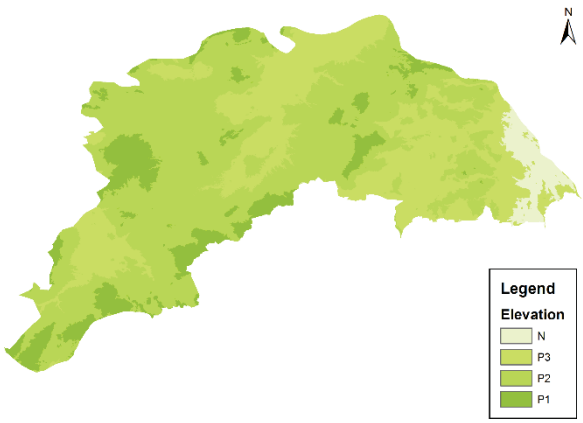

Figure 4. Elevation map

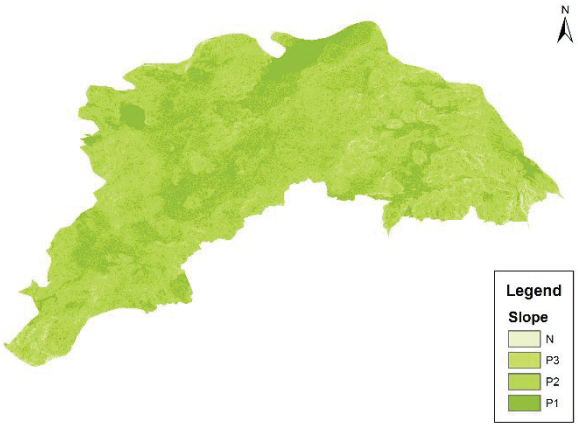

Figure 5. Slope map

d) Accessibility

- Distance from roads

This criterion was classified based on the transport condition by access types and distance from the road types according to remote areas are the best suited for ecotourism attractions and experiences (Bunruamkaew, 2012).

The distance from roads map classified into four classes with buffer analysis as described by Boyd et al. (1995) and new values N, P3, P2, P1 were assigned to each class. The classes are; the areas outside of any buffers around all roads are ranked as High potential for ecotourism development (P1); the areas within (2 km) buffer around third main roads are ranked as Moderate potential (P2); the areas within (5 km) buffer around second main roads are ranked as Low potential (P3); and the areas within (10 km) buffer around major roads are ranked as No potential (N). The result of the reclassified distance from the roads map is shown in Figure 6.

Figure 6. Distance from roads map

3.5. Determination of weight value for each criterion using AHP

The AHP is one of the most extended Multi-Criteria Decision Making (MCDM) techniques. This method provides a structural basis for quantifying the comparison of decision elements and criteria in a pair wise technique (Arabinda, 2003). After establishing the level framework and related factors of potential ecotourism resource area in this study, pair-wise comparison questionnaires were used to compare the importance of level framework factors in pairs, and a scale of 1 to 9 were assigned to quantitate the related factors (Tseng et al, 2013). Typically, the priority of each factor involved in the AHP analysis is determined based principally on the suggestions from experts (Tienwong, 2008). To ensure the credibility of the relative significance used, AHP also provides measures to determine inconsistency of judgments mathematically. Based on the properties of reciprocal matrices, the consistency ratio index (CR) as shown in Equation (1) can be calculated (Bunruamkaew, 2012). Saaty (Saaty, 1980) suggests that if CR is smaller than 0.10, then degree of consistency is fairly acceptable. But if it's larger than 0.10, then there are inconsistencies in the evaluation process, and the AHP method may not yield meaningful results.

$$Cr = \frac{CI}{RI}$$

In this process, 20 experts' opinions were asked to calculate the relative importance of the factors and criteria involved. CR was also calculated and found 0.10 acceptable to be used in the suitability analysis. The calculations of pair wise comparison matrix is given in Table 4.

In order to produce land suitability map, actual factor weight (or rating) for parameters involved in the study are needed. These were determined systematically based on the AHP. The priority of each factor involved in the AHP analysis is determined based principally on the expert's opinions. The method is implemented using the pair wise comparison technique that simplifies preference ratings among decision criteria (Geremew and Hailemeriam, 2015).

Table 4. Pair wise comparison matrix and weights

Factor		C1	C2	C3	C4	C5	Normalized Principal Eigenvector
Landscape/ Naturalness	(C1)	1	1	1	3	3	24,39
Wildlife	(C2)	1	1	1	5	5	30,50
Elevation	(C3)	1	1	1	3	5	28,39
Slope	(C4)	1/3	1/5	1/3	1	1/5	5,79
Roads	(C5)	1/3	1/5	1/5	5	1	10,93

The eigenvector of weights: land use land use/ cover 0,2439, wildlife 0,3050, elevation 0,2839, slope 0,0579 and road is 0.2439 respectively. Output evaluation was then computed for suitability map by multiplying each factor by these eigenvector weight values using weighted sum method.

Suitability Map = 0.24 (Land use-land cover map) + 0.31 (Wildlife map) + 0.28 (Elevation map) + 0.06 (Slope map) + 0.11 (Road map)

4. Results and discussions

The land suitability map for ecotourism was classified as Highly suitable area (S1), Moderately suitable area (S2), Marginally suitable area (S3), and Not suitable area (N), seen in Figure 7.

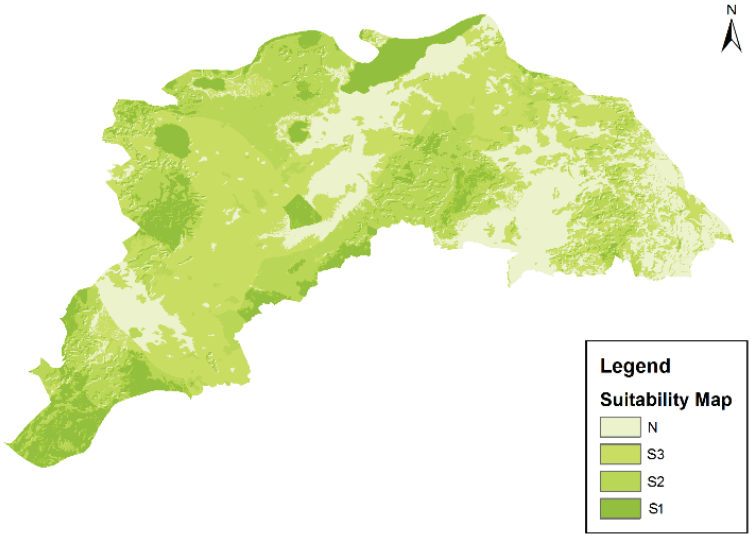

Figure 7. Suitability map

Based from the suitability map, it was found that the areas of Not suitable (N) is about 23 %, Marginally suitable (S3) is about 43 % and the Moderately suitable areas (S2) make up about 22 %. Highly suitable (S1) areas was found low as 12 % (Figure 8).

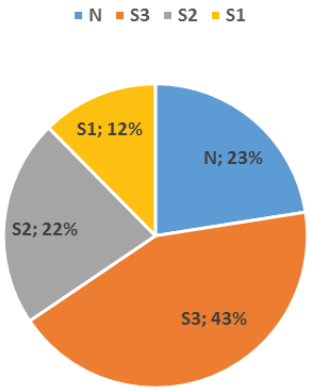

Figure 8. Ecotourism suitability areas in Burdur province

Not Suitable for Ecotourism (N);

From the findings it was determined that 23 % of the study area not suitable for ecotourism. These areas are located around Burdur city and north-east of Gölhisar, west of Bucak, south of Narlı and north of Pınarbaşı. Settlement areas and active or abandoned mines or built up lands can be seen in these areas. These areas have no importance for ecotourism.

Moderately Suitable for Ecotourism (S3);

From the findings it was determined that 43 % of the study area marginally suitable for ecotourism development. These are located around Tefenni, Yeşilova and Karamanlı, south-east of Burdur city. Major roads, farm lands and grasslands can be seen in these areas. These areas have low sensitivity and available for exploitation. These areas which are suitable for tourism development can control and promote tourism services.

Marginally Suitable for Ecotourism (S2);

From the findings it was determined that 22 % of the study area moderately suitable for ecotourism. These areas are located around Akçaören, Aziziye, Büyükyaka, Armutköy, Akçaköy, Gökçekaya, north-east of Kemer and south of Karacaören. Major roads, settlements can not be seen in these areas. These areas have low slope and high elevation. These areas can be considered for ecotourism attractions. Marginally suitable areas are available for tourist activities such as camping, trekking, sightseeing and any activities with minimum development.

Highly Suitable for Ecotourism (S1);

From the findings it was determined that 12 % of the study area highly suitable for ecotourism development. These areas are located in the south of Kemer, south of Tınaztepe, Salda, Yarışlı, Karataş, Akgöl, Burdur lake and around Gölhisar. Wetlands, wildlife protection and improvement areas can be seen in these areas. Highly suitable areas has the most sensitive areas. As seen from the suitibilty map most of these areas are outside human influence. These areas can be used for education as well as natural resource management and community based ecotourism development. Some of the highly suitable areas are located in the protected areas. For this reason, ecotourism should be controlled and managed to preserve the original conditions of the resources. High suitable areas are suitable for all kinds of ecotourism activities, especially bird watching.

Burdur province have many attributes and potentials that can be explored and utilized for a successful ecotourism development. But alternative scenarios needed for ecotourism management based upon resource management and biodiversity conservation. The final outcome of this study was the prioritization of the area which is best suited for ecotourism in Burdur province.

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