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Site Selection Using Analytical Hierarchy Process by Geographical Information System for Sustainable Coastal Tourism

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Abstract. A large number of tourists are oriented to coastal areas seeking sun and sea. So that, the present study focused on establish a feasible site-selection method for sustainable tourism in coast, based on comprehensive consideration to supply and demand. The site selection method developed in the present study is mainly based on spatial and geographic analysis in GIS.For this purpose, coast of Guilan Province was selected as the case study. The technique applied is based on multi-criteria decision- making methods. On this basis, four phases were carried out: Firstly, finding the criteria of destination selection for sustainable coastal tourism. The first phase is concerned with the literature review on existing theory, as well as the general principles and approaches for site selection. Based on the theory and methodology from literature review, in the second phase, site-selection procedure is developed by Boolean logics and analytical hierarchy process (AHP) method. In the third research phase, according to six environmental criteria, the site-selection procedure is implemented by Boolean logics in coast of Guilan province. Then, according to thirty criteria, seventeen candidate destinations are evaluated by AHP method.According to the final weight of each criterion in combination with candidate areas, sites are finally categorized in a final-weight decreasing order. Results indicate that coast of Amir, coast of Labeh Darya & east coast of Kiashahr are third priority of candidate areas.

Keywords: sustainable tourism, criteria, MCDM, Boolean logics, Caspian Coast

1. INTRODUCTION

Traditionally, recreation and coastal protection have been of high concern in beach management (Bird ECF, 1996). Also, ocean and coastal tourism is widely considered as one of the fastest growing areas of contemporary tourism (Orams, 1999). Therefore, as the tourism industry requires beaches, beach management will strictly attempt to accommodate this purpose. (Ariza et al, 2008) Recently, development of coastal destination has been the focus of a number of researchers; Bull 2002;; Jennings, 2004; Smith,2002;).Indeed, sustainable development became one of the main objectives in many economic sectors after the publication of the Brundtland Report by the World Commission on Environment and Development (United Nations) in 1987. Five years later, the United Nations' Conference on Environment and Development (the Earth Summit) was held in Rio de Janeiro to consolidate a worldwide strategy based on sustainable development models (Blancas et al, 2010). Considering tourism as a tool applied to economic development, international agencies such as the World Bank believed that coastal tourism is usually oriented to protect endangered ecosystems and biodiversity ignoring trade-offs between protection and use. Hence, suitable strategies are to be applied to produce economic benefits from marine areas while still yielding protection advantages. Therefore, government policies for tourism planning aim for a model based on diversity, quality and sustainability that can improve the competitiveness of destinations. During designing

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and implementing processes, indicators of sustainable tourism can help to evaluate destinations and define more suitable policies, as well (Blancas et al, 2010).

United States National Oceanic and Atmospheric Administration (1997) recognized that of all the activities done in coastal zones and the near-shore coastal ocean; none is increasing in both volume and diversity more than coastal tourism and recreation. Clean water, healthy coastal habitats, and a safe, secure, and enjoyable environment are clearly fundamental to successful coastal tourism. Similarly, extended living marine resources such as fish, shellfish, wetlands, coral reefs, etc. are of critical importance to most recreational experiences. Security from risks associated with natural coastal hazards such as storms, hurricanes, tsunamis, protects coastal tourism to be sustainable over the long term (Hall & Page, 2006).

As an ideal selection depends on several independent environmental, socio-economic, etc. factors, use of a multi criteria evaluation (MCE) method seems inevitable. Taking benefit of Geographic Information System (GIS) as a tool in combination with geographical information technology (GIT) equips the spatial decision support systems (SDSS) in appropriate destination selection of Coastal Tourism. GIS supplied with information gained by fuzzy logic, simple additive weighting (SAW) and analytic hierarchy process (AHP) has been used in destination selection all around the world (Chou et al, 2008; Jin et al, 2006; Lin et al, 2009; Reddy, 2009). The present study involves a kind of multi-criteria evaluation method using GIS as a practical instrument to evaluate the suitability of Guilan Province coast of Iran for sustainable tourism destinations., Guilan Province is located in the northern Iran, between the Alborz and Talesh Mountain Ranges. The Talesh and the Alborz Mountains lay out in a north to south and east to west direction, respectively which play role as a barrier against the humid north-west Caspian winds . The average rainfall in Rasht was reported as 1015.4 mm. with 156 rainy and 20 frosty days. The average minimum and maximum temperatures were reported as 11 °C and 20.9 °C respectively.

2. MATERIALS & METHODS

In order to select destination of sustainable coastal tourism using AHP process method in GIS, three distinct procedures were exercised:

1) Using GIS to generate information layers: first step in the methodology consists of development of a digital GIS database in which spatial information is formed.
2) Exercising GIS to analysis information layers to determining primary coastal tourism sites by Boolean logics (environmental criteria).
3) Exercising GIS to analysis information to determining priority of sustainable coastal tourism destination by Analytical Hierarchy Process (other criteria).

Based on previous research findings, information availability and priorities of factors, six parameters of topography (slope and aspect), water source, distance from the fault, flora, fauna (protected areas) and soil were selected for analytical processes by Boolean logics. The environmental criteria used in the present study are shown in Table 1. The weight of any information layer in this method is based on one and zero logic i.e., any unit of area is considered either good or bad. The three most commonly used Boolean operators are AND, OR, and NOT. (Brown, 2003).

Table 1. Environmental criteria used in destination selection of sustainable coastal tourism process

Criteria	Sources
Topography	Tanzania Coastal Management Partnership, 2003; Windupranata & Hayatiningsih 2009
Water Source	Al-Ramadan & Aina, 2004; Katiyar & Jain,2001; National Marine Sanctuaries, 2006
Distance from the fault	Salm & Price, 1995;
Flora	IUCN/WCPA, 1999; Salm & Price, 1995; Tanzania Coastal Management Partnership, 2003
Fauna	Ariza et al, 2008; IUCN/WCPA, 1999; Salm & Price, 1995
Soil	Ariza et al, 2008; PÉREZ O. M. et al, 2003

Based on previous research findings, information availability and priorities of factors, thirty parameters were selected in four category for analytical processes by AHP. In the context of criterion weights, a wide

variety of techniques exist for the development of weights (Eastman, 2001). The technique used here is that of pair wise comparisons developed by Saaty (1977) in the context of a decision making process known as the Analytical Hierarchy Process (AHP). In the procedure of multi-criteria evaluation using a weighted linear combination, it is necessary that the weights sum to one. The comparisons concern the relative importance of the two criteria involved in determining suitability for the stated objective. Since the complete pair wise comparison matrix contains multiple paths by which the relative importance of criteria can be assessed, it is also possible to determine the degree of consistency that has been used in developing the ratings. The results from the application of the presented methodology are sustainable coastal destinations. Finally, the coastal destination will be ranked and classified in descending order to indicate the priority of different options in front of the eyes of decision makers.

3. RESULTS

Environmental criteria are a fundamental contributing factor in the destination selection of sustainable coastal tourism.The topography (slope and aspect) layers are derived from DEM layer in GIS environment. Considering slope percent and aspect, two different classes are defined for each (0-15 % & 15-100% for slop layer and maximum sun radiation & relatively low sun radiation). Water Source criterion has a direct effect with destination for being used as coastal tourism. In other words, near lands from coastline will get more preferences for being selected. Accordingly, areas were fall inside 2 km buffer of water resources (Caspian Sea) were got one weight and other places were got zero weight.Destination location must be far to faults in order to reduce hazard. However, logically a buffer of 2 km has been considered in this study. In other words, direct relationship between distance from faults and land suitability is started from the 2 km distance of faults. Accordingly, three zones with different levels of suitability are determined and considered in further analysis (1 km buffer as very dangerous zone, 2 km buffer as fairly dangerous zone and other places as safe zone). In addition, areas were got zero weight where fall inside of protected area and have dense flora. Finally, according to the characteristics of geological texture of the region, soil criterion categorizes the whole area in to three distinct classifications; soils having high rate of permeability (district cambisols, haplic and gleyic solonchalks, cambic podzols with karst formations,…) are considered unsuitable for being used as a destination while soils with medium and relatively low rate of permeability (mollic gleysols, calcaric and eutric cambisols,…) and very low permeability (clayey soils, shale, calcaric fluvisols,…) are considered fairly suitable and optimal to site a destination respectively.Superposing all of the raster-type layers, the primary sites for sustainable coastal tourism have been identified. Results indicate that the large study area was reduced to some more suitable areas as search areas in the next step. In the end of first step, 15 site of the whole study area were candidate for more detailed evaluation (Fig. 1).

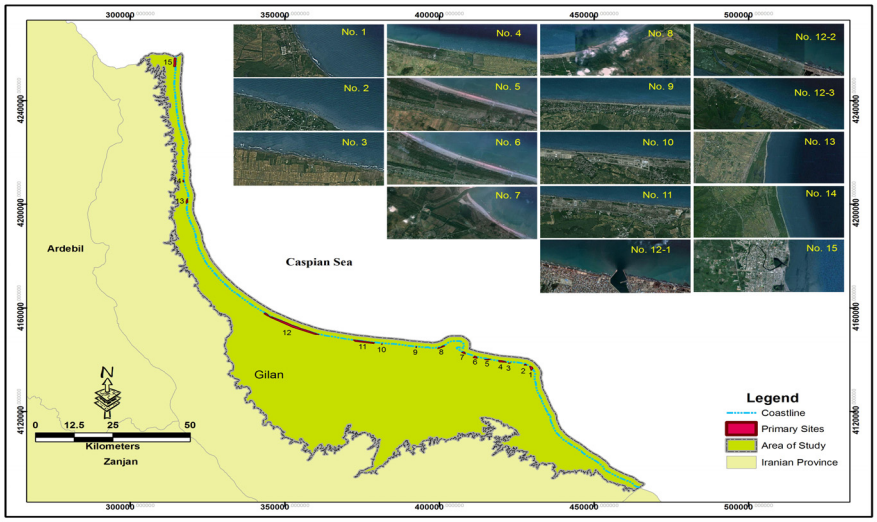

Fig. 1. sites sustainable coastal tourism in the study area

In continuation, in the second step using AHP, candidate areas were evaluated in more detailed. Considering relative priority of all criteria in comparison with others, a specific weight is designated to each criterion according to their total influence on the whole process of decision making. The relative weight designation of different criteria in interaction with each others is shown in Table 4. According to the final weight of each criterion, candidate areas are finally categorized in a final-weight decreasing order.

The infrastructure of a tourism destination is dimension that has not been put in place mainly to serve tourism. Such basic things as roads, sewage systems, communication networks, and many commercial facilities have been put in place to meet the needs of local residents. While these components of the infrastructure can also be important to visitors, their primary functions are related to the ongoing daily needs of residents. Results indicate areas of coastal park of Anzali (No. 12-1), Sahel recreational complex of Astara (No. 15) and east coast of Kiashahr (No. 7) are third priority of candidate areas and other areas are next priority

The competitiveness of a destination refers to its ability to compete effectively and profitably in the tourism marketplace. Sustainability pertains to the ability of a destination to maintain the quality of its physical, social, cultural, and environmental resources (supply) while it competes in the marketplace. Results indicate that areas of coast of Amir Kiasar (No. 6), coast of Labeh Daria (No. 5), coast of Anbarsar (No. 4) and east coast of Kiashahr (No. 8) are fourth priority of candidate areas and other areas are next priority .

Increasingly, the success of a destination is determined by its ability to assemble, interpret, and utilize information concerning the extent to which residents of the host region understand and support tourism as a long-term component of the socioeconomic system. Results indicate that areas of coast of Amirabad town (No. 1), east coast of Dastak (No. 2), north coast of Dastak (No. 3), coast between Khotbehsara , Sost (No. 14) and coast of Asalem (No. 13) are fifth priority of candidate areas and other areas are next priority .

Considering that tourism is a composite of activities, services, and industries that deliver a travel experience, it is important to identify and categorize its tourist service. The quality and quantity of these determine tourism's success in any area. Results indicate areas of Sahel recreational complex of Astara (No. 15), east coast of Kiashahr (No. 7), coastal park of Anzali (No. 12-1) & coast of Amir Kiasar (No. 6) are fourth priority of candidate areas and other areas are next priority.

According to the final weight of each criterion in combination with candidate areas, sites are finally categorized in a final-weight decreasing order. Results indicate that areas of coast of Amir Kiasar (No. 6), coast of Labeh Darya (No. 5) & east coast of Kiashahr (No. 7) are third priority of candidate areas and other areas are next priority

4. Discussion

The SCTD selection in Guilan Province is basically followed the site selection procedure developed in GIS.

This research develops approaches to integrate multi criteria evaluation into site selection process. The approaches are respectively described as two step of site selection:

5. Selecting suitable sites for SCTD from the study area with Boolean logics (environmental criteria).
6. Determining priority of suitable sites for SCTD with Analytical Hierarchy Process (other secondary criteria).

The factors involved in the first step include the environmental criteria such as topography, water source, fauna and flora, etc. The second step is accessibility evaluation of the whole candidate areas based on four major criteria (Infrastructure, Competitiveness and Supply, Socioeconomic, and Land use / Tourist facilities and service). This step is the location priority evaluation in selected suitable areas from the first step, based on other criteria. The specific method for the last step is deduced from site selection researches. This approach is logically structured and technically feasible.This site selection procedure is mainly a spatial analysis in GIS. The superiority of GIS in this site selection procedure is mainly lies on two aspects: natural suitability evaluation and sustainable priority evaluation in supply and demand part of coastal tourism destinations. The proposed method may be used for site selection processes in other locations and sectors of tourism industry.

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