INTEGRATION OF GIS TECHNIQUES WITH TOURISM PLANNING A CASE STUDY: BODRUM PENINSULA, MUĞLA, TURKEY

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

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ABSTRACT

INTEGRATION OF GIS TECHNIQUES WITH TOURISM PLANNING
A CASE STUDY: BODRUM PENINSULA, MUĞLA, TURKEY

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Tourism is an important economic activity in our country as it is all around the world. It is also defined as an industry which is related to other economical sectors. Therefore, governments need to manage, develop and market the tourism facilities so that tourism industry can help economical growth effectively.

Tourism planning means to manage large amount of data. Therefore, it is desirable to integrate Geographic Information Systems and also Remote Sensing to planning. The aim of the thesis is to define how to increase the contributions of GIS for site selection purposes for new tourism types.

The case study is chosen as Bodrum Peninsula that is the hearth of Turkey in tourism sector. The fast and unplanned tourism development is causing some problems in nature, transportation, social and technical infrastructure of Bodrum. Summer houses, hotels, holiday villages are built up increasingly, so a huge difference occurs between winter (97.000) and summer (1.500.000) populations, which produce one of the reasons for problems.

In this study, new tourism types, which are camping, caravanning, grass-skiing, site-parachuting and biking activities, are suggested in Bodrum Peninsula. Site

selection process for these types is performed according to the requirements defined by the Youth and Sport Association. Slope, aspect, and proximity analyses are performed in order to find the suitable areas for each tourism type. Then, analytical hierarchy process technique is used to give weight to each criterion to emphasize their effects. Finally, site selection results are compared with the environmental plan.

Key words: Bodrum Peninsula, Tourism management, Analytical Hierarchy Process, GIS

ÖZ

CBS TEKNİKLERİNİN TURİZM PLANLAMASI İLE ENTEGRASYONU
ÇALIŞMA ALANI : BODRUM YARIMADASI, MUĞLA, TURKİYE

Erkin, Eda
Yüksek Lisans, Joedezi ve Coğrafi Bilgi Teknolojileri Bölümü
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Turizm tüm dünyada olduğu gibi ülkemizde de önemli bir ekonomik aktivitedir. Diğer ekonomik sektörlerle de bağlantılı olan turizm sektörü bir çeşit sanayi olarak da adlandırılabilir. Dolayısıyla, hükümetler turizm sektörünün ekonomik kalkınmaya katkısını sağlayabilmek için, turizm olanaklarını yönetmeye, geliştirmeye ve satmaya ihtiyaç duymaktadırlar.

Turizm planlaması büyük miktarlarda verinin kullanılması, idare edilmesi anlamına gelmektedir. Bu nedenle Uzaktan Algılama ve Coğrafi Bilgi Sistemlerinin entegrasyonu istenmektedir. Bu tezin amacı, yeni turizm çeşitleri için yer seçimi sürecine Uzaktan Algılama ve Coğrafi Bilgi Sistemlerinin katkılarının nasıl arttırılacağını tanımlamaktır.

Turizm sektöründe Türkiye'nin kalbi olarak nitelendirilen Bodrum yarımadası çalışma alanı olarak seçilmiştir. Bodrum'daki hızlı ve plansız turizm gelişimi doğal kaynaklarda, ulaşımda, sosyal ve teknik altyapıda pek çok sorun yaratmaktadır. Yazlık evlerin, otellerin ve tatil köylerinin hızla inşa edilmesi yaz nüfusu (97.000) ile kış nüfusu (1.500.000) arasında büyük bir farkın doğmasına, bu fark da pek çok sorunun ortaya çıkmasına neden olmaktadır.

Bu çalışmada kamp, karavan, çim kayağı, yamaç paraşütü, bisiklet turları aktiviteleri Bodrum yarımadası için önerilmiştir. Gençlik ve Spor Genel Müdürlüğü tarafından belirlenen kriterler doğrultusunda yer seçimi analizleri gerçekleştirilmiştir. Her turizm çeşidi için uygun alanların belirlenmesinde eğim, bakı, uzaklık analizleri yapılmıştır. Analitik hiyerarşi tekniği kullanılarak her bir kritere tutarlı olacak şekilde ağırlıklar verilmiştir. Sonuçta, belirlenen yer seçimi sonuçları çevre düzeni planı ile karşılaştırılmıştır.

Anahtar Kelimeler : Bodrum Yarımadası, Turizm yönetimi, Analitik hiyerarşi süreci, CBS

To my parents Şirin and Erdal Erkin
to my brother Cem Erkin
and to my fiancé Emre Çamaşırcıoğlu

Thank you for your love and support

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CHAPTER 1

INTRODUCTION

Tourism is an important economic activity in our country as it is all around the world. It is also defined as an industry which is related to other economical sectors. Therefore, governments need to manage, develop and market the tourism facilities so that tourism industry can help economical growth effectively.

World Tourism Organization described tourism as a composite of activities, facilities, services and industries that deliver a travel experience, that is, transportation, accommodation, eating and drinking establishments, entertainment, recreation, historical and cultural experiences, destination attractions, shopping and other services available to travelers away from home (Dondo et al., 2003). As it is understood from the definition, tourism involves multiple parameters itself. All those parameters are major inputs of tourism planning.

Tourism planning requires the management of huge amount of data that are collected from different kinds of sources. The lack of availability of enough amount of data and how to manage and access those data are the difficulties in Turkey. As spatial data are used for different types of analyses, it is desirable to integrate Geographic Information Systems (GIS) and also Remote Sensing (RS) to this planning. By means of the linkage between spatial and attribute data in a GIS database, the data can be analyzed efficiently. GIS can be used as a decision support tool not only in public sector but also in private sector, because it has an ability of querying spatial relationship and analyzing attributes and spatial data.

GIS has a number of advantages for supporting decision-making and planning for tourism. Tourism is an activity which strongly implies the geographical dimension for all, the users (the tourists), the providers and the planners. GIS is the technology

specifically developed for the management and study of spatial phenomena (Farsari and Prastacos, 2003).

GIS could further facilitate and offer more tools to tourism planning and decision-making with the help of the capability of working along with other technologies such as RS, GPS, CAD, etc. (Malczewski, 1999). Another competitive advantage of GIS technology is that, because of its adaptiveness to add or remove thematic layers, constraints and data, it is a dynamic tool for planners rather than a static one, capable of being adjusted as new data become available and as tastes and preferences in demand change over time (Beedasy and Whyatt, 1999).

As the importance of tourism sector in economy is well-known; tourism development, and tourism plans get a bigger portion in city and regional planning. Therefore, defining the potential tourism development sites in planning activity is an essential part. Decision making process which is an important part of planning requires the data that are reliable, easily accessible and affordable (Pandey and Chakraborty, 2005).

Potential tourism sites in developing countries can be undeveloped places that have great natural scene and precious flora and fauna. It is important to manage the natural resources for all those activities without any damage to the nature. So preserving the non-renewable resources for future should be one of the aims of planning.

Population pressure, particularly the growth of urban areas, combined with the rapid expansion of industry and tourism in coastal areas has created a worldwide concern about sustainable development of these areas and their natural and environmental resources. Coastal resources are used for economic and social objectives which are urbanization, industry, tourism and recreation, fisheries and aquaculture, energy production and transportation. These activities may cause negative environmental impacts resulting in marine and fresh water pollution, air pollution, loss of marine resources, loss of natural land resources and land degradation, destruction of historic and architectural heritage, loss of public access to the coast, noise and congestion (UNEP, 1995).

Tourism activities on the coastal lines have accelerated and the number of people participating coastal tourism has reached to several millions a year. It is important to get maximum benefit from the coastal zone for government and municipality of the city. However, it is only possible to provide a sustainable development by using management plans suitable for characteristics of the area (Dursun et al., 2002).

As the environment is being increasingly recognized as the major resource for tourism, the impacts of tourism on the nature should be investigated thoroughly (Mason, 2008). However tourism-environment relationships are complex. This relationship is called "symbiotic" by Williams in 1998. Both sides should get benefits from each other in kind of symbiotic relationship. It is defined as one which tourism benefits from being in a good quality environment and this same environment should benefit from measures aimed at protecting and maintaining its value as a tourist resource (Williams, 1998). Unfortunately, environment can not benefit from tourism development in Turkey. This resource is used as an attraction spot but it is not preserved.

Some activities lead to minimal impact on the environment and are not resource consumptive. Sight-seeing from a bus will have little effect on the actual environment traveled through (McKercher, 1993). In many parts of the world, tourism is a seasonal activity. Under these conditions, tourism may only effect the environment for part of the year. During the rest of the year the environment may be able to recover (Mason, 2008). However, if the impacts of the tourism on the nature cannot be recoverable, the problems become significant. Unfortunately, in many coastal regions of Turkey summer houses, hotels and holiday villages destroyed the environment in an unrecoverable way.

Positive impacts of tourism:

1. tourism may stimulate measures to protect the environment and/or landscape and/or wildlife,
2. tourism can help to promote the establishment of National Parks and/or Wildlife Reserves,

3. tourism may provide the money, for example, via entrance charges, to maintain historic buildings, heritage sites and wildlife habitats.

Negative impacts of tourism:

1. tourism can contribute to congestion in terms of overcrowding of people as well as traffic congestion,
2. tourism can contribute to the pollution of water courses and beaches,
3. tourism may result footpath erosion,
4. tourism can lead to the creation of unsightly human structures such as buildings (e.g. hotels) that do not fit in with vernacular architecture,
5. tourism may lead to damage and/or disturbance to wildlife habitats (Mason, 2008).

"Integrated coastal zone management (ICZM) is defined as an adaptive process of resource management for sustainable development in coastal areas" (UNEP, 1995). ICZM process has three main stages: (a) initiation; (b) preparation of the Integrated Coastal Master Plan; and (c) implementation of the Plan. Initiation stage includes the analysis of triggering factors which could increase public awareness. Planning stage refers to the development of policies and goals, and selection of concrete sets of actions (strategies) to produce the desired goods and services from the coastal area over time. Implementation is the process of operational decision-making, working towards the objectives of the plan through interaction with relevant administrative, legal, financial, and social structures, and with the public participation (UNEP, 1995).

The analysis and site selection processes that are performed in this study can be integrated with the planning and implementation stages of the ICZM. The main objective of this thesis is to show what can be added to the planning process for coastal areas where tourism sector is developed. The case study is chosen as Bodrum Peninsula that is the hearth of Turkey in tourism sector. The fast and unplanned tourism development is causing some problems in nature, transportation, social and technical infrastructure in Bodrum. Summer houses, hotels, holiday villages are been

built increasingly, and a huge difference occurs between winter (97.000) and summer (1.500.000) populations, which produce one of the reasons for problems.

The increasing demand for owning a summer house in Bodrum, is also increasing the demand for new construction lands, which are unfortunately obtained by converting the agricultural lands and forest areas to residential lands. The legal number floors in the buildings is increased with annuity purposes in the last environmental plans for Bodrum in 2006. Non-governmental organizations and Architectures and City Planners Associations objected to that plan decision. So the plan was abrogated in 2008. That means the plan decisions do not provide answers to the demands of the city.

CHAPTER 2

TOURISM PLANING AND GIS APPLICATIONS

Geographic Information Systems (GIS) has been applied in many disciplines including geography, forestry, urban planning, and environmental studies. Similarly, tourism has been a subject of interest to geographers, economists, businesses, environmental planners, anthropologists, and archaeologists. GIS is now recognized widely as a valuable tool for managing, analyzing, and displaying large volumes of diverse data pertinent to many local and regional planning activities. Its use in environmental planning is rapidly increasing. Tourism is an activity highly dependent on environmental resources. It is also a phenomenon, which in the event of a lack of planning and management, is likely to erode its environmental base. Hence, the strength of tourism planning can be enhanced by GIS applications. GIS can be regarded as providing a toolbox of techniques and technologies of wide applicability to the achievement of sustainable tourism development.

Dursun at al. (2002) define two categories for the use of GIS in tourism, public use and management use. The public needs to find spatial information about a place, before they go there. It should be known where things are located, what kind of facilities are available, what the climate is like in the region of interest. This can be achieved through Web-based GIS, or Information Kiosks located in key tourist areas. The other user of GIS is the Management side which can be performed by individual planner, tourism group, or by the local municipality. Management users need to query the system for where tourists are coming from, their socio-economic backgrounds, and good potential locations for new tourist sites etc.

Bahaire and Elliott-White (1999) provided a brief description of various applications of GIS in tourism planning in the United Kingdom. These applications included data integration and management (for example data on tourism destination

types and accommodation), landscape resource inventory, designation of tourist areas in terms of use levels, tourism suitability analysis, and pre- and post-tourism visual impact analysis. The overall conclusion is that GIS is an efficient and effective means of helping the various stakeholders examine the implications of land-use decisions in tourism development.

The relationship between GIS and Tourism planning is summarized in Figure 2.1. Planning tourism is not only a formality or bureaucratic exercise. Its main purpose must be the long-term success in the planning region. This means the plan should provide protections for socio-economic and environmental impacts. Tourism involves so many individuals and organizations that it must work for the same purpose. If the planning process can not predict a better future, it will be ineffective (Gunn, 2002).

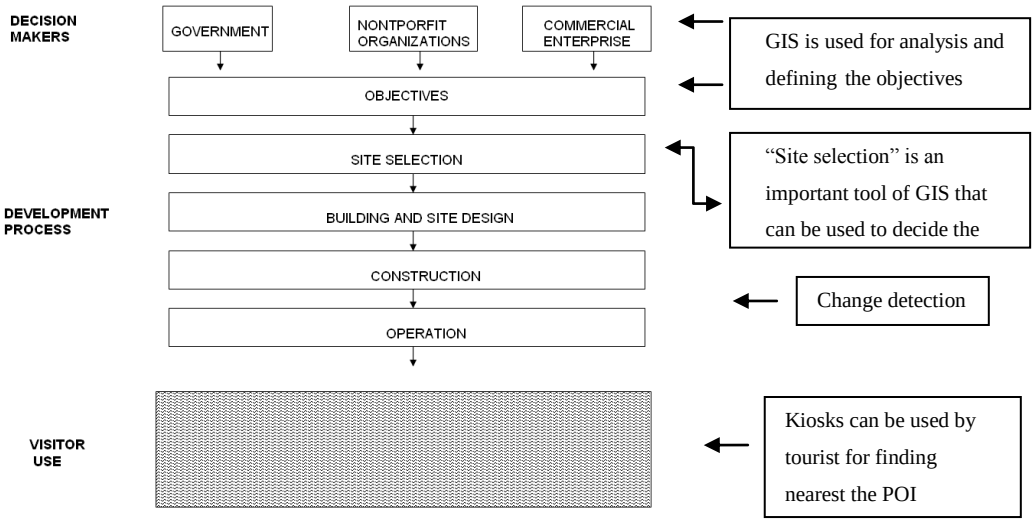


Figure 2.1. GIS and Tourism Planning Relationship

2.1. Capabilities of Geographic Information System

Farsari and Prastacos (2003) cited that GIS applications in the field of tourism management and planning first appeared in the early 90's. However the number of GIS applications for tourism planning did not increase as in the other fields. Rhind (1990) categorized GIS applications in a structured approach according to the

generic questions which GIS are frequently used to investigate. Bahaire and Elliott-White (1999) related these categories to the basic applications in tourism, as well as, to GIS basic functions as illustrated in Table 2.1.

Table 2.1 Capabilities of GIS (Bahaire and Elliott-White,1999)

Examples of functional capabilities of GIS	**Examples of basic questions that can be investigated using a GIS**		**Examples of tourism Applications**
Data entry, storage and manipulation	Location	What is at …?	Tourism Resource Inventories
Map production	Condition	Where is it …?	Identifying most suitable locations for development
Database integration and management	Trend	What has changed …?	Measuring tourism impacts
Data queries and searches	Routing	Which is the best way…?	Visitor management/flows
Spatial analysis	Pattern	What is the pattern…?	Analyzing relationships associated with resource use
Spatial modeling			
Decision Support	Modelling	What if …?	Assessing potential impacts of tourism development

2.1.1. Tourism Resources Inventories

Tourism planning and management involves different kinds of information in order to assist a quite complex decision-making process. Therefore, GIS ability to integrate, store, and manipulate different data sets - both qualitative and quantitative, both spatial and nonspatial- may prove very useful (Bahaire and Elliott-White, 1999). Tourism resource inventory is one of the very first and basic applications. They may include information on natural resources, tourism and other infrastructure, demographics, etc.

2.1.2. Location suitability

Site selection is perhaps the best known and most widely developed application of GIS. Tourism could not be excluded from this fact, and many of the cases are related directly or indirectly – such as the decision support examples - to identifying locations suitable for tourism development according to specified criteria in each case. Conflicting or complimentary land uses and activities, infrastructure availability, natural resources are considered to determine the possibility and the capacity of an area to be developed as a tourist destination (Butler, 1993; Bahaire and Elliott-White,1999).

2.1.3. Measuring / monitoring tourism impacts

Measuring and monitoring the tourism impacts applications involve tracing of trends and answering the question *'what has changed…?'*. Therefore, it is related to the monitoring of desired parameters over time and across space rather than predicting potential impacts which is related to a next category. In the case of tourism development, where environmental, social and economic information is required, GIS technology permits the integration and management of the various data (Farsari and Prastacos, 2003).

2.1.4. Visitor management / flows

This category is described as routing applications answering the question *'which is the best way…?'*. The best way may be determined on the basis of diverse criteria such as the shortest path, or the way that combines passing through various points. In tourism applications this is mostly related to **tourism timespace analysis**. Tourist time-space analysis aims at understanding the behavior of tourists or visitors. Traditionally this is being accomplished by analyzing static numbers of tourists/visitors and their socioeconomic and demographic characteristics (Dietvorst, 1995). GIS can be a powerful tool in such analysis offering a better understanding of tourist flows in a given region or area. Understanding of tourist behavior may further lead to better infrastructure and activities management, protection of the environment and spreading of benefits such as economic gains.

2.1.5. Analyzing relationships associated with resource use

Analyzing relationships associated with resource use refers to answering the question *'What is the pattern…?'*. Scientists, planners and decision-makers may undertake pattern detection to identify phenomena, their occurrence and their distribution. GIS can be used to delineate areas that should be undisturbed by tourism or any type of development activity. **Impact analysis** is related to this category as GIS can be used to identify patterns and the interaction between different components and evaluate potential impact of tourism development on the natural environment (Bahaire and Elliott-White, 1999). Satellite images can also be used for pattern detection with the help of image classification.

2.1.6. Assessing potential impacts of tourism development

This category includes applications which may integrate all the previously mentioned
features of GIS and which employ the more complex analytical capabilities of GIS. The *'what if…?'* question refers to the development and evaluation of different scenarios. **Visual impact analysis** may be undertaken in a number of tourism planning projects especially in the case of scenic or of high aesthetic value environments (Miller et al., 1993). Tourism relies strongly on the attractiveness of the landscape and therefore, GIS can be a valuable tool for evaluating proposals and alternatives (Butler, 1993; Bahaire and Elliott-White, 1999).

2.2. GIS and Tourism Planning Applications

The success of tourism in any country depends on the ability of that country to sufficiently develop, manage and market the tourism facilities and activities in that country. Most developing countries depend mainly on tourism for economic growth and diversity (Shojaee, 2005).

The major problem in tourism master planning is lack of availability of large volume of data. Even if the data are made available, the next problem is how to

manage and access those data in various permutations and combinations. Authentic information is the fundamental requirement for decision making process and therefore all the sources were identified as the information required being reliable, easily accessible and affordable. This demand for information and underlying data requires a new approach to the way in which the data related to tourism industry should be identified, collected, stored, retrieved, analyzed, communicated, and presented.

An appropriate model is designed to perform spatial analysis, network analysis, and manipulation. Most tourism impacts are spatial, that is the impact of services and facilities are in direct proportion to its geographic proximity to other cultural and natural phenomenon.

An information system that is capable of answering questions about where facilities and resources are located represents enormous benefits. Among the many benefits that may be realised through the system includes intelligent mapping capabilities, analytical capabilities, modelling and prediction, and revenue generation (Longmatey et al., 2002).

2.2.1. Goa (India) Tourism master plan

Goa is the smallest state of India in terms of area, and fourth smallest in terms of population. It is located on the west coast of India in the region known as Konkan. Panaji is the capital of the state, and the largest city in the state is Vasco da Gama. The Portuguese first landed in Goa as merchants, in the early 16^{th} century, and conquered it soon thereafter. The Portuguese overseas territory existed for about 450 years, until it was annexed by India in 1961. So the historic city of Margao still exhibits the influence of Portuguese culture.

The sunny beaches, the cool breeze, the lush green hills, the enchanting waterfalls and small houses in the elongated coconut grooves make Goa a natural paradise and people flock here to enjoy this splendid beauty. Reviewing the popularity of the paradise and to retain its serene beauty, it was essential to make a master plan in order to manage the tourism in the state.

The aims of the tourism master plan in Goa are:

1. To identify the entire major tourist places in Goa and their classification based on non-spatial and attribute data.
2. To make an inventory of existing tourist infrastructure in Goa.
3. To develop tourist circuits and virtual tourist network with the aim of shifting the pressure of tourist from coastal to hinterlands and exploit the tourist potentials in hinterlands.
4. To determine duration of stay of the tourist. Its spatial distribution on time scale and account of the expenditure made on different items in accordance with the income groups.
5. To assess the multiplier effect of tourism activity in generating additional employment.
6. To assess the impact at tourism in socio-cultural and economic aspects.
7. To assess the impact of tourism on environment.

This is the primary reason that GIS has been used for Tourism Master Plan in Goa. At GIS platform, the tourism databases are generally extended by interchanging huge sets of their attribute and spatial data through their linear and non-linear (logic relation) referencing system. Tourism-GIS facilitated integration of all other socio-economic data, environmental data, demographic data, tourism industry historical data, tourism work force, with database for wide variety of planning and decision functions.

A customized query model was developed for an interactive query in text, report, and graphic format. The developed model for Tourism Master Plan of Goa (Pandey and Chakraborty, 2005) has the following features:

1. The overall view of terrain characteristics of the state and the location of the tourist spots, in relation to the terrain.
2. The accessibility to the particular spots and the available infrastructure facilities of the spot may be analyzed and the problems in respect to the infrastructure can be identified.
3. The types of tourists visiting the places (domestic/foreign) and their respective expenditure on various items.

4. Types of economic activity centers as food, bars, hotels and restaurants, on time scale.
5. Transport and related services.
6. To identify the location of new touristic spots.
7. Possible impact of new tourist spot/activity on socio-economic and environmental aspects at particular locations.
8. Vivid picture of how the tourism activity may degrade or deteriorate the existing environment of Goa on time scale.

The Master Plan of Goa identifies and classifies the tourist places of Goa into following categories:

1. Beaches
2. Churches and Chapels
3. Temples and Mosques
4. Heritage Towns
5. Museums and Art Galleries
6. Wild Life Sanctuaries
7. Springs
8. Other places of interest

These classes are identified as the tourist spots in the master plan of Goa. Afterwards trend study is carried out as another planning task. GIS is also used here to forecast the number of tourists visiting Goa and it can also be predicated that which areas are going to have more concentration of tourists. The arrival of tourists by different transport modes like chartered flights, roadways, and railways are collected so that traffic management can be done accordingly. The trends of tourist arrivals in different seasons can be analyzed and accordingly GIS is used to predict how the tourist pressure can be managed in a particular season.

The next job of the tourism master plan is to identify the new tourist areas by studying the terrain, accessibility and other physical features. The impact of tourism has to be studied in economic terms, social values and environmental sensitivity. For measuring economic impacts, the average duration of stay of tourists and their average expenditure is tabulated and a total revenue generation is calculated. The

development of tourism sector generates new labor supply as the hotels and restaurants need to employ more workers. Further, the effects of new labor supply to the economy are analyzed. Finally it is clear that the tourism sector is contributing to the economy of Goa. The infrastructure like hotels, and holiday villages can deplete the forest cover and the physical environment of coasts. The common plastic pollution in the beaches is endangering the beach eco-system so the beaches can be degraded by increasing pressure of tourists. The identification of endangered environmental areas needs different data like flora and fauna, slope, land cover, and rainfall etc. So the different levels of protection zones are defined by the intersection of these areas. Afterwards, it is need to provide solution for effective management.

As a conclusion Goa tourism master plan emphasizes the importance of all existing and probable tourist spots, and the infrastructural facilities existing at the tourist centers. A comparison of the estimated demand of tourism facilities between present and future is carried out. The lack of these facilities can be called as gaps in tourism managements. So the gaps in current situations are identified. The trend analysis and future projection of tourist influx are made with the help of those analysis results. The impact of tourism on socio cultural and natural environment is understood as an output for future studies. GIS plays a crucial role in measurement, mapping, monitoring and modeling of the entire plan (Pandey and Chakraborty, 2005).

2.2.2. Eminönü (İstanbul, Turkey) GIS Design and Application for Tourism

Nowadays, time is considered as valuable as gold. It is important to use “time” sensibly, in order to access a lot of information. People who want to go sightseeing in different places as tourists may need to have some information about those places. Determining the shortest routes to the historical places and natural beauties from their accommodation points (locations) will be both timesaving and economical. GIS technologies provide us with these possibilities. GIS design and network analysis can be carried out for defining the shortest path or best route for sightseeing.

Eminönü as a historical district of İstanbul covers the location on which the Byzantine capital was built. The Galata Bridge crosses the Golden Horn into Eminönü and the mouth of the Bosphorus opens into the Marmara Sea. Topkapı Palace, the Blue Mosque (Sultanahmet Camii) and Hagia Spohia (Aya Sofya) are some of the important historical points that make Eminönü the main tourist destination in İstanbul. As the number of possibilities that should be visited increases it becomes hard to find the best routes or shortest path for people. Accordingly, in that kind of situations it is crucial to get help from GIS. Because of the significant spots network analysis was applied and possible routes for sightseeing were defined in this study.

Orthophotos, district boundary maps, maps which show the current condition of the region, roads, their names and middle lines are graphical components of GIS Design and Application for Tourism. In addition, non-graphical components consist of attributes of designed layers. And also, detailed information related to photos and objects is available for better recognition of query object.

In this study; middle lines of roads which have vector and graphical characteristic for network analysis, and historical and tourism places and all of the geographical objects considered as necessary items for tourism were designed as point layer. Building layer was designed as the only polygon layer.

This study was carried out in Eminönü district, which has a lot of historical and tourist places. Some of the four star hotels in Eminönü district and most important ones of those historical and touristic places were transferred to the system. These results can be achieved by queries in GIS Design and Application for Tourism:

1. Determination of important historical places for tourism.
2. Determination of the optimum plan for sightseeing places.
3. Determination of the shortest distance between the selected places (Türk and Gümüşay, 2005).

2.2.3. GIS-based geo-environmental evaluation for urban land-use planning

A geo-environmental evaluation for urban land-use planning often requires managing a large amount of data. Since, GIS is capable of managing those spatial data, providing the ability to integrate multiple layers, some of GIS techniques applied to planning process in many urban areas one of the example is about Lanzhou City and its vicinity in Northwest China.

In China, cities are growing and urban areas are expanding rapidly because of the increasing population. The census records show that the number of cities was 193 in 1978, 300 in 1984, 450 in 1989, and 622 in1994. Cities are growing both in number and also in size. The percentage of population living in cities increased from 14.4 in 1982 to 28.6 in 1994. It is predicted that this percentage will reach 44-47 in 2010 and almost 60 in 2020 (Liu, 1997).

This rapid development caused new problems for urban planning in China. The main objective of urban land-use planning is to evaluate the advantages and disadvantages of one use of areas compared to another in order to choose the suitable land use. In this selection process topography (slope, elevation), ground conditions (surficial geology, formation combination), groundwater (elevation of groundwater table, and its change corrosive potential of groundwater), geologic hazards (distance to debris flow, distance to land sliding, liquefaction potential, distance to fault) criteria are evaluated.

It is possible to integrate multiple layers in different combinations by using GIS. In addition, it can also avoid the existing difficulties of combining numerous spatially related parameters involved in geo-environmental evaluations. In this application a GIS-aid to geo-environmental evaluation for urban land use planning is used in the urban area of Lanzhou City in northwestern China (Dai et al., 2001). Multi criteria analysis is performed to evaluate development suitability of the geo-environment for various land-use categories, including high-rise building, multi-storey building, low-rise building, waste disposal, and natural conservation, according to appropriately measured and weighted factors. Suitability map for each category is

developed using an algorithm, which combines factors in weighted linear combinations.

The inputs to GIS include remote-sensed data like satellite images or aerial photos, existing digitized maps, and information from tables and reports. Each type of data input describes the attributes of recognizable point, linear or areal geographic features. The 1/ 50.000 scale topographical map sheets covering the study area are digitized manually. The slope and elevation maps are developed from the digital elevation model data, generated from the digitized contour lines. The vector base maps are transferred to the ArcView GIS, and rasterized for analyses. The raster grid cell definition is selected as 20 * 20 m^2 resolution. In the ArcView software environment, several base raster maps are generated according to the distances from landslides, debris flow gullies, and geologic faults.

In the geo-environmental evaluation process, a primary step is to create a standardized measurement system across all factors considered. "Since most images still hold cell values for original map codes, these have to be standardized to a uniform suitability rating scale- in this case between 0 and 4 for ease of analysis" (Dai et al., 2001). These integer numbers ranging from 0 to 4 are given to "very low", "low", "medium", "high", and "very high" classes, respectively. Table 2.2 shows the class boundaries and standardized measurements given to each factor.

A primary issue in the evaluation is to assign weights to each factor separately. For each land use category, a set of relative weights for each factor is developed so that it can be used as input for suitability evaluation in the next step. Analytic Hierarchy Process (AHP), a method for dealing with complex technological, economical, and socio-political problems (Saaty and Vargas, 1991), is a suitable method for deriving the weight assigned to each factor. In the construction of a pair-wise comparison matrix, each factor is rated against every other factor by giving a relative dominant value between 1 and 9 to intersecting cell (Table 2.3). The weights should add up to 1.0, as the linear weighted combination calculation requires. This process is applied for all land use categories as shown in Table 2.3.

Table 2.2. Standardized potential rates (HB - high-building, MB – multi-storey building, LB-low-rise building, WD-waste disposal, NC-natural conservation) (Dai et al., 2001)

Factors	**Category**	**Potential Rating**				
		0	1	2	3	4
Slope (°)	HB/WD	>12	8-12	5-8	2-5	<2
	MB	>15	12-15	8-12	5-8	<5
	LB	>20	15-20	10-15	5-10	<5
	NC	<5	5-10	10-15	15-20	>20
Elevation (m)	HB/MB	>1660	1620-1660	1580-1620	1540-1580	<1540
	LB	>1700	1660-1700	1620-1660	1580-1620	<1580
	WD	<1540	>1700	1540-1600	1640-1700	1600-1640
	NC	<1600	1600-1700	1700-1800	1800-1900	>1900
Depth of ground water (m)	HB	<2	'2-4	4-6	6-9	>9
	MB	<1	1-3	3-5	5-7	>7
	WD	<3	3-5	5-8	8-15	>15
Corrosion potential of ground water	HB/MB/WD	High		Medium	Low	Very Low
Distance to debris flow (m)	HB	<80	80-150	150-200	200-300	>300
	MB/WD	<40	40-80	80-150	150-250	>250
	LB	<20	20-50	50-100	100-150	>150
	NC	>500	300-500	200-300	100-200	<100
Distance to land sliding (m)	HB/WD	<50	50-100	100-150	150-250	>250
	MB	<30	30-60	60-100	100-150	>150
	LB	<20	20-50	50-80	80-120	>120
	NC	>400	300-400	200-300	100-200	<100
Distance to fault (m)	HB/WD	<40	40-80	80-120	120-160	>160
	MD/LD	<30	30-60	60-90	90-120	>120
Surficial Geology	LB	Collapsible soils		Loess		Sand, bedrock
	WD	Sand, bedrock		Collapsible soils		Loess
Formation Combination	WD	Sand, bedrock, sand underlain by bedrock	Collapsible soils underlain by sand	Collapsible soils underlain by bedrock	Collapsible soils	Loess
Lithology of bearing layer	HB/MB	Collapsible soils		Loess		Bedrock, sand
Ground water rise	HB/MB/LB/WD	Yes				No
Liquefaction potential	HB/MB/LB/WD	High				Low

Table 2.3. Example of relative weighting of factors for high rise building-urban land use category (Dai et al., 2001)

Factors	1	2	3	4	5	6	7	8	9	10	Weights
(1)Slope	1										0.2623
(2)Eevation	1/3	1									0.1212
(3)Lithology of bearing layer	1/5	1/3	1								0.0611
(4) Depth of …	1/7	1/5	1/3	1							0.0290
(5)Corrosion of…	1/3	1	2	3	1						0.0770
(6)Ground water rise	1/5	1/3	1	2	3	1					0.0720
(7)Distance to …	1/2	2	3	5	3	3	1				0.1640
(8)Distance to…	1/2	2	3	5	3	3	1	1			0.1640
(9)Liquefaction…	1/7	1/5	1/3	1	1/3	1/2	1/4	¼	1		0.0322
(10)Distance to fault	1/9	1/7	1/5	1/2	1/5	1/4	1/7	1/7	1/3	1	0.0172
Consistency ratio	0.04										

Multi criteria evaluation is used to combine a set of criteria to form a suitable map according to a specific category. The suitability map is created by summation of the results.

$$s = \sum w_i x_i$$

where S is the suitability, w_i the weight of factor *i*, and x_i is the potential rating of factor *i* (Dai et al., 2001).

As a result, to make the maximum beneficial use of land for a certain area, a planner should pay attention to the actual geo-environment. This will allow to implement basic information to the planning process accurately. The evaluation results can assist planners in making decisions on land use alternatives for specific land parcels. In addition, land use categories can be much more complicated and similar planning can be carried out for more comprehensive classification of urban land use types (Dai et al., 2001).

2.3. Tourism Planning Process in Turkey

During the last two decades tourism in Turkey has become a mass industry concentrated in the western and southern coastal areas. At the end of the millennium

Turkey is ranked 19th of the most visited countries in the world. The choice for the Aegean and Mediterranean regions can be observed both with foreign and domestic tourists. Although in each of the five-year-development plans the government stresses the capacity of tourism to eliminate socio-economic problems, these plans do not cover the spatial problems (Seckelmann, 2001).

In Turkey tourism is planned, managed and developed by the Ministry of Culture and Tourism. One of the regulations that are in force is "Regulation of concerning the preparation of the plans in cultural and tourism preservation and development areas". In the principles of planning part, item 9 defines the data which are to be used in the process of planning. They are listed below.

1. The location of the places (city, town) that will be planned.
2. Boundaries, administrative borders.
3. Geological and hydrological structure (rivers, flood areas, ground and surface water sources) of the area.
4. Agricultural lands and agricultural land use.
5. Irrigation areas.
6. Hazard information, under risk areas.
7. Cultural and natural assets to be preserved.
8. Environmental and natural protection areas that are defined by laws.
9. Forest areas.
10. Demography and socio-economic structure.
11. Technical infrastructure.
12. Land use.
13. Military areas.
14. Ownership pattern.
15. The settlement characteristics.

All those 16 topics to which more can be added, show the importance of spatial and also statistical information in planning.

The concept of sustainability in tourism development means the protection of the cultural and natural values that are the resources for tourism development (Çubuk,

1996). Sustainable tourism is a development type where natural and cultural heritage is under protection. The group of people who lives in that region where tourism develops should benefit economically and socially. Besides, the resources should be managed as they should continue to exist for next generations (Dinçer, 1996).

Tourism activities should not give harm to the nature. It is possible to get benefit from the tourism industry without destroying the forest areas, or polluting the seas. As the belief, that tourism needs to be sensitive to the environment develops, the new tourism types are created. "Alternative tourism", "Soft tourism", "Eco-tourism", and "Conscious Tourism" types are defined nowadays (Doğaner, 1995).

Alternative tourism can be defined by decreasing the negative effects of tourism on the population living in the destination points (touristic region) without causing any decreasing in their income. *Soft tourism* is proposing to benefit from the natural and cultural values for tourism purposes in a balance of usage and protection. The potential number of tourists should be defined according to the environment and the demand of the local people in *conscious tourism*. *Eco-tourism* is based on the protection of the nature. In this type of tourism, tourists are aware of the protection of the environment (Özgüç, 1998).

CHAPTER 3

INTEGRATION OF MULTI CRITERIA ANALYSIS WITH TOURISM PLANNING

Stynes and O'Halloran (1987) cited that tourism is one of many activities in a community or region that requires planning and coordination. This sentence explains the complexity of tourism activity and the necessity of planning. If we analyze the sentence part by part "one of many activities" shows that there is an interaction among the tourism and all other economical and social activities. "in a community or region" statement presents that the spatial and social data should be used and analyzed. "requires planning" means that defining aims and goals, problems and possibilities should be achieved. Finally "coordination" confirms the importance of relationship among the civil organizations, community, municipality, commercial units (hotels, motels, restaurants, bars, etc.).

Planning is the process of identifying objectives and defining and evaluating methods of achieving them. Comprehensive planning means planning which considers all of the tourism resources, organizations, markets, and programs within a region. Comprehensive planning also considers economic, environmental, social, and institutional aspects of tourism development (Stynes and O'Halloran, 1987). Tourism planning process can be summarized in the flow chart in Figure 3.1.

Like any planning, tourism planning is goal-oriented, striving to achieve certain objectives by matching available resources and programs with the needs and wants of people. Comprehensive planning requires a systematic approach, usually involving a series of steps. The process is best viewed as an iterative and on-going one, with each step subject to modification and refinement at any stage of the planning process.

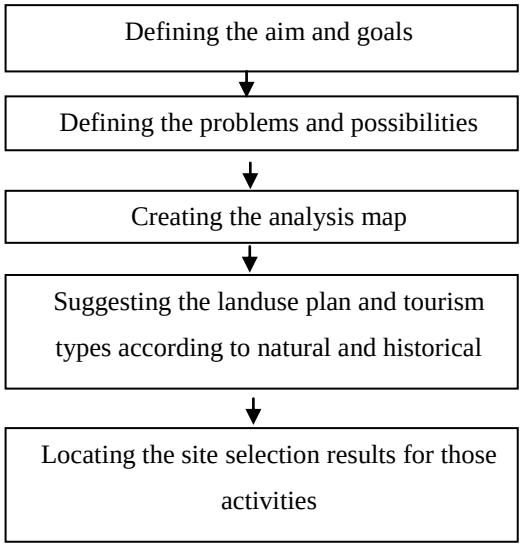


Figure 3.1. Tourism Planning Process

Stynes and O'Halloran (1987) defined the planning process as having the following six steps:

1. Define goals and objectives.
2. Identify the tourism system.
   a) Resources
   b) Organizations
   c) Markets
3. Generate alternatives.
4. Evaluate alternatives.
5. Select and implement.
6. Monitor and evaluate.

These six steps should be explained in detail in order to see the importance of GIS and Remote Sensing (RS) in tourism planning stages, and what can be added to those stages with the help of GIS and RS must be clarified.

1) Define goals and objectives: Obtaining clear statements of goals and objectives is difficult, but important. Having a good understanding of tourism and the tourism system in a community is the first step toward defining goals and objectives for tourism development. The types of goals that are appropriate and the precision with

which you are able to define them will depend upon how long one's community has been involved in tourism and tourism planning (Stynes and O'Halloran, 1987).

2) Identify the tourism system: When planning for any type of activity, it is important to first define its scope and characteristics. Clarifying the tourism system by breaking it down into three subsystems as (1) tourism resources, (2) tourism organizations, and (3) tourism markets can simplify to understand the system.

Tourism resources are any natural, cultural, human, or capital resources that either are used or can be used to attract or serve tourists. A tourism resource inventory identifies and classifies the resources available that provide opportunities for tourism development.

Tourism organizations combine resources in various proportions to provide products and services for the tourist. The most difficult part of tourism planning is to get public and private organizations to work toward common goals.

Successful tourism programs require a strong market orientation. The needs and wants of the tourists you choose to attract and serve must be the focus of much of your marketing and development activity. Therefore, it is important to clearly understand which tourism market segments you wish to attract and serve.

3) Generating Alternatives: Generating alternative development and marketing options to meet the goals requires some creative thinking and brainstorming. Creating new alternatives to solve the development problems especially for spatial ones can be easier with the help of GIS.

Tourism marketing decision questions include product, place, promotion and price. Product and place questions are important for this thesis. "What kinds of tourism products and services should be provided?" question should be replied in order to define the new tourism types that will be developed. "Where should tourism facilities be located?" is the most important question that must be answered correctly.

4) Evaluating Alternatives: Tourism development and marketing options are evaluated by assessing the degree to which each option will be able to meet the stated goals and objectives. There are usually two parts to a systematic evaluation of tourism development and marketing alternatives: Feasibility Analysis, and Impact Assessment. These two tasks are interrelated. They can be summarized as answering two questions which are "Can it be done?" and "What are the consequences?"

Feasibility analysis includes screening alternatives and eliminating those that are not feasible due to economic, environmental, political, legal, or other factors. However, comparing the alternative solutions and deciding the best one is not an easy task. Multi criteria decision support systems take a critical role in this step.

Impact assessment is also an important step that should be thought. Because evaluating alternative development and marketing strategies are important to understand the impacts, both positive and negative, of proposed actions. Tourism impacts can be summarized below in six topics,

- Volume of tourist activity relative to local activity
- Length and nature of tourist contacts with the community
- Degree of concentration/dispersal of tourist activity in the area
- Similarities or differences between local populations and tourists
- Stability/sensitivity of local economy, environment, and social structure
- How well tourism is planned, controlled, and managed.

5 and 6) Implementation, and Monitoring and Evaluation: Decision making, plan implementation, and monitoring are critical steps in the success of a tourism plan. A set of specific actions should be prescribed with clearly defined responsibilities and timetables. Plans generally need to be adjusted over time due to changing goals, changing market conditions, and unanticipated impacts. It is an ideal case to build monitoring and evaluation systems into the planning efforts.

“Remember, tourism should serve the community first and the tourist second” (Stynes and O’Halloran, 1987) is a key sentence which emphasizes the importance of preventing culture and nature, besides developing the tourism in the country.

It is possible to evaluate all those steps in scale of Bodrum Peninsula. The first step of tourism planning process is defining goals and objectives. Tourism is a developing sector in the last 20 years, however the increasing demands give rise to damage the nature in Bodrum. In such a case the first goal should be preserving the cultural and natural heritages in Bodrum. It must be known what can be done in order to preserve those cultural and natural values. GIS takes a significant role in this step. The boundaries of natural richness like forest, fertile agricultural land, green valley, river, bay (with blue flag which shows the clearness of the sea) etc. can be defined exactly. The detailed archeological, natural and urban site borders can be determined and should not be changed in any planning purpose.

The second step is identifying the tourism system which is formed by tourism resources, tourism organizations, and tourism markets. In Bodrum case, marketing is really important for new developing tourism types. If the marketing draw attention to camping and caravanning tourism instead of big hotels or holiday villages, no more buildings will be constructed.

The third step is generating alternatives and marketing options in order to suggest new tourism types in planning region. Tourism marketing decision questions include product and place that are the important inputs for planning. In Bodrum Peninsula, camping, caravanning, grass skiing, site-parachuting, and biking are the new tourism types which are suggested. The site selection process for these tourism activities, the requirements and evaluation of the criteria are discussed in chapter four.

3.1. Using GIS for Supporting Decision Making System in Tourism

Jankowski and Nyerges (2001) introduced a macro-micro approach to decision processes. “It is a systematic yet flexible approach for characterizing complex geographical decision making, and one way of setting a foundation for

understanding the complex character of decision support opportunities." This approach is summarized in Table 3.1. Macro phases are classified in three parts as intelligence, design and choice. Micro activities can be performed in four steps as gather, organize, select, and review.

The intersection cells of in Table 3.1 are summarizing the concept of decision making process. It is needed to define the values, objectives and criteria. In the first column, the intersection of the "gather" and "intelligence" shows the importance of gathering the values and creating the value tree according to the objectives. The intersection of "organize" and "intelligence" underscores the organization of the aims, goals and objectives according to the criteria and constraints. The importance of choosing the criteria that is used in the analysis stressed in the intersection of "select" and "intelligence".

The second column of Table 3.1 emphasizes the designing process of feasible options. The third column defines selecting the best option according to the objectives and adherent criteria. The last intersection cell (review and choice) stressed on the recommendations which give the input for inefficient decisions. So it is possible to go back and develop the objectives or criteria.

A lot of information in various fields is necessary for decision making in tourism field. Tourist statistics, tourism industry statistics, tourism law, tourism administration, tourism policy, tourism research materials, national land use plan, environment, transportation, and investment are the related fields with a tourism decision-making system. It is needed to build a database of those and make a plan for connecting the system with the related database. For the effective management of tourism resources (mountain, river, valley, beach, historical place, forest etc.), in the process of planning, execution and evaluation the right information is very important for policy makers, local administrators, and the planners. Those information should reflect the characteristics and current status about tourism resources (Kim, 2002).

Table 3.1. Micro-Macro Approach in Decision Strategy (Jankowski and Nyerges, 2001)

Micro- Activities in a Decision Strategy	**Macro- Phases in a Decision Strategy**		
	1. Intelligence about values, objectives and criteria	**2. Design** of a set of feasible options	**3. Choice** about recommendations
A-Gather…	Issues to develop and refine value trees as a basis for objectives	Primary criteria as a basis for option generation	Values, criteria, and option list scenarios for an evaluation
B-Organize…	Objectives as a basis for criteria and constraints	And apply approaches for option generation	Approaches to priority and sensitivity analyses
C-Select…	Criteria to be used in analysis as a basis for generating options	The feasible option list	Recommendation as a prioritized list of options
D-Review…	Criteria, resources, constraints, and standards	Option set in line with resources, constraints and standards	Recommendations in line with original values, goals and objectives

However, surveying, monitoring, and information management are conducted by each municipality or ministry in Turkey. For example, information about forested areas like forest area boundaries, types of the trees, etc. are stored by the Ministry of Forestry. On the other hand, information about the cultural heritage, boundaries of the protected zones in the same area are collected and stored by the Ministry of Culture and Tourism. So it is not easy to use those information and survey results systematically. If all those data are stored in a shared database, it can be possible to access the data.

There is a linkage between spatial data and non-graphic data in a database of GIS. Storing the graphic (spatial) and non-graphic data in the same space means that searching, editing, analyzing the data are done very efficiently. In addition, GIS data have topology in spatial features, therefore feature layer overlay, analysis, search, select by theme are possible. These kinds of characteristics make GIS as a tool of decision support such as location analysis, land use plan, tourism development plan, etc.

3.2. Multi Criteria Decision Analysis

"Geographical information is defined as georeferenced data that have been processed into a form that is meaningful and of real or perceived value to decision makers"(Malczewski, 1999). As pointed out by Phua and Minowa (2003), spatial problems are often made under a multi-decision maker context. Tourism planning is also under multi-decision maker context. Because, there should be a number of specialists from different disciplines who work for planning process.

The original data are interpreted and analyzed to produce useful information for decision makers. Information can be classified as hard (objective) and soft (subjective) information. Hard information is derived from reported facts, quantitative estimates, and systematic opinion surveys. Soft information, as a subjective one, represents the opinion of decision makers. This type of information has an important role in decision process because social values and political considerations also take place in the computations of decision makers (Malczewski, 1999).

In the planning process, the life style of the population is as important as the census data. The life style as a kind of soft information is derived from the city planner's judgments.

In general, Multi Criteria Decision making problems involve six components:

1. A goal or a set of goals that the decision makers attempt to achieve;
2. The decision makers or group of decision makers involved in the decision-making process along with their preferences with respect to evaluation criteria;
3. A set of evaluation criteria on the basis of which the decision makers evaluate alternative courses of action;
4. The set of decision alternatives, that is, the decision or action variables;
5. The set of uncontrollable variables or states of nature (decision environment);
6. The set of outcomes or consequences associated with each alternative-attribute pair (Malczewski, 1999).

There is a big structure (Figure 3.2) including goal, decision makers, objectives, attributes, and alternatives. The central element of this structure is a decision matrix consisting of a set of rows and columns. "The matrix represents the decision outcomes for a set of alternatives and a set of evaluation criteria." (Malczewski, 1999). The goal is the most general level of this structure. For example, to improve the quality of life in a region may be the goal of a land-use planning.

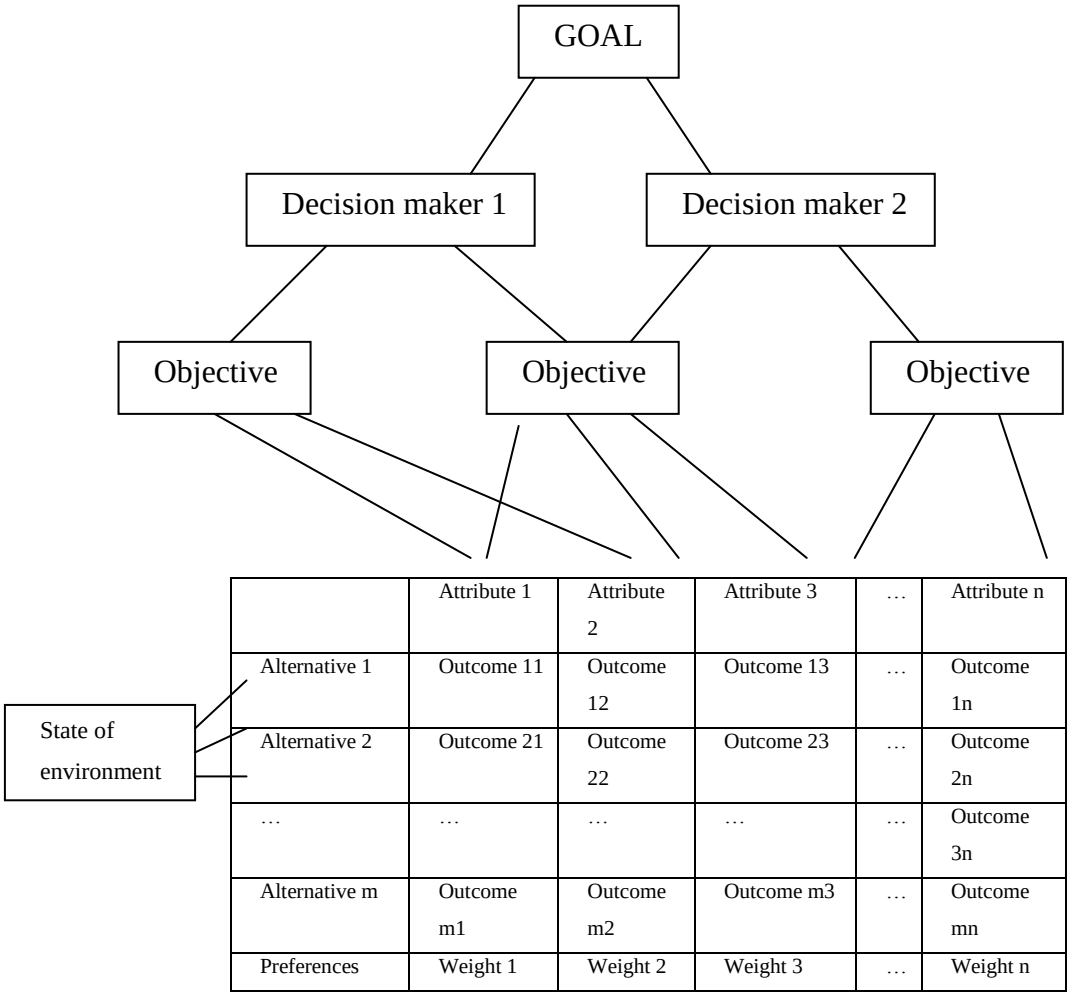


Figure 3.2. Framework for multi criteria decision analysis (Malczewski, 1999)

Multi-criteria decision making can be divided into two broad classes of multi-attribute decision making and multi-objective decision making. If the problem is to evaluate a finite feasible set of alternatives and to select the best one based on the scores of a set of attributes, it is a multi-attribute decision making problem. The

multi-objective decision making deals with the selection of the best alternative based on a series of conflicting objectives (Massam, 1988).

A decision maker may be a single person or a group of people, such as government or corporate organizations. The environmental plans are created by a group of planners, geological engineers, environmental engineers, architectures, agricultural engineers, and financial specialist etc. The third level of the structure is an objective that is a statement about the desired state of a spatial system. The rows of the decision matrix represent decision alternatives and the columns of the matrix represent the attributes (Figure 3.2).

The decision outcomes depend on the attributes and the alternatives. The intersection of each row and column create a new outcome. The decision problem requires that outcomes should be ordered so that the best alternative can be selected.

In Bodrum case, to develop tourism sector in peninsula without giving harm to nature is the goal of the tourism planning (Figure 3.3). The objectives are suggesting new tourism types and defining the best places for these activities. The attributes are the requirements for each tourism activity as slope, land use, and proximity. The outcomes are the possible regions which can be ordered in five classes as most suitable, very suitable, suitable, less suitable, and not suitable.

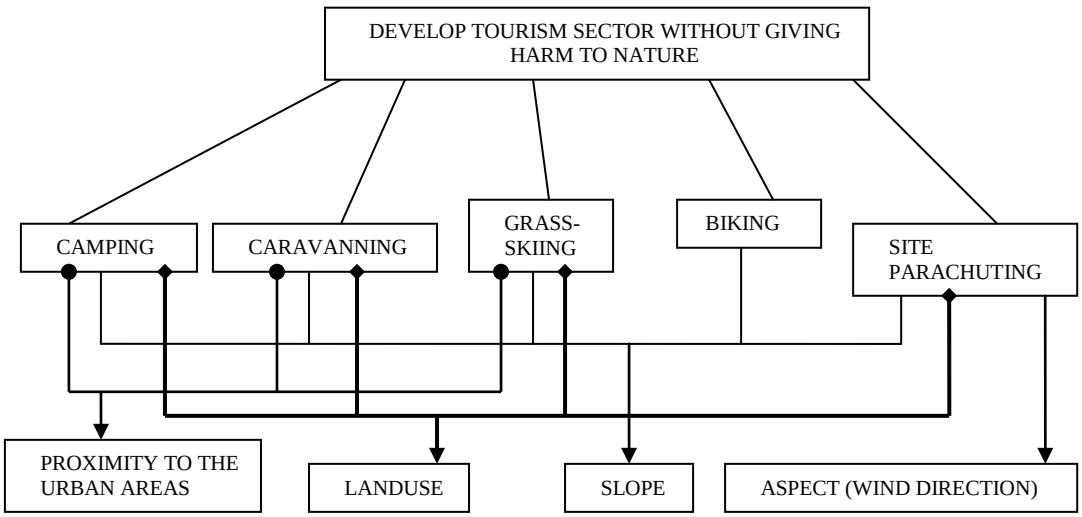


Figure 3.3. Hierarchical Structure of the objectives and attributes

CHAPTER 4

SITE SELECTION FOR NEW TOURISM TYPES IN THE STUDY AREA

4.1. The Importance of Bodrum Peninsula in Turkey Tourism Sector

Bodrum is a peninsula as a district of Muğla which is located in Aegean Region between Güllük and Gökova Gulfs. The intersection point of Mediterranean and Aegean Seas can be added to the definition of Bodrum location (Figure 4.1). The area of the district is 686 km² except the islands, and the indented coastal line is 224 km with 50 small bays (MTC, 2006). Some of the names of the bays are Güvercinlik, Akyarlar, Göltürkbükü, Bağla, Yahşi, Aspat, Bitez, etc. There are 22 islands around Bodrum Peninsula. The biggest one is Karaada which is in view of Bodrum Center. This island is one of the first degree natural protected areas and also has an archeologically protected site. Most of the other islands are also first degree natural protected areas.

Bodrum Peninsula is declared as "Culture and Tourism Conservation and Development Region" by the 11189 numbered decision of Cabinet at 10.30.2006. The district consists of 11 municipalities (Bodrum Center, Bitez, Göltürkbükü, Gümüşlük, Gündoğan, Konacık, Mumcular, Ortakent, Turgutreis, Yalı, Yalıkavak) and 19 villages. A number of historical places (castle, churches, cemeteries, fountains, windmills, etc.), and protected areas are located in this historical peninsula. Most of these date back as early as 1100 BC. It is indicated in the historical archives that Bodrum had been established in 1872 during the Ottoman times. (MTC, 2006).

The history of Bodrum where diverse civilizations lived, start from 5000 years ago as it is understood from the archeological findings. The small rocky island is the first settlement where St. Peter Castle existed. The castle was enclosed with the castle walls in that time. When St. John Knights came to build their castle, they

faced with an old castle that had been erected during Doric times (1100 BC). The most prominent feature of Bodrum is the Castle of St Peter. Whether entering the town by land or sea, it is impossible not to be influenced by the sturdy presence of the castle (Figures 4.2 and 4.3).

Figure 4.1. Location of Bodrum in Turkey

Figure 4.2. Bodrum Castle (Ikonos Image, 2006)

Figure 4.3. Bodrum Castle

Herodotus, the "Father of History", who lived in the Fifth Century BC and was born in Halicarnassus, wrote that the Dorians came from Troezen on the east coast of the Peloponnese. They called their new island Zephyria and the settlement Zephyrium.

Historians have little evidence concerning the foundation of mainland Halicarnassus. The first known mention of it comes form the Seventh Century BC. Halicarnassus was one of six members in the Dorian Confederation of Hexapolis, along with the mainland city of Cnidos, the island of Cos, and three cities on Rhodes. Dorians had to fend off the continuous attacks of wild natives known as Carians. However one small agreement between the Dorians and the Carians is made when a Greek opened a tavern around the spring at Salmacis (in the western end of Bodrum harbor, in present day Bardakçı). Both Dorians and Carians became regular patrons, and trade relations were established, and for a while the two races lived in peace.

Bodrum was invaded by a lot of civilizations from the Aegean Islands since it has been an important centre for who wanted to control the Mediterranean region. This Region, which included Muğla and Aydın cities, was called as “Caria” in ancient time. Halicarnassus (Bodrum) that was governed by 1st Artemisia who was the first woman commander in the history, was one of the important cities of Caria. Afterwards, Bodrum was governed by Persians, Macedonians, Roman Empire, and Byzantine Empire in the following centuries (Özükan, 2004).

Just one kilometer to the north from the castle, one of the Seven Wonders of the Ancient World, the Tomb of King Mausolus (now called The Mausoleum), was located, which was constructed in 356 BC and ruined 1500 years later by an earthquake. A made-up picture of the Mausoleum of Halicarnassus is given in Figure 4.4 and its location in the city in Figure 4.5. There is a museum where the fragments are exhibited today. Another historical structure is the Theater that stands as the only surviving structure from Classical Age. It is located just to the north of center of Bodrum (Figure 4.6). This theater is one of the oldest in Anatolia. A Turkish team restored it in the 1960's and today the people of Bodrum still use the theater for festivals (Figure 4.7). This historical value is a big potential for tourism development that must be evaluated.

Figure 4.4. Mausoleum of Halicarnassus

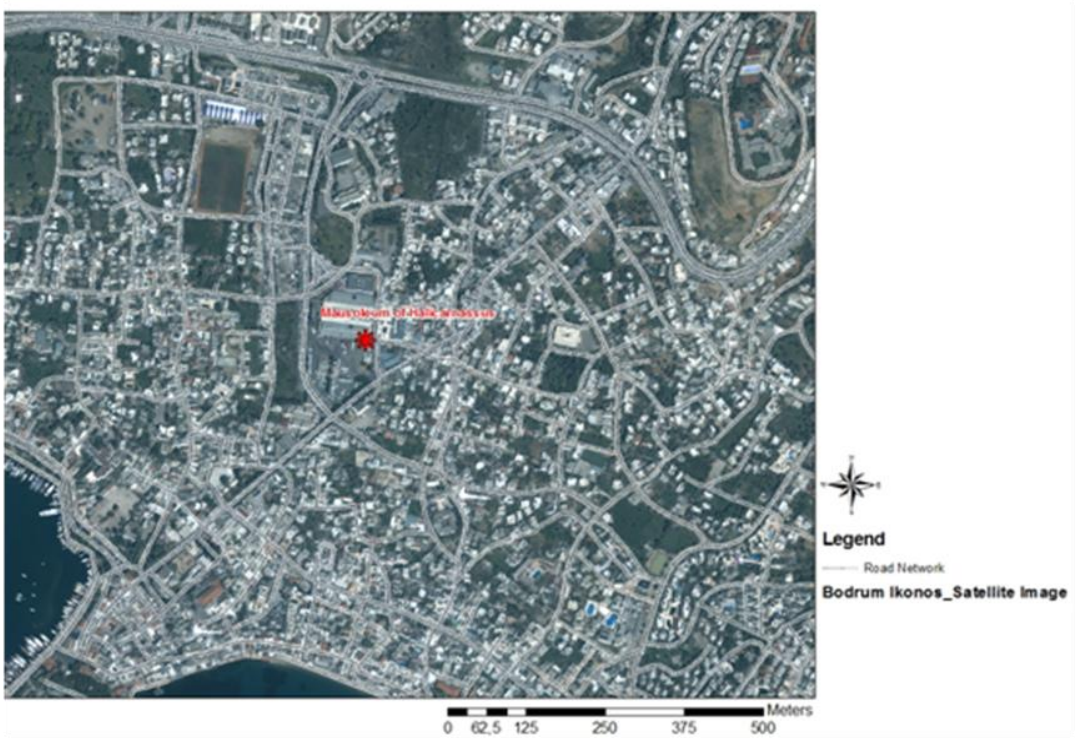


Figure 4.5. The location of Mausoleum of Halicarnasus (Ikonos Image 2006)

Figure 4.6. The location of Theatre (Ikonos Image, 2006)

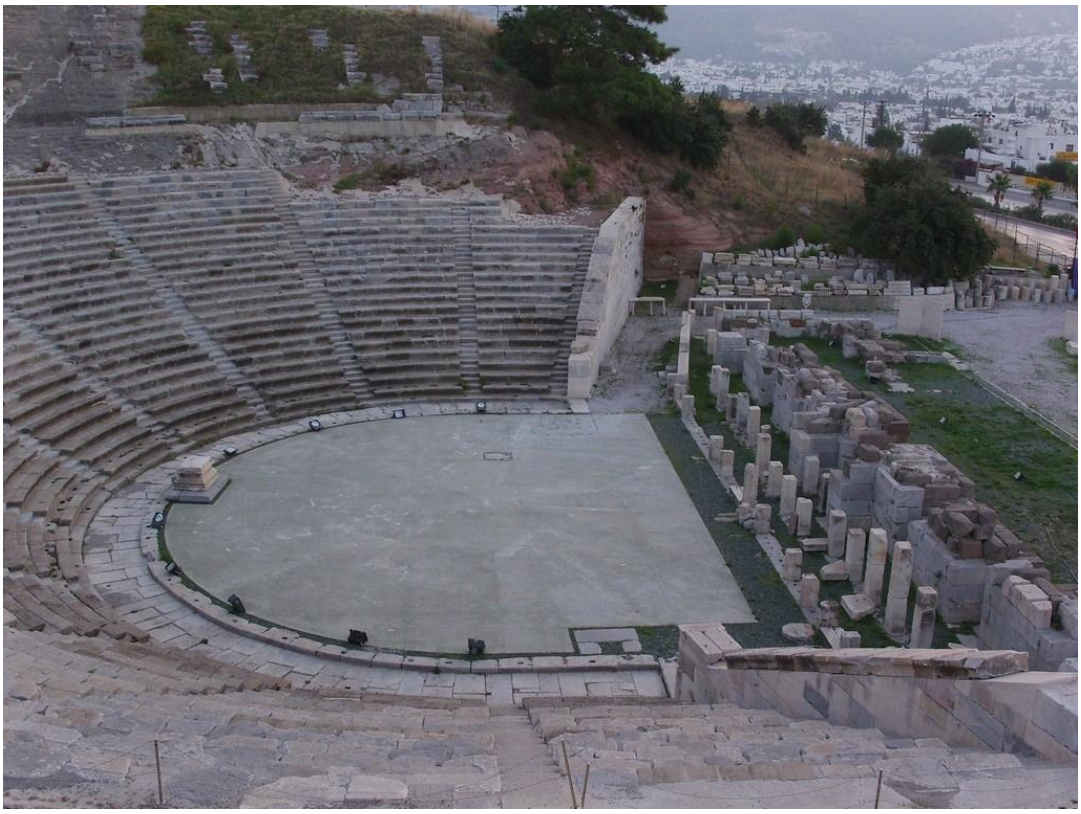


Figure 4.7. Theatre of Bodrum

Bodrum Peninsula is extending in an east-west direction in south-west Anatolia with Datça Peninsula. Peninsula which has a wavy topography, is fragmented by

deep valleys. Almost 90 percent of surface area is over 20 percent slope. The south-west of Anatolia has a karst structure which is very permeable. This structure of land does not allow the formation of surface flows since all the water infiltrates, and so there is not any river in Bodrum Peninsula (MTC, 2006). So it is not sensible to suggest rafting activities for this region.

The land use of Bodrum Peninsula is classified into seven groups which are forest (55%), olive land (12%), scrub-shrub land (12%), settlement area (10%), agricultural land (7%), fruit (citrus) garden (2%), and pasture land (2%). These percentages show that more than half of peninsula surface is covered by forest areas. The coastal line is followed by the bays and long beaches with blue flag which show the clearness of the sea water. That means, Bodrum Peninsula is in the middle of green and blue intersection, for which an example is given in Figure 4.8. Bodrum Peninsula is one of the significant tourism centers of Turkey, and has an international value in tourism sector. This fertile peninsula has a great potential for sea, natural and cultural tourism. People have been immigrated to this district center and its villages in order to benefit from the employment possibilities since 1970. Consequently, the historical name "Halicarnassus" as a small coastal town became one the most important tourism centers in Turkey (MTC, 2006).

Figure 4.8 The Natural Beauty of Bodrum

Both the summer and the winter populations are increasing, because the second residence owners and the foreign nationality people began to live permanently in Bodrum. Nowadays Bodrum changes from maturation period to standstill period in terms of the usage of the potentials, therefore it is in a turning point of its life. The fast and unplanned tourism development causes some problems in nature, transportation, social and technical infrastructure in Bodrum. The increase in the settlement area of Bodrum center is seen very clearly in the satellite images as shown in Figure 4.9. Summer houses, hotels, holiday villages are built up increasingly, and a big difference occurs between winter (97.000) and summer (1.500.000) populations. Table 4.1 shows the increase in the number of domestic and international tourists between 1992 and 2003 (Açıkbaş, 2005). It is obvious that this unplanned development may cause some damages to nature, human and also to daily life in the region.

Table 4.1. Number of domestic and international tourists (1992-2003)

Years	**International**	**Domestic**	**Total**
1992	59.169	65.830	**124.999**
1993	90.236	84.003	174.239
1994	85.105	57.931	123.036
1995	42.636	34.551	77.287
1996	158.714	98.097	256.811
1997	365.147	143.760	508.907
1998	270.956	180.726	451.682
1999	184.685	223.252	407.937
2000	238.747	386.318	625.065
2001	501.958	343.035	844.993
2002	548.387	280.268	828.655
2003	425.111	281.472	**706.583**

IKONOS SATELLITE IMAGE
07.30.2001

IKONOS SATELLITE IMAGE
07.02.2007

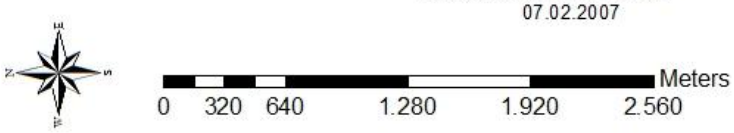


Figure 4.9. Ikonos Images collected 2001 (up) and 2007 (down) in Bodrum City Center

The population of Bodrum in 1990 was 56.821, and it became 97.826 in 2000. This means there was 54 % increase in the population in ten years. Another parameter of development in Bodrum and Muğla is the foreign population. 14.108 foreign people are living in Muğla where the whole population is 715.328. That means two percent of the population is foreign people, who are also buying property in the region (MTC, 2006). However, detailed information about the property which was bought by foreigners could not be reached.

4.2. Collected Data of the study Area

Data are the most important component of the geographic information systems. There are two types of GIS data which are categorized in raster and vector format. The collected data are illustrated in Figure 4.10. The arrow direction in the figure shows the input and the output relation. For example, contour lines are used for creating the Digital Elevation Model.

4.2.1. Raster Data

In this study IKONOS color Satellite imagery which has 1 m resolution is used for detailed analyses. The ground control points which are collected with 50 centimeters accuracy and digital elevation model in 10 meter horizontal accuracy are used in ortho rectification. So the horizontal accuracy of the images is 3 m. In order to perform change detection, two mosaic images and ten raw images which are collected at different dates between 2001 and 2008 are used.

The contour lines which are created from 1/25.000 scale topographic map sheets are used for the creation of Digital Elevation Model. This DEM is created in 5 m pixel size, and used for the ortho rectification of the satellite images. The slope analysis is also performed by using this DEM (Figure 4.10).

Environmental Plan of Bodrum Peninsula in 1/25.000 scale that is created in 2006 is acquired in jpeg format from the Ministry of Tourism and Culture. However this jpeg does not have the coordinate information. It is not possible to overlay the plan

on the satellite images in this case. So the polynomial rectification process is performed. It is also known that the plan was abrogated in 2008.

4.2.2. Vector Data

The vector data that are handled can be categorized in point, line and polygon shape data. The ones that were used during the environmental planning are also used for the analysis of this thesis after some adjustments.

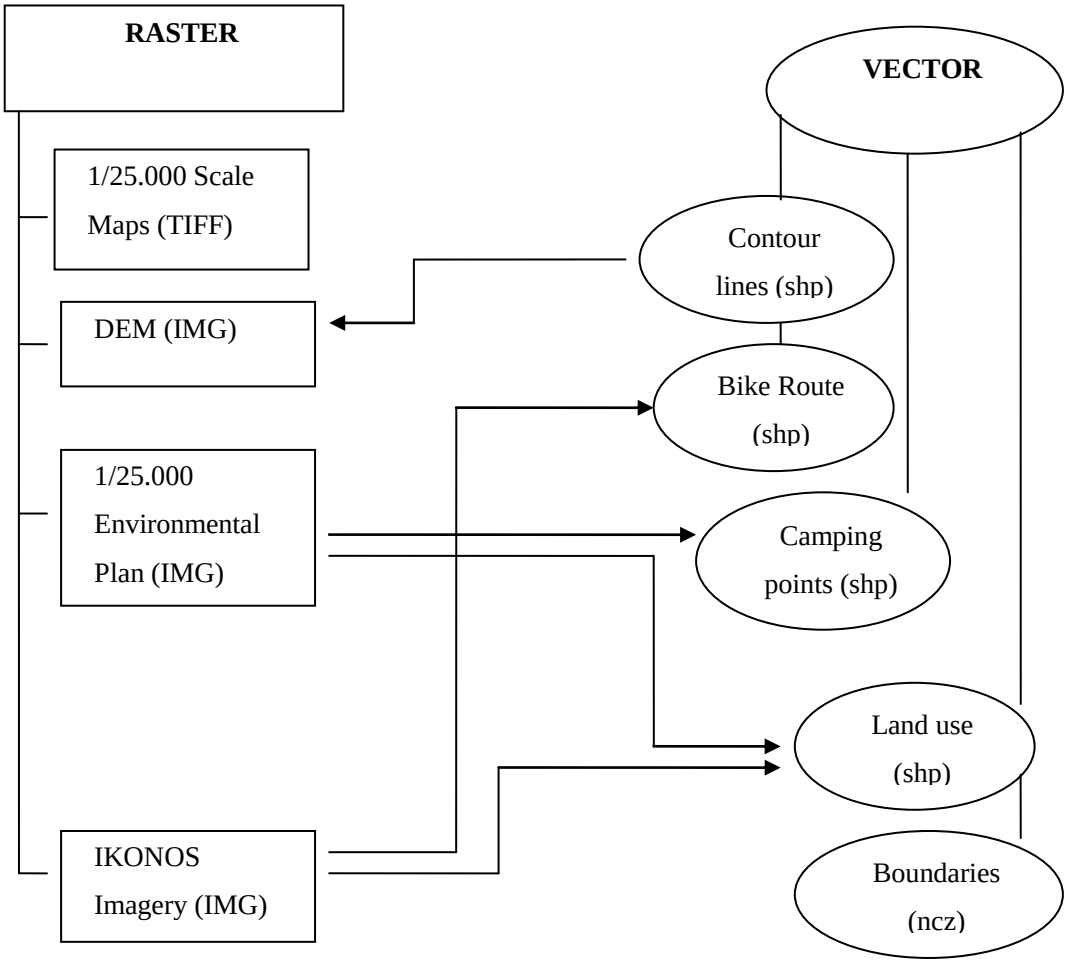


Figure 4.10. Collected Data

Point data: The planned camping areas in the Environmental Plan are shown as points in the plan. The camping points are marked in shape format by using the plan in “img” format which is coordinated (Figure 4.10).

Line data: The bike routes are digitized from the Ikonos Satellite image which is acquired in 2006.

Polygon data: Historical area boundaries (Archeological, Natural and Urban Site Boundaries) are gathered from the Tourism and Culture Ministry in “ncz” format that is created in NetCAD program. It is converted to shape format in order to use in Arc Map with the other data. Land use data, which is also in polygon form, is gathered from the Ministry of Tourism and Culture, however it is updated from the Ikonos satellite image.

4.2.3. Non-graphic Data

Documental data are also significant inputs for this study. Environmental Plan Decisions and Definition Report are worked on and summarized. Abrogation Judgement is another document that has critical comments on the plan. It explains the reasons why the environment plan is abrogated in 2008.

4.3. 1/25.000 Scale Environmental Plan of Bodrum Peninsula

The Environmental Plan of Bodrum which was abrogated in 2008 is gathered from the Tourism and Culture Ministry in high quality jpeg format (Figure 4.11). However this jpeg does not have the coordinate information. So it is not possible to overlay the plan and the satellite images in order to see the differences.

Therefore, the plan in jpeg format is converted to img format. However it gives only visual information like an ordinary photograph. So it must be corrected geometrically in order to have coordinate information. The plan is created in 2 dimensions and does not have the elevation information. So it is not necessary to use the digital elevation model (DEM) in correction model. For example, the correction of the satellite images needs the use of DEM in order to correct the shifting because of the acquisition angel. This type of correction method is called ortho rectification and the model is selected according to the satellite type. The polynomial model is selected, which does not need the use of DEM for the correction of the plan. The polynomial model uses ground control points (GCP) in

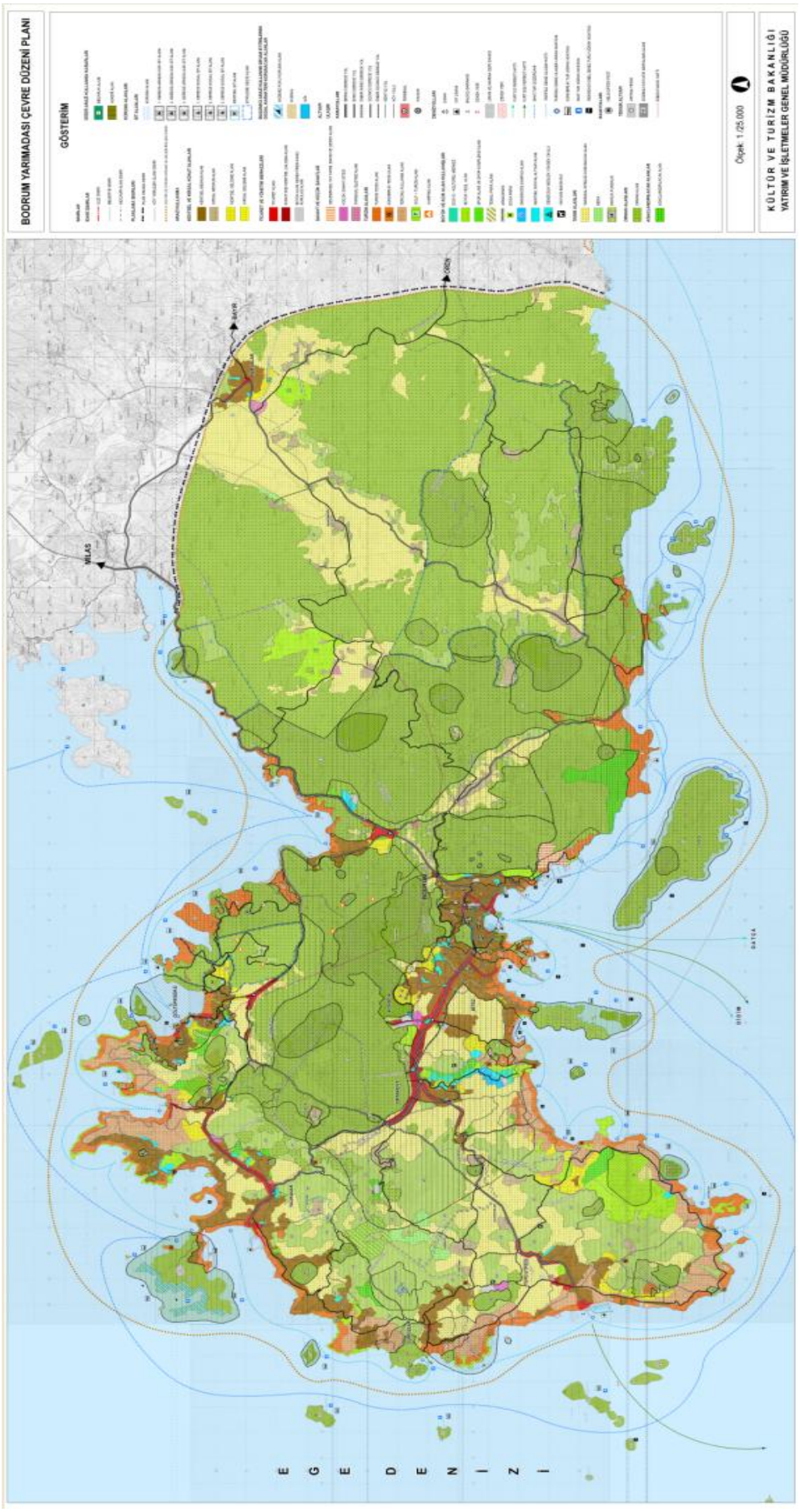


Figure 4.11. Bodrum Environmental Plan

Point #	Point ID	>	Color	X Input	Y Input	>	Color	X Ref.	Y Ref.	Type	X Residual	Y Residual	RMS Error	Contrib.	Match
1	GCP #1			7384.608	-6407.392			240644.701	199378.443	Control	0.035	0.201	0.204	0.048	
2	GCP #2			6925.471	-6353.803			239457.548	199622.784	Control	0.122	-5.299	5.301	1.241	
3	GCP #3			4277.606	-468.686			234090.929	215685.845	Control	5.974	0.823	6.031	1.412	
4	GCP #4			1053.632	-4743.725			224520.845	205382.909	Control	-5.558	8.433	10.100	2.365	
5	GCP #5			8938.355	-3218.814			245535.854	207320.783	Control	-1.514	7.918	8.061	1.888	
6	GCP #6			5746.667	-539.897			237905.967	215113.767	Control	4.040	-1.662	4.368	1.023	
7	GCP #7			7324.953	-1543.222			241750.377	212093.060	Control	-3.202	0.292	3.215	0.753	
8	GCP #8			8288.676	-2498.949			244019.440	209348.333	Control	-3.209	0.156	3.213	0.752	
9	GCP #10			3368.188	-1916.213			231326.000	212132.564	Control	2.461	-3.285	4.104	0.961	

Figure 4.12. Geometric Correction

order to correct the raw data. The GCPs can be collected from either the field or any reference data (imagery or map). The ortho rectified Ikonos image which is collected in 2006 and has 2 meters spatial accuracy is used as reference data. As it is shown in Figure 4.12, common ground control points are selected from both plan and the image. Erdas Imagine 9.3 which is a remote sensing program is used for these correction steps. After the plan gets the coordinates it is possible to read the location information, and the satellite image and the plan can be overlaid.

4.4.Site Selection Result without Giving Priority to Requirements

GIS can be an important tool for the "objectives" step of tourism planning as it is shown in the GIS and Tourism Planning Relationship figure (Figure 2.1). New suggestions about the city that are planned should be defined as the objectives of the plan. New suggestions can be new tourism types that are not seen in the area. Camping, caravanning, biking, grass skiing, and site parachuting can be some of the suggestions. However the areas where those activities can be performed should be determined and shown in the physical plan. GIS take a significant role in "site selection" step of tourism planning. Different types of parameters should be analyzed like slope, aspect land use, proximity, etc. in order to define the suitable areas for new activities. Site selection results are defined with the help of GIS tools.

"A primary objective of a site selection process is to assure that new facilities are located at intrinsically superior sites that, by virtue of their natural features and land use setting, provide a high degree of protection to natural resources and environment" (Yeşilçınar and Çetin, 2005).

Camping, caravanning, bike routing and site parachuting are suggested in the plan decisions for Bodrum Peninsula. However there are only camping areas, which are pointed out in the physical plan. There is no suggested region for caravanning or site parachuting or routes for biking. The overlay, intersection, and union techniques are used as the methodology for preparing a final site selection map including all of the evaluations.

The Youth and Sport Association is an organization that is appurtenant to Ministry of State. This organization is responsible from all the sport activities in Turkey. The specialists are working on different kinds of sports in detail, according to 61 federations (basketball, tennis, skiing, camping, biking, etc.). This organization defines the parameters for suitable areas for these sports activities including the ones studies in this thesis as camping, caravanning, grass skiing, and site parachuting. According to their requirements, slope is one of the important variables, and proximity to the urban areas is another one. Both camping and caravanning areas should be in the forest, however the condition of the forest, whether it is dense or sparse is also important for this case. For example, grass skiing and site parachuting can be performed in sparse forest or open land.

In order to perform the slope analysis contour lines of 1/25.000 scale map sheets are used in shape format. Those contour lines are created in CAD based programs not in GIS based. Because, in CAD based programs visuality is important, and colors, line weights, marks can be used. However in GIS based programs those types of data are stored in the database and color does not define any elevation information by itself. For example the highest point of a hill can be digitized as a cross in a CAD program. However it should be defined as a point in order to be used while creating a surface in GIS based programs. Those kind of problematic lines and points are cleaned and deleted before the digital elevation model is created. “Create Surface” tool in Erdas Imagine 9.3 is used for the creation of DEM. The column which stores the elevation information is given as an input to the model. Finally DEM (Figure 4.13) is created in five meters pixel size and img data format. Slope (Figure 4.14) and aspects maps (Figure 4.15) are created by using DEM data with the help of Arc GIS 9.0.

4.4.1. Camping Areas

The Youth and Sport Association defines three parameters for suitable camping areas. One of those parameters, is the requirement that camping areas should be 500 meters away from the buildup areas like city, district and village. Because camping activity should be performed in quite natural places away from the noisy locations. Another parameter is about land use. They should be in the forest area and there

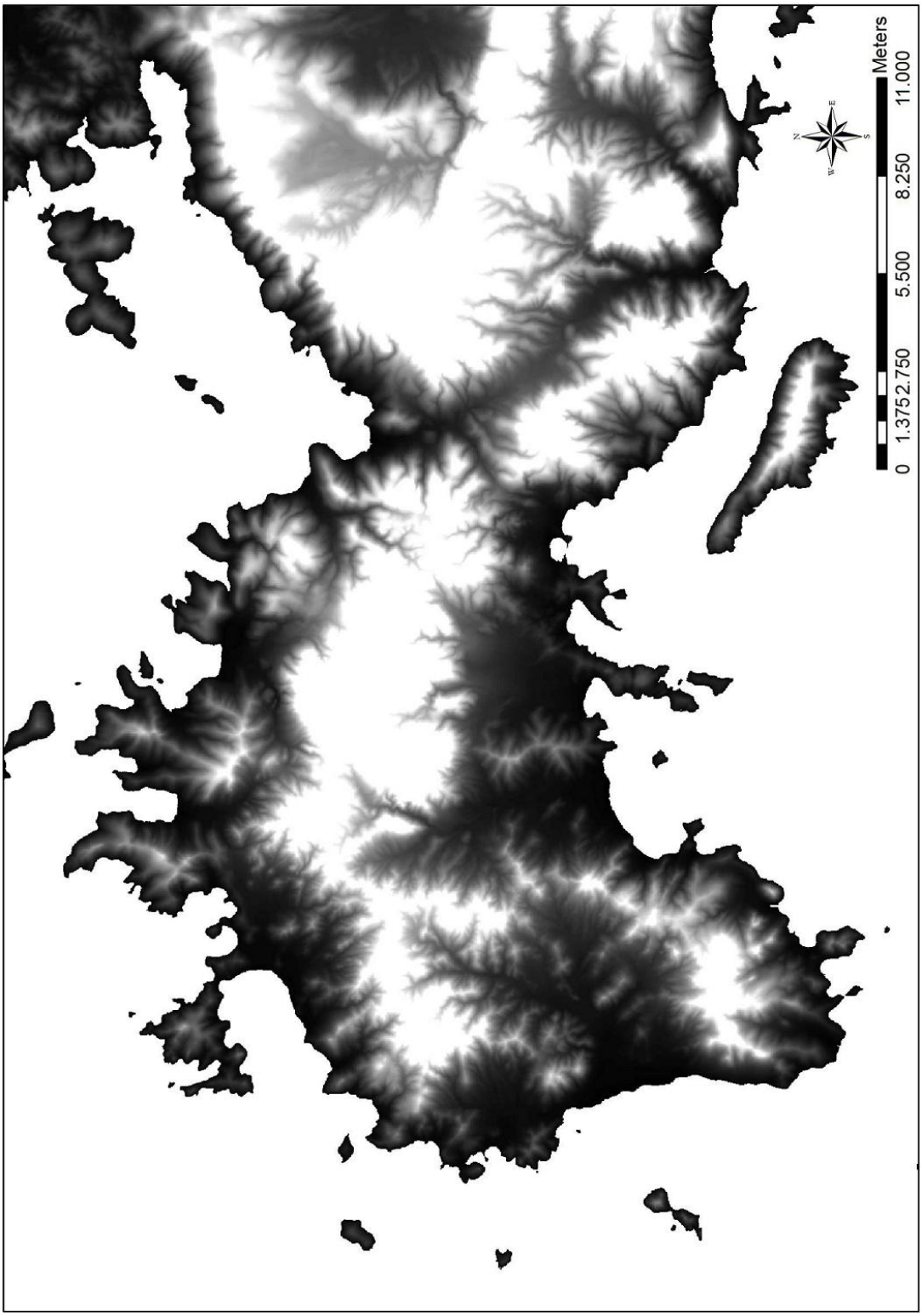


Figure 4.13. Digital Elevation Model of Bodrum Peninsula

should be big and high trees in order to benefit from the tree shadows and clean air. This type of forest is called dense forest. The last parameter is the slope, and it should be under 20 percent so that tents can be settled up easily.

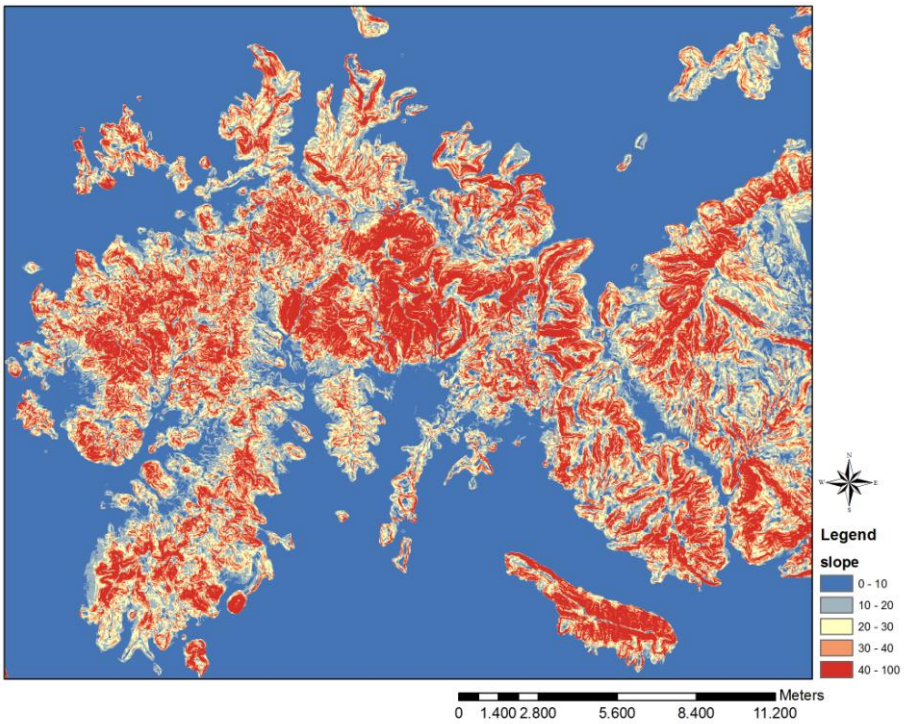


Figure 4.14. Slope Map

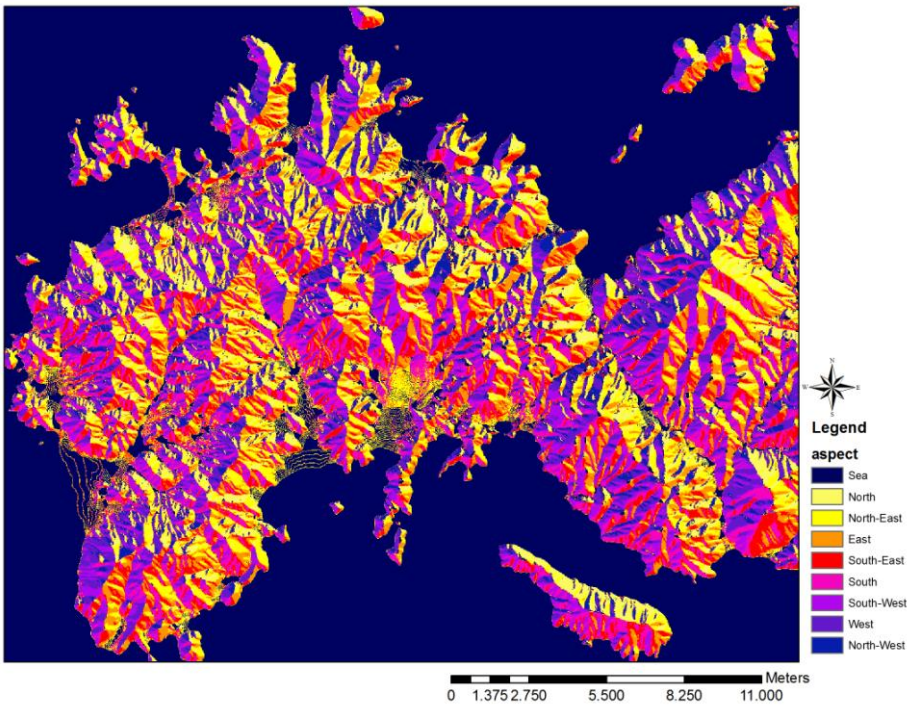


Figure 4.15. Aspect Map

Firstly, slope data are created in “img” format by using “Spatial Analyst” tool in Arc Map 9.0. Slope analysis is performed to determine the areas with 5 percent intervals and among them the areas which have less than 20 percent slope are selected.

Secondly, the dense forest areas and build up areas are digitized by using the ortho rectified Ikonos image (acquisition date: 2006). Up-to-date data are very important in decision making level, since there can be changes in urban area or forest boundaries in time. New houses, factories, commercial buildings can be settled up so the boundaries of the urban areas may change in time. In the forest area, a lot of trees may be lost because of the fires or they can be cut for different reasons. So forest area boundaries can also change in time. In order to update those boundaries a field survey must be done and the changes should be detected with the coordinate information. Afterwards they must be converted to digital format. However with the help of a current satellite image, change detection can be performed at the office easily and more precisely. GIS and remote sensing are effectively used for this level of planning as an example of updating the forest and build up areas that is mentioned above.

Proximity to the city, districts, and villages is the last parameter for suitable camping areas. The 500 meters buffers around the buildup areas are created as a polygon shape file. However camping areas should not be inside of those regions. In order to define the regions which are outside of these buffers but inside of Bodrum Peninsula, another polygon layer which is defining the whole study area is created. Afterwards, the buffer regions are erased from the whole area in order to create the polygon which defines the outside of buffers.

The buffering process is performed with the help of “Buffer” tool under the Proximity part in Analysis Tool of Arc Toolbox. The erasing is also performed with the help of “Erase” tool under the Extract part in Analysis Tool of Arc Toolbox.

Possible camping areas can be defined by finding the intersection of those regions which are selected according to three parameters. So the intersection process of three different layers is performed with the help of “Intersection” tool under the

Overlay part in Analysis Tool of Arc Toolbox. Finally, areas which are suitable places for camping purposes are selected, and they have 6 km^2 size.

In the environmental plan there are six proposed camping areas which are denoted with points (Figure 4.16). However the suggested points and analysis results do not overlap with each other. Four of those points are not inside the areas that are defined in the analysis results (Figure 4.17). The result of site selection processes shows that there are 6 km^2 areas that are suitable for camping. However those regions are not denoted in the environmental plan. That difference may indicate the importance and necessity of geographical information systems for any site selection case.

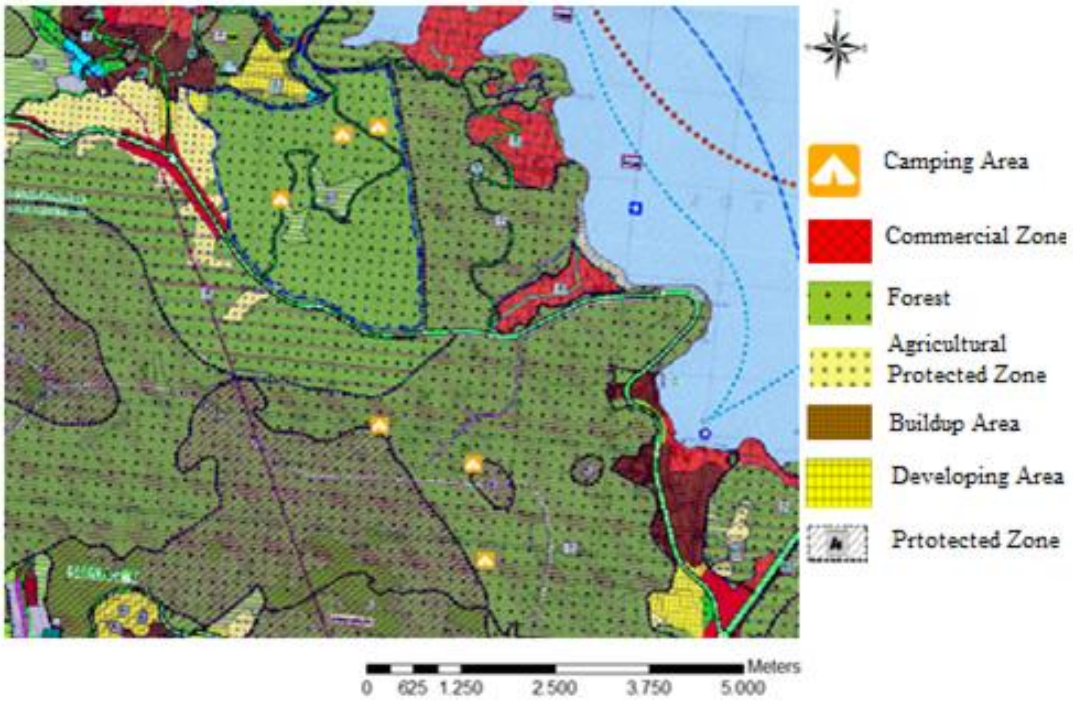


Figure 4.16. Proposed camping areas in the environmental plan

4.4.2. Caravanning Area

In the environmental plan it is stated that “caravan tourism” will be promoted in the peninsula, however there is no area shown in the physical plan. So it is searched if there are possible caravanning areas or not in the region.

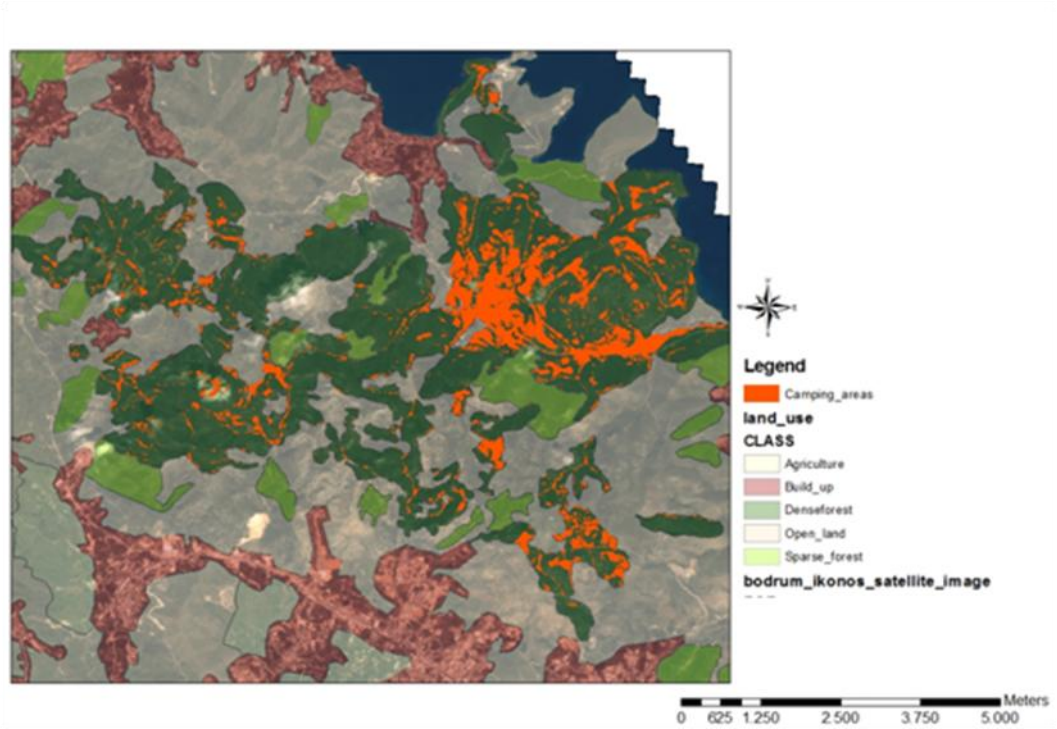


Figure 4.17. Possible Camping Areas

The Youth and Sport Association defines three requirements for suitable caravanning areas. One of those requirements is that caravanning areas should be 500 meters away from the city, district and village, but inside 1000 meters zone in order to benefit from the electricity and water resources. The accessibility is also important for the vehicles. So, any place that is not accessible with a road is not suitable for caravanning purpose. Another requirement is about land use. They should be in the forest; however the texture of forest area should not be dense. The big and high trees should not be close together in order to be able to drive and park the vehicles. This kind of forest is called sparse forest. The last requirement is the slope, and it should be under 10 percent so that caravans can stay safely.

The legal forest area boundaries are determined by the Ministry of Forestry. However those boundaries may also be created according to the ownership information. If the land is owned by the Ministry of Forestry it is shown as forest, although there may not be any trees on it. It is important to define the areas with the help of a current satellite image or by a field survey. So the sparse forest areas are digitized according to Ikonos Satellite image collected in 2006. Then, these sparse

forest areas are used as the first layer in the site selection process for suitable caravanning areas.

Slope data are created in “img” format by using “Spatial Analyst” tool in Arc Map 9.0. Slope analysis is performed with 5 percent intervals and the areas which have less than 10 percent slope are selected.

Proximity to the city, districts, and villages is the last parameter for suitable caravanning areas. Than 500 meters and 1000 meters buffers around the buildup areas are created as polygon shape files. It is needed to find the zone which is inside the 1000 meters buffer but outside the 500 meters buffers. “Clip” tool is used in the extract part of ArcToolbox in order to define this zone.

Finally, “Intersection” tool under the Overlay part in Analysis Tool of ArcToolbox is used to select the possible caravanning regions in Bodrum Peninsula. In the environmental plan there is no proposed caravanning area. However 0.5 km^2 possible areas are determined in the site selection result (Figure 4.18).

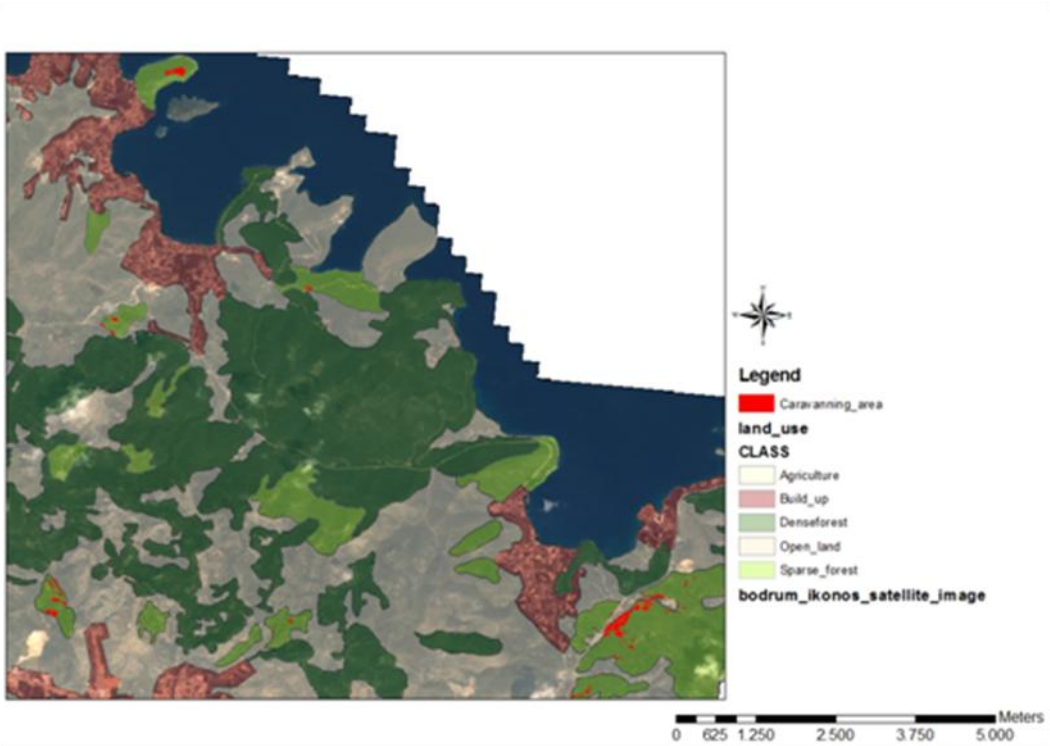


Figure 4.18. Possible Caravanning Areas

4.4.3. Biking Routes

In the decisions of environmental plan, it is stated that biking will be promoted in the Bodrum Peninsula. However no route is given in the prepared plan. Therefore, possible biking routes are searched.

Firstly, the paths in the forest and mountain areas are digitized with the help of Ikonos satellite image which is acquired in 2006. While digitizing the paths it is not possible to know the slope. However, the slope of the paths should be under 20 percent in order to be suitable for biking (Youth and Sport Association). So the slope layer is created from the DEM. This polygon layer shows different slope classes in 5 percent interval. The areas which are under 20 percent are selected. Afterwards, those selected areas are clipped from the paths in order to find the most suitable parts of the paths for biking activity.

Finally, it is seen that there are paths with a total of 56 km length in the mountainous area (Figure 4.19). The slope of 20 km of those paths is under 20 percent which is most suitable and the slope of 36 km of them is between 20 and 30 percent which is acceptable.

4.4.4. Site Parachuting Areas

Site Parachuting is another tourism activity which is suggested to be developed in the environmental plan decisions. However there are not any suggested areas for this activity in the plan. Slope, land use, and wind direction are requirements for selecting the suitable areas for this activity (Youth and Sport Association).

For site parachuting, the slope should be over 30 percent. So the slope layer which is a raster data is created from DEM in five meter pixel size. It is used to define the areas which are over 30 percent with the help of raster calculator tool in Arc Map.

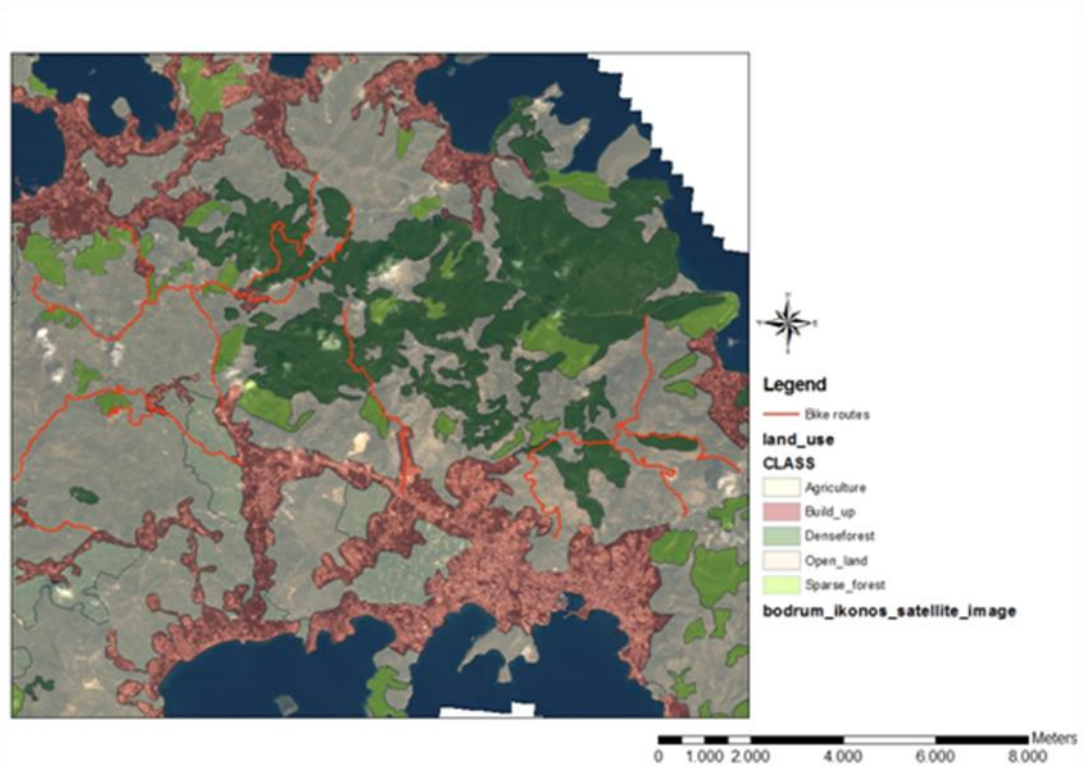


Figure 4.19. Possible Bike routes

The wind direction is generally south-west in Bodrum Peninsula. It is important to take the wind from the back of the person to be able to fly away from the cliff surface. So it is needed to find the north-east sides of the mountain areas. Therefore, aspect analysis is performed in order to define those areas. The aspect layer is created from the Surface Analysis tool in Arc Map.

Land use should be open land type or sparse forest in order to be suitable for site parachuting. So open land and sparse forest areas are selected from the land use raster data. Finally, the three raster layers are multiplied in raster calculator in order to define the areas which are over 30 percent slope, at the north-east side of the mountains, and also open land or sparse forest. The raster layer is then converted to vector layer in order to define the suitable areas for site parachuting in polygons. As a result, it is found that there are areas with approximately 20 km^2 size which are suitable for site parachuting activity in the region (Figure 4.20).

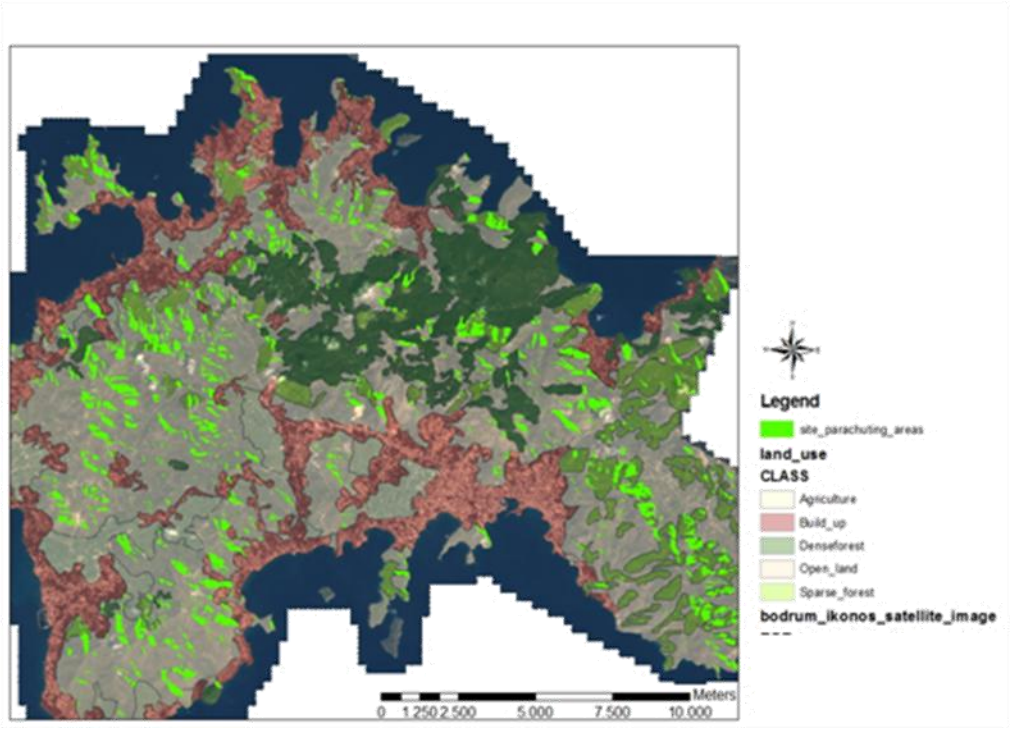


Figure 4.20. Possible Site-Parachuting Areas

4.4.5. Grass Skiing Areas

Grass skiing can be suggested as one of the new tourism types in Bodrum Peninsula. Slope, land use, and proximity to the urban areas are the requirements for selecting the suitable areas for this activity (Youth and Sport Association). Slope is an important requirement for the skiers to be accelerated. So, slope should be between 15 and 20 percent. Slope analysis is performed to determine the areas with 5 percent intervals, and the areas which have less than 20 percent and more than 15 percent slope are selected.

Another requirement is the land use. Sparse forest or open land areas where the grass can be grown are suitable for grass skiing. Beside, there should not be trees not to disturb the skiers. The boundary definitions of those areas are very important so these boundaries are digitized from the one meter resolution satellite Ikonos image. Updated land use data is converted to raster format to be used in raster format.

Proximity to the urban areas is the last one of the three requirements. Grass skiing areas should be 500 meters away from the city, district and village but inside 1000 meters zone in order to benefit from the electricity and water resources. This zone is created in shape file and then converted to raster format.

Finally, those three layers are multiplied in raster calculator in order to define the areas that meet the requirements for grass skiing areas. As a result, 8 km^2 possible areas are determined in the site selection result (Figure 4.21).

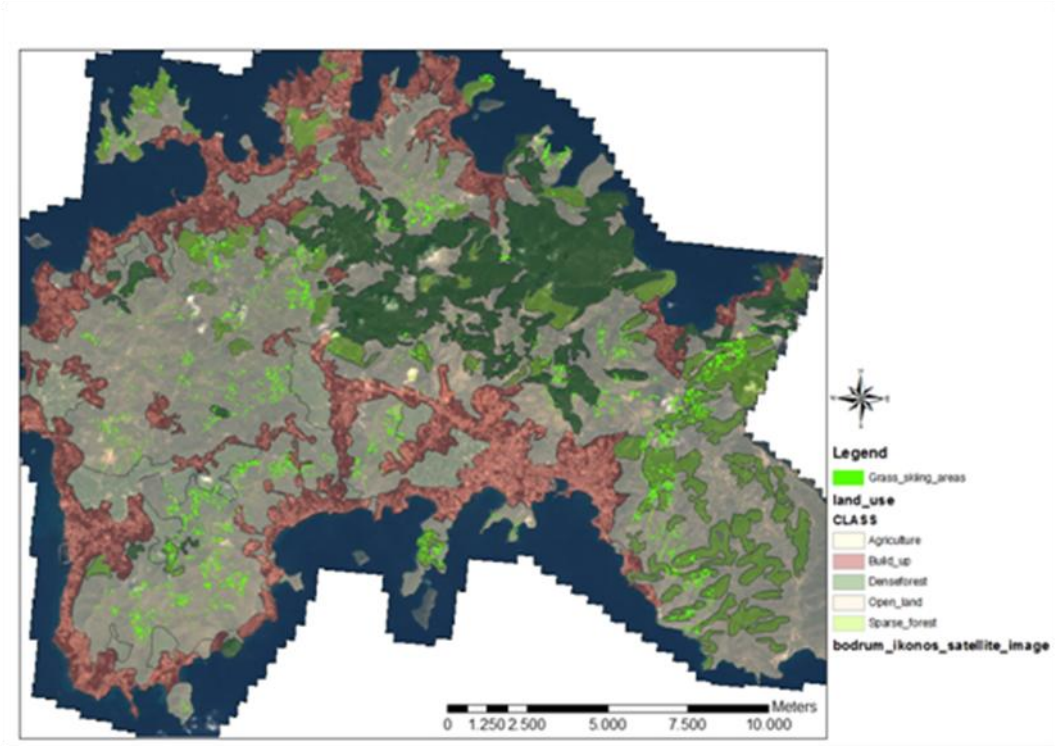


Figure 4.21. Possible grass skiing areas

4.5. Analytic Hierarchy Process

The Analytic Hierarchy Process (AHP) is a commonly used solution technique for any multi criteria decision making problem. This method is one of the most flexible and easily implemented multi criteria decision making techniques. It is a technique of measurement concerned with dominance priorities from pair wise comparison of elements with respect to a common criterion. It is possible to consider both objective and subjective factors in selecting the best alternative with the help of AHP.

Despite the widespread use of the AHP in diverse decision problems, this multi-attribute approach has not been without criticisms. For example, some of the criteria can not be easily detected, like social effects. Therefore measurement of some criteria will be made by decision-makers with the subjective assessment of each alternative. On the other hand it is possible to face with a subjective assessment even in the case that the parameter can be measured easily. In spite of these criticisms, in fact it is one of the most popular multi criteria decision making methodologies available today. Thus the areas in which the AHP is applied are diverse and numerous. The popularity of the AHP is due to its simplicity, flexibility, ease of use and interpretation etc. in analyzing complex decision problems (Saaty, 1980).

Tourism planning often requires large amount of spatial information. The site selection process for new tourism types like camping, caravanning and grass-skiing encloses different factors. These factors are slope, elevation, land use category and proximity to urban areas. Multi-criteria analysis is performed to evaluate development suitability map for Bodrum peninsula for each tourism type, according to appropriately measured and weighted factors.

A primary issue in the evaluation is to assign weights to each factor separately. For each factor, a set of relative weights for influential factors should be developed in advance so that it can be used as input for suitability evaluation in the next step. To apply this approach, it is necessary to break down a complex unstructured problem into its component factors. Afterwards, it is necessary to arrange these factors in a hierarchic order, and assign numerical values to subjective judgements on the relative importance of each factor (Dai et al., 2001).

In the construction of a pair wise comparison matrix, each factor is assigned a relative dominant value between 1 and 9 to the intersecting cell (Table 4.2). When the factor on the vertical axis is more important than the factor on the horizontal axis, this value varies between 1 and 9. Conversely, the value varies between the reciprocals 1/2 and 1/9 when the factor on the horizontal axis is more important than the factor on the vertical axis (Saaty and Vargas, 1991).

Table 4.2. Scale for comparisons

1	Equal importance
3	Moderate prevalence of one over another
5	Strong or essential prevalence
7	Very strong or demonstrated prevalence
9	Extremely high prevalence
2,4,6,8	Intermediate values

The factors are compared against all others with respect to the three different tourism types. The pair wise comparison matrix for these three factors can be constructed as shown in Table 4.3, where the main diagonal value is always equal to unity.

Slope is prefered very strongly to proximity to urban areas so 7 is given in the intersection cell between slope and proximity to urban areas in Table 4.2. Then 1/7 is given to the reciprocal intersection cell. Slope is moderately prefered to land use so 3 is given in the intersection cell between slope and land use, and 1/3 is given to the reciprocal intersection cell.

This way a vector of weights is obtained which reflects the relative importance of the various factors from the matrix of paired comparisons. In order to calculate the weights for each factor, firstly the sum of each column is calculated (Table 4.3). Secondly every cell is divided by its column sum (Table 4.4). Finally, the average value of each row is calculated. In this case, the weights for the three factors are obtained from the matrix in Table 4.4.

In AHP, an index of consistency, known as the consistency ratio (CR), is used to indicate the probability that the matrix judgements are randomly generated (Dai et al., 2001).

$CR = CI / RI$

Where RI is the average of the resulting consistency index depending on the order of matrix given by Dai et al. (2001) and CI is the consistency index and can be expressed as

$CI = (\lambda_{max} - n) / (n - 1)$

where λ_{max} is the largest or principal eigenvalue of the matrix and can be calculated from the matrix, and n is the order of the matrix. The "n" value is also defined as the number of the factors that is evaluated.

Table 4.3. Pairwise Comparison Matrix Showing Preferences for the Three Factors in Terms of Camping Areas

	Slope	Land use	Proximity to Urban Areas
Slope	1	3	7
Land use	1/3	1	4
Proximity to Urban Areas	1/7	1/4	1
Total	1,4761	4,25	12

Table 4.4. Pairwise Comparison Matrix Showing Weights for the Three Factors in Terms of Camping Areas

	Slope	Landuse	Proximity to Urban areas	**WEIGHTS**
Slope	0,6774	0,7058	0,5833	**0,6555**
Land use	0,2258	0,2352	0,3333	**0,2648**
Proximity to Urban areas	0,0967	0,0588	0,0833	**0,0796**
Total	1	1	1	**1**

In order to calculate the consistency ratio for Table 4.4, firstly the matrix of Table 4.3 and the matrix of weights are multiplied by using Matlab 7.0 as shown below (Yılmaz, 2004).

camping = [1,3,7;0.333,1,4;0.1428,0.25,1]

w= [0.6555; 0.2648; 0.0796]

ans = camping*w

ans = 2.0071, 0.8015, 0.2394

Afterward the values of this vector are divided by the weights one by one.

2.0071/ 0.6555= 3.0617

0.8015/0.2648= 3.0266

0.2394/0.0796= 3.0058

λ_{max} = (3.0617 + 3.0266 + 3.0058) / 3 = 3.0314

CI = (λ_{max} - n) / (n - 1)

n= 3

CI = (3.0314-3) / 2 = 0.015

Consistency ratio is equal to the division of consistency index and resulting index.

CR= CI/RI

Consistency Ratio = 0.015/0.58 = 0.02

The Resulting index value is taken from Table 4.5 as 0.58 if three factors are evaluated.

Table 4.5. Resulting Index

n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI	0,00	0,00	0,58	0,90	1,02	1,24	1,32	1,41	1,45	1,49	1,51	1,48	1,56	1,57	1,59

A consistency ratio of the order of 0.10 or less is a reasonable level of consistency (Dai et al., 2001). A consistency ratio above 0.10 requires revisions of the judgements in the matrix because of an inconsistent treatment of particular factor ratings. In this case the consistency ratio of the matrix of paired comparisons between the three influential factors in the suitability assessment of camping areas is 0.02, and is thus acceptable. Once a satisfactory consistency ratio is obtained, the resultant weights are applied. The weights should add up to 1.0, as the linear

weighted combination calculation requires. A similar process takes place in other types of tourism activities like caravanning and grass skiing as shown in Tables 4.6 and 4.7.

Table 4.6. Pairwise Comparison Matrix Showing Preferences for the Three Factors in Terms of Caravanning Areas

	Slope	Land use	Proximity to Urban Areas	**WEIGHTS**
Slope	1	6	3	**0,6269**
Land use	1/6	1	1/2	**0,0806**
Proximity to Urban Areas	1/3	5	1	**0,2923**
Total	1,5	12	4,2	**1**

Consistency ratio = 0.08

Table 4.7. Pairwise Comparison Matrix Showing Preferences for the Three Factors in Terms of Grass Skiing Areas

	Slope	Land use	Proximity to Urban Areas	**WEIGHTS**
Slope	1	3	9	**0,6688**
Land use	1/3	1	5	**0,2673**
Proximity to Urban Areas	1/9	1/5	1	**0,0637**
Total	1,4444	4,2	15	**1**

Consistency ratio = 0.02

Three factor groups are graded according to the importance for different types of tourism activities. Slope is an important determinant of suitability assessment for all three of them. However the six classes of the slope can take different grade for each tourism type between one and four. For example the slope between zero and five percent zone is most suitable for camping areas, however the same zone is not that much suitable for grass-skiing activity. So this zone takes four for camping but one for grass-skiing. The slope over 20 percent zone is unsuitable for caravanning activity so it takes zero (Table 4.8).

Table 4.8. The grading of slope values for three types of tourism

Slope (percent)	Camping	Caravanning	Grass-Skiing
0-5	4	4	1
5-10	3	3	2
10-15	3	2	3
15-20	3	1	4
20-30	2	0	2
30+	1	0	1

The second factor for suitability is land use. There are five different categories in land use maps which are dense forest, sparse forest, build up area like district center or villages, agricultural land, and open land. The grading of land use categories also differ according to the tourism types. For example dense forest is the best place for camping activity. However it is not suitable for caravan parking. It is impossible to create grass-skiing floor in a dense forest area. So this category takes three for camping, one for caravanning, and zero for grass-skiing. In direct contradiction the category of open land takes three for grass-skiing, two for caravanning, and one for camping in Table 4.9.

Table 4.9. The grading of land use areas for three types of tourism

Land use type	Camping	Caravanning	Grass-Skiing
Dense-Forest	3	1	0
Sparse-Forest	2	2	2
Build up area	0	0	0
Agricultural area	1	1	1
Open Land	1	2	3

The last factor for suitability is the proximity to the build up areas like district centers and villages. Five different buffer zones are created according to the build up areas as zero to 500 meter zone, 500 to 1000 meter zone, 1000 to 1500 meter zone, 1500 to 2000 meter zone, and more than 2000 meter zone. The grade of the

first zone is zero for all three activities. Because the first zone is very close to build up areas, and therefore not suitable for these tourism types. However, the second zone which is between 500 meter and 1000 meter to the urban area is the most suitable zone for caravanning activity in order to access to the electricity and water resources, so it takes the highest grade. In direct contradiction the last buffer zone which is more than 2000 meter far from the urban areas is the most suitable places for camping areas so it takes four for this activity (Table 4.10).

Table 4.10. The grading of proximity to urban areas values for three types of tourism

Buffer zones (meter)	Camping	Caravanning	Grass-skiing
0-500 m	0	0	0
500-1000 m	1	4	4
1000-1500 m	2	3	3
1500-2000 m	3	2	2
2000 + m	4	1	1

The weights can be changed according to the experience of the specialist who is performing the analysis for site selection. For example, if the specialist thinks that land use is the most important factor for selecting the possible areas for camping then he or she may give different weights to the factors. Table 4.11 shows the results of such a case.

Table 4.11. Pairwise Comparison Matrix Showing Preferences for the Three Factors in Terms of Camping Areas with different weights

	Slope	Land use	Proximity to Urban Areas	**WEIGHTS**
Slope	1	1/7	1/3	**0,0853**
Land use	7	1	4	**0,7014**
Proximity to Urban Areas	3	1/4	1	**0,2132**
Total	11	1,392857	5,3333	**1**

Consistency ratio = 0.03

4.6. Analysis Using Analytic Hierarchy Process

In this section the analyses are performed in raster format in order to be able to create the suitability map. Every cell in raster maps has a value that gives the suitability of that location. Three different maps in raster format are created. The slope, land use and proximity maps are created according to the values that are defined in tables 4.8, 4.9, and 4.10. Every cell takes a grade which shows the suitability for different types of tourism.

The DEM (Figure 4.13) is used in order to create the slope map (Figure 4.14) with the help of surface analysis tool. The slope requirement that the specialists from the Youth and Sport Association explain, is defined in degree. So the slope is selected to be defined as percent not in degree.

As the slope map is created, it is arranged in six intervals which are zero to five percent, five to ten percent, ten to 15 percent, 15 to 20 percent, 20 to 30 percent, and over 30 percent intervals. Finally, the slope map is created, however it is needed to be reclassified according to the grading for every category. For example in Figure 4.22 the gradings of camping areas are pointed out for every class of slope.

The land use map in vector format is converted to raster format according to the land use categories like dense forest, sparse forest, built up area, agricultural area, and open land. Afterwards, it is reclassified for three different grades for each tourism activity.

Proximity analysis is performed in four different distance as 500, 1000, 1500, and 2000 meter zones which are created and graded according to the importance for each tourism type.

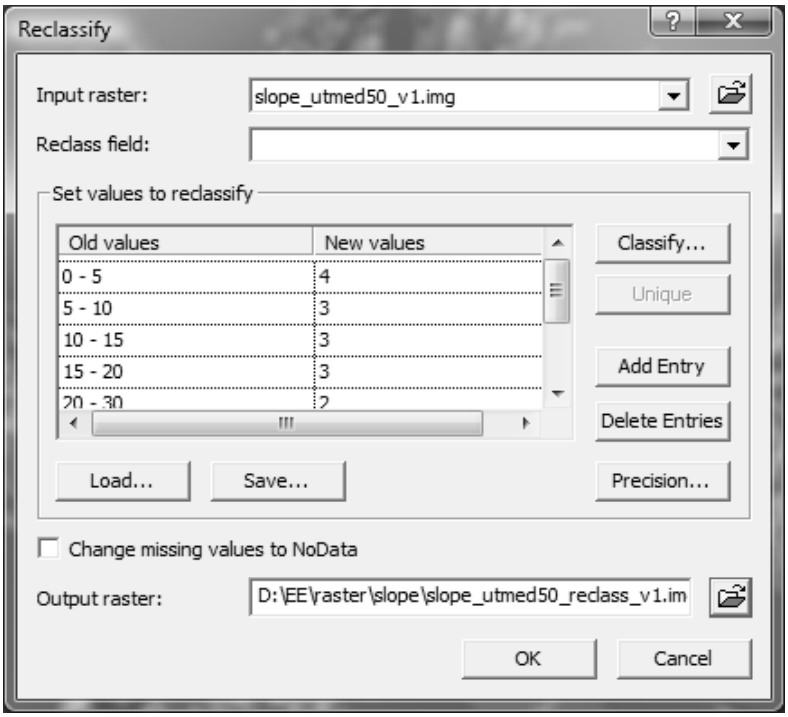


Figure 4.22. Reclassification of slope

The multiple buffers are created in vector format. In the attribute table three different columns are added in which the grades are calculated. The first column takes the grade for camping, the second column takes for caravanning and the last one for grass-skiing. Afterwards it is converted to three different raster maps according to the grade which shows the importance of each tourism category.

Finally, three raster maps are multiplied with the weights that are defined in Tables 5, 6 and 7, nd they are also multiplied with each other. For example, in order to define the suitability map for camping areas slope is multiplied with 0.66, land use is multiplied with 0.26, and proximity map is multiplied with 0.08 (Figure 4.23).

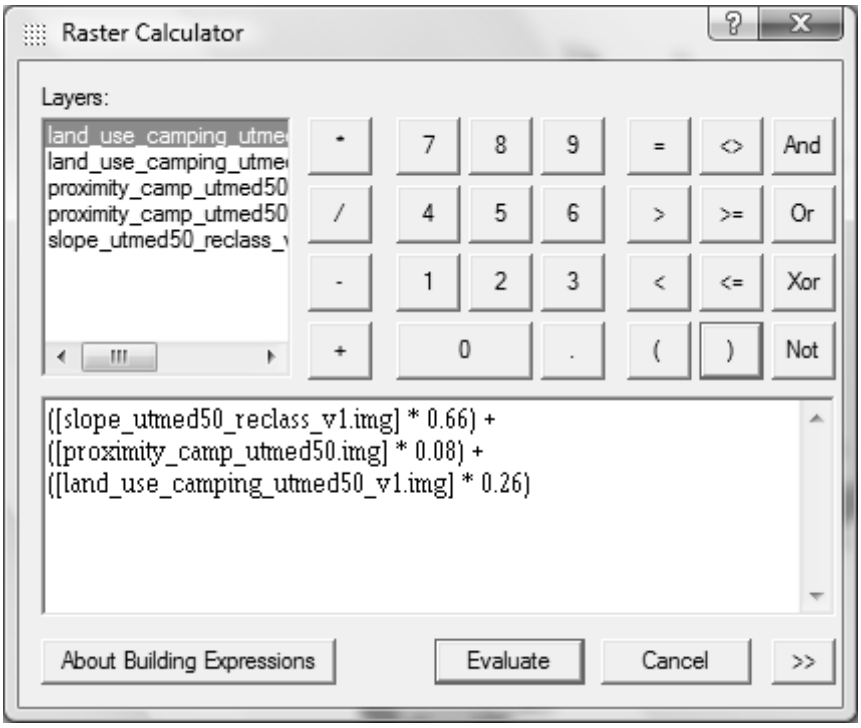


Figure 4.23. The calculation of possible camping areas in Raster Calculator

4.7. Site Selection Results

Site selection as a tool, is used to locate the new land use in the study area with an evaluation of the requirements. Evaluation of the requirement is an important factor for deciding the best location. Each requirement should be analyzed and the analysis results become the inputs for the final site selection result. These steps are summarized as a flow chart in Figure 4.24.

Figures 4.25, 4.26, 4.28 and 4.29 show the results for possible camping (with two different sets of weights), caravanning and grass skiing areas. The result of possible areas classified in five intervals are called “not suitable”, “less suitable”, “suitable”, “very suitable”, and “most suitable” in turn. The area calculations are given in Table 4.11.

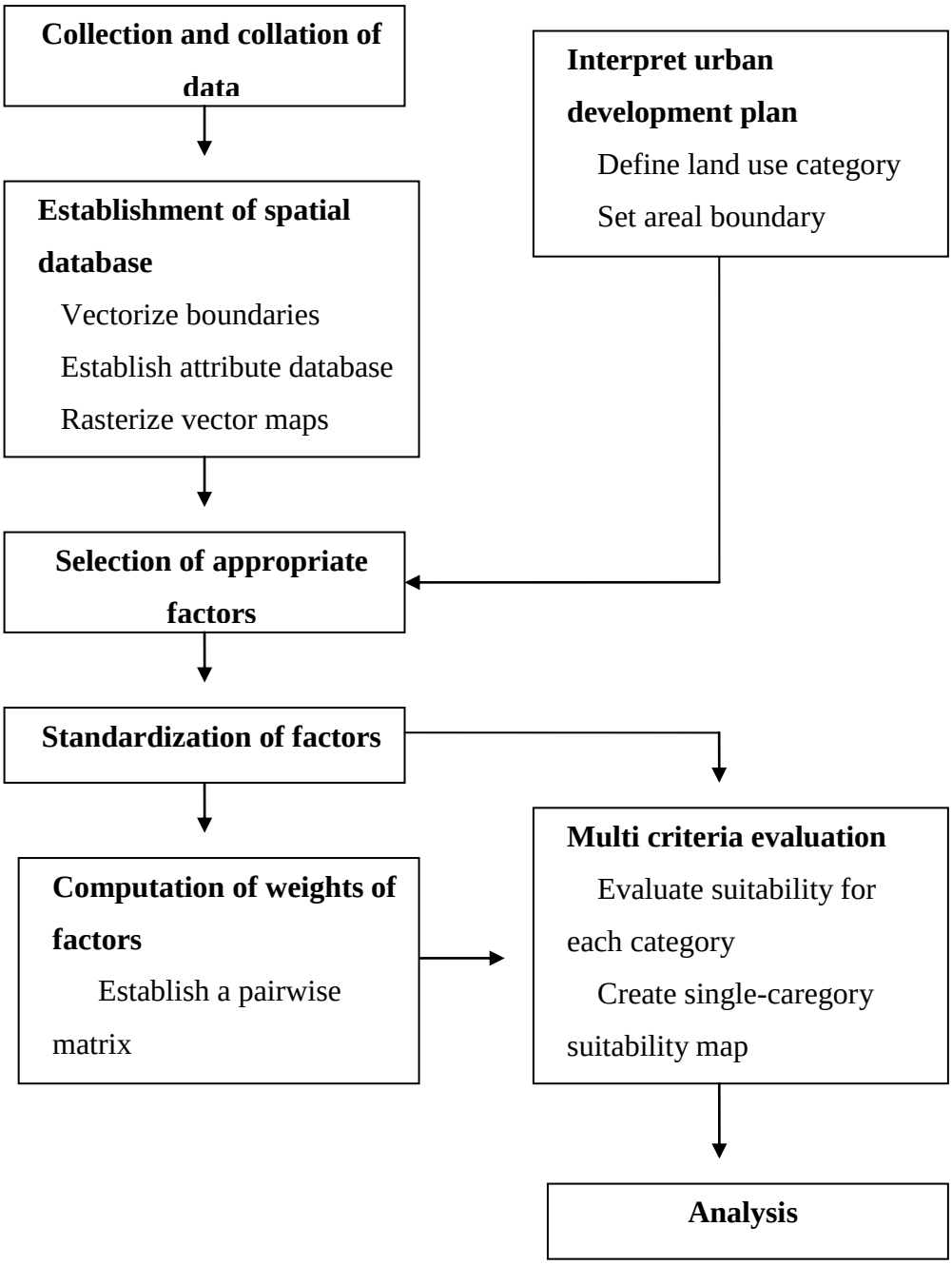


Figure 4.24. Flow-chart of the process for Site Selection

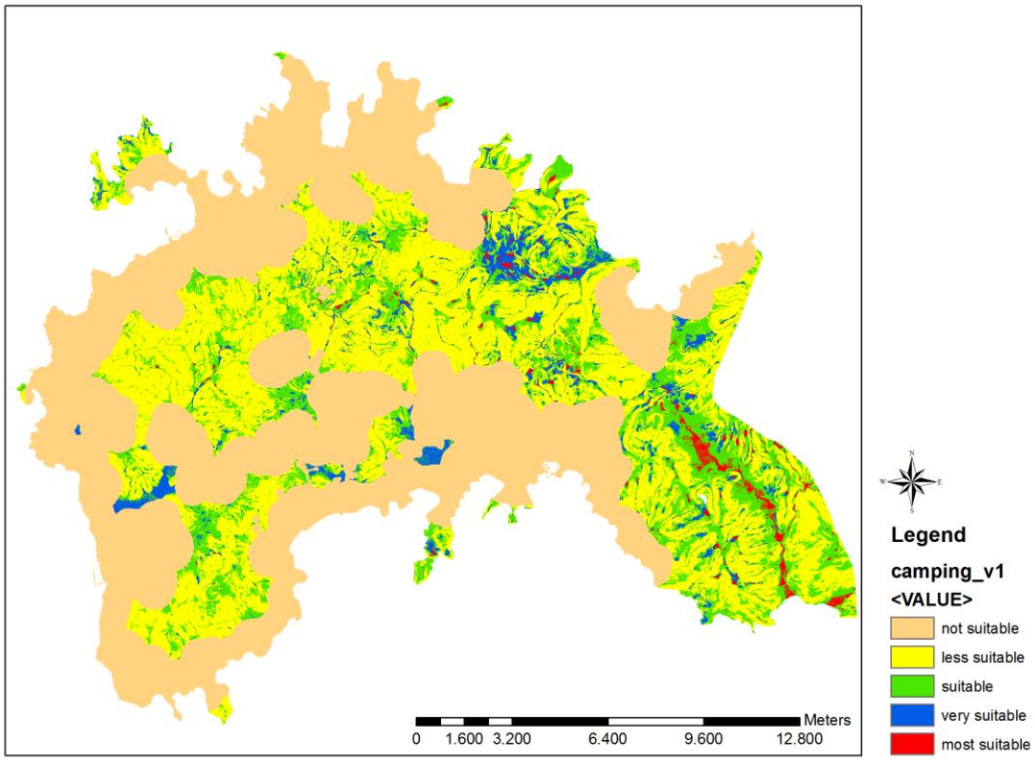


Figure 4.25. Site Selection Results for Suitable Camping Areas

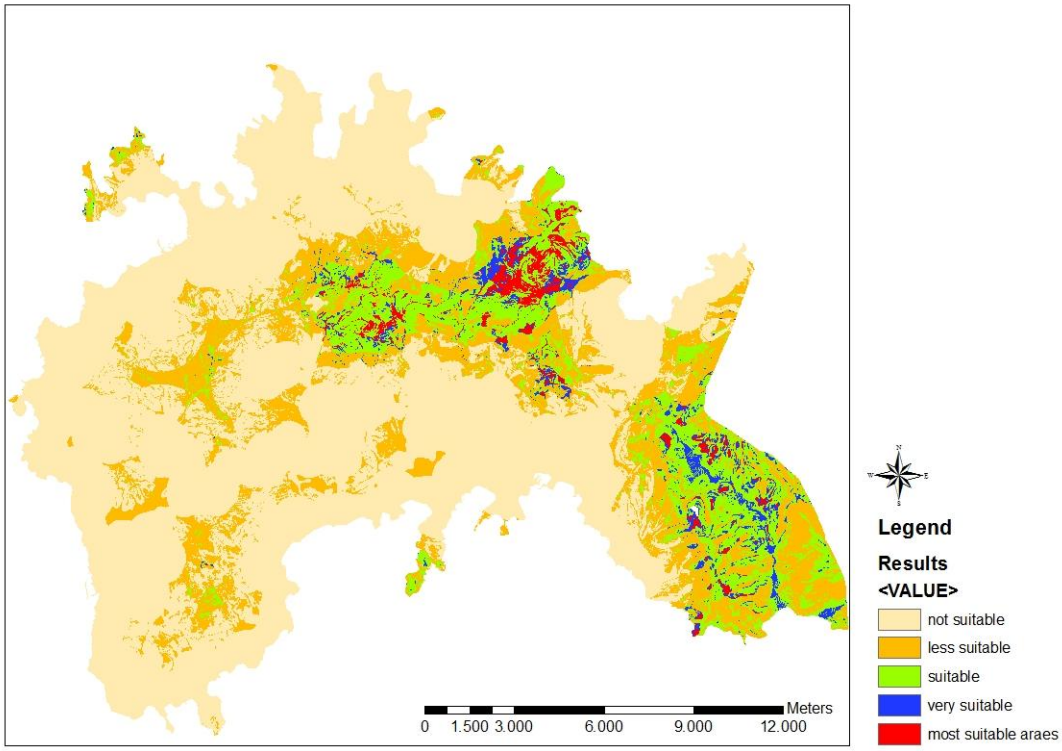


Figure 4.26. Site Selection Results for Suitable Camping Areas with different weights

Table 4.12 Site Selection Results for each tourism type

	Camping	Camping_v2	Caravanning	Grass-Skiing
Not Suitable	470 km^2	470 km^2	470 km^2	501 km^2
Less Suitable	102 km^2	75 km^2	126 km^2	74 km^2
Suitable	45 km^2	42 km^2	13 km^2	35 km^2
Very Suitable	10 km^2	24 km^2	13 km^2	9 km^2
Most Suitable	3 km^2	19 km^2	8 km^2	11 km^2

In the vector based analysis, suitable camping areas are calculated as 6 km^2, however with the help of analytical hierarchy process more areas are found in most suitable, very suitable and suitable classes. There are 3 km^2 areas classified as most suitable for camping purposes. Very suitable and suitable classes can be planned for camping purposes where the area sums up to 55 km^2. When the results are overlayed on the environmental plan, it is seen that 2 km^2 of 3 km^2 most suitable areas are shown as tourism facility area, which means there will be hotels in that region (Figure 4.27). When the weights are changed as mentioned before the suitable camping areas change also as shown in Figure 4.26. The areas, determined for this case are given in Table 4.12 as Camping_v2. As it is seen in the table suitable and better areas increases from 58 to 85 km^2, which indicates the importance of the weights used. Therefore before making such analysis a through study of the affecting factors should be made.

In the vector based analysis, suitable caravanning areas are calculated as 0.5 km^2, however with the help of analytical hierarchy process 8 km^2 area is found as most suitable, 13 km^2 area as very suitable, and 13 km^2 area as suitable. The area calculations show that caravanning activity is not as suitable as camping or grass skiing according to the structure of the peninsula (Figure 4.28).

Possible grass skiing areas are calculated as 8 km^2 in the first type of analysis. However in the analytical hierarchy process 11 km^2 areas are defined as most suitable, 9 km^2 areas as very suitable, and 35 km^2 areas as suitable for grass skiing purposes (Figure 4.29).

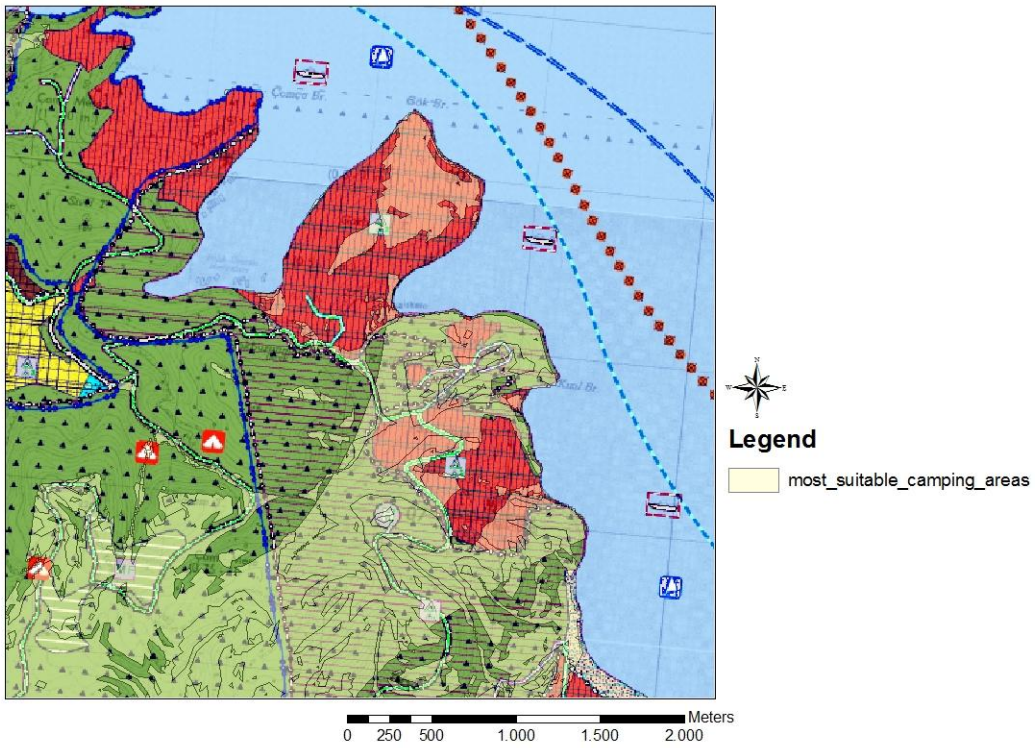


Figure 4.27 Possible camping areas showing on the environmental plan

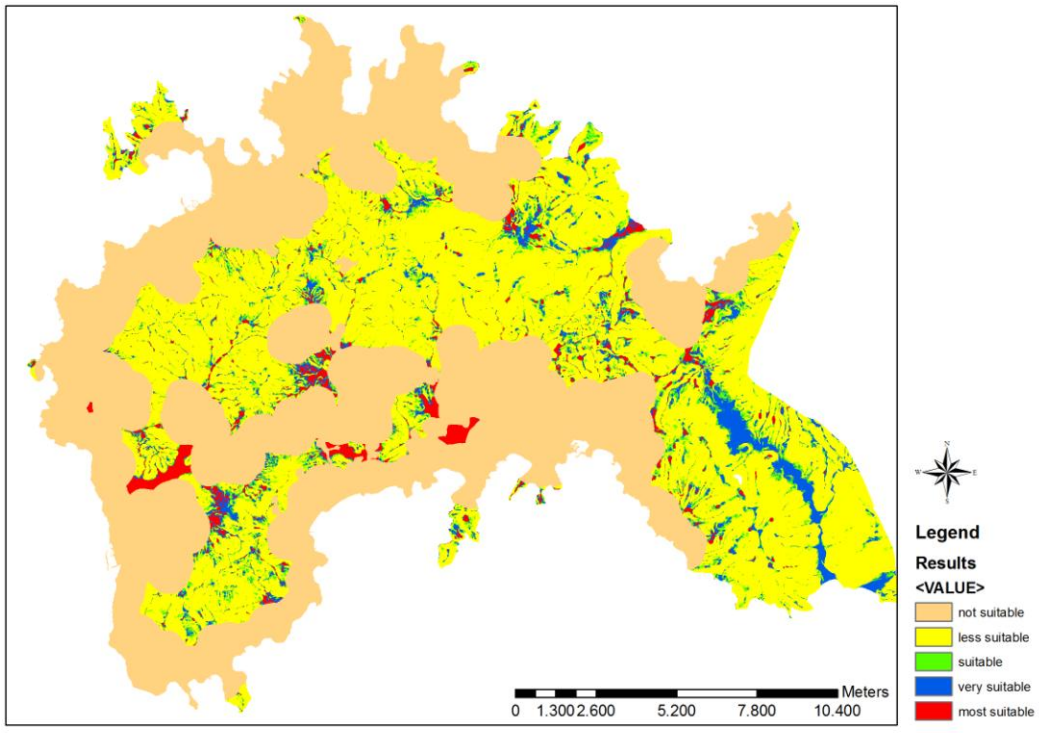


Figure 4.28 Site Selection Results for Suitable Caravanning Areas

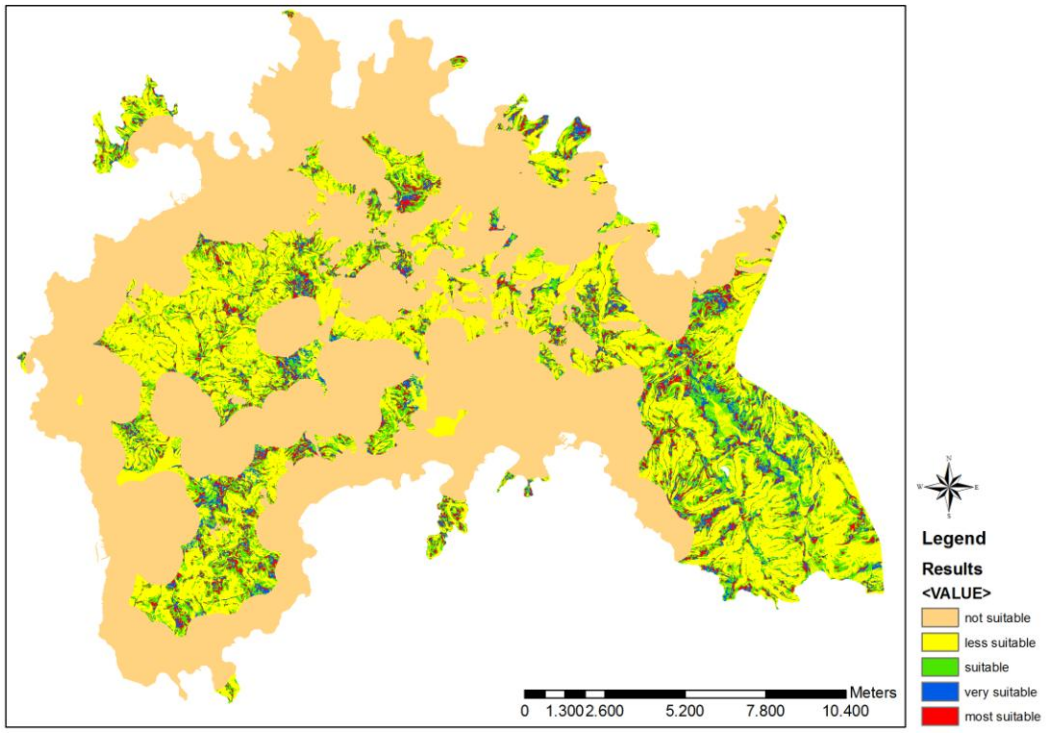


Figure 4.29. Site Selection Results for Suitable Grass-Skiing Areas

4.8.Change Detection for Tourism Planning

Tourism and Culture Ministry published the "Principle Decision of number 740" (740 Nolu İlke Kararı) and determined the rules for natural protected areas in three levels. In these three levels there are different types of rules. No building is permitted in the first degree natural protected zone. The buildings can be erected only for public benefits like schools, hospitals, museums, etc. in the second degree natural protected zone. However, if the region is in the third degree zone it is legal to build houses, commercial buildings, or any kind of structures. Figure 4.30 indicates borders of first and third degree natural protected zones in Yalıkavak region. It is possible to control the changes in any protected area with the help of satellite images without any field survey. Change detection analysis can be used for this purpose as well as for others, and it can be performed automatically also.

It is possible to detect the changes in protected areas by looking over satellite images acquired in different dates. The images of this region are collected on 2002, 2003, 2004, 2006 and 2008 by Ikonos Satellite, so it is possible to detect the change

with the help of those imageries. It is seen that there are more buildings in the image of 2008 compared to the image of 2002. The development in the urban area causes pressure on the first degree zone. So there is an important and illegal change in the first degree natural protected area. There is a shanty settlement which can be interpreted as a hotel building in the image collected in 2008 (Figure 4.31).

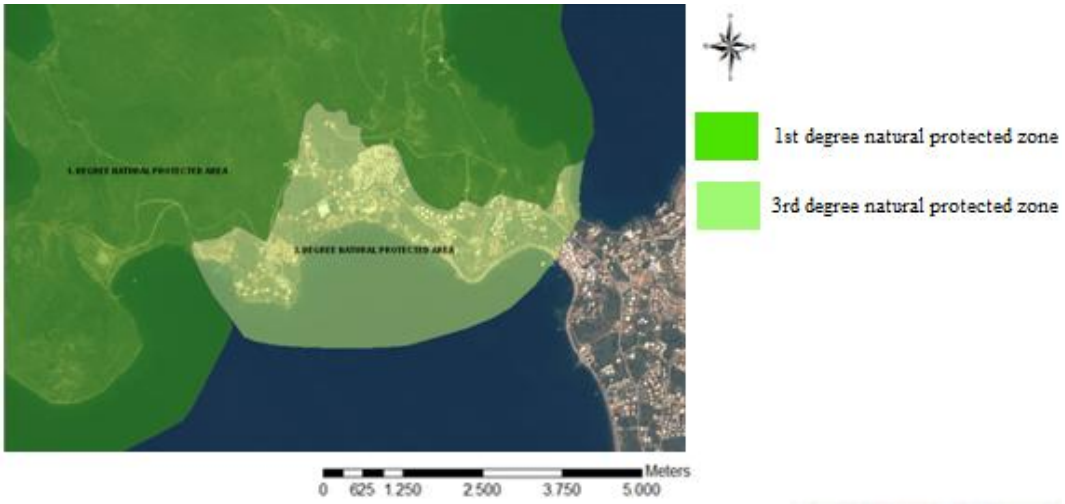


Figure 4.30. Natural Protected Area Problem

In Turkey, starting in the 1980s, yacht tourism has an important place in tourism sector by providing social and economic benefits as well as providing promotional activities and the exchange income. Turkey has large possibilities for yacht tourism with suitable coastal line, natural bays, long beaches, suitable sea winds, etc. (Açıkbaş, 2005). Bodrum Peninsula is one of the most suitable regions for yacht tourism in Turkey. In addition, a large marina which is called D-Marin began to be built in 2000 in Turgutreis that is the second biggest and developed district center in Bodrum Peninsula. The marina was finished in 2003 and began to accept yachts.

The second change detection case is in Turgutreis region. The satellite images, which are collected in 2003 and 2008, are compared for that region and the increase of the number of housing is remarkable (Figures 4.32 and 4.33). This increase can be interpreted as one of the effects of new marina. After the marina is built, the demand for the facilities like restaurants, bars, hotels, shopping-centers, etc. is increased. Those facilities supply new job opportunities for the local people. So the population and the number of summer and winter houses also increased in

Turgutreis. The change detection results support this argument. In Figure 4.32 new buildings around the marina region can be detected easily. In addition, not only around marina region but also other areas in Turgutreis district are effected by marina as shown in Figure 4.33.

IKONOS SATELLITE IMAGE
01/08/2002

IKONOS SATELLITE IMAGE
09/13/2008

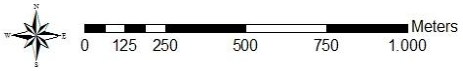
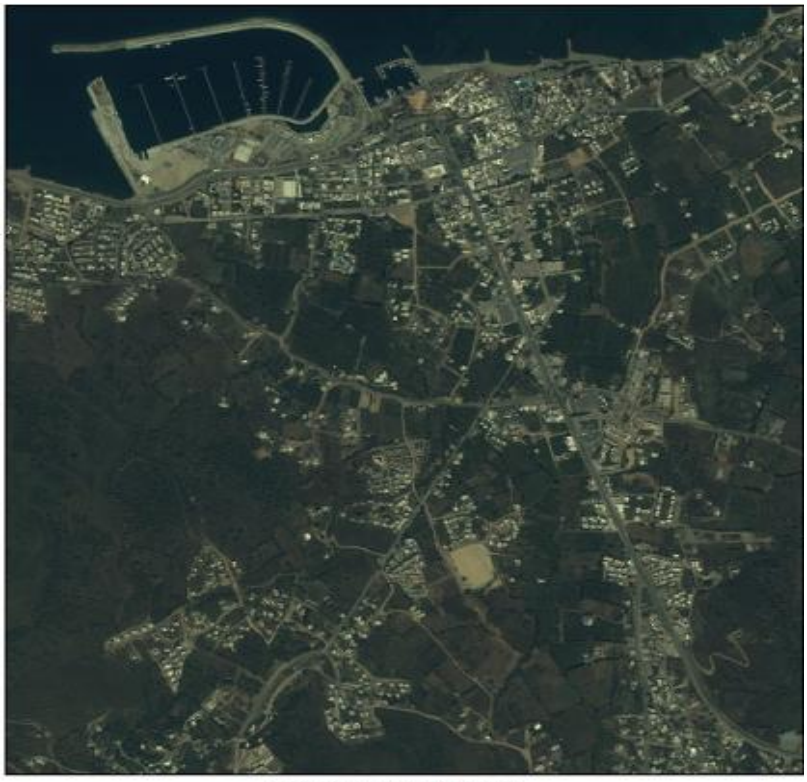


Figure 4.31. First and Third degree Natural Protected Zones in Yalıkavak Region



IKONOS SATELLITE IMAGE
08/06/2003

IKONOS SATELLITE IMAGE
09/13/2008

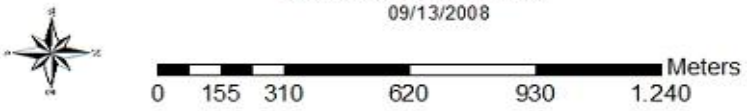


Figure 4.32 Ikonos Images collected 2003 (up) and 2008 (down) in Turgutreis Marina

Figure 4.33 Ikonos Images collected 2003 (up) and 2008 (down) in Turgutreis

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

This study aimed to apply GIS techniques to tourism planning and to suggest new tourism types in Bodrum Peninsula. Camping, Caravanning, Grass-Skiing, Site-Parachuting and Biking are the suggested tourism activities some of which were also mentioned in the Environmental Plan of Bodrum Peninsula, which was given in a scale of 1/ 25.000.

The study consists of four stages to achieve this aim. Firstly, what kind of tourism activities can be suggested is searched and new tourism activities are defined. The requirements of site selection for those activities are found from the Youth and Sport Association. Additionally, the environmental plan is reviewed according to the suggested tourism types and the structure of the study area is examined. Secondly, site selection methods are carried out within the study area by making use of GIS in order to define suitable areas for each tourism activity. The slope analysis is performed and used as a criterion for all types of tourism. The aspect analysis is performed, however it is important only for suitable site-parachuting areas. Buffer zones are created for proximity analysis for all types of tourism. In this stage, the analyses are performed without giving any priority to the requirements.

In the third stage, analytical hierarchy process is used in order to give priority to the requirements for each tourism types which are camping, caravanning and grass-skiing. Slope is the most important criterion for all these activities so it takes the biggest weight. The consistency ratio is calculated for the three activities in order to find the consistency of pair wise comparison matrix. Finally, suitability maps are created with GIS to generate the potential areas for the tourism activities in five levels which are called “most suitable”, “very suitable”, “suitable”, “less suitable”, and “not suitable”. Then, the results are compared with the environmental plan in

order to show the difference between the plan decisions and site selection results of this study.

In the site selection analysis without giving priority to the requirements, suitable camping areas are found as 6 km². However in the analysis that is performed by using analytic hierarchy process technique, most suitable area for camping is calculated as 13 km². Besides, if the results are overlayed with the environmental plan, it is seen that 2 km^2 of 3 km^2 most suitable areas are shown as tourism facility area which means there will be hotels in that region. Suitable caravanning areas are found as 0.5 km². Then, with the analysis made by using analytic hierarchy process technique most suitable area for caravanning is calculated as 8 km². Although caravanning activity is suggested in the environmental plan, there is no caravanning area that is suggested in the plan. There is 56 km path suitable for biking purposes in the peninsula. 20 km of this path is under 20 percent slope and 36 km path is between 20 and 30 slope which is also acceptable. Suitable site-parachuting area is found as 20 km². Finally, suitable grass-skiing areas are determined as 8 km² and in the analysis that is performed by using analytic hierarchy process technique most suitable area for this activity is obtained as 11 km².

In the last stage, change detection examples are shown in order to emphasize the benefits of Remote Sensing to define the impacts of tourism development in a city. In the planning process, it is important to know the current situation of the city in order to define the problems. The effects of the development since the beginning of the planning should be analyzed. At this point, remote sensing can be a powerful tool. Satellite images that are acquired in different dates can be used for change detections.

Finally, one remarkable change is found in Yalıkavak region. The Ikonos satellite images which are collected in 2002 and 2008 are compared for that region and new buildings are found in 2008 image which were not in 2002 image. In addition, the buildings are in the boundary of first degree natural protected zone where no structure is allowed. The second case is in Turgutreis region where a big marina was built and finished in 2003. The satellite images which are collected in 2003 and 2008 are compared for that region. It can be argued that the increase of the

population and number of summer and winter houses can be interpreted as one of the effects of the new marina. After the marina is built, the demand for the facilities like restaurants, bars, hotels, shopping-centers, etc. is increased. Those facilities supply new job opportunities for the local people. The change detection results also support this argument.

In the thesis, it is observed that the abilities of GIS such as managing data, organizing in different spatial units, providing quick and objective results and linking the spatial and other kind of information satisfy the better results for site selection analysis. The findings of this study showed that GIS is compatible with tourism planning process. Site Selection analysis supply numerous benefits to decision making level in planning.

Since, tourism planning is a complicated planning process city planners may take into account all parameters while suggesting new land use types in the city. Those parameters or requirements can have different importance according to the planner or other specialists who are working for the plan. A group of people that consists of city planners, architects, art historians, archeologists, agricultural engineers, geological engineers, etc. may work for a plan. In Turkey, tourism plans are created or approved by the Ministry of Tourism and Culture. In such planning processes GIS may be used in the analysis part which needs to manage large amount of data. Site selection can be performed for all other land use types in the decision level of planning.

As the planning process is performed by different kinds of specialists from different disciplines, the importance of the requirements can differ according to the specialists. Analytical hierarchy process (AHP) technique can be used in order to define the weights for the criteria. As it is shown in finding suitable areas for camping, the weights of factors change the results considerably. Therefore, utmost care must be paid while determining the weights. It is also possible to measure the consistency of those weights with the help of AHP. Finally, it can be recommended to use such techniques to the specialists, who are working on the tourism plans.

In this thesis because of the lack of data that are necessary for planning process, site selection could be applied for only some tourism types. However, in further studies, tourism planning process may be performed with the help of GIS techniques. The requirements for each land use type can be defined and the weights can be given consistently. Finally, site selection can be applied for all suggested land uses in the planning area.

On the other hand, GIS techniques can also be applied for tourism planning in different city or regions where tourism sector is developing in Turkey. There are number of districts or cities like Kuşadası, Çeşme, Didim, Fethiye, Datça, Kaş, etc. where tourism is developing with the positive effects of the natural beauty, historical and cultural values. However, this development may give harm to the nature or social life of the local people in those regions if it is not done carefully by considering every aspect. Similar site selection applications for different tourism types can be performed in those cities or regions.

REFERENCES

Açıkbaş, C. (2005) "Yacht Tourism and Marinas within the Context of Coastal Use; Bodrum Peninsula and Bodrum Marina Case", Ms Thesis, Gazi University, Ankara, Turkey.

Bahaire, T., and Elliott-White, M. (1999) "The Application of Geographical Information Systems (GIS) in Sustainable Tourism Planning: A Review. In: *Journal of Sustainable Tourism,* Vol. 7, No. 2.

Beedasy, J., and Whyatt, D. (1999) "Diverting the tourists: A spatial decision-support system for tourism planning on a developing island", *in ITC-Journal,* (3-4): 163-174

Butler, R. (1993) Alternative Tourism: The Thin Edge of the Wedge. In V. Smith and W. Eadington (eds) *Tourism Alternatives* (pp. 31-46). Chichester: Wiley.

Çubuk, M. (1996) "Sustainable Tourism; Ecological Approach to Tourism Planning", 19th World Urbanism Day Conference, Mimar Sinan University, İstanbul, Turkey.

Dai, F.C., Lee, C.F., Zhang, X.H. (2001) "GIS-Based Geo-Environmental Evaluation for Urban Land-Use Planning: A Case Study", *Engineering Geology*, 61: 257-271, People's Republic of China.

Dietvorst, A.G.J. (1995) Tourist Behaviour and the Importance of Time-Space Analysis. In G.J. Ashworth and A.G.I. Dietvorst (eds) *Tourism and Spatial Transformations: Implications for Policy and Planning.* Oxon, England.

Dinçer, İ. (1996) "The Dynamics and Fuctions that should be activated for the sustainable tourism; Ecological Approach to Tourism Planning, 19th World Urbanism Day Conference, Mimar Sinan University, İstanbul, Turkey.

Doğaner, S. (1995) “Eco-tourism around Köyceğiz-Dalyan”, Development Bank of Turkey, Tourism Yearbook 1994, Ankara, Turkey.

Dondo, C., Bhunu, S.T., Rivett, U. (2003) “GIS in Tourism – A Zimbabwean Perspective”, University of Cape Town, South Africa.

Dursun, S., Kabdaşlı, S., Duran, E., Mercan, D., Elginöz, N. (2002) ”Analyzing and Management of Tourism Activities by Means of GIS Technique”, ITU Civil Engineering Faculty, İstanbul, Turkey

Farsari, Y., and Prastacos, P. (2003) GIS Contribution for the Evaluation and Planning of Tourism: A Sustainable Tourism Perspective Foundation for Research and Technology Hellas, Institute of Applied and Computational Mathematics, Regional Analysis Division, Heraklion, Crete.

Gunn, C.A. (2002) *Tourism Planning: Basics, Concepts, Cases,* Routledge, United States.

Jankowski, P., and Nyerges, T. (2001) *GIS for Group Decision Making,* Taylor & Francis Publishers, UK.

Kim, D. (2002) “GIS for a Policy Decision Support in National Tourism Portal” Korea Culture and Tourism Policy Institute, Korea.

Liu, Y.H. (1997) “An effective way for utilization of urban solid waste in China”, Exploration of Nature, China.

Longmatey, D., Amoako-Atta, S., Prah, K.B. (2002) “Management and Promotion of Tourism in Ghana: A GIS Approach”, Texas A and M University, Texas, United States.

Malczewski, J. (1999) *GIS and Multicriteria Decision Analysis,* John Wiley and Sons Ltd, United States.

Massam, B.H., (1988) “Multi-criteria decision making techniques in planning”, Department of Geography, York University, Ontario, Canada.

Mason, P. (2008*) Tourism impacts, planning and management*, Butterworth-Heinemann, Linacre House, Jordan Hill, Oxford, England.

McKercher, B. (1993) “Some Fundamental Truths About Tourism: Understanding Tourism's Social and Environmental Impacts” Journal of Sustainable Tourism, Charles Sturt University, Australia.

Miller, D., Morrice, J.G., Horne, P.L., and Aspinall, R.J. (1993) Analysis of landscape Views for Visual Impact. *Association for Geographical Information Systems Conference Proceedings 1993.*

MTC. (Ministry of Tourism and Culture) (2006) “Research and Decision Report of Environmental Plan, 1/25.000 Scale Bodrum Peninsula”, Ankara, Turkey.

Özgüç, N. (1998) *Turizm coğrafyası özellikler bölgeler,* Çantay Kitabevi, İstanbul, Turkey.

Özükan, B. (2004) “Türkiye Gezi Kitaplığı: Bodrum”, Boyut Yayın Grubu, İstanbul, Turkey.

Pandey, P., and Chakraborty, R. (2005) “Geographical Information System (GIS): Information technology for planning management and development of GOA tourism master plan in next millennium” Consulting Engineering Services India Ltd. 57, Nehru Place, New Delhi, India.

Phua, M., and Minowa, M. (2003) “A GIS-based multi-criteria decision making approach to forest conservation planning at a landscape scale: a case study in the Kinabalu Area, Sabah, Malaysia” University of Tokyo, Japan.

Rhind, D.W. (1990) “Global Databases and GIS”, In M.F. Foster and P.J. Shands

(eds.) *The Association for Geographic Information Yearbook 1990*. Taylor and Francis, London, England.

Saaty, T.L. (1980) *The Analytic Hierarchy Process*, McGraw-Hill, New York, United States.

Saaty, T.L., and Vargas, L.G. (1991) Prediction, Projection and Forecasting. Kluwer Academic Publishers, Dordrecht, Netherlands.

Seckelmann, A. (2001) "Domestic Tourism-a chance for regional development in Turkey" University of Passau, Germany.

Shojaee, D. (2005) "Using GIS and Application for Tourism" Meibod Islamic Azad University, Yazd, Iran.

Stynes, D., and O'Halloran, C. (1987) "Tourism Planning", Cooperative Extension Service, Michigan State University, Extension Bulletin E-2004, United States.

Türk, T., and Gümüşay, M. (2005) "GIS Design and Application for Tourism"**,** Yıldız Technical University (YTU), Department of Geodesy and Photogrammetry Engineering, Beşiktaş, Istanbul, Turkey.

UNEP (1995) "Guidelines for Integrated Management of Coastal and Marine Areas with Special Reference to the Mediterranean Basin" Regional Seas Reports and Studies No 161

Williams, S. (1998) Tourism Geography, Routledge Publisher, New York, United States.

Yeşilçınar, M., and Çetin, H. (2005) "Site Selection for hazardous wastes: A case study from the GAP area, Turkey", Department of Environmental Engineering, Harran University, Adana, Turkey.

Yılmaz, A. (2004) “Solving Multiple Criteria Decision Making Problems Using the Analytic Hierarchy Process”, Eastern Mediterranean Forestry Research Institute, Mersin, Turkey.