Site Suitability Evaluation for Ecotourism Using GIS & AHP: A Case Study of Surat Thani Province, Thailand

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ABSTRACT

The main objective of this study is to identify and prioritize the potential ecotourism site in Surat Thani province, Thailand, using Geographic Information System (GIS) and Analytic Hierarchy Process (AHP). This work was assessed the potential suitable areas for ecotourism based on bio-physical characteristics of the land ecosystems and socio-economic data. These are landscape or naturalness (visibility, land use/cover), wildlife (reservation/protection, species diversity), topography (elevation, slope), accessibility (proximity to cultural sites, distance from roads) and community characteristics (settlement size). These criteria and factors were selected according to the professional expert's opinions. First, a resource inventory and a list of ecotourism criteria were developed using the AHP method. At the next stage GIS techniques were used to measure the ranking of different sites according to the set criteria and thus identify those with the 'best' potential. Subsequently, the land suitability map for ecotourism was created, based on the linear combination of the criteria and factors with their respective weights. The degree of suitability of each factor was classified as highly suitable (S1), moderately suitable (S2), marginally suitable (S3) and not suitable (N) for ecotourism.

Based from the suitability map, the areas of highly ecotourism potential (S1) are located in protected areas. These areas can be used for education as well as conservation. It could serve as main ecotourism attractions but with the use of certain limitations and guidelines. The areas of moderately ecotourism potential (S2) are located in the eastern and western parts of the province, especially in Ban Ta Khun and Phanom districts. It can be developed as ecotourism destination by facilitating proper ecotourism infrastructure and

services. These areas can still be considered for ecotourism attractions. The S3 areas are suitable for tourism development in general. These areas are located in the central part of the province. They are the most appropriate areas for development. Most of them are located in Punpin, Karnjanadit and Tha Chang districts. However, the N areas are currently not suitable for ecotourism, including areas with several effects of development and degraded environment. As concerns theirs utilization, they may have some environmental problems but these are controllable.

The methodology proposed was useful in identifying ecotourism sites by linking the criteria deemed important with the actual resources of the province. This study result helped to identify whether the land has been used by optimally or renovate for future development within Surat Thani province. The result appears practically useful for tourism facilities development and ecotourism resource utilization where ecotourism could be more developed in near future. GIS can then subsequently evaluate dynamic patterns of land use/cover as well as, providing a new tool for ecotourism planning in Surat Thani province. AHP was effectively used to calculate the details of the factors and class weights. Likewise, this study can be used as a basis for evaluating the suitability of other areas for ecotourism. Additionally, it may also serve as a starting point for more complex studies in the future.

Keywords: Site Suitability Evaluation, AHP, GIS, Ecotourism, MCDM, Surat Thani, Thailand

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LIST OF ABBREVIATIONS

AHP	Analytic Hierarchy Process
CR	Consistency Ratio
DBMS	Database Management System
DEM	Digital Elevation Model
DEP	Department of Environmental Quality Promotion
FAO	Food and Agriculture Organization
GIS	Geographic Information System
GPP	Gross Provincial Product
GPS	Global Positioning System
LULC	Land Use /Land Cover
MCDM	Multi Criteria Decision Making
MCDA	Multi Criteria Decision Analysis
MCE	Multi Criteria Evaluation
NGOs	Non-Governmental Organizations
OEPP	Office of Environmental Policy and Planning
RI	Random Consistency Index
TAT	Tourism Authority of Thailand
TIES	The International Ecotourism Society
TISTR	Thailand Institute of Scientific and Technological Research
TNNP	Taman Negara National Park
UNEP	The United Nations Environment Program
UNWTO	The United Nations World Tourism Organization

LIST OF ABBREVIATIONS (Continued)

USGS	United States Geological Survey
WLC	Weighed Linear Combination
WTO	World Tourism Organization
WTTC	World Travel and Tourism Council

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Ecotourism has a strong connection with sustainable tourism. The latter depends on the relationship between tourism and environment. Ecotourism can be defined as an opportunity to promote the social values in the protected areas, and to finance for related stakeholders. However, ecotourism can be classified as a possible threat to ecosystems because ecotourism attractions are based on fragile ecological relations (OK, 2006). In the meantime existing tourism activities in potential ecotourism areas are in need of proper control and guidelines. The ecotourism resources are not yet fully ready to receive tourists. Therefore, planning is a must for future development to conserve the natural environment of the ecotourism destinations in a sustainable manner. Suitable management for ecotourism development is essential in order to conserve and maintain the biological richness. This necessitates a systematic management of ecotourism destination, which can minimize the negative impacts of ecotourism activities while offering benefits to the local communities. This can be made possible by adopting the ecosystem approach of ecotourism development, which adopts tourism as a means to protect the environment and, in turn, sustain biodiversity (Kumari et al., 2010).

Ecotourism's perceived potential as an effective tool for sustainable development is the main reason, why developing countries are now embracing it in their economic development and conservation strategies (Stem et al., 2003). This can be judged with the help of criteria and indicators approach, which is basically a concept of sustainable ecotourism management developed in a set of principles, criteria and indicators (Prabhu et al., 1999). However, a fundamental problem of decision theory is how to derive the relation weights of the criteria. A well-known weight evaluation method is the Analytic Hierarchy Process (AHP). AHP method has been shown as a useful and rational way to determine weights for various destination attributes through prioritization using pair wise comparisons. This method has steps including specify the hierarchical structure, determining the relative importance weights of the criteria and sub-criteria, assigning preferred weights of each alternative and determining the final score (Mazaher, 2010).

Ideally, ecotourism should satisfy several criteria such as conservation of biological and cultural diversity through ecosystem protection promotion of sustainable use of biodiversity with minimal impact on the environment being a primary concern (Ryngnga, 2008). Abidin (1995) identified 15 criteria and 58 indicators of sustainable ecotourism management in Taman Negara National Park (TNNP), Malaysia. The Delphi method and public survey were used to solicit opinions from an interdisciplinary panel of Malaysian experts and public groups regarding suitable criteria and indicators of sustainability for TNNP. Bukenya (2000) employed six criteria (high number of species, wildlife management potential, endangered species, potential to attract more tourists, less susceptibility to encroachment and degradation over long period) to prioritize the potential national parks in Uganda; based on the stated objectives and criteria for the

development of ecotourism industry. The site-specific criteria and indicators can be developed with stakeholders' participation. Boyd (1995) identified naturalness, wildlife, cultural heritage, landscape and community within a Northern Ontario by linking the criteria important, which are the actual landscape characteristics of Northern Ontario. OK (2006) used multiple criteria activity selection for ecotourism planning in Igneada. The model was applied using a participatory approach which consists of 19 alternates and 28 criteria based on an ELECTRE method. Kumari (2010) integrated five indicator indices (wildlife distribution index, ecological value index, ecotourism attractively index, environmental resiliency index, ecotourism diversity index) in order to identify and prioritize the potential ecotourism sites in West District of Sikkim state in India.

1.2 PROBLEM STATEMENT

Thailand, like many other countries, has adopted ecotourism as one of the country's important tourism development strategies a few years after its emergence. It is shown as an expression of the new paradigm of social and economic development (Leksakundilok, 2004). Nevertheless, early ecotourism destinations like Thailand have suffered from extensive impacts as a result of increased numbers of tourists (Dearden and Harron, 1992). The experience of ecotourism practices in Thailand shows some successes but also shows how the mismanagement of the ecotourism development process could lead to confusion.

Ecotourism emerged as an alternative form of tourism in the 1990s to mitigate the faults of conventional (mass) tourism in meeting the needs of sustainable development. It has

since become widespread in Thailand and is adopted not only in natural areas but also in rural communities (Leksakundilok, 2006). People are traveling to the original and natural regions and enjoy from landscapes, wild animals, plants, etc. These actions have impact on the environment and natural resources. Thus, people play a significant role in the protection of the natural resources (Eslami and Roshani, 2009). Many organizations and individuals in Thailand participate in ecotourism at different levels and concepts due to differences in understanding of ecotourism concepts and applications. This is creating confusion in ecotourism implementation with considerably different practices and outcomes showing up in the last few years (Leksakundilok, 2004).

Due to rapid growth of ecotourism, a challenge for a decision maker is on how to manage ecotourism in order to minimize the negative impacts for sustainable development of tourism. The benefits of ecotourism being at the center of the wider system of tourism should be put forward in the development planning and management. GIS appears to be a significant tool for planning, assessment and monitoring of natural resources. Limiting ecotourism, (which has within it the potential to become mass tourism on a small scale), to such areas where the region's characteristics are most suited for ecotourism, will to an extent reduce impacts compared to areas which are more fragile in nature (Boyd et al, 1995). In light of the above, it is imperative that only some areas are suitable for ecotourism to be developed and ensure that ecotourism criteria are matched with the basic resource characteristics of the area. Suitable management for ecotourism development is essential in order to be able to maximize the positive impacts and minimize negative impacts on all aspects of tourism. Therefore, this study is an attempt to identify potential ecotourism sites using GIS and

AHP; a case study of Surat Thani province, Thailand. The integration of the AHP in GIS combines decision support methodology with powerful visualization and mapping capabilities which in turn should considerably facilitate the creation of land use suitability map (Marinoni, 2004). This is also an additional benefit achieved by integrating geo-scientific aspects in the land use decision process, as demanded by Agenda 21 (Lamelas et al., 2008).

1.3 RESEARCH OBJECTIVE

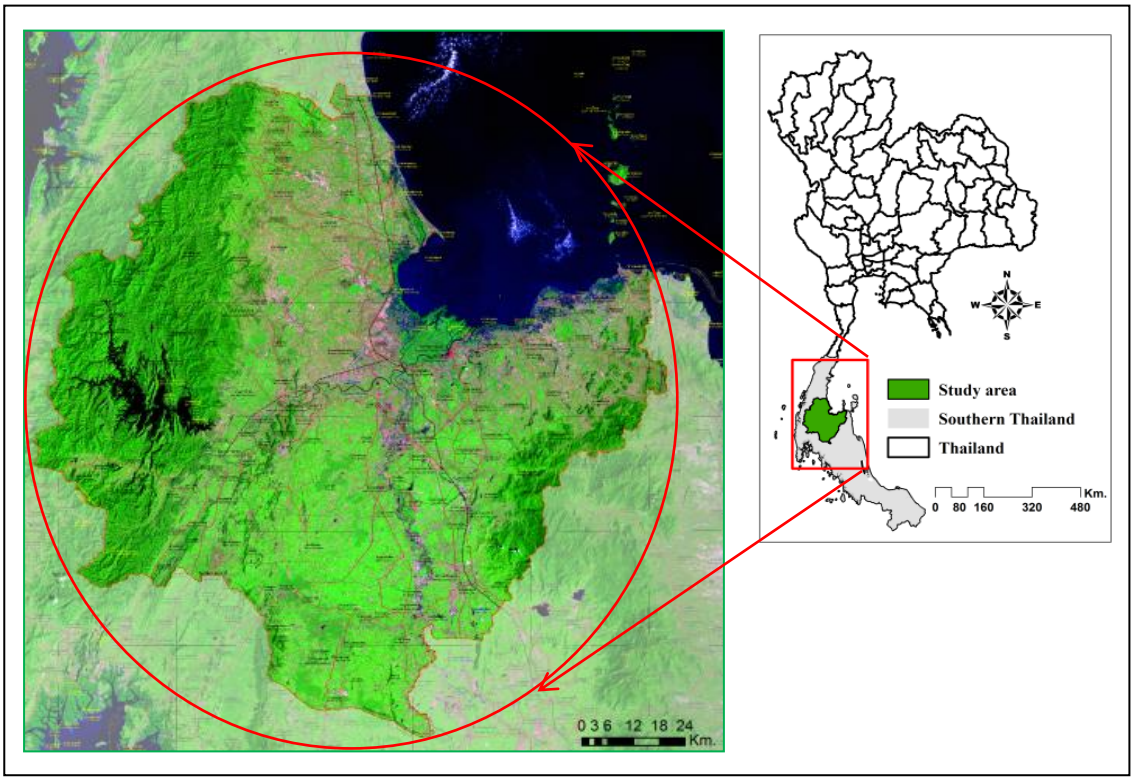
This research aims to identify and prioritize the potential ecotourism sites in Surat Thani province, Thailand using GIS and AHP techniques.

1.4 STUDY AREA

1.4.1 Study Area Location

The area chosen for this research is specially focused on the land ecosystems (Appendix A) of Surat Thani province, Southern Thailand (Figure 1.1), where 49 % of the area is mountainous with high mountain ranges along the north and south of the province. The total area covers approximately 1,250,957.61 ha. This province is located on the east coast of the south and about 645 km by road from Bangkok (capital of Thailand). This area appears to have many attributes which are needed for the successful development of ecotourism. There are some important attributes which should be considered in order to develop the successful ecotourism in Surat Thani province. For instance, it is largely free from urban settlements, untouched landscape, a rich vegetation cover, considerable

wildlife, traditional indigenous population, and recreational tourist attractions. Finally, there have been a number of provincial parks, including Marine parks and National parks, which further the recreational-tourist presence and help to safeguard some of the natural features. In addition, the physical attributes and scale of the Surat Thani landscape make the area a prime candidate for ecotourism. Therefore, sustainable management of ecotourism in this area is very important to Thailand's long-term commitment for sustainable development. In many respects, such characteristics suit the selection of the area for the case study to demonstrate the application of the methodology.



Remarks: 1) Satellite image map acquired on January 31, 2005 and February 25, 2005
2) Processed on December 07, 2005.

Figure 1.1 Location of the study area

Source: Geo-Informatics and Space Technology Development Agency (Public Organization), Ministry of Science and Technology.

1.4.2 Physical Characteristics

1.4.2.1 Geography

The study area occupies the largest area on the coast of the Gulf of Thailand with the length of around 156 km. The geographic characteristics of Surat Thani are high plateau and mountains covered in west of the province with valuable wood forest to the west and low basins in the central and along the eastern coast. There are a tremendous number of islands along the coast and two major rivers: the Tapi River and Phum Duang River, which join at the town Tha Kham shortly before they drain into the Bandon Bay. All rivers flow east of the province to the Gulf of Thailand. The delta of these rivers, locally known as 'Nai Bang', is located directly north of the city Surat Thani. It consists of several channels with small islands mostly covered with mangrove or orchards.

1.4.2.2 Climate

The climate in Surat Thani province is influenced by the northeast monsoon toward the Gulf of Thailand and the southeast monsoon from the Indian Ocean. The temperature average is 26.3-28.4 ^{o}C (Max. 35.6-37.5 ^{o}C, Min. 17.0-19.5 ^{o}C). Annual rainy days is 159 days per year. Rainy season starts from around October to January, where rainfall in November is approximately 50-70 % and humidity is 79 % (range 68-89 %).

1.4.3 Socio-Economic Characteristics

1.4.3.1 Historical Background

Surat Thani is an old city and may have been the centre of the Mahayana Buddhist, Srivijaya Empire, which steeped in legend and mystery, dominated the Malay Peninsula

and much of Java some 1,500 years ago. Some areas were actually already populated at prehistoric time by tribes. Its original people included the Semang and the Malay. Their homes before the Indians migrated into the area were in the Luang basin and around the Bandon bay. The lands along the river banks consisted of rich soil where people could settle themselves and do farming along with trading. The river was then considered as one of the most important resources of the country. The social structure is one big family where most people are 97.5 % Buddhist, 2.0 % Muslim and 0.5 % Christian.

1.4.3.2 Population (Demography)

The entire of Surat Thani province is administratively divided into 19 districts (Table 1.1) which are further subdivided into 131 sub-districts and 1,028 villages. It is the largest province of Southern Thailand. The population of the province in 2010 is 1,000,383 with 494,825 males and 505,558 females. The highest number of the population is in the district of Muang Surat Thani followed by the district of Karnjanadit and Punpin.

But in this present study, the study area consists of 17 districts on land ecosystem of Surat Thani (Figure 1.2), namely Muang Surat Thani, Karnjanadit, Wieng Sra, Kiansa, Chai Buri, Chaiya, Don Sak, Tha Chang, Tha Chana, Ban Takhun, Ban Nadeam, Ban Nasan, Phanom, Prasang, Punpin, Wipavadee and Khirirat Nikom. The excluded area is marine ecosystems that appear along the coastal area and under the sea which are island, shoal and sand dune, beach, coral reef, etc. These are Samui Island, Pha-ngan Island, Ang-Tong Island and some part in the district of Chiya and Don Sak with small islands.

Table 1.1 Number of population from registration recorded by district in Surat Thani

District and area	2005	2006	2007	2008	2009	2010
Muang Surat Thani	165,609	168,060	169,988	170,237	171,712	170,336
Karnjanadit	96,547	97,556	97,550	97,735	99,719	100,393
Pha-ngan Island	11,933	12,884	13,317	13,429	14,700	15,142
Samui Island	47,271	48,986	50,880	51,349	53,990	54,674
Khirirat Nikom	39,957	40,483	40,982	41,118	41,908	42,461
KiansSa	42,619	43,486	44,097	44,210	45,491	46,120
Chai Buri	23,347	24,005	24,616	24,742	25,557	25,783
Chaiya	47,138	47,668	47,589	47,753	48,802	49,198
Don Sak	35,468	35,636	35,863	35,869	35,980	36,125
Tha Chang	31,033	31,270	31,371	31,454	32,379	32,609
Tha Chana	49,938	50,520	50,767	50,890	52,406	52,736
Ban Takhun	14,116	14,312	14,514	14,735	15,025	15,213
Ban Nadeam	21,797	21,989	22,144	22,229	22,762	22,930
Ban Nasan	68,345	68,773	68,961	68,987	69,326	69,495
Phanom	33,513	33,898	34,506	34,645	35,867	36,338
Prasang	60,512	61,608	62,833	63,022	64,500	65,436
Punpin	88,021	88,677	89,005	89,215	90,441	91,048
Wipavadee	12,791	13,098	13,282	13,399	14,217	14,536
Wieng Sra	57,394	57,789	58,159	58,270	59,439	59,810
Total	947,349	960,698	970,424	973,288	994,221	1,000,383

Source: Department of Local Administration, Ministry of Interior, Thailand.

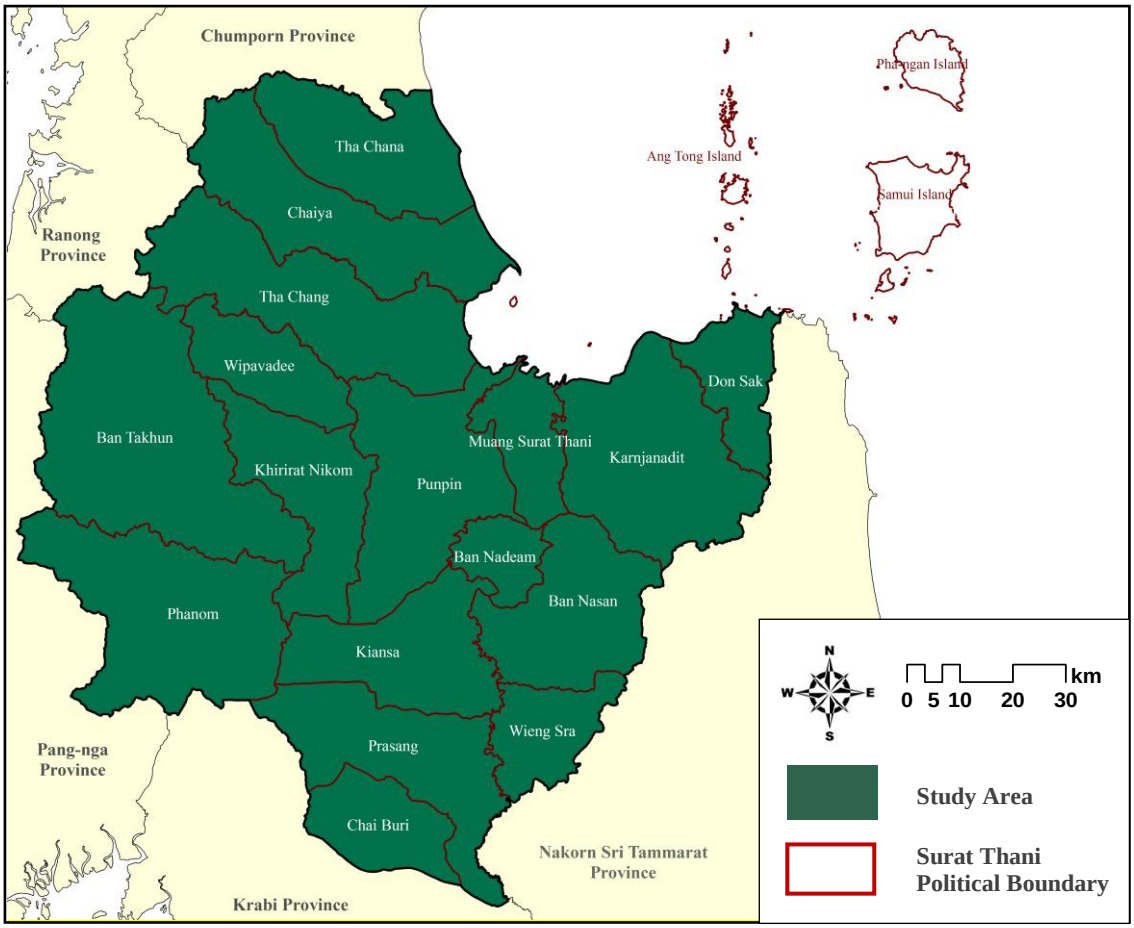


Figure 1.2 Study area and political boundary of Surat Thani province

1.4.3.3 Economic System

In 2009 census, the province has a Gross Provincial Product (GPP) of about 131,475 million Baht (4,185 million US$). Most incomes depend on agriculture, industrial, services and trade respectively. Per Capita GPP was 125,912 (4,009 US$), it is the second in Southern Thailand. This area has its potentiality in raw agricultural materials. The basic economic system of the province emphasizes agriculture which means that 33.67 % of the product cost comes from agricultural products. The major raw agriculture materials are supplied from renewable industries which are rubber industry, oil palm, rambutan fruit and fishery. Surat Thani has the most rubber plantations in Thailand with a production rate of

more than 400,000 tons per year. The province is also second in glowing oil palm in Thailand with a production rate of about one million tons per year. Same as rambutan (Ngoe Rong Rean), a famous fruit, oil palm is also a continued-industry and is accepted nationwide. However, because of low price in some seasons, there are fewer farms cultivating it. Moreover, the location of Surat Thani is prompted for fishery farm along the coast which is gradually increasing. The important aquatic animal in economic system is prawn and others such as oyster, granular ark and giant sea perch. Furthermore, a notable local product is the hand woven silk clothes from the coastal village namely, Phum Riang in Chaiya district. Chaiya is also the most famous source of the red eggs, a local specialty.

1.4.4 Transportation

1.4.4.1 By Car

From Bangkok, Surat Thani can be reached by driving on highway no.41 (that was taken from Phetchagaseam road at Chumporn province to get to Malaysia border which passes through Surat Thani) and proceeding on highway no.401 at Punpin district to get to town directly (Figure 1.3).

1.4.4.2 By Train

All southern express and rapid trains pass Surat Thani railway station at Punpin district, which is about 14 km from the town. The total distance from Bangkok is 650 km.

1.4.4.3 By Air

Surat Thani has two airports namely the Surat Thani airport in Punpin district and Koh Samui airport on Samui Island offering domestic and international flights.

1.4.4.4 By Boat

Surat Thani is also accessible by boat which provides transportation passengers and logistic products from Bangkok via Tapi River. There are also ferries providing transportation from main land to Samui Island and Pha-ngan Island at Don Sak district.

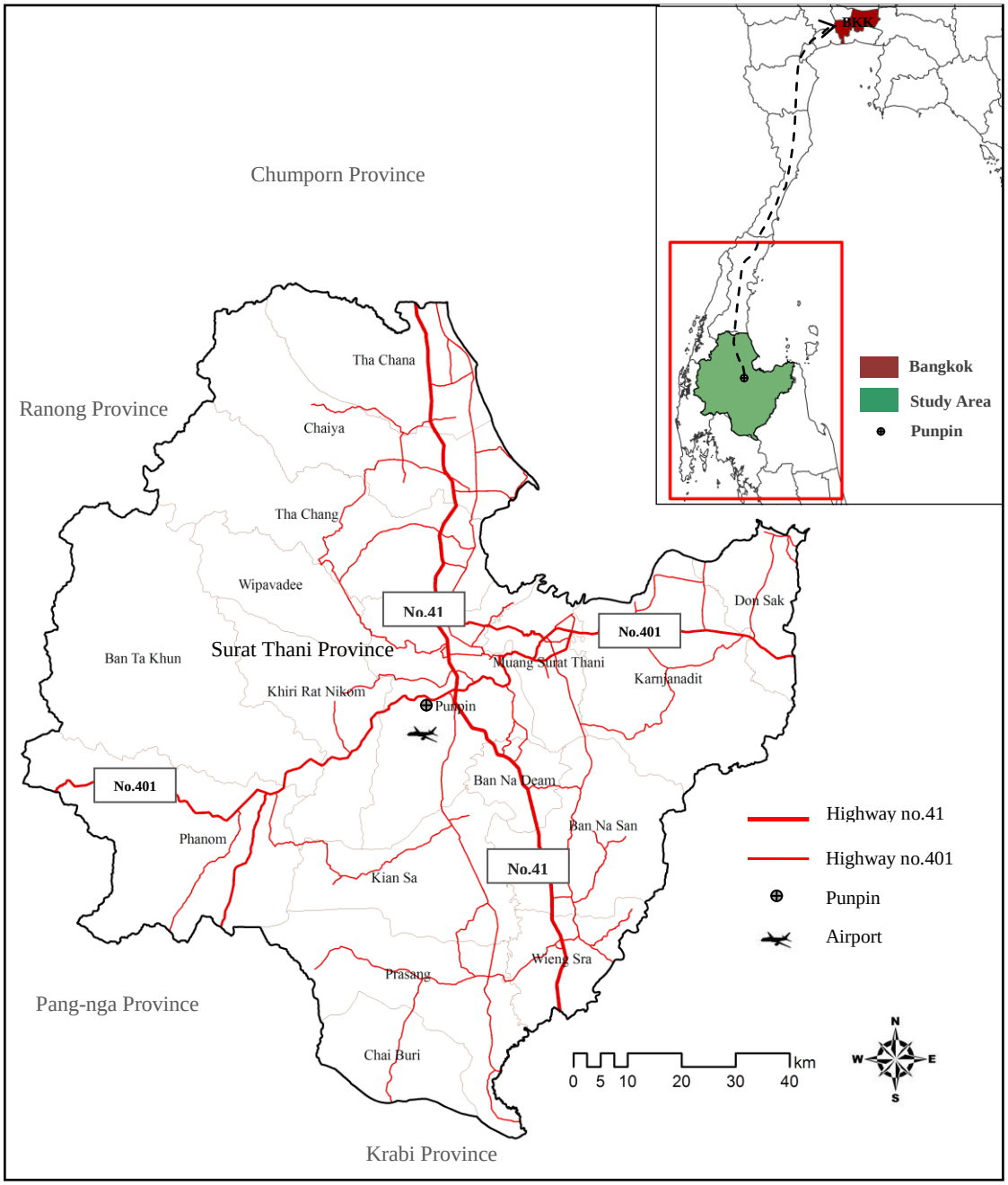


Figure 1.3 Transportation in Surat Thani province

1.4.5 Accommodation Service

There are several types of lodging and accommodation services, some of which are registered and some unregistered. Some lodgings are located in remote areas and some in less remote areas. Lodgings types comprise of the following:

1.4.5.1 Hotels and Resorts

In 2007, there were a total of 827 hotels and resorts establishments in Surat Thani offering number of rooms about 25,420 tourist rooms. Almost all of these are unsuitable to serve as eco-1odges. Only some resort lodgings have appropriate features which can be developed into eco-lodges as seen in Figure 1.4.

Figure 1.4 Resort lodging in Surat Thani province

1.4.5.2 Guesthouses in National Park Areas

These lodgings are under the administration of the Royal Forestry Department and are located in every national park. Staff houses of some national parks are also used as guest-houses, and there are tents and camping facilities, as well. These types of lodging are appropriate and can be arranged easily into eco-lodges. However, most of them have not reached the appropriate standard of management required for ecotourism. Apart from the national parks, the Royal Forestry Department also provides lodgings in various conservation areas, including several research and experimental stations which do not currently offer services to tourists (Figure 1.5).

Figure 1.5 National parks guesthouses and tent in Surat Thani province

1.4.5.3 Official Guesthouses and Lodgings

Official guesthouses and lodgings in the compounds of dams and reservoirs boy-scout camps, and the operating centers of various government agencies are in the area (Figure 1.6), as well as monastic halls, etc. These lodgings are not part of the tourism services industry and thus do not have the characteristics of eco-lodges.

Figure 1.6 Official guesthouses and lodgings in the compounds of dams and reservoirs boy-scout in Surat Thani province

1.4.5.4 Home Stay

This is a form of lodgings which has the purpose of allowing house-owners to gain some income, and to facilitate cultural exchanges. This alternative type of lodging is being experimented with in various locations e.g. Ban Tham Phung Homestay in Phanom district,

Bang Baimai Homestay at Klong Roi Sai in Muang Surat district, etc. This type of lodgings has a cultural basis and is highly suitable for developing into eco-lodges.

1.4.6 Tourism

Surat Thani province is one of the most popular and important tourism areas of Thailand. It is rich in nature, history and culture which make a favorite destination for various international tourists. Most tourist attractions are popular among Thais and foreigners with a gradually increasing number. The tourism industry is growing rapidly. Tourism is a highly complex activity and, thus, requires tools to aid in effective decision making and fulfill the competing economic, social, and environmental demands of sustainable development.

1.4.6.1 Major Tourist Attractions

There are so many tourist attractions in Surat Thani province. These include historical, cultural and natural sites such as waterfall, mountain, sea, beaches, and islands. Some of which are described below.

1. Historical and Heritage Sites include the Soan Morkhapararam, Chaiya National Museum, Borommathat Chaiya Woraviharn Temple, Keaw Temple, Long Temple, Khaosuwanpradid Temple, Sing-Khorn Cave temple, Phrathat Sri Surat Pagoda, Big Buddha Statue, Leam-So Pagoda, among others.

2. Cultural and Handicraft Sites include the oyster farm, salted egg product village and Phum Riang silk handicraft village and Monkey Training Center.

3. Natural Sites include the Ang-Tong National Marine Park, Samui Island, Pha-ngan Island, Nangyuan Island, Khao Sok National Park, Ratchaprapha Dam, Dadfa waterfall, Khamin Cave, Tai Rom Yen National Park, among others.

However, some tourist attractions in Surat Thani are still undeveloped. In order to achieve sustainable tourism, it is necessary for Surat Thani to plan for regional development. In addition, rapidly increasing tourists and major tourist attractions in this province contribute to the degradation of nature, over consumption and waste, water shortage and destruction of forests and mangrove areas. Public areas have also been encroached and utilized for expansion construction of new hotels, resorts and bungalows. Thus, in order to sustain the development and management of tourism in the area and to support the growth of tourism, it is necessary for Surat Thani to carry out effective planning taking into consideration the future trends in tourism development.

1.4.6.2 Tourism Industry

This area has its own potential in the tourism industry of southern Thailand. This province is a hub for travelers in the south of Thailand. A port and hub for tourists are going to the islands of Samui (Tao and Pha-ngan) and also the Andaman region in the South West (Phuket, Krabi, Pang-nga and Trang). The area has been hit by a tsunami disaster. Surat Thani's tourism industry is currently the leading provider of foreign exchange income for the Southern of Thailand. Government efforts are already under way through the TAT and Provincial Administrative Organization to develop and promote of the tourism industry. The capacity of facilities such as hotels, resorts, and bungalows in Surat Thani can provide and support the tourism industry (Table 1.2). Most tourist attractions are popular among Thais and foreigners with the increasing number of tourists greatly. The number of tourists and average length of stay by accommodation establishments in Surat Thani in 2007 presented in Tables 1.3 and 1.4. In this said year, the number of tourists was 2,579,621 and the total income reached up to 21,530.71 million Baht.

However, effective tourism planning and policy making have rather been neglected. Though several attempts have been made to enhance its rapid development and promotion, these efforts have suffered some major drawbacks. The existence of planning and responsible tourism marketing including lack of information and sharing, information systems to assist decision making are even less apparent. Therefore, it is necessary to identify the area suitable for tourism in order to help in the decision making of the concerned authorities. This future planning is a very important aspect for high-quality tourism in Surat Thani province. Moreover, the rapid increase of visitors in this province can be considered a warning signal for tourism development in this region. Therefore, ecotourism planning is needed for sustainable tourism development the area.

Table 1.2 Number of hotels and visitors in Surat Thani province

Item	2003	2004	2005	2006	2007
Number of hotels	744	806	771	776	827
Number of rooms in hotel	19,988	21,971	22,686	23,825	25,420
Number of visitors	1,639,636	1,732,263	1,855,090	2,422,066	2,579,621
Thai	937,287	919,485	969,338	1,086,367	1,221,359
Foreigner	702,399	812,778	885,752	1,335,699	1,358,262
Number of tourists [1/]	1,556,670	1,637,670	1,744,246	2,283,533	2,425,450
Thai	864,263	838,416	869,858	981,241	1,094,214
Foreigner	692,407	799,254	874,388	1,302,292	1,331,236
Number of excursionists [2/]	83,016	94,593	110,844	138,533	154,171
Thai	73,024	81,069	99,480	105,126	127,145
Foreigner	9,992	13,524	11,364	33,407	27,026

Notes: 1/ = Tourists: Those who visit the province on their own any seasons except during work and education, and those who are not living or studying in the province must stay at least one night.

2/ = Excursionists: The visitors who do not stay overnight in the province.

Source: Tourism Authority of Thailand, Southern Region Zone 5.

Table 1.3 Tourism attributes in Surat Thani province

Item		2005	2006	2007
Number of visitors [1/]	Thai	969,338	1,086,376	1,221,359
	Foreigner	885,752	1,335,699	1,358,262
Sex	Male	937,808	1,215,699	1,410,163
	Female	917,282	1,206,367	1,169,458
Age group (year)	15 - 24	525,562	280,544	706,264
	25 - 34	826,904	708,779	961,740
	35 - 44	314,613	745,504	613,180
	45 - 54	132,408	405,204	260,768
	55 - 60	25,487	216,705	21,237
	65 and over	30,116	65,330	16,432
Purpose of visit	Holiday	1,733,920	2,015,157	2,039,757
	Convention and Business	58,451	156,272	153,693
	Official Visit	20,266	88,924	92,783
	Others	4,417	35,723	64,219
Travel arrangement	Group Tour	-	408,841	331,636
	Non Group Tour	-	2,013,225	2,247,985
Mode of transport	Plane	394,418	527,107	651,018
	Train	65,074	341,161	396,527
	Bus	521,778	733,655	698,385
	Automobile	807,143	759,356	797,177
	Others	66,677	60,787	36,514

Notes: 1/ Visitors: tourist and excursionist;

- Tourists: Those who visit the province on their own any seasons except during work and education, and those who are not living or studying in the province must stay at least one night.

- Excursionists: The visitors who do not stay overnight in the province.

Source: Tourism Authority of Thailand (TAT).

Table 1.4 Number of tourists and average length of stay by accommodation establishments in Surat Thani province

Types	2005	2006	2007	Percent change 2006	Percent change 2007
	Number of Tourists (Person)				
Hotel	1,494,083	1,964,207	2,071,791	31.46	5.47
Guesthouse	-	-	-	-	-
Bungalow/ Resort	-	-	-	-	-
House's friend	236,546	283,704	271,734	19.93	4.21
Accommodation in the National park	3,872	15,589	79,209	302.6	408.10
Accommodation in the official place	5,963	1,778	961	-70.18	45.95
Others	3,782	18,255	1,755	382.68	-90.38
	Average length of stay (Day)				
Hotel	3.18	4.12	-	29.55	-
Guesthouse	-	-	-	-	
Bungalow/Resort	-	-	-	-	-
House's friend	4.23	4.81	-	13.71	-
Accommodation in the National park	1.53	2.62	-	71.24	-
Accommodation in the official place	1.62	1.45	-	10.49	-
Others	3.41	5.81	-	70.38	-

Source: Tourism Authority of Thailand, Southern Region Zone 5.

CHAPTER 2

LITERATURE REVIEWS

2.1 OVERVIEWS OF ECOTOURISM

To understand the development of ecotourism, this chapter critically examines the concept of ecotourism via definitions and practices in many parts of the world, particularly Thailand which is the focus of this study.

2.1.1 Definitions and Concepts of Ecotourism

2.1.1.1 Definitions of Ecotourism

There are many definitions of ecotourism. The term 'ecotourism' has been debated and discussed again and again in almost all meetings and conferences. Since 1986, there have probably been more than 50 definitions or explanations of ecotourism (Leksakundilok, 2004). The simplest definition of ecotourism consists of just two words; one that originates from 'ecology' plus 'tourism' (Anomasiri, 2004). However, the most commonly used definition is the one established by The International Ecotourism Society (TIES), which states that ecotourism is *"Responsible travel to natural areas that conserves the environment and sustains the well-being of local people"* (TIES, 2002). More specifically, Ceballos-Lascurain (1993, 1996) first defined ecotourism as *"Traveling to relatively undisturbed or uncontaminated natural areas*

with the specific objective of studying, admiring, and enjoying the scenery and its wild plants and animals, as well as any existing cultural manifestations (both past and present) found in these areas." In addition, Boyd & Butler (1993) claimed that ecotourism should be based upon a balanced understanding of both ecosystems and tourism systems.

The evolution of ecotourism can be traced to the twin ideas of natural resources conservation and the human need for recreation. Similarly with Lindberg and McKercher (1997) support the idea that ecotourism is tourism and recreation which are both nature-based and sustainable. Weaver (2001) claimed that ecotourism is a way to sustainable development and can be defined as *"Ecotourism is a form of tourism that fosters learning experiences and appreciation of the natural environment, or some component thereof, within its associated cultural context. It has the appearance (in concert with best practice) of being environmentally and socio-culturally sustainable, preferably in a way that enhances the natural and cultural resource base of the destination and promotes the viability of the operation."*

In the Thai context, ecotourism has made its presence felt in Thailand. The process of ecotourism development was seen as a learning process and ecotourism as a process to sustain environmental and ecological values, promote local participation in tourism development. The Tourism Authority of Thailand (TAT) has adopted the concept that ecotourism is a way to sustainable development for the country's ecotourism development. TAT defines ecotourism as *"a visit to any particular tourism area with purpose to study, enjoy, and appreciate the scenery, natural and social as well as the life*

style of the local people, based on the knowledge about and responsibility for the ecological system of the area" (TAT, 1996). In addition, The Thailand Institute of Scientific and Technological Research (TISTR) defined ecotourism as a responsible travel in a natural area that has a special identity and a culture closely related to the area's ecosystems. Local participation in ecotourism management is intended to create awareness about the need for ecosystem conservation. In addition, providing a definition of ecotourism can serve a useful purpose of helping to clarify the ideas of concerned persons, especially, in Thailand where as mentioned earlier. The concept tends to mean all things to all people. The following definition from is offered: "*Ecotourism is a responsible travel in areas containing natural resources that possess endemic characteristics and cultural or historical resources that are integrated into the area's ecological system. Its purposes are to create awareness among all concerned parties of the need for and the measure used to conserve ecosystems and as such is oriented towards community participation as well as the provision of a joint learning experience in sustainable tourism and environmental management*" (TISTR, 1997). Therefore, this research has taken this philosophy and its attendant principles as central to the analysis.

2.1.1.2 Concepts of Ecotourism

Ecotourism is intimately related to the concepts of 'Sustainable Tourism and Environmentally Sustainable Development'. The concept of sustainable tourism has focused on the management of an entire tourism industry in order to bring it into line with the global trend towards sustainable development (Dowing, 1995). It was one of the responses of the tourism industry to Agenda 21 for the travel and tourism industry, published by the World Travel and Tourism Council (WTTC) and World Tourism

Organization and Earth Council (WTO) in 1995 (Honey 1999; WTTC-WTO, 1995). Generally, the basic concept of ecotourism incorporates the three main elements of (1) natural resources, (2) sustainable management and (3) environmental education activities. Other minor elements are low impact, a limited number of tourists or tour operators, protection and increase of the benefits to nature and local people and local participation (Buckley, 1990). These elements are normally included in a sustainability component. Nevertheless, many authors have raised some minor elements to the same level of those three major elements in order to stress and focus on them for specific purposes. Although other responsible forms of tourism follow this concept, many of them are not ecotourism. Most of the literature claims that ecotourism lies on the opposite side of mass tourism and is more sustainable than mass tourism. While most of mass tourism practices are unsustainable, a small part of ecotourism can be accused as being unsustainable, as illustrated by Butler (Weaver, 1998). Ecotourism should in all cases, aim to achieve sustainable development. Ecotourism is based on principles, guidelines, and standards and a growing industry needs to have a regulatory system of certification. Ecotourism is considered as a component of sustainable tourism development (Lindberg and Mckercher, 1997; Boyd and Butler, 1993). Ecotourism should be integrated the conservation and development concept in a holistic manner that means all components must be linked, compromised and balanced to each other (Pra Dhammapititaka, 2000).

The similarity or difference of those definitions depends on the overall concept of tourism development, the perspective of the definers and the purpose of its application. The United Nations Environment Program (UNEP) considers ecotourism to be of

special interest to UNEP because of its relationship with conservation, sustainability, and biological diversity, while the Quebec Declaration on Ecotourism defined ecotourism as “embracing” the principles of sustainable tourism and the following principles which distinguish it from the wider concept of sustainable tourism (Anomasiri, 2004): contributes actively to the conservation of natural and cultural heritage, includes local and indigenous communities in its planning, development and operation, contributing to their well-being, interprets the natural and cultural heritage of the destination to visitor, lends itself better to independent travelers, as well as to organized tours for small size groups". In the light of this suggestion and in comparing all the definitions and concepts of ecotourism, three elements could be identified: natural based, educational, and sustainable management which includes economic and/ or socio-cultural issues (Diamantis and Ladkin, 1999).

2.1.2 Characteristics and Measures of Ecotourism

Ecotourism's influence is having far reaching impacts toward extending principles of sustainability into other forms of tourism (Wight, 1993; Western, 1993). Ecotourism in the context of other tourism types (Figure 2.1), ecotourism has also been called nature tourism, green tourism, adventure tourism, natural history tourism, and rural tourism (Whelan, 1991; Western, 1993; Honey, 1999). Ecotourism often involves small-scale tourism oriented to natural areas, wildlife, and traditional culture. Typically, ecotourism contributes to rural economies and to maintaining land in a natural state. Ecotourism has developed according to the world trend of sustainable tourism development. Sustainable tourism is development that meets the needs of present tourists and hosts

regions while protecting and enhancing opportunities for the future. It is envisaged as leading to management of all resources in such a way that economic, social and aesthetic needs can be fulfilled while maintaining cultural integrity, essential ecological processes, biological diversity and life support systems" (WTO, 1996).

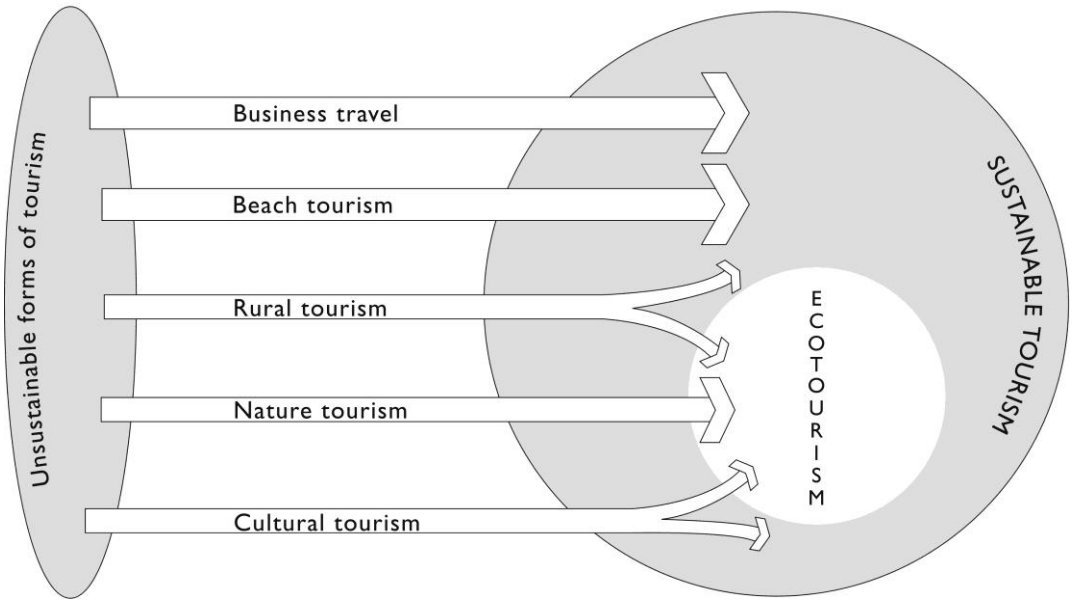


Figure 2.1 Ecotourism in the context of other tourism types

Source: Weaver, 2001.

As mentioned above, ecotourism's influence is having far reaching impacts toward extending principles of sustainability into other forms of tourism. Wight (1993); Western (1993) have identified nine principles for sustainable ecotourism. These are:

1) Develop the resource in an environmentally sound development, and no degradation of the resource.
2) Provide first-hand, participatory and enlightening experiences.
3) Involve all party education (communities, government, NGOs, industry and tourists).
4) Recognition of the intrinsic values of the resources.

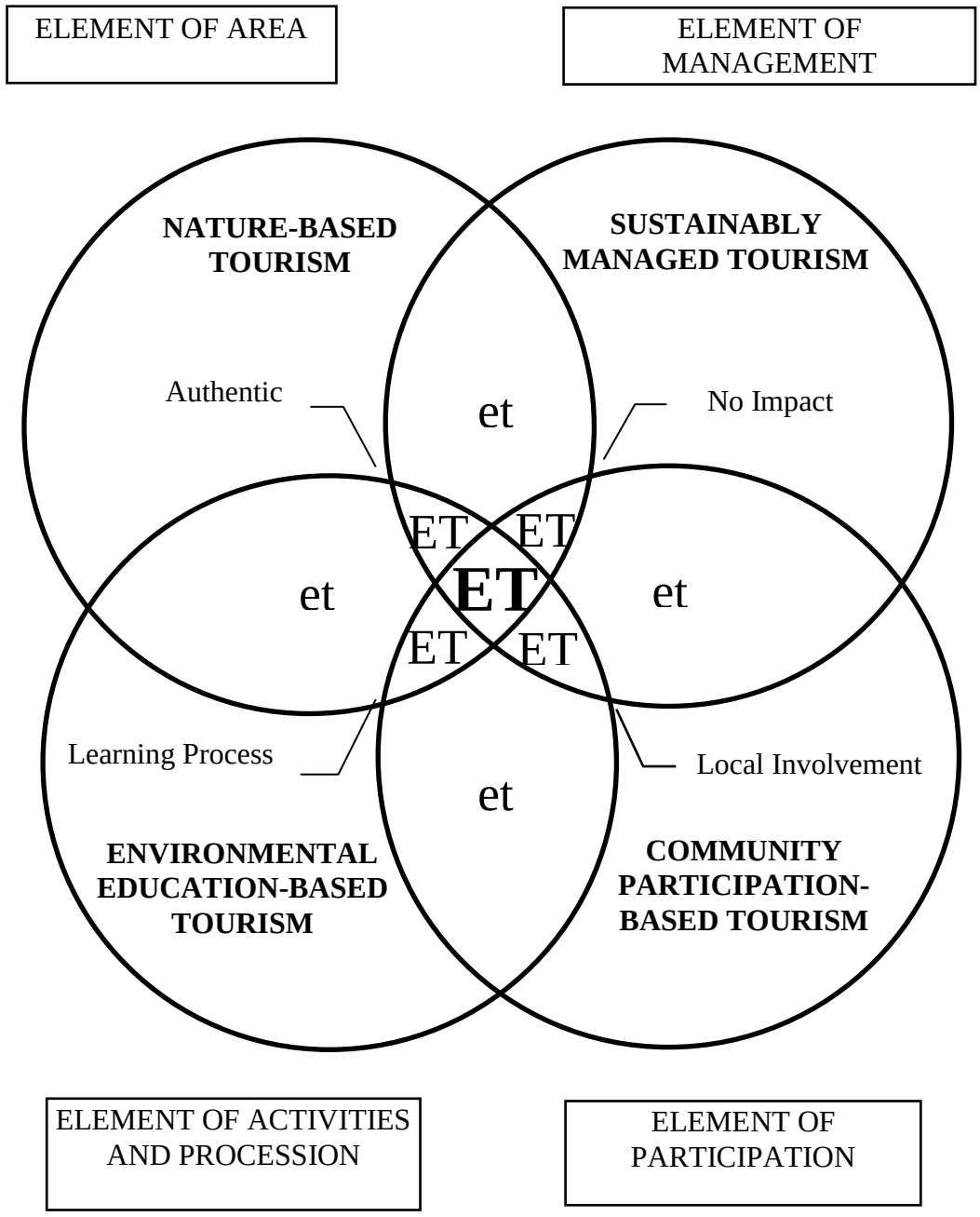
5) Reorganization of limits and acceptance of the resource on its own terms.
6) Promote understanding and partnerships between many players.
7) Promotion of ethical responsibilities and behavior towards the natural and cultural environment.
8) Provides long-term benefits (economic and non-economic) to the resource.
9) Ensures the underlying ethics of responsible conservation practices related to both internal and external operations.

The defining key elements of ecotourism can be discussed in terms of tourism area, tourism activities, concerned persons and management system as follows (Figure 2.2);

1) *Area*: Ecotourism takes place in natural tourism areas which have endemic characteristics, including cultural and historical resources that are closely connected to the ecosystems in the areas. This component can be called Nature-based Tourism.

2) *Activities and Processes*: Ecotourism provides an opportunity for learning about the environmental condition and ecosystem functioning of the tourism resources area. This results in increased knowledge, experience, appreciation and a deeper awareness by tourists, local people and concerned entrepreneurs of the need to promote conservation values. This can be referred to as Environmental Education-based Tourism.

3) *Management System*: Ecotourism involves responsible travel that has no or low impact upon the environment and society. The management system is comprehensive and addresses issues of resource conservation, environmental management, pollution control and disposal, and the control of tourism development. This can be called Sustainably Managed Tourism.



Remarks: 1. Adapted from Ralf Buckley, 1994

2. **ET**, ET, et indicate the intense of Ecotourism

Figure 2.2 The basic key elements of ecotourism

Source: TISTR, 1997.

4) *Participation*: Ecotourism emphasizes the involvement of local communities, including local government, in the organization and/ or management of ecotourism programs so that they might directly benefit from them. The benefits include income generation, the enhancement of the people's quality of life and economic returns that can be used in maintaining and managing the tourism resources. Finally, the local community would participate in supervising the tourism development of the areas and ensuring that it was appropriate. This can be referred to as Community Participation-based Tourism.

These 4 elements from Figure 2.2 together constitute the unique character of ecotourism. If any element is missing, then the form of tourism should not be referred to as ecotourism but as some other form of tourism, most likely natural tourism or cultural tourism which are closely related to ecotourism but do not have its key elements. Besides, on the basis of key elements some additional observations can be made, as follows:

1) Ecotourism is a new form of tourism which differs from the usual or traditional forms of tourism that focus mainly on the tourists' satisfaction and are promoted specifically to increase revenue.

2) Ecotourism does not necessarily exclude Mass Tourism because it cannot categorically be stated that the higher the number of tourists at a particular destination the greater the environmental damage will be. Indeed, without proper management, a small group of tourists can destroy the environment as much as or more than a large group. If mass tourism is managed according to the principles of ecotourism we may legitimately speak of mass ecotourism.

3) Ecotourism is not confined to having simple and low-cost management, to offering little comfort to tourists, or to generating small amounts of revenue from tourism. What is important is to have proper management which ensures effective environmental conservation, reasonable comfort for tourists, and meets the tourists' expectations. On this basis ecotourism may meet the demands of a wide range of tourists, and earn substantial revenue as well.

4) Ecotourism, rather than focusing on the gratification of tourists, emphasizes the provision of environmental education and the raising of awareness of the need for and the measures required to conserve an area's ecosystems.

2.1.3 Development of Criteria and Indicator for Ecotourism Site

Based on the literature and past experience, seven key attributes are suggested as having applicability. Suitable elements and criteria of ecotourism should be:

1) Environmentally and socially responsible.
2) Focused on elements of the natural environment.
3) Managed in such a way as to have minimal environmental and social impacts.
4) Non-consumptive.
5) Capable of providing desired economic benefits to local residents.
6) Compatible with other resource uses in the area.
7) Appropriate in scale for conditions and environment.

In addition, the criteria and indicators for the sustainability of ecotourism should include the measurement of these socio-economic benefits as described by Boo (1990) and Lindberg (1991):

1) Ecotourism generates local employment, both directly in the tourism sector and in other related supporting sectors of the tourism industry.

2) Ecotourism offers profitable domestic tourism services and industries such as hotels, chalets, restaurants, transport services, guide services, and souvenir and handicraft sales.

3) It allows eco-tourists to spend money and thus generates foreign exchange to the local economy.

4) In addition to agriculture, the local economy can be diversified with ecotourism activities.

5) Ecotourism stimulates local economies with tourism demand for food and lodging services.

6) The infrastructure of the local communities develops together with the development for ecotourism benefiting both tourists and local people.

7) Ecotourism promotes conservation, protection, and sustainable development of the national park.

8) Ecotourism encourages protection of wildlife habitat, landscape, soil, water, local culture, and ecosystem.

As mentioned, ecotourism is a "Responsible Travel' in areas containing natural resources that possess endemic characteristics and cultural or historical resources that are integrated into the area's ecological system (TISTR, 1997). In this respect, ecotourism should be regarded as an important tool for sustainable development of tourism in a protected area, provided that the natural resources of the park is well managed and protected (Ceballos-Lascurain, 1996).

2.2 ECOTOURISM IN THAILAND

2.2.1 Ecotourism Resources in Thailand

Land ecotourism resources and aesthetics are related to terrestrial ecotourism and these resources cover landscape, flora, fauna, culture and the way of life of local people while its activities consist of trekking, biking, bird watching, cultural study, natural study etc. Terrestrial ecosystems are ecosystems located inland. The ecosystems may include a variety of forests. There are two main types of forests in Thailand: evergreen forest and deciduous forest (Anomasiri, 2004).

2.2.1.1 Evergreen Forest

The evergreen forest is subdivided into the tropical evergreen forest, the pine forest, the mangrove forest and the beach forest. The tropical evergreen forest is found all over the moist parts of the country. This type of forest is also subdivided into the tropical rain forest, the semi-evergreen forest and the hill evergreen forest. The pine forest, there are two species of tropical pines in Thailand. They are the two-needle pine and the three-needle pine. Mangrove and beach forests occur along the coastal areas of the Eastern, Central and Southern regions. The mangrove forest is scattered along the estuaries of rivers and muddy seashores where the soil is muddy and influenced by the tide. The beach forest occurs along the sandy coastal plains especially in the eastern coast of the Southern regions.

2.2.1.2 Deciduous Forest

The deciduous forest is commonly found throughout the country. It is broadly subdivided according to the species composition into the mixed deciduous forest (with

and without teak) and the dry dipterocarp Forest. The mixed deciduous forest is among the most commercially valuable forest of Thailand. The dry dipterocarp forest is commonly found in the dry area (rainfall below 1,000 millimeters) where the soil condition is infertile and sandy or gravelly lateritic soil.

2.2.2 Ecotourism Practice and Development in Thailand

Thailand, like many other countries, adopted ecotourism as one of the country's tourism development strategies (Leksakundilok, 2004). Ecotourism has been operating in Thailand since 1994-1995 first under the name of 'Kanthongthiao Choeng Anurak', which means conservation tourism, and since 1998 under the name of 'Kanthongthiao Choeng Niwet', which means ecological tourism. Both terms are still in use to refer to ecotourism and conservation tourism (TISTR, 1997). Ecotourism has been applied not only in tourism industry, but also in the fields of environmental conservation and community development. It is seen as an expression of the new paradigm of social and economic development. Ecotourism is going very well in the sense of acceptability of all stakeholders and community development (Leksakundilok, 2004). The National Ecotourism Policy was determined during 1996-1997, by TISTR that supported by TAT, based on research, surveys, and discussion among stakeholders, including public and private sectors, academics and NGOs. The policy offered a common understanding and framework for action for the various organizations and individuals involved in ecotourism. In 1998, the National Ecotourism Policy was officially proclaimed and followed by the National Ecotourism Action Plan 2002-2006 in 2001.

According to TAT, ecotourism is a concept that entails three important factors: the promotion of public awareness in natural and environmental conservation, tourist satisfaction, and the participation of local communities, as well as income distribution. Most ecotourism definitions refer to and focus on these issues. Thus, conceptually, ecotourism is accepted and adopted world-wide including Thailand. TAT policies cover eight important issues, three of which concern ecotourism: (1) expansion of tourism sites to local areas to create income distribution to the people of all regions; (2) conservation and renovation of cultural heritage, natural resources and environment so as to maintain the Thai identity; and (3) support public participation in activities related to the development of tourism. TAT work plans and directions in promoting ecotourism have also been outlined.

1) To establish a committee responsible for policy formulation. This committee will be responsible for making plans, establishing guidelines for development of ecotourism, preparing media and publicity, solving problems and organizing training programs in ecotourism for personnel of various agencies.
2) To conduct research on the implementation project for establishing policies in ecotourism in Thailand.
3) To organize activities related to ecotourism, such as The Youth Conservation of Thai Tourism Project, tours under the concept of ecotourism, and producing media and campaigns to instill awareness in ecotourism.

In 1994, a group from the faculty of Forestry at Kasetsart University in Bangkok compared 109 sites in 14 provinces of Southern Thailand to assess their potential for ecotourism (Emphandu and Chettamart, 1997). The study was funded by TAT. The sites

included national parks, forest parks, wildlife sanctuaries and other natural areas. The group interviewed tour operators, land managers and local representatives of TAT in order to score each site for attractiveness to tourist; resistance to tourist impacts; educational opportunities; diversity of potential activities, and compatibility with other tourism development in the area. The study did not include either local community participation or the actual or potential contribution to conservation agencies. The five criteria listed above were weighted equally, except that the diversity of potential activities was down weighted to 60 % of the others. Of the 109 sites investigated, the study group concluded that 17 had high potential for ecotourism, 56 had medium potential and the remaining 36 had low potential. Of the 17 high-potential sites, 12 were within national parks and the remainder was natural areas and wildlife sanctuaries of various types. Of the 17, seven are terrestrial, three are wetlands and seven are marine. The two top-ranked sites were Khao Sok and Khao Luang National Parks. The marine sites are all in Satul, Pang-nga and Krabi provinces. The group recommended that ecotourism development should not be encouraged in wildlife sanctuaries because of regulatory constraints. It recommended that ecotourism should be promoted in national parks, since these were already being used for public recreation. Interestingly, one of the major reasons why 36 sites had low potential for ecotourism was that sites had already been subjected to intensive or large-scale tourism development (Buckley, 2003). As mentioned above, ecotourism has been practiced in Thailand for a decade. To assess the potential of ecotourism resources in Thailand the resources were ranked on the basis of their uniqueness, their authenticity, their attractiveness and on how well they were managed to ensure their ecological integrity or that of the area in which they are located. Any related tourist activities have been promoted, such as bird watching,

biking, trekking, snorkeling and scuba diving. This includes visiting local communities in rural areas, sharing views with the locals learning from local activities dealing with the natural environment (forest and coastal areas) and talking part in traditional agricultural practices. Nevertheless, early ecotourism destinations in Thailand have suffered from extensive impacts as a result of increased numbers of tourists.

2.2.3 Related Administrative and Managerial Organizations

Related personnel in the ecotourism process come from various agencies and organizations, namely:

1) The owner of the tourism area or those who are responsible for the supervision of the resources in the area, namely The Royal Forestry Department (Office of Natural Resources Conservation), Department of Fisheries, The Fine Arts Department, all levels of local administration, The Forest Industry Organization, communities and people, other individuals and organizations in the tourism areas.

2) Tourism intermediaries, namely marketing agencies, companies that conduct tourism-related business and tour operators, educational institutes, agencies, non-governmental organizations and various media.

3) Service providers and entrepreneurs who support tourism, namely lodging places, vehicle hire and travel services, guides, agencies who are responsible for infrastructures, etc., and including the communities which aim to benefit from tourism business development.

4) The persons who formulate and implement management policy and plans, from the highest level to administrative level, and who follow up the policy within the tourism areas. These are the Cabinet, TAT, the Province, Office of Environmental Policy

and Planning (OEPP), Department of Environmental Quality Promotion (DEP), the Royal Forestry Department, the Fine Arts Department, including various educational administrators.

At present, these related organizations and persons tend to conduct their responsibilities (which can have an important bearing on ecotourism) under an existing broad framework which does not really address the issues of ecotourism. The problem is that there is no distinct organizational structure to facilitate cooperation and communication on a regular basis so ecotourism management problems frequently occur. The experiences of these practices in Thailand show some successes but also show how the mismanagement of the ecotourism development process could lead to confusion. Even though all stakeholders are recognized in the national policy, few of them learn and use the policy as a guideline for their practice. They may learn and use from other experiences and create ecotourism tools to suit the organizations' objectives. The Action Plan, thus, may only be of benefit to TAT and government agencies concerned about government requests for a budget. Moreover, because of lack of information and sharing including information systems, decision making are even less apparent. Therefore, many organizations and individuals in Thailand participate in ecotourism at different levels and use different concepts due to differences in understanding of ecotourism concepts and applications. However, all stakeholders including local people have had very little experience in managing this form of tourism and its varying objectives. This is creating confusions in its implementation with considerably different practices and outcomes showing up in the last few years.

CHAPTER 3

MATERIALS AND METHODS

3.1 MATERIALS

3.1.1 Data Used and Thematic Maps

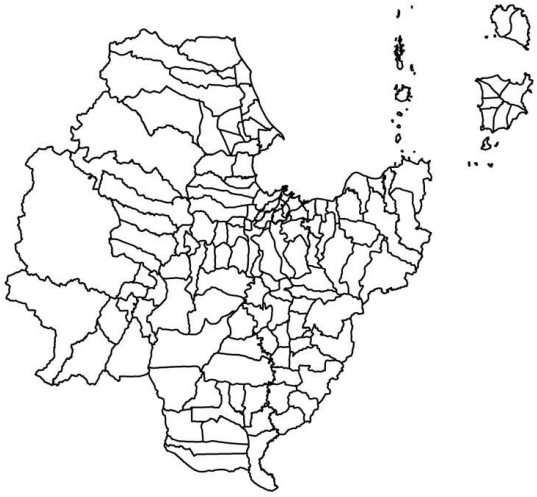
This study focuses on land suitability evaluation of ecotourism in Surat Thani province using GIS and AHP techniques. Data used were collected to assess the indicators of land utilization in various altitudinal ranges. Data gathering included field surveys, laboratory analysis and secondary data collection from various organizations and individuals (Table 3.1). A collected material includes annual reports along with statistical data at the district level, and other documents related to tourism projects and research.

Firstly, the primary data from the field survey were collected through interviews and questionnaires. The experts were selected according to their knowledge in sustainable development and their experience in tourism, ecology, economic, wildlife conservation, social science, natural resource management and GIS. In addition, a Global Positioning System (GPS) receiver was used in the field survey for the collection of natural attraction places and location of National Park Headquarters in Surat Thani province.

Majority of the secondary data were gathered from Department of Land Development, Thailand which are boundary map, land use land cover map 2007 and topography map. Majority of the demographic and socio-economic figures are based on the population census of 2007 from the National Statistical Office in Thailand. In addition, national and international institutions are also contacted of GIS datasets for the collection of necessary information and literatures.

Table 3.1 List of data used and their original sources

Data	Scale	Source
Boundary Map	1:50,000	Department of Land Development, Thailand.
Land Use/ Cover Map 2007	1:50,000	Department of Land Development, Thailand.
DEM (View-shed Map)		United States Geological Survey (USGS).
Tourist Map	1:50,000	Tourism Authority of Thailand (TAT).
Natural Attraction Places		Field Survey with GPS.
Protected Areas 2004	1:50,000	Department of National Parks, Wildlife and Plant Conservation, Thailand.
Location of National Park Headquarters		Geo-Informatics Operation Center, Thailand.
Surat Thani Wildlife Areas		Thailand Institution Scientific and Technological Research (TISTR).
Topography: Slope, Contour Line, Spot Height	1:50,000	Department of Land Development, Thailand.
Cultural Attraction Places		Ministry of Natural Resources and Environment, Thailand.
		Ministry of Cultural, Thailand.
Road Map	1:50,000	Road Layer, ESRI.
Population Data 2007		National Statistical Office, Thailand.

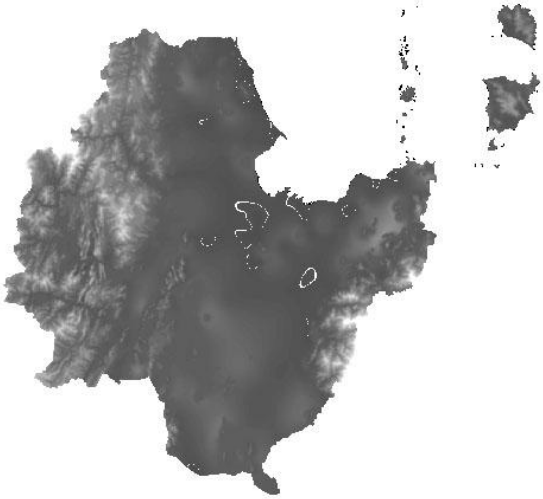


Political Boundary

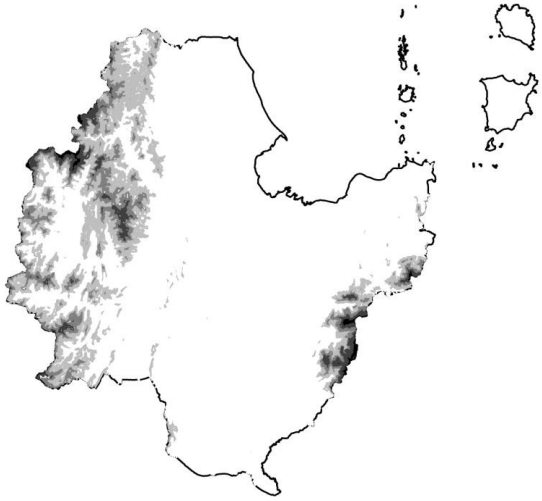
Land Use/ Cover

Protected Areas

Location of National Park Headquarters



DEM



Slope

Figure 3.1 GIS-based data layers used in the analysis of suitable area for ecotourism

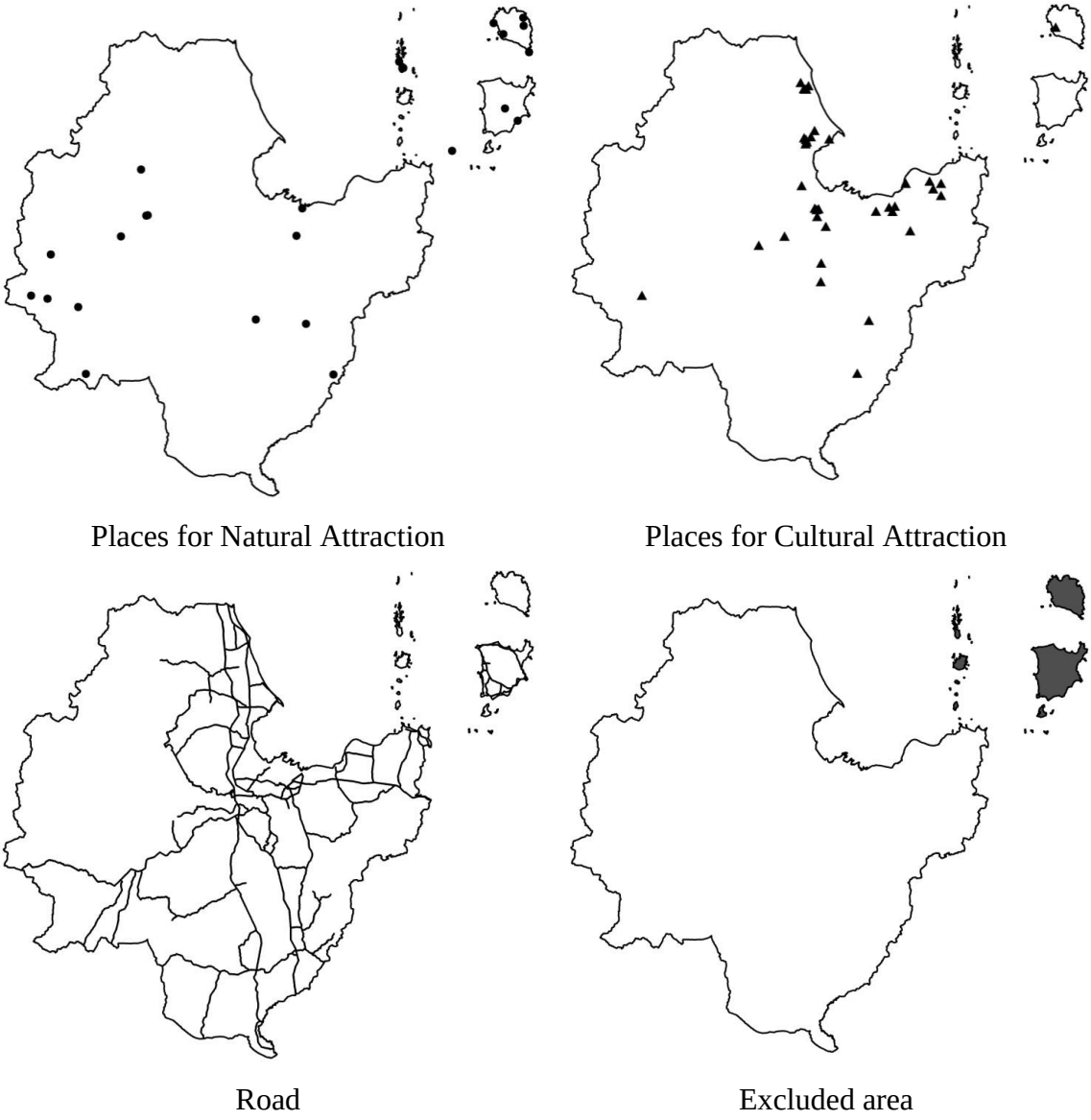


Figure 3.1 GIS-based data layers used in the analysis of suitable area for ecotourism (continued)

The thematic maps (Figure 3.1) were prepared and edited, overlaid and visualized on the basis of the suitability analysis for ecotourism using ArcGIS 9.3 software of ESRI. The application of GIS for overlaying thematic layers to establish land databases requires that all the layer maps need to be converted into a common coordinate system.

3.1.2 Interview, Meeting and Discussion

As mentioned above, the primary data collection was accomplished by using a survey questionnaire which is one of the important social research methodologies. Direct and indirect unstructured interviews were also done with the experts. Formal and informal interviews and group discussion were also conducted during the field survey to gather more information. A first round survey using questionnaires were used to converge and identify priority criteria and factors for the sustainable management of ecotourism in Surat Thani. The information derived from this study was used to develop a set of criteria and factors of land suitability evaluation for ecotourism in land ecosystems of Surat Thani. It is also used to identify problem in the study area. Conclusion was derived from attribute data. A final round survey using questionnaires were used to identify and prioritize the potential ecotourism sites in Surat Thani.

3.1.2.1 Distributed Questionnaire to Contracted Experts

In order to produce land suitability map, actual factor weight and class weight (or rating) for parameters involved in the study are needed. These were determined systematically based on the AHP. The priority of each factor involved in the AHP analysis is determined based principally on the expert's opinions. The method is implemented using the pair wise comparison technique that simplifies preference ratings among decision criteria. The first step of this procedure is to make pair wise comparisons between the vendors for each criterion. The standard scale for making these comparisons is shown in Figure 3.2.

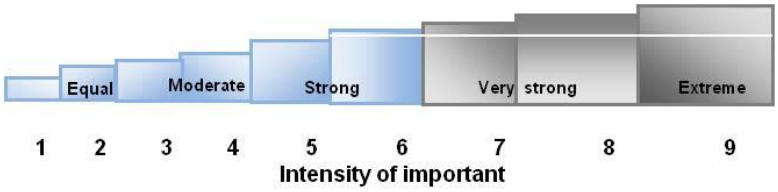


Figure 3.2 Preference scale for pair wise comparison in AHP

The first step of the analysis was designing questionnaires (Table 3.2) where expert opinions were asked to determine the relative importance of the involved criteria and factors. Results of the comparison (for each factors pair) were described in term of integer values from 1 (equal value) to 9 (extreme different) where higher number means the chosen factor is considered more important in greater degree than other factor being compared with. Moreover, to ensure the credibility of the relative significance used, AHP also provides measures to determine inconsistency of judgments mathematically. In this study, the questionnaires were distributed to experts and follow up interviews were conducted in all cases, to ensure that the respondents understood the contents of the questionnaire.

Table 3.2 Primary questionnaire design: effective criteria and pair wise comparison

Factor	Factor weighting score																	Factor
	More importance than								Equal	Less importance than								
C1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C2
C2	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C3
C3	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C1

3.1.2.2 The Degree of Suitability Classes

FAO Guidelines for Land Evaluation (FAO, 1976) are the basis of this research. These were used for analyzing land evaluation for ecotourism potential in order to lay the foundation for collecting, evaluating and analyzing information. The identification of suitable land classes based on the different factors is presented as follows:

a) Land suitability orders reflect kinds of suitability: S (Suitable) and N (Non suitable).

b) Land suitability classes that reflects the degrees of suitability in the following S1 (highly suitable), S2 (moderately suitable), S3 (marginally suitable), N (not suitable).

3.2 METHODS

3.2.1 Analytic Hierarchy Process (AHP) Application

The main goal of this research is to deal with the Analytic Hierarchy Process (AHP) for analyzing the factors of ecotourism integrated with Geographic Information System (GIS) techniques with the participation of experts in order to determine the suitability of an area for ecotourism development.

3.2.1.1 Definition of AHP

Spatial Multi-Criteria Decision Making (MCDM) is a process that combines and transforms geographical data into a decision (Malczewski, 1999). MCDM, combined with GIS data, is a powerful approach to systematically and comprehensively analyze a problem. The fundamental components of a multi-criteria problem are human value

judgment, trade-off evaluations, and assessments of the importance of criteria. Nonetheless, criteria that have GIS capabilities can be used to achieve a desired objective (Moldovanyi, 2003). The main purpose of the multi-criteria evaluation techniques is to investigate a number of alternatives in the light of multiple criteria and conflicting objectives (Voogd, 1983).

AHP is a widely used method in MCDM and was introduced by Saaty (Saaty, 1977; Saaty & Vargas, 2001). It is easily implemented as one of the MCDM techniques. AHP is a decision support tool, which can be used to solve complex decision problems. It uses a multilevel hierarchical structure of objectives, criteria, sub criteria and alternatives. AHP is based on three principles: decomposition of the overall goal (suitability), comparative judgment of the criteria, and synthesis of the priorities (Arabinda, 2003; Baniya, 2008). AHP uses a fundamental scale of absolute numbers to express individual preferences or judgment (Table 3.3). This scale consists of nine points. In general, nine objects are the most which an individual can simultaneously compare and consistently rank. The score of differential scoring presumes that the row criterion is of equal or greater importance than the column criterion. The reciprocal values (1/3, 1/5, 1/7, 1/9) have been used where the row criterion is less important than the column criterion.

To ensure the credibility of the relative significance used, AHP also provides measures to determine inconsistency of judgments mathematically. Based on the properties of reciprocal matrices, the consistency ratio (CR) can be calculated. CR < 0.1 indicates that level of consistency in the pair wise comparison is acceptable. Saaty (1980) suggests that if CR is smaller than 0.10, then the degree of consistency is fairly acceptable. But if it is larger than

0.10, then there are inconsistencies in the evaluation process, and AHP method may not yield meaningful results. More details of the CR calculation were given in Ma et al. (2005) and Hossain et al. (2007).

Table 3.3 The preference scale for pair wise comparison in AHP

Scale	Degree of preference	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Moderate importance of one factor over another	Experience and judgments slightly favor one activity over another
5	Strong or essential importance	Experience and judgments strongly favor one activity over another
7	Very strong importance	An activity is favored very strongly over another and dominance is demonstrated in practice
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation
2,4,6,8	Intermediate values between the two adjacent judgments	When compromise is needed
Reciprocals	Opposites	Used for inverse comparison

Source: Adopted from Saaty, 1980; Saaty, 1990.

3.2.1.2 Application of AHP in Decision Support System

- Structure of the decision problem

Applying AHP to a decision-making problem involves four fundamental steps (Piamviriyawong, 2006).

1) Model specification: Feasible investment alternatives are specified first followed by the determination of criteria for the evaluation of alternatives. These criteria are further grouped into logical categories.

2) Pair wise comparison of categories and criteria: The relative importance of criteria within each category and of each category within the group of categories is established through pair wise comparisons using a square matrix structure. The values of importance are taken from Saaty's 1-9 scale mentioned above.

3) Weighting of investment alternatives: Every investment alternative is rated with respect to every investment criterion in the evaluation model. Pair wise comparison is applied to obtain weighting for qualitative data. If quantitative data are available then the weighting is done by using the existing or estimated performance data.

4) Investment rankings: Finally, weighting of the alternative is combined with the weighting of the criteria to form an overall rating for each investment alternative. The alternative with the highest weighting is ranked as the best choice, taking into account the relative importance of each criterion and the relative desirability of the alternatives with respect to each criterion.

- Data standardization

Most GIS have very limited capabilities for integrating geographical information and the decision maker's preferences. It is suggested that the integration of MCDM and a GIS provides a platform for incorporating preference into GIS procedure

(Piamvinyawong, 2006). The fundamental issue in deciding the data model for the integrated system is the compatibility of the data constructs between the GIS model and the MCDM modeling system.

The AHP approach requires standardization of the input data, the need for data standardization in GIS-based land suitability evaluation often arises as a consequence of the need to integrate into the evaluation process data measured not only in different units but also in different scales of measurement, such as nominal, ordinal, interval and ration scales. Data standardization is not designed to make the multi-criteria scores independent from the absolute values of the criteria. In fact, the value functions are clearly not independent of a positive linear transformation of individual values (Abinda Lakar, 2003). The purpose of standardization can be summarized as follows (Pereira and Duckstein, 1993):

1) To ensure that all natural scales, some of which may include nominal or ordinal data are converted to a common value scale with interval properties.

2) To account for the possibly non-linear or even non-monotonic character of relationship between nature and value scale.

3.2.2 GIS Application

3.2.2.1 GIS Application in Tourism and Ecotourism Planning

The application of GIS has been used in tourism research including of that which relates to ecotourism planning, visual resource assessment and management, recreation and park management, facility monitoring and suitable location identification. Additionally and very recently, analysts have begun using GIS in a limited fashion in applications

relating to tourism marketing. Mainly, this technology uses tourism research to derive specific benefits as a supporting tool of decision making process (Bahaire and White, 1999). In tourism research, GIS is used to characterize tourism destinations by using points, lines and polygons especially in different landscapes. Point features represent individual tourist attractions. More specifically, 'GIS can be used to map out land covers and habitats' 'monitor landscape changes' 'model species distribution' and 'predict suitable habitats for different species' (Fung and Wong, 2007). It can minimize conflict in the case of allocating resources between what are often conflicting demands, needs and data change over time, and their ability to identify patterns or relationships based on particular criteria to support in the decision-making. Site selection is also an important use of GIS in tourism planning. For instance, by using suitable location identification tools and topology it is simply possible to identify potential areas for further tourism development (Md., 2010).

In ecotourism planning, the first issue that emerges is the environment and its conservation. An ecotourism destination must in no way be developed without planning in terms of environmental concern. Boyd and Butler (1996) demonstrate the application of GIS in the identification of areas suitable for ecotourism in Northern Ontario, Canada. At first, a resource inventory and a list of ecotourism criteria were developed. At the next stage, GIS techniques were used to measure the ranking of different sites according to the set criteria and, therefore, identify those with the best potential (Farsari, 2003).

3.2.2.2 GIS Application for Land Suitability Evaluation

GIS techniques have been effectively used in recent times as tools in carrying out the morphometric analysis, which helps in suitability evaluation and management of land

resources (Obi et al., 2002). GIS technology can be used for scientific investigations, resource management, and development planning. Since the 1990s, GIS has been claimed as a magic tool in natural resource management as "it is ultimate in GIS the perfect answer to each and every resource problem" (Heit and Shortreid, 1991). Culbertson et al. (1994) note the great potential for GIS technology in planning for sustainable development, as an extension of its traditional use in environmental analysis. GIS is a powerful and sophisticated tool for displaying and analyzing spatial relationships between geographic phenomena in the form of vectors and images. Data from different sectors can be integrated into a single analysis without the need for each sector duplicating data collection efforts (Baniya, 2008). This information should present both opportunities and constraints for the decision maker (Ghafari et al., 2000). GIS and MCDA as the typical cases that can help planners handle the complexity of calculations in relation to many criteria. A set of contributions concerning three areas of application of land planning has been reviewed: location choice, land suitability assessment, and collaborative decision support systems (Joerin et al., 2001). The combination of GIS and MCDA is also a powerful tool for land suitability assessments. New concepts and approaches like multi-criteria method and GIS application have developed dramatically in land evaluation, especially since 2000. GIS is an information system with the ability to perform numerous tasks utilizing both spatial and attribute data stored in it (ESRI, 2001).

According to spatial multi-criteria evaluation of land suitability, there are three major phases of suitability analysis with GIS, namely: problem formulation phase, where the situation is analyzed for the problem and prospects; problem understanding, generating alternatives, selecting criteria and establishing relationships among them; and evaluation of the alternatives using the set criteria to achieve the objective (Sharifi, 2003).

Decision making is the process that leads to a choice within a set of alternatives, and is often used in land suitability evaluation of alternatives like S1: high level of suitability, S2: medium level of suitability, S3: low level of suitability and N: non-suitability (Baniya, 2008). Multi-criteria evaluation is a transparent way of systematically collecting and processing objective information, and expressing and communicating subjective judgments concerning choice from a set of alternatives affecting several stakeholders. Such systematic, rational and transparent judgments most probably lead to more effective and efficient decisions by individuals or groups of decision makers (Sharifi et al., 2004). The land suitability classifications can be determined by overlaying thematic maps and by analyzing attribute data. With the support of GIS, this leads to the faster presentation of accurate results. The building of a GIS is a chain of operations that leads us from planning data observation and collection, to their storage and analysis, to the use of the derived information in some decision making process (Chuong, 2007). For instance, there is very little site-specific information about sources of visitors' origin and destination, spatial patterns of recreation and tourism use and suitability of sites for recreation/ tourism development all of which are suitable application areas of GIS. GIS application in ecotourism development has been limited to tourism-based land management, recreational facility inventory, visitor impact assessment, recreation-wildlife conflicts, mapping wilderness perceptions, and tourism information management system and decision support systems. Multidisciplinary natural resources teams are required to make GIS systems an effective tool in support of land evaluation and land use planning. Database is set up in the forms of maps and layers of information. Each map demonstrates information, spatial and non-spatial attributive relating to land evaluation objective. Sets of evaluation criteria are established, then, evaluation criteria in GIS

context are set up. Land unit map and land use inquiries are also established and evaluation criteria are standardized to make the criterion comparable with each other. Finally, a land suitability map is created and the findings are applied to sustainable planning (Baniya, 2008).

3.2.3 Software Used for Data Management

Research methods include collection of available data and a new field work data, data analysis using various tools and techniques. Microsoft word was used for the write up this thesis setting. Macro created on Microsoft Excel software was used for multi criteria analysis (weighting, rating) based on the AHP method (Saaty, 1980). ArcGIS 9.3 software was used to analyze all the factors represented by GIS thematic layers and to produce the ecotourism suitability map. The map overlay approach was applied following the concept of Weighed Linear Combination (WLC).

3.2.4 Conceptual Framework and Flowchart of the Analysis

There were four crucial steps to produce site suitability map for ecotourism and these are: (1) finding suitable factors to be used in the analysis, (2) assigning factor priority, weight and class weight (rating) to the parameters involved, (3) generating land suitability map of ecotourism, and (4) determining potential areas for ecotourism. The details of the conceptual framework and each processing step are shown in Figures 3.3 and 3.4, respectively.

MCDA technique is applied to incorporate decision maker's judgment and preferences using the AHP method. This method includes the selection of the criteria for the spatial Multi-Criteria Evaluation (MCE) technique for the suitability analysis for ecotourism. With regards to the standardization of the criteria maps, the relative importance of the class of each criterion. The final step involved in AHP is the aggregation of the relative weights obtained at each level of the hierarchy to calculate the suitability index. ArcGIS is used to combine the spatial data with suitability index so that a continuous land suitability map is generated. The output is a suitability map for ecotourism development. The final part deals with the recommendations in order to determine the potential areas for ecotourism development.

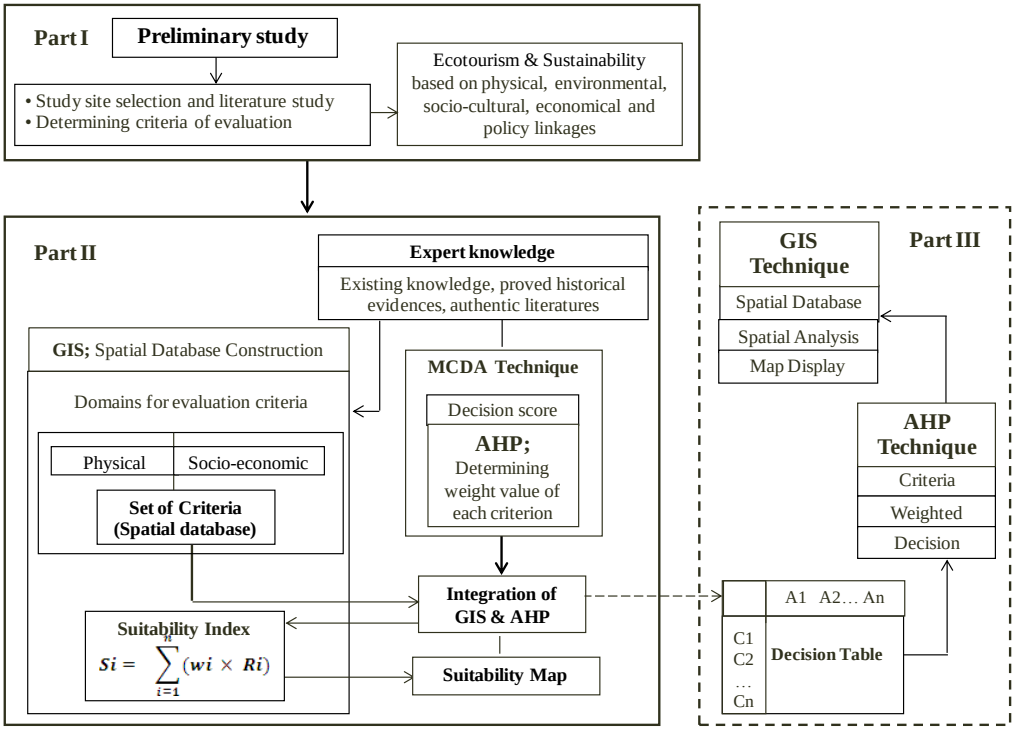


Figure 3.3 Conceptual framework of the study

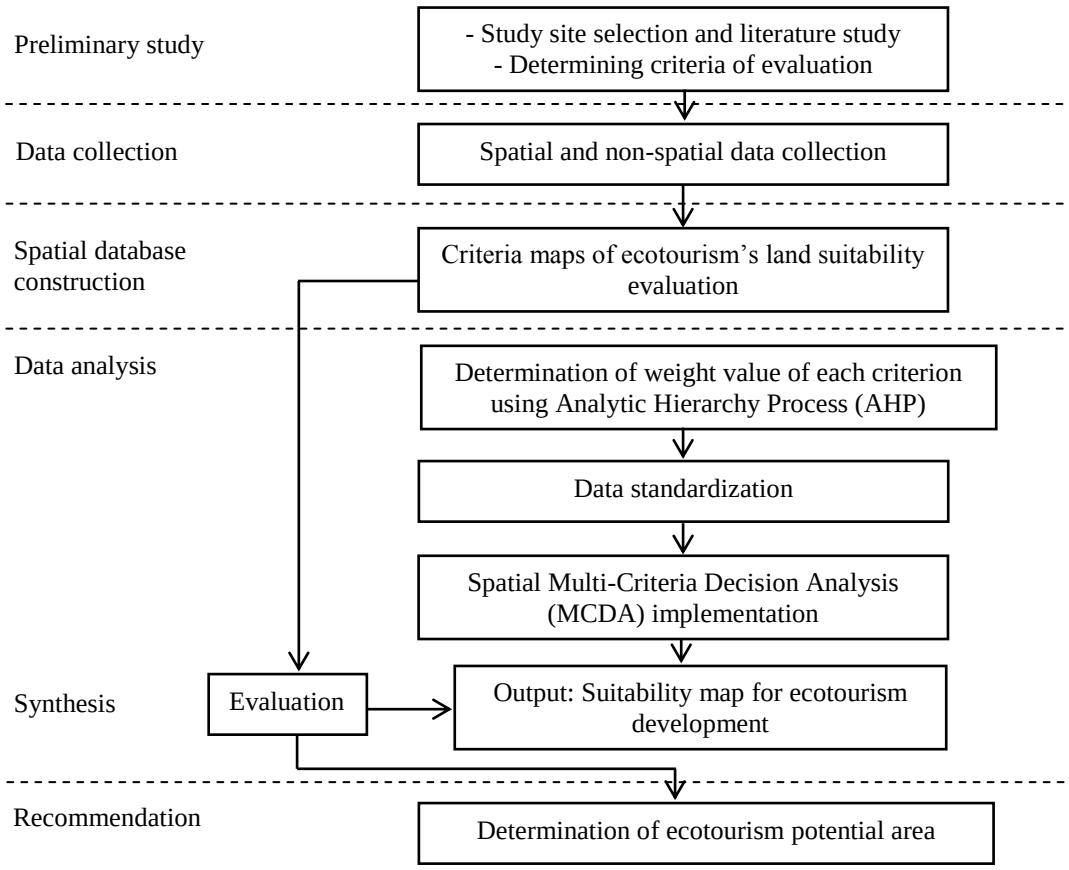


Figure 3.4 Schematic diagram for modeling suitable ecotourism sites in Surat Thani province

Figure 3.4 presents the analytical flowchart, step by step. The first part is the preliminary study which includes study site selection and literature review on indicators and criteria for suitability analysis for ecotourism. The next step is data collection (spatial and non spatial data as mentioned in Table 3.2 and Figure 3.1) and spatial database construction, in order to create criteria maps for ecotourism land suitability evaluation. GIS-based multi-criteria evaluation can be thought of as a process that combines and transforms spatial and aspatial data (input) into a resultant decision (output) (Malczewski, 2004). The approach followed in this research integrates GIS based spatial analysis technique

and MCDM technique for multiple evaluation. The next step is data analysis and synthesis with deals with multi-criteria land suitability evaluation for ecotourism.

3.2.5 Determination Criteria and Factor Involved

The decision criteria and factors are evaluated based on socio-economic factors and bio-physical characteristics of the land suitability evaluation for ecotourism. Based on the acquired information, MCE is done based on 5 criteria as indicators of suitability within the land ecosystem of Surat Thani province: (1) landscape/naturalness, (2) wildlife, (3) topography, (4) accessibility and (5) community characteristic. In addition, the evaluation process for ecotourism site was conducted based on 9 important factors, namely: (1) visibility, (2) land use/cover, (3) reservation/protection, (4) species diversity, (5) elevation, (6) slope, (7) proximity to cultural sites, (8) distance from roads and (9) settlement size (Figure 3.5). These criteria and factors were chosen based on the opinion experience and expertise of experts and information from various sources. Knowledge acquisition was accomplished through discussions with experts of related fields of study, surveying of authenticated literatures and analysis of historical data. MCDM was applied to incorporate decision maker's judgment and preferences to evaluations regarding to AHP technique. Each factor received a weight and a score which represented its relative importance in the suitability evaluation. The overall results recorded were in form of a pair wise comparison matrix.

The first step in the hierarchy is to set the objective that is to identify and prioritize the potential ecotourism sites. The hierarchy contains decision criteria and factors of this

study based on bio-physical characteristics and socio-economic factors. At the second and third levels, the decision of criteria and factor of this study are evaluated based on five criteria and nine factors for the suitability analysis for ecotourism. These are landscape/ naturalness (visibility, land use/cover), wildlife (reservation/protection, species diversity), topography (elevation, slope), accessibility (proximity to cultural sites, distance from roads) and community characteristics (settlement size). At the fourth level is the degree of suitability of each factor classified as highly suitable (S1), moderately suitable (S2), marginally suitable (S3) and not suitable (N).

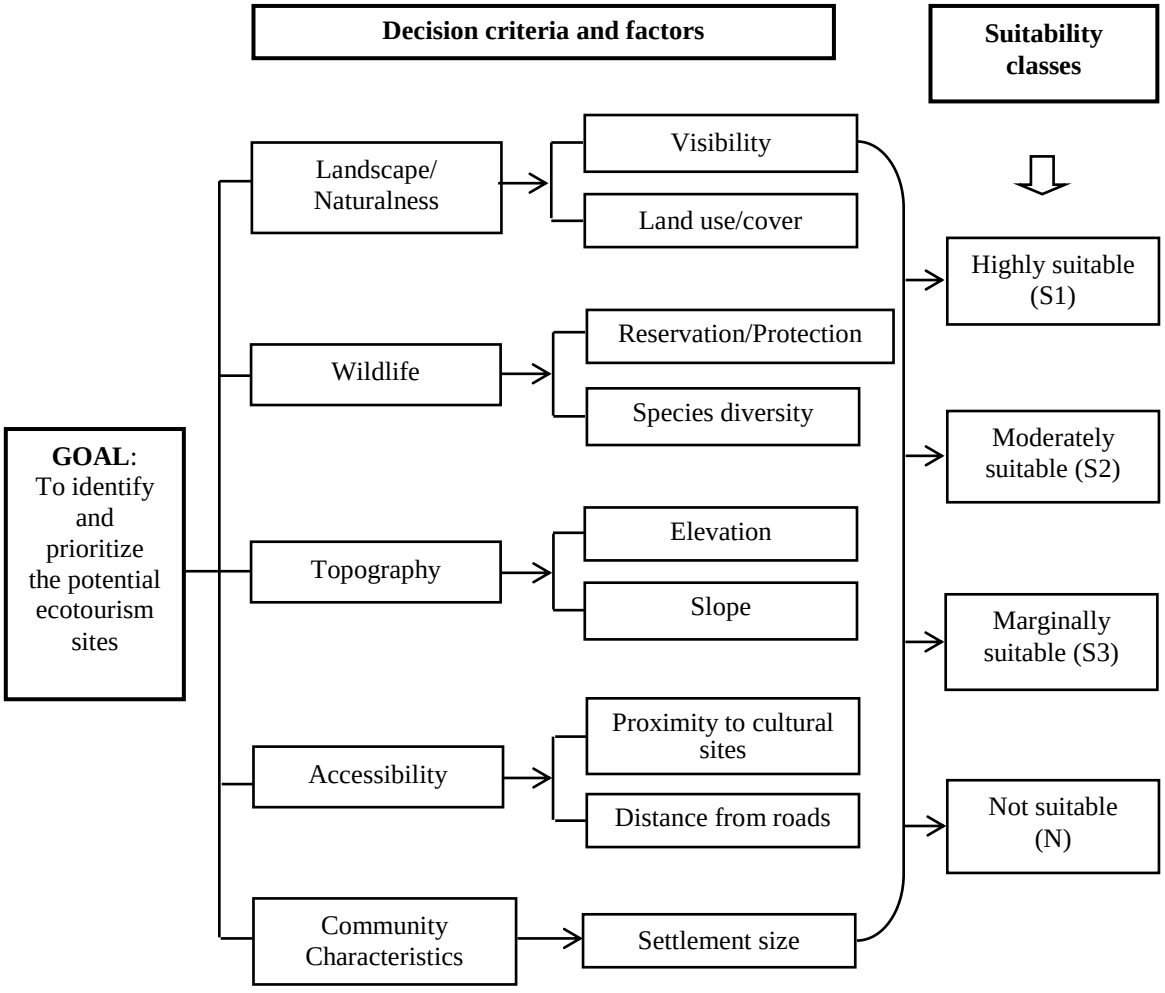


Figure 3.5 Schematic diagram of the evaluation process of criteria of ecotourism in Surat Thani province

CHAPTER 4

POTENTIAL ECOTOURISM SITES

USING GIS & AHP ANALYSIS

4.1 CRITERIA MAPS GENERATION AND CLASSIFICATION

This part discusses the determination of criteria and classification of factors for the identification of ecotourism potential areas which were divided into 2 main categories: bio-physical and socio-economic sections. There were five criteria and nine factors in the form of nine GIS-based layers incorporated for land suitability evaluation for ecotourism.

4.1.1 Determination of Criteria and Classification of Factors

Ecotourism takes place in natural tourism areas which have endemic characteristics, including cultural and historical resources that are closely connected to the ecosystems in the areas. Ecotourism provides an opportunity for learning about the environmental condition and ecosystem functioning of the tourism resources area (TISTR, 1997). Ideally, ecotourism should satisfy several criteria, such as: conservation of biological and cultural diversities through ecosystem protection; promotion of sustainable use of biodiversity with minimal impact on the environment being a primary concern; local culture; and flora & fauna being the main attractions (Honey, 1999). In addition, ecotourism often involves small-scale tourism oriented to natural areas, wildlife and

traditional culture. Typically, ecotourism contributes to rural economies and to maintaining land in a natural state (WTO, 1996). Seven key attributes are suggested as having applicability. Elements and criteria of ecotourism suitable should be: environmentally and socially responsible; focused on elements of the natural environment; managed in such a way as to have minimal environmental and social impacts; non-consumptive; capable of providing desired economic benefits to local residents; compatible with other resource uses in the area; and appropriate in scale for conditions and environment (Boyd et al., 1995).

Based on the acquired information from literature search, previous works and interviews with experts, there were five criteria determination and nine factors classification for identifying and prioritizing the potential ecotourism sites as presented in Table 4.1. These are landscape/naturalness (visibility, land use/cover), wildlife (reservation/ protection, species diversity), topography (elevation, slope), accessibility (proximity to cultural sites, distance from roads) and community characteristics (settlement size). These important criteria and factors in determining what areas are best suited for ecotourism development.

A criterion is a basis for a decision that can be measured and evaluated. It is the evidence upon which a decision is based. Selecting/formulating criteria that need to be fulfilled in order to make the right decision is one of the difficulties in multi-criteria evaluation (Chhetri and Arrowsmith, 2008). In the GIS database, the attribute factors are represented by map layers, which contain attribute values for each pixel in raster data (Kiker et al., 2005). The nine related factors were grouped based on the five criteria. In this process, the data of all the selected factors were kept, displayed and managed individually.

Table 4.1 Criteria and factors in land suitability analysis for ecotourism

Ecotourism Requirement		Unit	Factor Suitability Rating				Reference
Criteria/ factors			High Potential (P1)	Moderate Potential (P2)	Low Potential (P3)	No Potential (N)	
1.Landscape/ Naturalness	(1) Visibility	Visibility values (Lines of sight)	7-9 (High visibility values)	4-6 (Middle visibility values)	1-3 (Low visibility values)	0 (Invisible)	Compiled from Kumari et al., 2010 and Chhetri & Arrowsmith, 2001.
	(2) Land use/cover	class	Highly potential	Moderately potential	Marginally potential	No potential	Compiled from Banerjee et al., n.d. An analysis
2.Wildlife	(3) Reservation/ Protection	protected areas class	Highly potential	Moderately potential	Marginally potential	No potential	Questionnaire
	(4) Species diversity	% of recorded species	> 30%	20-30%	5-20 %	<5%	Questionnaire
3.Topography	(5) Elevation	meter	300-400	100-300	> 400	0-100	Jangpradit, 2007.
	(6) Slope	degree	0-5 %	5-25 %	25-35 %	> 35 %	Jangpradit, 2007.

Table 4.1 Criteria and factors in land suitability analysis for ecotourism (continued)

Ecotourism Requirement		Unit	Factor Suitability Rating				Reference
Criteria/ factors			High Potential (P1)	Moderate Potential (P2)	Low Potential (P3)	No Potential (N)	
4.Acessibility	(7) Proximity to cultural sites	Kilometer	0-15 km from cultural sites	15-30 km from cultural sites	30-45 km from cultural sites	> 45 km from cultural sites	Questionnaire
	(8) Distance from roads	Kilometer	Areas outside of any buffers around all road	Areas within 2 km. buffer around third main roads	Areas within 5 km. buffer around second main road	Areas within 10 km. buffer around major roads	Compiled from Boyd et al., 1995.
5.Community Characteristics	(9) Settlement size	population size	0 (absence of permanent settlement)	1-1000 (unincorporated communities)	1001-10000 (small towns)	>10000 (urban settlements)	Compiled from Boyd et al., 1995.

4.1.2 Classification of Criteria Maps (in form of 9 GIS-based layers)

With regards to the acquired information, there were 9 important factors in the form of 9 GIS-based layers incorporated for suitability analysis for ecotourism. Please note that these factor maps were overlaid together for final suitability classification of the study area for ecotourism. However, in this process the data of all the selected factors shown in Table 4.1 are kept, displayed, and managed individually. Because the factors have different scales of measurement; they cannot be compared by their raw scores. Therefore, in order to allow comparability, the factor maps were standardized. Standardization allows comparison of criterion scores within one alternative. In order to standardize, the raster features of all the factors were reclassified into a common scale range. It should be noted that not all attributes have a range from 0 (no potential) to 1 (high potential).

4.1.2.1 Landscape/ Naturalness

In this study, 'Natural' is defined to mean the present landscape has adjusted to human interaction and modification, and given that this interaction and modification the landscape varies spatially (Boyd, 1995). What areas are best suited to different types of eco-tourists and ecotourism experiences? Naturalness is often described in terms of scenic quality influenced by the degree of alteration of the natural landscape or the valued landscape character. Therefore, an area's degree of landscape and naturalness is expressed in terms of the following;

- Visibility

A visibility (scenic attractiveness) factor was generated from a digital elevation model integrated with the location of natural uniqueness by view-shed

analysis on the basis of visible or not visible (lines of sight). Naturally unique places were collected using GPS in the form of point feature data. The view-shed analysis was done to determine the scenic attractiveness (Chettri and Arrowsmith, 2001). This was carried out by visibility values (lines of sight). In this study, high visibility values (7-9) are ranked as high, middle visibility values (4-6) are ranked as moderate, low visibility values (1-3) are ranked as marginal and invisible are ranked as not suited. The result of the reclassified visibility map is shown in Figure 4.1.

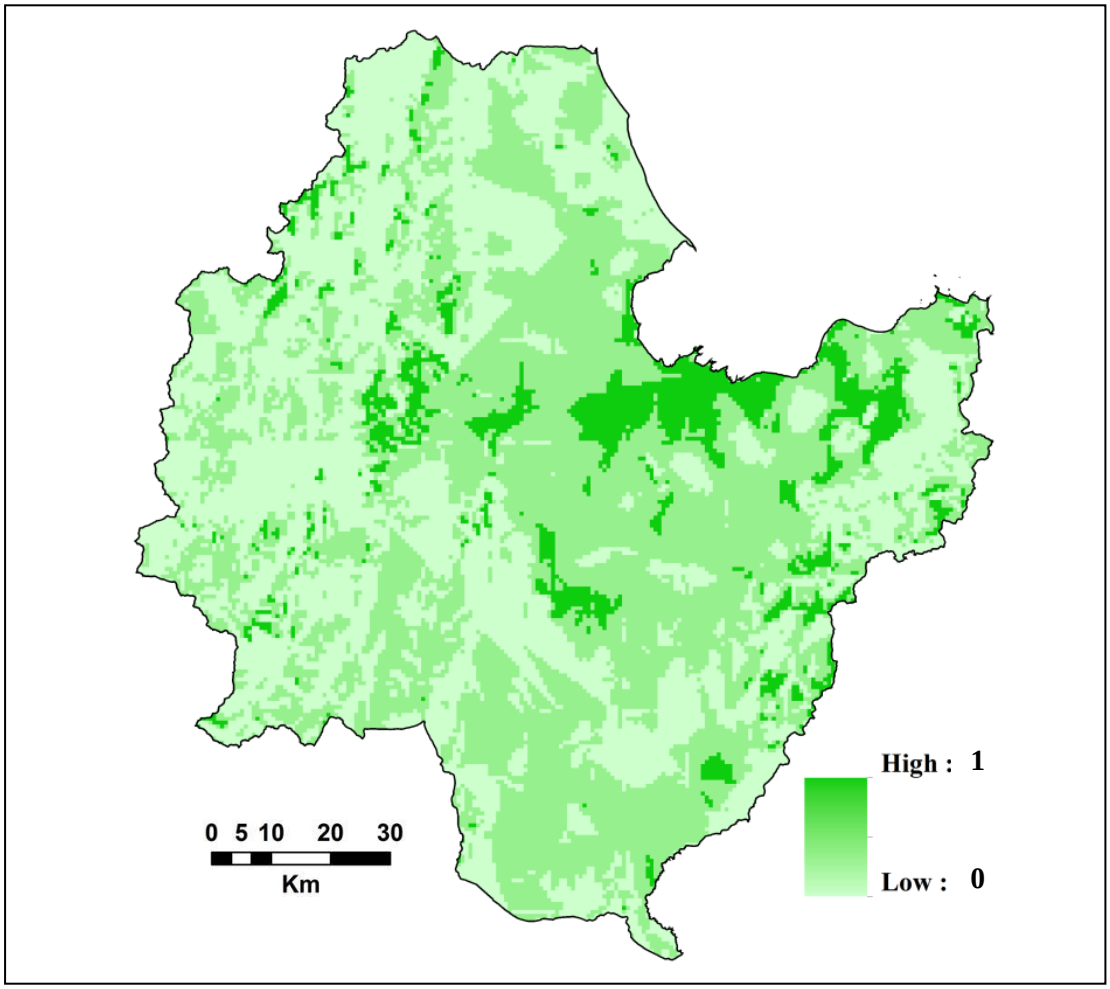


Figure 4.1 Visibility

- Land use/ cover

Land use map in 2007 was classified and reclassified into 10 classes of land use/ cover according to bio-physical vegetation characteristics of ecotourism potential resources as seen in Table 4.2. These are dense forest, open forest, orchard, water body, plantation, crop land, farm land (F), urban and built-up land, degraded forest, and miscellaneous land.

Table 4.2 Land use/ cover classification for ecotourism potential resources

LULC Type	LULC Suitability
Dense forest	Highly importance for ecotourism, can serve as major ecotourism attraction, area need to be conserved.
Open forest	Very important for ecotourism, area needs to be managed and conserved properly to attract eco-tourist as well as general tourist.
Orchard	Highly importance for agro-tourism can serve as main ecotourism attraction.
Water body	Active recreation as boating, parks and natural zoological parks.
Plantation	Should be properly monitored and protected from any encroachment.
Crop land and Farm land	Area under agriculture and farm should not be converted to other schemes. Any infrastructure development should be restricted.
Urban and built-up land	Suitable for eco-tourist infrastructure development
Degraded forest	Need to be managed, properly with possibilities of new plantations. Important from point of view of medicinal plantations and agro-forestry scheme.
Miscellaneous land	-do-

Source: Compiled from Banerjee U.K. et al., n.d.

Therefore, dense forest are ranked as highly potential; open forest, orchard and water body are ranked as moderately potential; plantation, crop and farm lands are ranked as marginally potential; urban and built-up land, degraded forest, miscellaneous land are ranked as no potential. The result of the reclassified land use/cover map is shown in Figure 4.2.

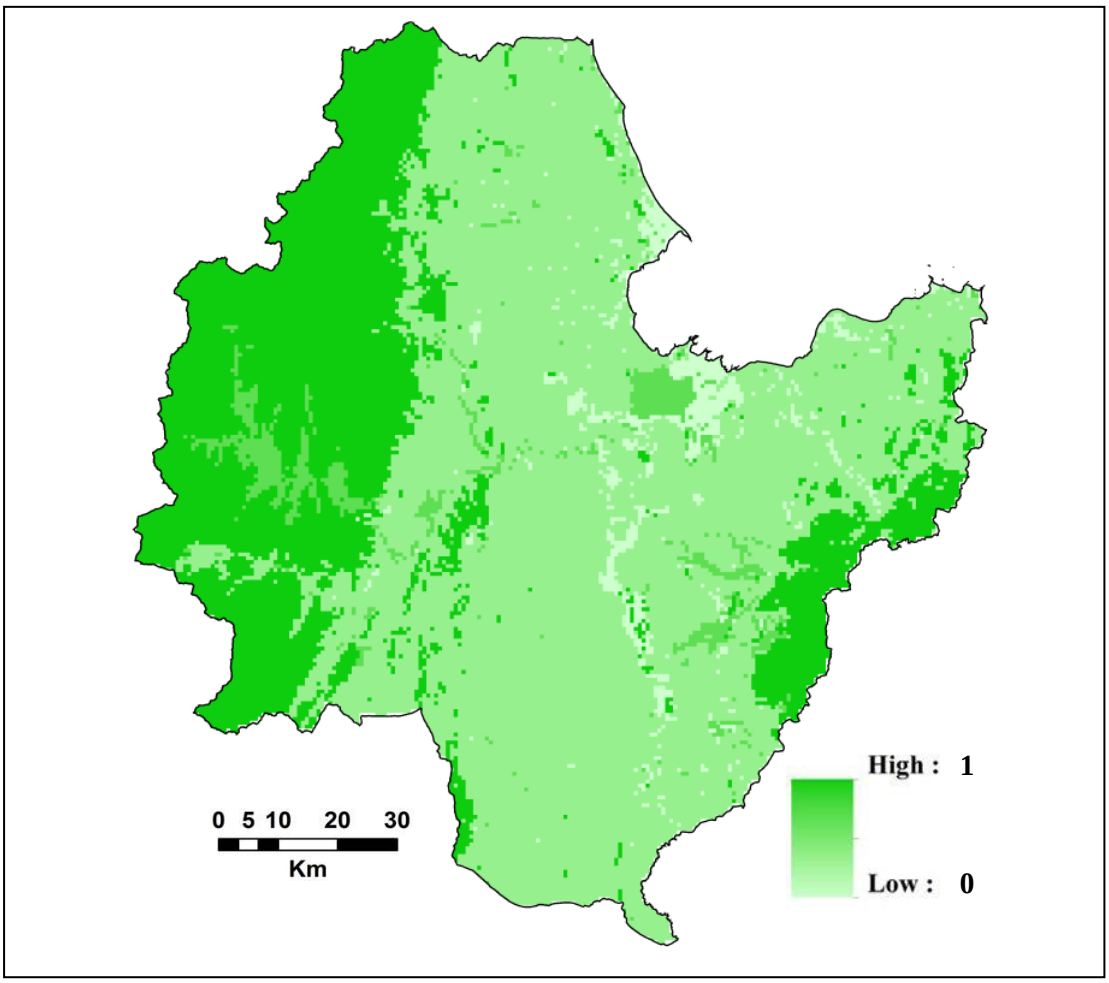


Figure 4.2 Land use/ cover

4.1.2.2 Wildlife

Wildlife criteria concerns with reservation and protection areas where the places are suitable for habitats, species diversity and endemism data characterization. Because of flora and fauna are being the main attractions for ecotourism (Honey, 1999).

- Reservation/ Protection

The reservation/ protection factor was classified by the type of protected areas which are suitable for habitat and wildlife abundance with regards to wildlife reserve, rare species and newly found species. In this study, Wildlife Sanctuary (WS) and Non Hunting Area (NHA) are ranked as highly potential for habitat; National Park (NP) areas are ranked as moderately potential for habitat; and Non Forest Reserve (NFR) areas are ranked as marginally potential for habitat. On the other hand, the areas outside of the protected area are ranked as no potential for habitat. The result of the reclassified reservation/ protection map is shown in Figure 4.3.

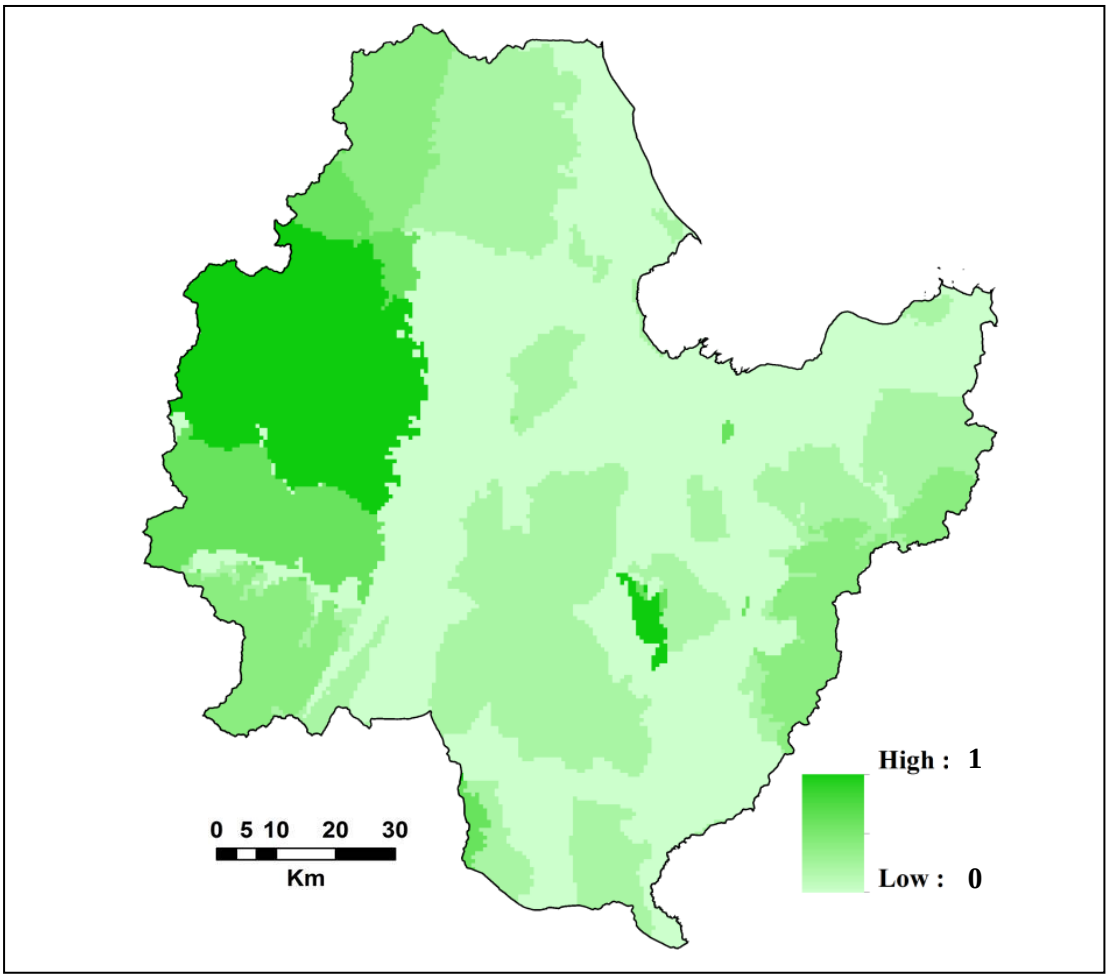


Figure 4.3 Reservation and protection

- Species diversity

Species diversity factor was classified from the number of recorded species (mammals, birds, reptiles and amphibians) in order to consider wildlife population abundance in the area. The data on the recorded species in Surat Thani wildlife areas were gathered from Thailand Institution Scientific and Technological Research (TISTR). In this study, above 30 % of recorded species are ranked as high; moderate (20-30%); marginal (5-20 %); and less than 5 % of recorded species are ranked as no potential. The result of the reclassified species diversity map is shown in Figure 4.4.

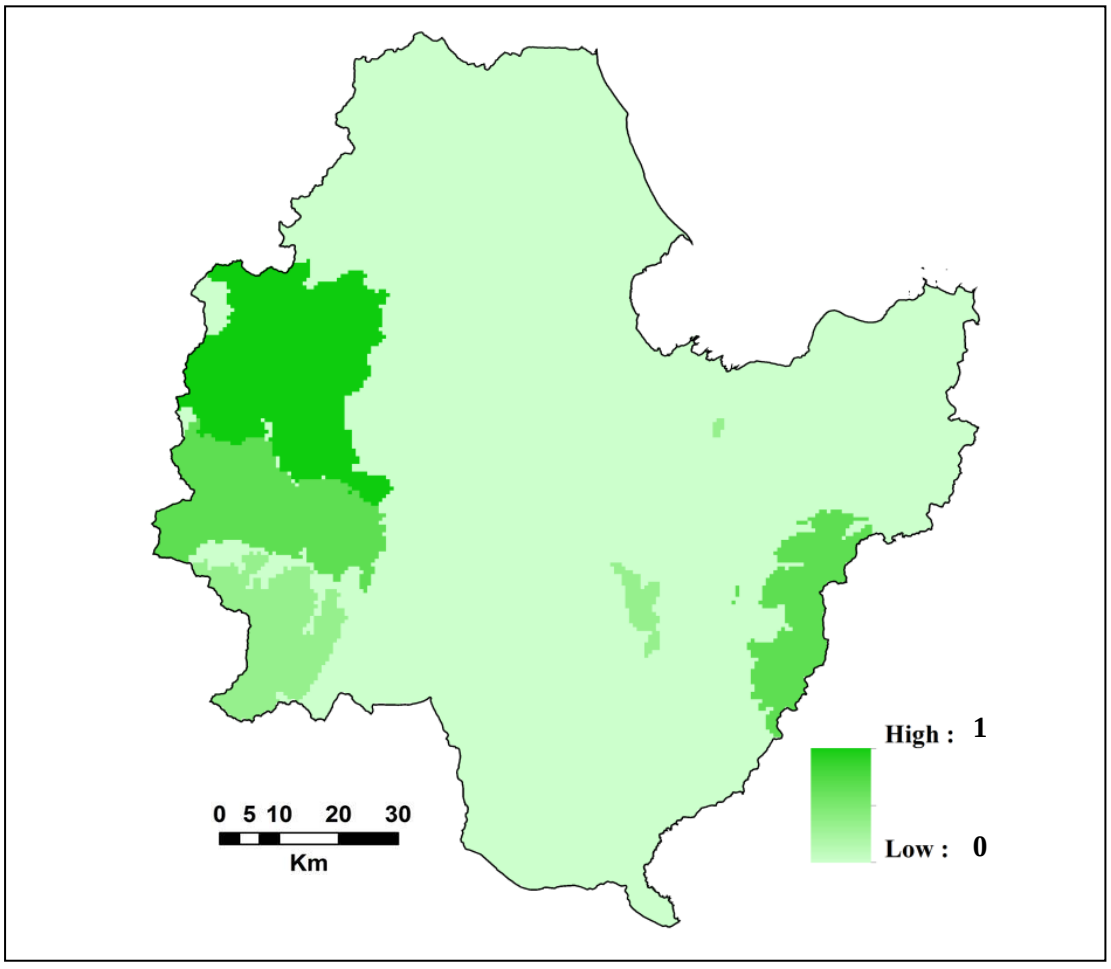


Figure 4.4 Species diversity

4.1.2.3 Topography

Topography describes the surface shape and relief of the land. It refers to various landforms (physical features) which represent the external shape of the earth (Tewodros, 2010). Earlier studies suggest that topography is one of the most important dimensions of attractiveness in landscape, scenic potential or the topographic attractiveness for tourism, as it enables patterns and form for many other landform and land cover features to be determined (Linton, 1968; Bishop and Hulse, 1994; Miller et al., 1994). Furthermore, elevation and slope should be considered when selecting site for tourism construction project what areas are best suited to different types of eco-tourists and ecotourism experiences.

- Elevation

Elevation called altitude is the height of place above or below a reference level such as mean sea level. To evaluate the nature and element of an area making the landscape what areas is suitable for tourism, it is necessary to consider the position, angle and stage.

In this study, elevation factor was generated from a Digital Elevation Model (DEM). The elevation classes are evaluated based on the basis of attractiveness in landscape or the topographic attractiveness for tourism significant feature. The elevation of 300-400 m are ranked as high relative relief; medium relative relief (100-300 m); little relative relief (above 400 m); and no relative relief (0-100 m) as described by Jangpradit (2007). The result of the reclassified elevation map is shown in Figure 4.5.

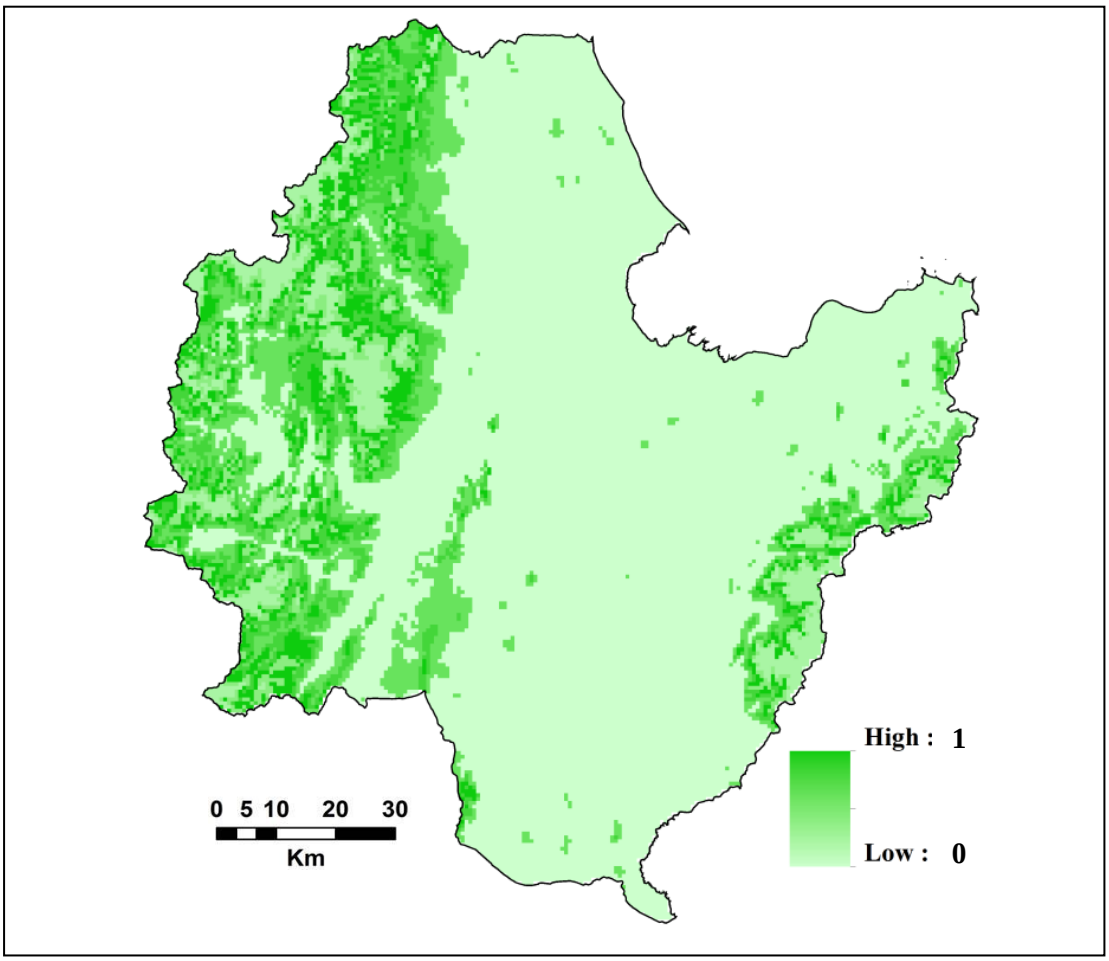


Figure 4.5 Elevation

- Slope

Slope profile appears visually attractive to observers across a wider geographical area. The complexity of the area in terms of slope is a vital factor in the suitability analysis for ecotourism. This factor is show a varying degree, a complexity of area and slope of area which effect to selected area by defining percentage of slope that related to site suitable of ecotourism. In addition, slope is a safety indicator implying the gentler the slope, the higher the safety factor and vice versa.

In this part, the reclassified slope map was given from the degree measurement unit for ecotourism requirement. Flat landform is the most suitable for ecotourism.

Therefore, the 0-5 degree are ranked as highly potential; moderately potential (5-25 degree); marginally potential (25-35 degree); and no potential (above 35 degree) as described by Jangpradit (2007). The result of the reclassified slope map is shown in Figure 4.6.

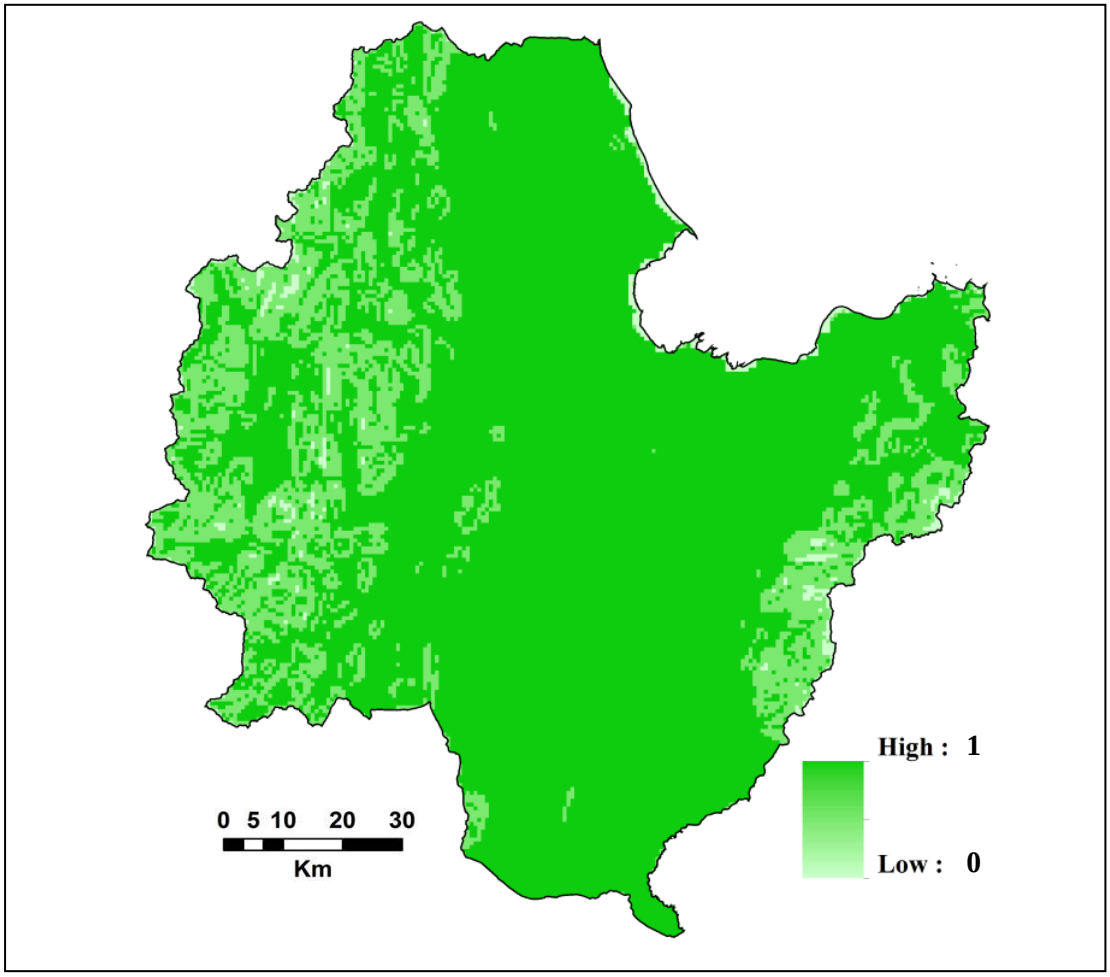


Figure 4.6 Slope

4.1.2.4 Accessibility

Ecotourism often takes place in natural areas, cultural or historical resources and traditional culture. Therefore, the accessibility to the cultural sites, historical sites, traditional and local community, includes the distance from road (with regards to the naturalness of the area) is both important factors for ecotourism.

- Proximity to cultural sites

The proximity to cultural sites factor was classified by Euclidean analysis according to the nearby cultural sites, historical sites, traditional and local community. Cultural unique places were known from the Ministry of Natural Resources and Environment, Thailand and Ministry of Cultural, Thailand. In this study, the areas nearby cultural sites (0-15 km) are ranked as highly potential; moderately potential (15-30 km); marginally potential (30-45 km); and no potential (above 45 km). The result of the reclassified proximity to cultural sites map is shown in Figure 4.7.

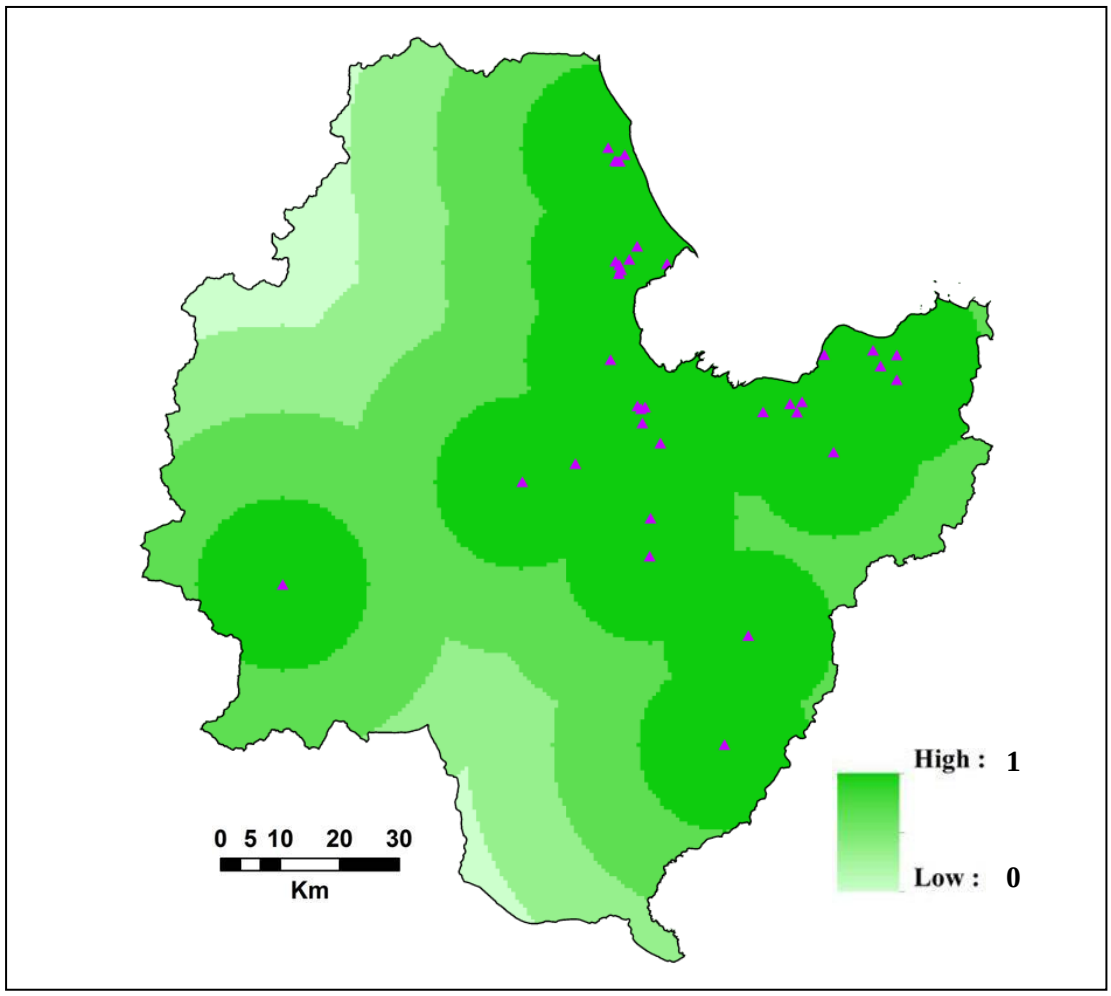


Figure 4.7 Proximity to cultural sites

- Distance from roads

This criterion was classified based on the transport condition by access types and distance from the road types according to remote areas are the best suited for ecotourism attractions and experiences. Therefore, the areas outside of any buffers around all roads are ranked as high potential for ecotourism development; the areas within 2 km buffer around third main roads are ranked as moderate; the areas within 5 km buffer around second main roads are ranked as marginal; and the areas within 10 km buffer around major roads are ranked as no potential that described by Boyd et al. (1995). The result of the reclassified distance from the roads map is shown in Figure 4.8.

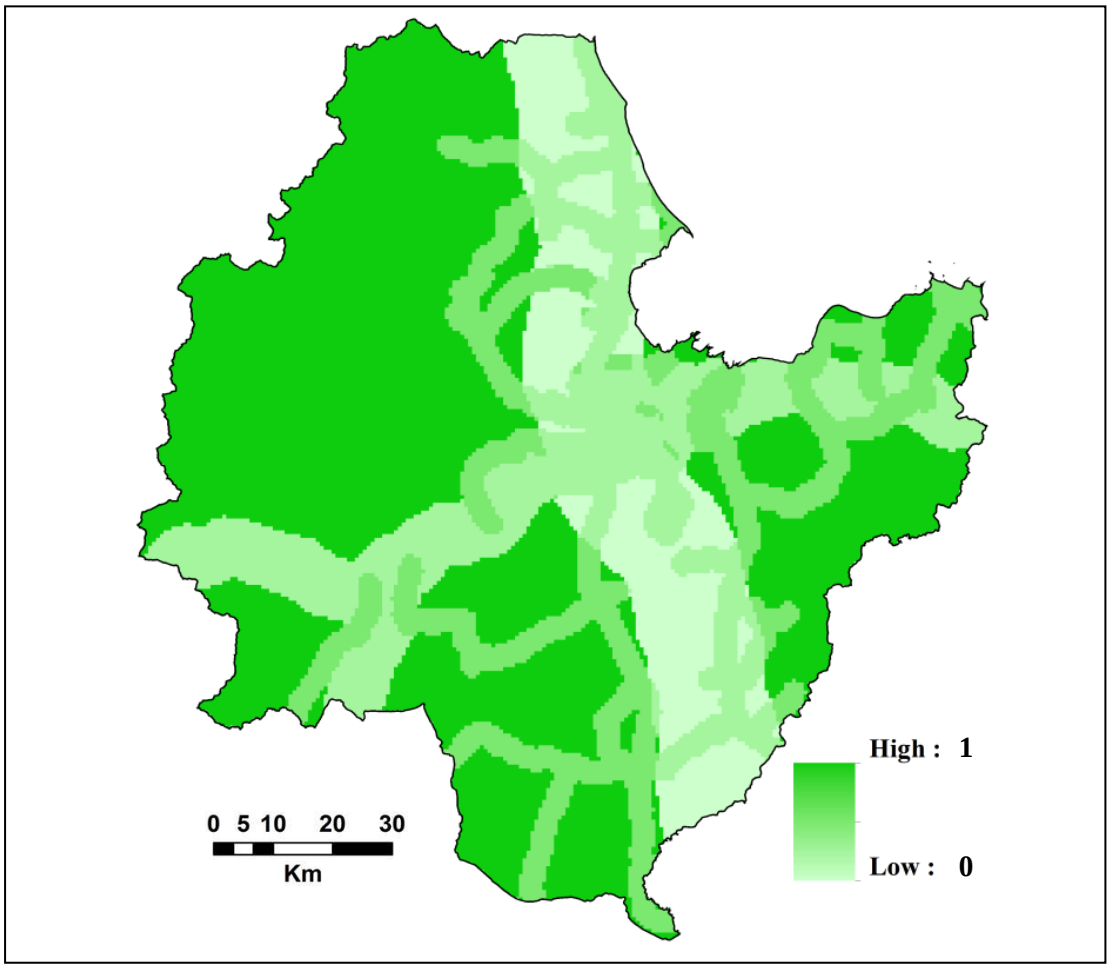


Figure 4.8 Distance from roads

4.1.2.5 Community Characteristics

- Settlement size

Population data for the year 2007 were collected from the National Statistical Office, Thailand. With regards to a primitive of area, the settlement size factor was evaluated based on community type and population size. In this study, absence of permanent settlement (0) are ranked as highly potential; unincorporated communities (1-1000) are ranked as moderately potential; small towns (1001-10000) are ranked as marginally potential; and urban settlements (>10000) are ranked as no potential that described by Boyd et al. (1995). The result of the reclassified settlement size map is shown in Figure 4.9.

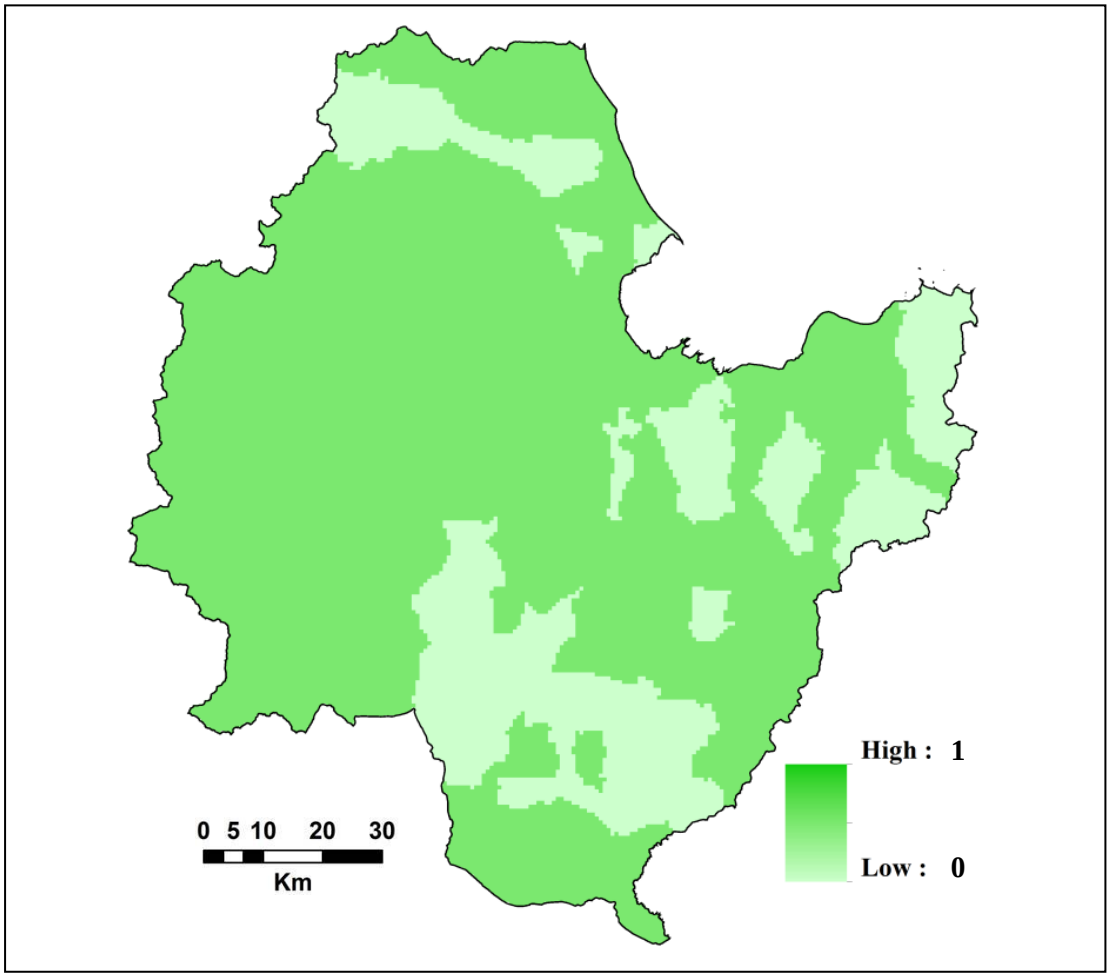


Figure 4.9 Settlement size

4.2 FACTRS WEIGHT AND CLASS WEIGHT (RATING)

In order to produce the land suitability map, the actual factors and class weights (or rating) of the parameters involved in the study are needed. These are determined systematically based on the AHP. Typically, the priority of each factor involved in the AHP analysis is determined based principally on the expert's opinions. The first step to achieve this goal was developing questionnaires (Appendix B) where experts were asked to determine the relative importance of each factor. The method evaluates the relative significance of all the parameters by assigning weight for each of them in the hierarchical order, and in the last level of the hierarchy, the suitability weight for each class of the used factors was given. Typically, the priority of each factor involved in the AHP analysis is determined based principally on the suggestions from experts (Tienwong, 2008). Prioritization is the determination of the relative importance of the map elements which requires brain storming among various experts to assign values on a Saaty's scale (Saaty, 1980) for a pair wise comparison of map elements (criteria). Experts were asked to rank the value of a criterion map for a pair wise matrix using Saaty's scale (Sadasivuuni et al., 2009).

AHP is one of the most extended MCDM techniques and widely used MCE method. It assists the decision-makers in simplifying the decision problem by creating a hierarchy of decision criteria with different number of factors taken into account in each step (Saaty, 1977; 1980; 1990). In most study, expert opinions were used to calculate the relative importance of the involved criteria and factors. When the AHP method is applied to solve spatial decision problems in a GIS environment it is called spatial AHP

method (Siddiqui et al., 1996). In the GIS database, the attribute factors are represented by map layers and contain attribute values for each pixel in a raster data format (Kiker et al., 2005).

AHP provides a structural basis for quantifying the comparison of decision elements and criteria in a pair wise technique (Laskar, 2003). Once the pair wise matrix is made, relative weights are calculated by the following;

(1) For a matrix of pair wise elements (Normalization):

$$\begin{bmatrix} C_{11} & C_{12} & C_{13} \\ C_{21} & C_{22} & C_{23} \\ C_{31} & C_{32} & C_{33} \end{bmatrix}.$$

In step 1, sum the values in each column of the pair wise matrix,

$$C_{ij} = \sum_{i}^{n} = 1 C_{ij}.$$

In step 2, divide each element in the matrix by its column total to generate a normalized pair wise matrix,

$$X_{ij} = \frac{C_{ij}}{\sum_{i}^{n} = 1\ C_{ij}} \begin{bmatrix} X_{11} & X_{12} & X_{13} \\ X_{21} & X_{22} & X_{23} \\ X_{31} & X_{32} & X_{33} \end{bmatrix}.$$

In step 3, divide the sum of the normalized column of matrix by the number of criteria used (n) to generate weighted matrix,

$$W_{ij} = \frac{\sum_{i}^{n} = 1\ X_{ij}}{n} \begin{bmatrix} W_{11} \\ W_{12} \\ W_{13} \end{bmatrix}.$$

(2) The consistency analysis:

Consistency vector is calculated by multiplying the pair wise matrix by the weights vector,

$$\begin{bmatrix} C_{11} & C_{12} & C_{13} \\ C_{21} & C_{22} & C_{23} \\ C_{31} & C_{32} & C_{33} \end{bmatrix} * \begin{bmatrix} W_{11} \\ W_{21} \\ W_{31} \end{bmatrix} = \begin{bmatrix} Cv_{11} \\ Cv_{21} \\ Cv_{31} \end{bmatrix}.$$

Then it is accomplished by dividing the weighted sum vector with criterion weight,

$$Cv_{11} = \frac{1}{W_{11}} [C_{11}W_{11} + C_{12}W_{21} + C_{13}W_{31}]$$

$$Cv_{21} = \frac{1}{W_{21}} [C_{21}W_{11} + C_{22}W_{21} + C_{23}W_{31}]$$

$$Cv_{31} = \frac{1}{W_{31}} [C_{31}W_{11} + C_{32}W_{21} + C_{33}W_{31}].$$

λ is calculated by averaging the value of the Consistency Vector,

$$\lambda = \sum_{i}^{n} = 1\, CV_{ij}.$$

CI measures the deviation,

$$CI = \frac{\lambda - n}{n - 1}$$

where, *n* is number of criteria used (Table 4.3)

$$C_r = \frac{CI}{RI}.$$

Table 4.3 Random inconsistency indices for *n* = 10

n	1	2	3	4	5	6	7	8	9	10
RI	0.00	0.00	0.58	0.9	1.12	1.24	1.32	1.41	1.46	1.49

Source: Saaty, 1980.

However, to ensure the credibility of the output weights, the consistency ratio index (CR) was also calculated. Based on the properties of reciprocal matrices, the CR can be calculated. Saaty (1980) suggests that if CR is smaller than 0.10, then degree of consistency is fairly acceptable. But if it's larger than 0.10, then there are inconsistencies in the evaluation process, and AHP method may not yield meaningful results.

4.2.1 Calculation of the Details of the Criteria and Class Weights

The method is usually implemented using the pair wise comparison technique that simplifies preference ratings among decision factors. In this study, experts' opinions were used to calculate the relative importance of the involved criteria and factors. In this regard, thirty experts from the central and local government departments were interviewed. These experts were selected based on their experience on site selection and availability of time to answer the questionnaire. Then a primary questionnaire is designed and asked for fill out of this and reply to author. The questionnaire used contained the comparison matrices of the 5 most important criteria and the 9 factors selected for this study. The final weights of the criteria and factors were computed based on the AHP method. However, out of the 30 experts, only 21 experts were found consistent (Appendix C). The calculations of pair wise comparison matrix and computation of consistency ratio are given in Tables 4.4 and 4.5, respectively.

Table 4.4 Development of the pair wise comparison matrix

Criteria	C1	C2	C3	C4	C5
Landscape/Naturalness (C1)	1.00	5.29	2.05	5.57	4.05
Wildlife (C2)	0.19	1.00	0.31	2.05	1.73
Topography (C3)	1.00	3.00	1.00	4.57	3.10
Accessibility (C4)	0.18	0.49	0.22	1.00	0.90
Community Characteristics (C5)	0.25	0.58	0.32	1.11	1.00
Total	2.62	10.36	3.90	14.30	10.78

The AHP also provides measures to determine inconsistency of judgments mathematically. The CR, which is a comparison between Consistency Index (CI) and Random Consistency Index (RI), can be calculated using the following formula:

$$C_r = \frac{CI}{RI}.$$

Table 4.5 Computation of the criteria weights and estimate of the consistency ratio

Criteria	C1	C2	C3	C4	C5	SUM	Weight	Consistency Measure
C1	0.38	0.51	0.53	0.39	0.38	2.18	0.44	5.36
C2	0.07	0.10	0.08	0.14	0.16	0.55	0.11	5.08
C3	0.38	0.29	0.26	0.32	0.29	1.54	0.31	5.28
C4	0.07	0.05	0.06	0.07	0.08	0.33	0.07	5.18
C5	0.09	0.06	0.08	0.08	0.09	0.40	0.08	5.25
Total	1.00	1.00	1.00	1.00	1.00		CI=	0.06
							RI=	1.12
							CR*	0.05

In this process, experts' opinions were asked to calculate the relative importance of the factors and criteria involved. It is recommended that the consistency ratio presents values below 0.1. CR* was also calculated and found to be 0.05 for ecotourism, which is acceptable to be used in the suitability analysis.

4.2.2 Calculation Detail of Factor Rate

This part shows the relative weights and rates of the attributes associated with the criteria. Please not that, each factor suitability rating is classes as: high potential (P1), moderate potential (P2), low potential (P3), and no potential (N). The calculations of factor rate performed in this work are as follows.

1. Land use/ cover

Step I: Development of the pair wise comparison matrix

Land use/ cover	P1	P2	P3	N
P1	1.00	2.81	3.67	8.68
P2	0.36	1.00	1.10	4.05
P3	0.27	0.91	1.00	3.00
N	0.12	0.25	0.33	1.00
Total	1.74	4.97	6.10	16.73

Step II: Computation of the factor rate

Land use/ cover	P1	P2	P3	N	SUM	Weight	Rate
P1	0.57	0.57	0.60	0.52	2.26	0.56	1.00
P2	0.20	0.20	0.18	0.24	0.83	0.21	0.37
P3	0.16	0.18	0.16	0.18	0.68	0.17	0.30
N	0.07	0.05	0.05	0.06	0.23	0.06	0.10
Total	1.00	1.00	1.00	1.00			

2. Visibility

Step I: Development of the pair wise comparison matrix

Visibility	P1	P2	P3	N
P1	1.00	2.10	3.33	7.29
P2	0.48	1.00	1.90	5.29
P3	0.30	0.53	1.00	3.71
N	0.14	0.19	0.27	1.00
Total	1.91	3.82	6.50	17.29

Step II: Computation of the factor rate

Visibility	P1	P2	P3	N	SUM	Weight	Rate
P1	0.52	0.55	0.51	0.42	2.01	0.50	1.00
P2	0.25	0.26	0.29	0.31	1.11	0.28	0.55
P3	0.16	0.14	0.15	0.21	0.66	0.17	0.33
N	0.07	0.05	0.04	0.06	0.22	0.06	0.11
Total	1.00	1.00	1.00	1.00			

3. Reservation/ Protection (RP)

Step I: Development of the pair wise comparison matrix

RP	P1	P2	P3	N
P1	1.00	1.43	4.19	7.76
P2	0.70	1.00	3.05	6.33
P3	0.24	0.33	1.00	3.43
N	0.13	0.16	0.29	1.00
Total	2.07	2.92	8.53	18.52

Step II: Computation of the factor rate

RP	P1	P2	P3	N	SUM	Weight	Rate
P1	0.48	0.49	0.49	0.42	1.88	0.47	1.00
P2	0.34	0.34	0.36	0.34	1.38	0.35	0.73
P3	0.12	0.11	0.12	0.19	0.53	0.13	0.28
N	0.06	0.05	0.03	0.05	0.20	0.05	0.11
Total	1.00	1.00	1.00	1.00			

4. Species diversity (SD)

Step I: Development of the pair wise comparison matrix

SD	P1	P2	P3	N
P1	1.00	1.86	3.95	6.14
P2	0.54	1.00	2.00	4.38
P3	0.25	0.50	1.00	2.38
N	0.16	0.23	0.42	1.00
Total	1.95	3.59	7.37	13.90

Step II: Computation of the factor rate

SD	P1	P2	P3	N	SUM	Weight	Rate
P1	0.51	0.52	0.54	0.44	2.01	0.50	1.00
P2	0.28	0.28	0.27	0.32	1.14	0.29	0.57
P3	0.13	0.14	0.14	0.17	0.58	0.14	0.29
N	0.08	0.06	0.06	0.07	0.28	0.07	0.14
Total	1.00	1.00	1.00	1.00			

5. Elevation

Step I: Development of the pair wise comparison matrix

Elevation	P1	P2	P3	N
P1	1.00	1.10	3.10	3.29
P2	0.91	1.00	1.05	2.24
P3	0.32	0.95	1.00	1.38
N	0.30	0.45	0.72	1.00
Total	2.54	3.50	5.87	7.91

Step II: Computation of the factor rate

Elevation	P1	P2	P3	N	SUM	Weight	Rate
P1	0.39	0.31	0.53	0.42	1.65	0.41	1.00
P2	0.36	0.29	0.18	0.28	1.11	0.28	0.67
P3	0.13	0.27	0.17	0.17	0.74	0.19	0.45
N	0.12	0.13	0.12	0.13	0.50	0.12	0.30
Total	1.00	1.00	1.00	1.00			

6. Slope

Step I: Development of the pair wise comparison matrix

Slope	P1	P2	P3	N
P1	1.00	1.52	2.76	3.95
P2	0.66	1.00	1.71	2.86
P3	0.36	0.58	1.00	1.14
N	0.25	0.35	0.88	1.00
Total	2.27	3.45	6.35	8.95

Step II: Computation of the factor rate

Slope	P1	P2	P3	N	SUM	Weight	Rate
P1	0.44	0.44	0.43	0.44	1.76	0.44	1.00
P2	0.29	0.29	0.27	0.32	1.17	0.29	0.67
P3	0.16	0.17	0.16	0.13	0.61	0.15	0.35
N	0.11	0.10	0.14	0.11	0.46	0.12	0.26
Total	1.00	1.00	1.00	1.00			

7. Proximity to cultural sites (PCS)

Step I: Development of the pair wise comparison matrix

PCS	P1	P2	P3	N
P1	1.00	1.33	3.76	5.57
P2	0.75	1.00	2.33	4.14
P3	0.27	0.43	1.00	1.81
N	0.18	0.24	0.55	1.00
Total	2.20	3.00	7.64	12.52

Step II: Computation of the factor rate

PCS	P1	P2	P3	N	SUM	Weight	Rate
P1	0.46	0.44	0.49	0.44	1.84	0.46	1.00
P2	0.34	0.33	0.30	0.33	1.31	0.33	0.71
P3	0.12	0.14	0.13	0.14	0.54	0.13	0.29
N	0.08	0.08	0.07	0.08	0.31	0.08	0.17
Total	1.00	1.00	1.00	1.00			

8. Distance from roads (DR)

Step I: Development of the pair wise comparison matrix

DR	P1	P2	P3	N
P1	1.00	1.61	3.48	5.29
P2	0.62	1.00	1.90	3.71
P3	0.29	0.53	1.00	1.81
N	0.19	0.27	0.55	1.00
Total	2.10	3.41	6.93	11.81

Step II: Computation of the factor rate

DR	P1	P2	P3	N	SUM	Weight	Rate
P1	0.48	0.47	0.50	0.45	1.90	0.47	1.00
P2	0.30	0.29	0.27	0.31	1.18	0.29	0.62
P3	0.14	0.15	0.14	0.15	0.59	0.15	0.31
N	0.09	0.08	0.08	0.08	0.33	0.08	0.18
Total	1.00	1.00	1.00	1.00			

9. Settlement size (SS)

Step I: Development of the pair wise comparison matrix

SS	P1	P2	P3	N
P1	1.00	1.76	3.67	5.96
P2	0.57	1.00	1.90	4.19
P3	0.27	0.53	1.00	2.29
N	0.17	0.24	0.44	1.00
Total	2.01	3.52	7.01	13.44

Step II: Computation of the factor rate

SS	P1	P2	P3	N	SUM	Weight	Rate
P1	0.50	0.50	0.52	0.44	1.96	0.49	1.00
P2	0.28	0.28	0.27	0.31	1.15	0.29	0.59
P3	0.14	0.15	0.14	0.17	0.60	0.15	0.30
N	0.08	0.07	0.06	0.07	0.29	0.07	0.15
Total	1.00	1.00	1.00	1.00			

Linear scale transformation method used to convert weights into standardized criteria score. Then, the maximum score used to standardize as equation:

$$X'ij = \frac{X\,ij}{X\,j\,max}$$

where, X'ij is the standardize score for the i^{th} object and j^{th} attribute,

X ij is the raw score (weight), and

X jmax is the maximum score for j^{th} attribute.

CHAPTER 5

SITE SUITABILITY EVALUATION

FOR EOTOURISM

5.1 LAND SUITABILITY ASSESSMENT FOR ECOTOURISM

This section discusses of the calculation results of the land suitability index for ecotourism development. This was achieved based on the professional opinions of 21 experts in the related field and literature reviews. In this process, the CR was calculated and found to be 0.05 for ecotourism, which is acceptable to be used in the suitability analysis as mentioned earlier. Subsequently, the land suitability map for ecotourism was created based on the linear combination of the criteria and factors with their respective weights. The AHP method was applied to determine the relative importance of all selected criteria and factors. The total suitability score "*Si*" for each land unit [i.e. each raster cell in the map for pixels at 30 x 30 m] was calculated using the following formula:

$$S_i = \sum_{i=1}^{n} (Wi\ X\ Ri)$$

where "*Wi*" is the multiplication of all associated weights in the hierarchy of "i^{th}" factor (or the total weight as shown in Table 5.1 and "*Ri*" represents the class weight (or rating) given for specific class of the "i^{th}" factor found on the assessed land unit. The calculation of total suitability score is shown in Table 5.1.

In a MCE using a weighted linear combination, the assigned weights need to be summed up to 1 for each category and subcategory. These scores were derived by multiplying each class weight with all associated factor weights found in each level of the hierarchy, or the class weight multiplies with the total factor weight. However, each factor in the last layer was classified into 4 suitability classes (P1, P2, P3, N) and their suitability scores were presented in the standardized format ranging from 0 (no potential) to 1 (high potential). The total score for suitability is achieved by multiplying criterion score with its appropriate weight and adding all weighted scores.

Table 5.1 Criteria, factors weight and rating for ecotourism land suitability analysis

Criteria (Category)	Weight	Factors (Sub-category)	Weight	Total Suitability Score	Rating			
					P1	P2	P3	N
Landscape/ Naturalness	0.44	Visibility	0.47	0.21	1.00	0.55	0.33	0.11
		Land use/cover	0.53	0.23	1.00	0.37	0.30	0.10
Wildlife	0.11	Reservation/ Protection	0.54	0.06	1.00	0.73	0.28	0.11
		Species diversity	0.46	0.05	1.00	0.57	0.29	0.14
Topography	0.31	Elevation	0.53	0.16	1.00	0.67	0.45	0.30
		Slope	0.47	0.15	1.00	0.67	0.35	0.26
Accessibility	0.06	Proximity to cultural sites	0.53	0.03	1.00	0.71	0.29	0.17
		Distance from roads	0.47	0.03	1.00	0.62	0.31	0.18
Community characteristics	0.08	Settlement size	1.00	0.08	1.00	0.59	0.30	0.15

Finally, the total suitability score from each factor were assembled to create site suitability map for ecotourism. The land suitability map has been created, based on the linear

combination of each used factor's suitability score. These maps had been organized to present 4 suitability classes for ecotourism (Table 5.2) like S1, S2, S3 and N, indicating the degree of suitability with respect to the criteria and factors considered of this study, as described in Prakash (2003).

Table 5.2 Defined score ranges for land suitability classification

Suitability class	Score range	The degree of suitability
Highly suitable (S1)	0.75 - 1.00	Suitable capacity of locations is high and satisfies all criteria set up.
Moderately suitable (S2)	0.50 - 0.75	Suitable capacity of locations is medium and satisfies most of the criteria set up, but some criteria are not satisfied
Marginally suitable (S3)	0.25 - 0.50	Suitable capacity of locations is low and satisfies some of the criteria set up, but most of the criteria are not satisfied
Not suitable (N)	0.00 - 0.25	Can assume that all of criteria are not satisfied

After the needed factor and class weights were derived as seen in Table 5.1. The formulation of land suitability map for ecotourism is shown in Figure 5.1. The analysis was performed using AHP and GIS techniques. The AHP method was applied to determine relative importance of all selected factors. For the final output, all factor layers were multiplied with their respective weights and added together. MCE is done based on 9 factor maps to produce the site suitability for ecotourism. The total suitability scores range from 0 and 1. Finally, these values were further reclassified to create land suitability map for ecotourism. It has been observed that the raster-based GIS and relational Database Management System (DBMS) are more appropriate for

multi-attribute decision modeling. The grid-based spatial construct provides a convenient data model for reprinting the attribute data in tabular format (i.e. in the form of decision matrix) that can serve as data input for multi-attribute modeling (Arabinda, 2003). The land suitability map for ecotourism was produced using GIS overlay. Further analysis was done in raster-based format the layers were converted into raster were then reclassified into 4 classes using the 'reclassify' function. Finally, spatial data of the 9 factors as a set of GIS layers were overlaid together accordingly for final suitability classification for ecotourism. At the end of this process, the land suitability map for ecotourism development is generated (Figure 5.2).

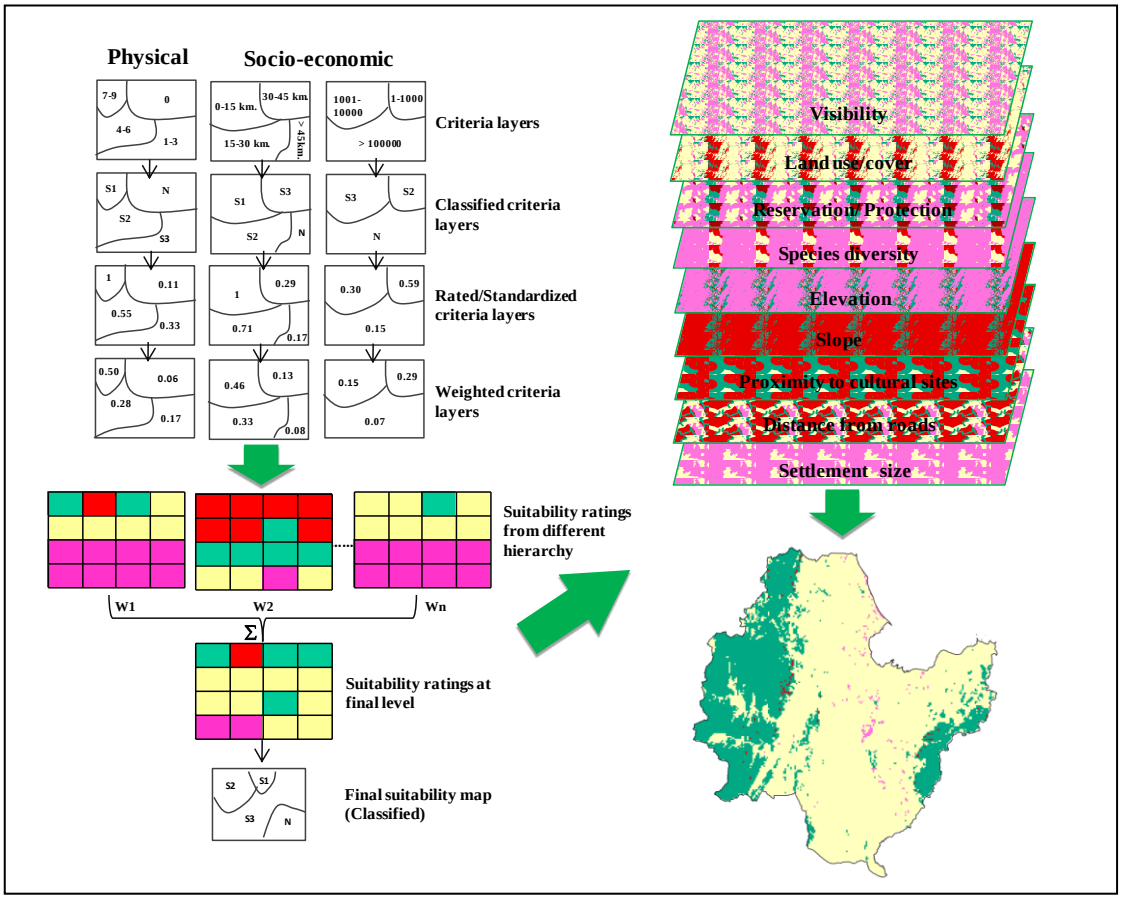


Figure 5.1 GIS-based model for multi-criteria land suitability evaluation for ecotourism in Surat Thaini province

Source: Modified from Baniya, 2008.

5.2 CLASSIFICATION OF SUITABLE AREAS FOR ECOTOURISM

This study presents an integrated approach of ecotourism development constructing methodology to assess the ecotourism suitability by matching the characteristics of an area with those attributes most appropriate for ecotourism. The analysis approach was undertaken with useful consideration of the factors for ecotourism such as scenic views and landscape forms appropriate for an ecotourism destination, biodiversity species, wildlife abundance, unique natural resources, cultural and historical intrinsic values for existing ecotourism activities, etc.

The corresponding data of area cover for ecotourism suitability class and the classified suitability map for ecotourism is shown in Table 5.3 and Figure 5.2, respectively. The level of suitability of the areas for ecotourism development was classified as: highly suitable area (S1); moderately suitable area (S2); marginally suitable area (S3); and not suitable area (N).

Table 5.3 Area cover on classified land suitability map for ecotourism

Suitability class	Score range	Area coverage	
		Hectares (ha)	Proportion (%)
Highly suitable (S1)	0.75 - 1.00	4,995.43	0.40
Moderately suitable (S2)	0.50 - 0.75	361,525.77	28.90
Marginally suitable (S3)	0.25 - 0.50	873,507.55	69.83
Not suitable (N)	0.00 - 0.25	10,928.86	0.87
Total area		1,250,957.61	100.00

Based from the suitability map, it was found that the areas of marginally suitable (S3) is about 69.83 % (873,507.55 ha) and are located in the central part of the province. The moderately suitable areas (S2) make up about 28.90 % (361,525.77 ha) and are located in the Eastern and Western parts of the province. Only a few percentages (0.87 % and 0.40 %) of the area were classified as not suitable (N) and highly suitable (S1), respectively. Likewise, the highly suitable areas are mainly located in protected areas (Figure 5.3).

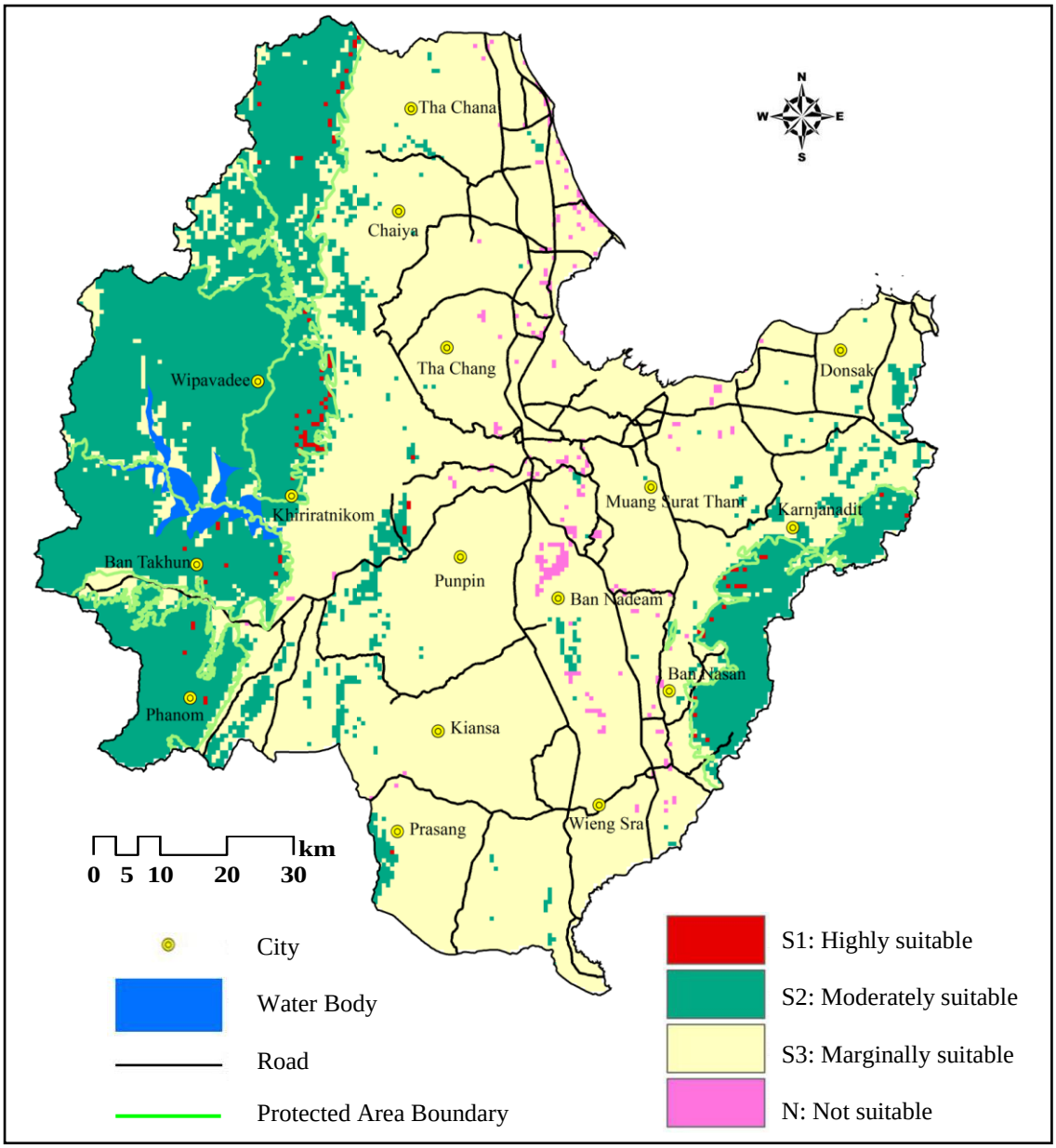


Figure 5.2 Classified land suitability map of ecotourism development in Surat Thani province

Likewise, it should be noted that the land suitability map is intended to guide regional land use decisions. It can be used for a decision making process that allocates land to the uses that provide the greatest benefits of conservation of biodiversity and other ecosystem services in this province.

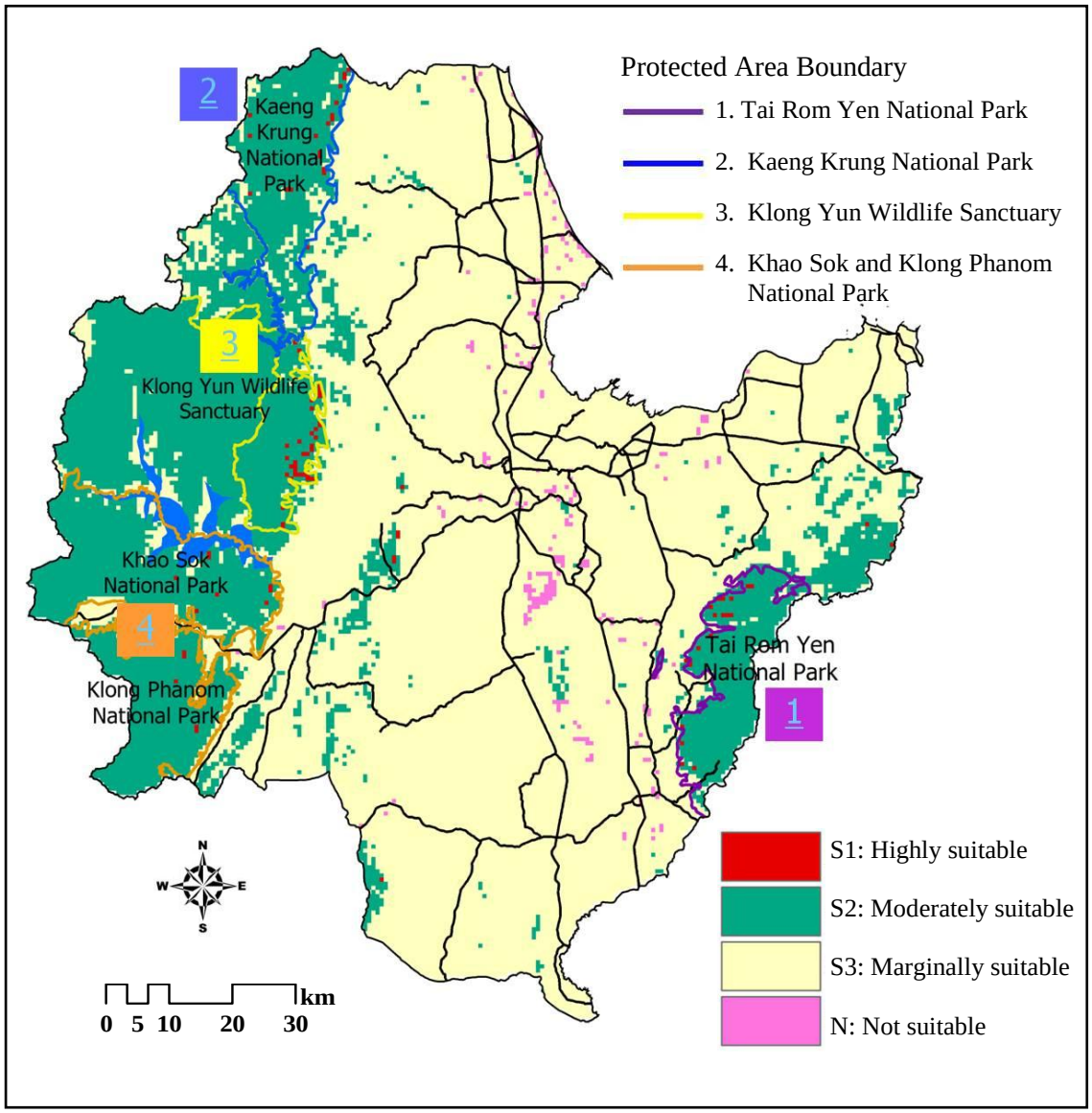


Figure 5.3 Location of the area with high ecotourism potential in the protected area of Surat Thani province

5.3 CLASSIFICATION OF SUITABLE AREAS FOR ECOTOURISM AT DISTRICT LEVEL

The zonal analysis method was used to determine the average suitability for each district. The ecotourism land suitability analysis at district level was also assessed and the results are shown in Table 5.4.

The highly suitable areas (S1) are mainly located in the districts of Khiriratnikom (30.94 %) and Ban Nasan (16.13 %). These districts are characteristically endowed with lush green forests and abundances of wildlife and they are mainly located in parks. Therefore, the management of these areas is comprehensive and addresses issues of resource conservation, environmental management, and the control of tourism development. The moderately suitable areas (S2) are mostly located in the districts of Ban Takhun (34.25 %) and Phanom (19.25 %). Most of these are largely free from urban settlements with a unique and outstanding natural beauty, diverse attractions and great tourism potential. The three areas with the highest percentages of marginally suitable land (S3) are located in Punpin (10.75 %), Karnjanadit (9.54 %) and Tha Chang (8.79 %) districts. The areas have an appropriate for facilities development; also, there are no conflicts or any restrictions on usage. These areas can provide ecotourism services which take into account the condition of the natural environment, local society and culture. Infrastructure should be developed in harmony with local identity and with nature. Finally, the percentages of unsuitable areas (N) for ecotourism are also located of Punpin district (26.55 %) and Chiya district (13.30 %), respectively. To use ecotourism in this region, we need to consider additional environmental problems which can be controlled.

Table 5.4 Classification of suitable areas for ecotourism at district level

District	Highly Suitable (S1)		Moderately Suitable (S2)		Marginally Suitable (S3)		Not Suitable (N)	
	ha	%	ha	%	ha	%	ha	%
Tha Chana	315.45	7.34	6,338.70	1.75	59,013.36	6.78	1,126.26	10.06
Chaiya	446.94	10.41	29,117.70	8.06	61,376.67	7.05	1,489.50	13.30
Tha Chang	87.12	2.03	32,950.89	9.12	76,571.64	8.79	986.04	8.81
Ban Takhun	290.70	6.77	123,723.63	34.25	34,942.05	4.01	87.12	0.78
Wipavadee	526.86	12.27	22,603.68	6.26	20,031.84	2.30	0.00	0.00
Donsak	0.00	0.00	4,085.01	1.13	29,469.06	3.38	0.00	0.00
Karnjanadit	248.40	5.78	22,564.62	6.25	83,084.40	9.54	648.36	5.79
Punpin	0.00	0.00	313.92	0.09	93,665.52	10.75	2,973.24	26.55
Muang Surat Thani	0.00	0.00	43.56	0.01	33,273.90	3.82	78.03	0.70
Khiriratnikom	1,329.03	30.94	14,945.04	4.14	51,322.05	5.89	75.24	0.67
Phanom	306.90	7.14	69,532.47	19.25	49,318.11	5.66	132.66	1.18
Ban Nasan	692.82	16.13	25,640.73	7.10	47,035.71	5.40	946.89	8.46
Ban Nadeam	0.00	0.00	11.61	0.00	20,121.21	2.31	1,453.68	12.98
Kiansa	0.00	0.00	1,885.41	0.52	69,457.68	7.97	468.72	4.19
Wiengsra	7.65	0.18	3,680.28	1.02	31,178.61	3.58	601.83	5.37
Prasang	42.57	0.99	2,022.21	0.56	75,213.90	8.64	130.68	1.17
Chaiburi	0.99	0.02	1,739.97	0.48	35,900.55	4.12	0.00	0.00
Total	4,295.43	100.00	361,199.43	100.00	870,976.26	100.00	11,198.25	100.00

5.4 CLASSIFICATION OF LAND USE/ COVER MAP

The primary input data of the 2007 land use/cover (LULC) and topographic map are generated from the Department of Land Development, Thailand at the scale of 1:50,000. There are 5 main classified land use/cover types in Surat Thani province. These are urban and built-up land (U), agricultural land (A), forest (F), water body (W) and miscellaneous land (M). This study considered some important issues related to ecotourism potential resources. Therefore, the output maps were organized to have 10 land use/cover categories according to bio-physical vegetation characteristics for ecotourism potential resources and the background knowledge of the study area. Finally, the area in hectares was calculated for each land use/cover category as seen in Table 5.5. The distribution of land use/cover classes in 2007 is shown in Figure 5.4. The definition and characteristics of major land cover categories are described as follows:

1. Crop land (AC) includes paddy fields, field crops, truck crop and horticulture.

2. Farm land (AF) includes pasture and farm houses, poultry farm houses and aqua cultural land.

3. Orchard (AO) consists of mixed orchard and orchard (orange, durian, rambutan, coconut, and cashew).

4. Plantation (AP) consists of mixed perennials and perennials (oil palm, para-rubber, eucalyptus, teak, magosa, casuarinas, and coffee).

5. Dense forest (F) consists of the main natural forest including evergreen forest, swamp forest and mangrove forest.

6. Disturbed forest (FD) includes disturbed evergreen forest, disturbed swamp forest, disturbed mangrove forest and disturbed forest plantations.

7. Open forest (FO) includes mixed forest plantations, forest plantations and agro-forestry that are caused by human activity such as conversion of forest areas, vegetated areas for new cultivation.

8. Miscellaneous land (M) includes rangelands (grass, scrub, and bamboo), marsh and swamp, mines and pits (laterite pits, sand pits, and soil pits) and other.

9. Urban and built-up land (U) is composed of cities, towns and commercial, residential houses, villages, institution land, industrial land, transportation, communications, utilities and other.

10. Water body (W) includes both natural water bodies (rivers, canals, and lakes) and man-made (reservoirs, dams, farm ponds, and irrigation canals).

Table 5.5 Area coverage of land use/cover classes in 2007

Land use/cover classes	Area coverage	
	Hectares (ha)	Proportion (%)
Crop Land (AC)	24,793.02	1.98
Farm Land (AF)	18,050.94	1.44
Orchard (AO)	43,688.62	3.49
Plantation (AP)	665,634.10	53.21
Dense Forest (F)	381,372.70	30.49
Disturbed Forest (FD)	8,893.26	0.71
Open Forest (FO)	825.03	0.07
Miscellaneous Land (M)	45,822.42	3.66
Urban & Built-up Land (U)	33,064.38	2.64
Water Body (W)	28,813.14	2.30
Total area	1,250,957.61	100.00

The results show that the major land use/cover was employed as plantation about 53.21 % (or 665,634.10 ha). Surat Thani has a potential in raw agricultural materials. This province has the most para-rubber plantations in Thailand and the second largest oil palm growing province. Therefore, the plantation areas are mainly consisting of oil palm and para-rubber and these are often found on the flat and undulating to mountainous terrain. Secondly, dense forest was 30.49 % (or 381,372.70 ha) and this area should be considered in order to develop the successful ecotourism in Surat Thani province.

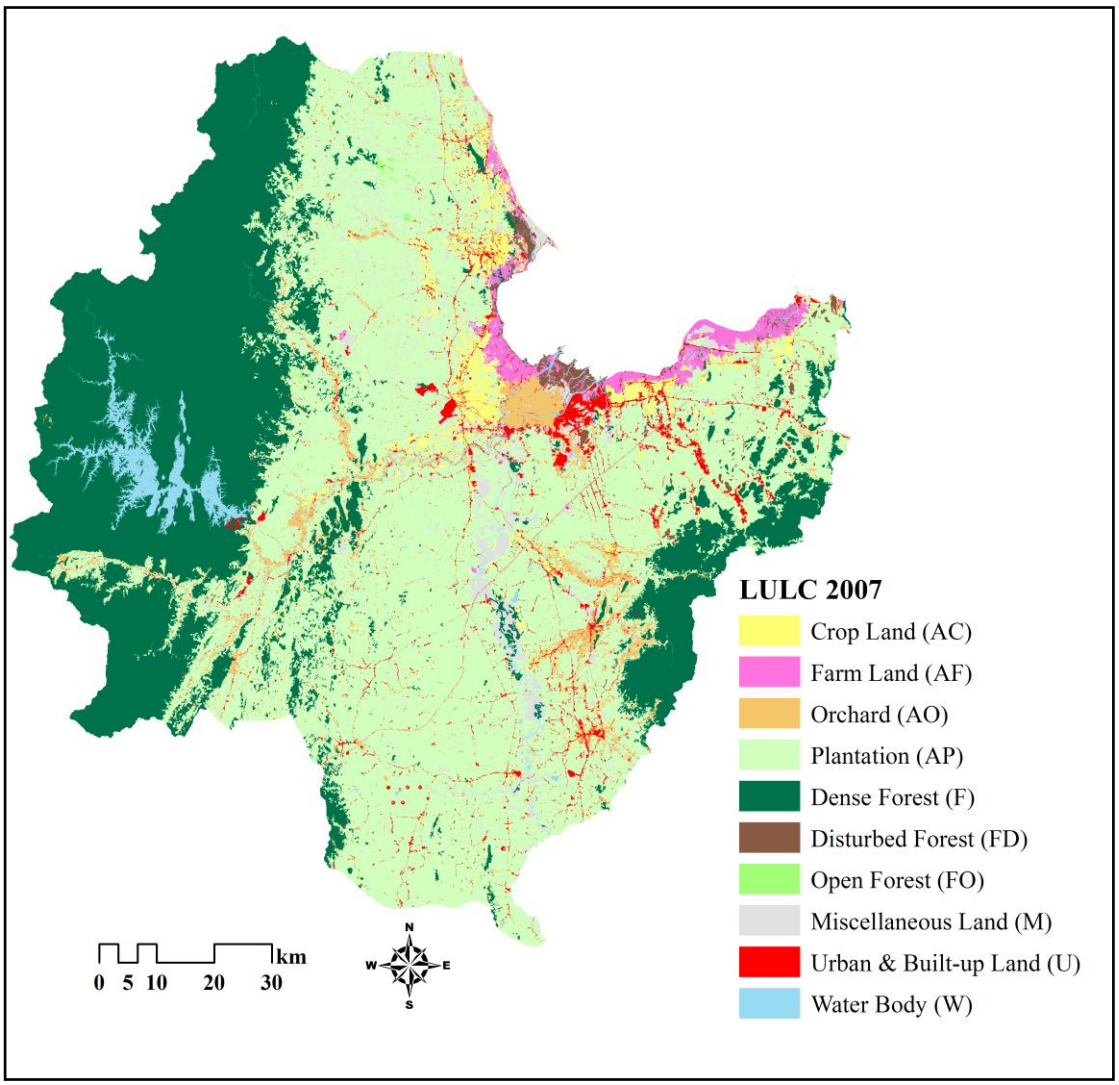


Figure 5.4 Classified LULC map of Surat Thani province in 2007

5.5 COMPARISON BETWEEN LULC MAP AND SUITABILITY MAP

The spatial matching offered valuable information to identify whether the land was optimally utilized in the region (Khoi and Murayama, 2010). In order to find potential areas where these ecotourism sites should be promoted, the result of overlaying the suitability map (Figure 5.2) with the LULC map of 2007 (Figure 5.4) is presented in Table 5.6. The LULC map indicates that the major land uses are plantation (655,634.10 ha), dense forest (381,372.70 ha), miscellaneous land (45,822.42 ha) and orchard (43,688.62 ha), which account for 53.21 %, 30.49 %, 3.66 % and 3.49 %, respectively, of the total study area. Dense forest that is mainly dry evergreen forest and mixed deciduous forest is mainly located in the park. Plantation is characterized by oil palm and para-rubber. Miscellaneous land includes rangelands, marsh and swamp. The orchard is mainly mixed orchard.

As expected, the highly suitable and moderately suitable areas were found in the dense forest. The result indicates that 95.73 % of the highly suitable class was distributed over the dense forest, while only 4.06 % of the class was located in the plantation. With respect to the moderately suitable class, 91.70 % of the class was also found in the dense forest, whereas only 5.52 % of the class was located in the plantation. For the marginally suitable class, 73.68 % of the class was found in the plantation. This class was also found in the orchard (4.70 %) and the miscellaneous land (4.57 %). Finally, the not suitable class was mainly stretched over the miscellaneous land (47.46 %). The highly and moderately suitable areas were found in the dense forest, if too many people are attached to the most valuable areas, this could again harm the quality of the areas. Therefore, these utilized lands should be controlled under the use of certain limitations and guidelines.

Table 5.6 Comparison between classified land use/cover map and land suitability map for ecotourism

LULC Type	S1 (ha)	%	S2 (ha)	%	S3 (ha)	%	N (ha)	%	Total (ha)	%
Cropped Land (AC)	0.00	0.00	38.61	0.01	24,229.35	2.77	525.06	4.80	24,793.02	1.98
Farm Land (AF)	0.00	0.00	13.77	0.00	17,717.67	2.03	319.50	2.92	18,050.94	1.44
Orchard (AO)	3.6	0.07	2,119.2	0.59	41,025.37	4.70	540.45	4.95	43,688.62	3.49
Plantation (AP)	202.77	4.06	19,952.97	5.52	643,562.73	73.68	1,915.63	17.53	665,634.10	53.21
Dense Forest (F)	4782.04	95.73	331,527.84	91.70	44,918.73	5.14	144.09	1.32	381,372.70	30.49
Disturbed Forest (FD)	5.22	0.10	400.86	0.11	8,076.87	0.92	410.31	3.75	8,893.26	0.71
Open Forest (FO)	0.00	0.00	183.96	0.05	641.07	0.07	0.00	0.00	825.03	0.07
Miscellaneous Land (M)	0.00	0.00	723.96	0.20	39,911.76	4.57	5,186.70	47.46	45,822.42	3.66
Urban & Built-up Land (U)	1.80	0.04	330.75	0.09	31,185.09	3.57	1,546.74	14.15	33,064.38	2.64
Water Body (W)	0.00	0.00	6,233.85	1.72	22,238.91	2.55	340.38	3.11	28,813.14	2.30
Total (ha)	4,995.43	100.00	361,525.77	100.00	873,507.55	100.00	10,928.86	100.00	1,250,957.61	100.00

Note: S1: Highly Suitable; S2: Moderately Suitable; S3: Marginally Suitable; S4: Not Suitable

5.6 ECOTOURISM DEVELOPMENT IN SURAT THANI PROVINCE

5.6.1 Development Potential and Problems of Ecotourism in Surat Thani Province

The overall tourism potential in Surat Thani is high because of the province's abundant and beautiful tourism resources that attract both Thai and foreign tourists. The type of tourism that is common at present is mostly the traditional type of tourism which includes cultural tours, excursions and recreational activities. All of these, and their management, predominantly aim to satisfy the tourists' demands in order to ensure good economic returns. In recent years, policy makers have begun to advocate sustainable destination planning for tourism in Thailand with a set of management approaches but it is essential to ensure that they are managed appropriately and this can be supported by government policy. This policy should identify the province's ecotourism attractions and help to maintain the environment of these attractions.

However, it must be recognized that at present resource managers at site level still lack a fundamental understanding of ecotourism management and an ability to develop the resources' ecotourism potential. Most of the managements are focused on meeting the demands of the tourists rather than the needs of the ecotourism resources. Moreover, the activities, educational provision and the interpretation materials are still rather uninspiring. Most of the existing ecotourism focused on adventure travel and nature appreciation rather than the serious educational provision which would have a greater impact on the goal of promoting sustainability. Both marketing and service provision are still underdeveloped.

Many of the tourists are not serious about ecotourism, perhaps because they lack a proper understanding of its essential and defining features. In addition, the ecotourism resources are not yet fully ready to receive tourists. Ecotourism marketing will have to wait until the resources are more ready, but in the meantime existing tourism activities in potential ecotourism areas are in need of proper control and guidelines if they are not to be subject to environmental deterioration, and destructive competition to attract ever greater numbers of visitors. Therefore, the ecotourism market is expected to grow somewhat slowly until many of the issues mentioned here are addressed. When there is sufficient readiness, ecotourism market should be able to grow rapidly through proper marketing and promotion as there appears to be a large potential market for ecotourism both in foreign and in domestic markets.

The main obstacles of ecotourism development are the lack of specialized guides and the tourists' lack of appreciation of ecotourism. Environmental interpretation materials have been provided in many national parks, but they are often of poor quality. Many ecotourism resources still lack the readiness to attract and serve the more serious eco-tourist. Moreover, many tourists behave inappropriately at ecotourism sites. For example, they are noisy and throw their garbage everywhere and show disrespect of local or indigenous cultural values. It is very difficult for the entrepreneurs such as tour operators and guides to control them as they have no real authority over the tourists.

Due to the rapid growth of ecotourism, a challenge for a decision maker is on how to manage ecotourism in order to minimize the negative impacts. Some places have wrongly applied ecotourism concept or have been poorly managed and thus adverse

impacts are common and in some cases other forms of tourism development have replaced ecotourism. Planning is a must for future development to conserve the natural environment of the ecotourism destinations in a sustainable manner.

Furthermore, community-managed tourism or people's participation in ecotourism still needs to be strengthened and guided, particularly through facilitating human resource development related to tourism service provision and natural resource management. The problem of the lack of qualified, registered and knowledgeable guides, referred to earlier, still needs to be seriously tackled. A critical lacuna in this area is that there is no exchange of relevant knowledge and experiences concerning ecotourism management among concerned parties, nor is the wealth of local knowledge, which is highly relevant in this context, used to further ecotourism policy goals and objectives.

5.6.2 Proposed Plan for Ecotourism Development in Surat Thani Province

Tourism in Surat Thani is largely dependent on and a major user of natural resources and biodiversity, it is recommended that tourism be specifically addressed by regional policies that deal with biodiversity and conservation. Thus, this study considered some key issues for ecotourism development planning in Surat Thani province according to the United Nations World Tourism Organization (UNWTO) destinations guideline, in order to manage tourism and environmental resources, especially ecotourism resources. UNWTO published an important guideline in 2004 known as indicators of sustainable development for tourism destinations. This guideline is the result of efforts from over 60 authors working in 20 countries, in both developed and developing countries. Its

intent is to provide a process by which policy makers can use research-based indicators to make decisions on guiding the development of sustainable tourism such as:

- Wellbeing of Host Communities
- Community Participation in Tourism
- Tourist Satisfaction
- Health and Safety
- Capturing Economic Benefits from Tourism
- Sustaining Cultural and Natural Heritage
- Managing Scarce Natural Resources
- Limiting Impacts of Tourism Activity and Controlling
- Use Intensity
- Products Development and Marketing
- Sustainability of Tourism Operations and Services
- Baseline Issues and Baseline Indicators of Sustainable Tourism

In addition, ecosystem protection will get the first priority for sustainable development in this Surat Thani province. Six major components for sustainable tourism planning are proposed in order to develop ecotourism in this province (Figure 5.5). These components which are interrelated with each other includes ecosystem protection, monitoring tourism effect, tourism facilities development, government and NGOs cooperation, community involvement and tourism marketing (Md, 2010). Ecotourism development must promote educational development and create awareness in people of the need to jointly maintain the ecosystem of the area, rather than to focus on the economic growth and income generation only. There is a need to implement development plans and manage natural

resources in a way that ensures ecological and environmental integrity. This can be done by allowing local people, communities and organizations to participate in environmental and resource management and by creating legal and economic measures to control environmental and resource use, including setting up a management system that can foster economic development and improvements in people's quality of life. In addition villagers should be empowered to manage natural resources within the boundary of the village.

Figure 5.5 Major components for sustainable tourism planning in Surat Thani province

Additionally, there are planning issues that are deemed important for a successful ecotourism development in Surat Thani province. In order to ensure that tourism is not environmentally damaging, contributes to conservation and local community development, and provides opportunities for enhanced conservation and sustainable development, there are as follows:

1. Ecotourism development plan should be incorporated into the development plans at various levels (district, province and region) along with sufficient budget

allocation and distribution to facilitate implementation. The development objectives should be supported by research which analyzes and assesses all aspects of tourism so as to determine or adjust the management guidelines, to solve any problems which arise, and to improve the plans step by step.

2. Ecotourism development planning must support the development of tourism resource networks at district, provincial and regional levels to link resources which can complement each other. This will make it easier to redirect tourists away from tourism resources whose carrying capacity is already exceeded.

3. Ecotourism management must take the character and potential of existing resources (from the suitability map for ecotourism as seen in Figure 5.2) into consideration, in order to arrange appropriate activities and to ensure the compatibility between ecotourism and the original activities carried out in the area. This should be notified of any serious conflict, especially in the areas of highly suitable for ecotourism with other forms of tourism. If people are attached to the most valuable areas, this could again harm the quality of the areas. Likewise, the benefits of ecotourism being at the center of the wider system of tourism should be put forward in the development planning and management.

4. The law should be used strictly to control, supervise and maintain the environmental condition of tourism resources by focusing on providing advice and cautions among tourists. For example, zoning, i.e. establishing a tourism zone, a conservation zone, a buffer zone, and a rehabilitation zone, should be done not only in protected areas but also in areas which are currently not suitable for ecotourism, due to their degraded environment areas.

5.7 TYPICAL AND POTENTIAL SITES FOR ECOTOURISM

According to FAO (1967), the land suitability map for ecotourism was classified based on 4 suitability classes as S1, S2, S3 and N are seen in Figure 5.2. The results are based on the ranking of different sites according to the set criteria and thus identify those with the 'best' potential for ecotourism. With regards to the typical and potential sites for ecotourism, the following data were considered that are the results of analysis in particular, the results of the survey (Appendix D) in order to examine the existing tourism facilities, present situation of tourism, future possibilities of ecotourism, ecotourism requirement and the main policy of ecotourism development in the area. For purposes of identifying and prioritizing ecotourism sites, the typical and activities were proposed as follows:

5.7.1 Highly Suitable for Ecotourism (S1)

'Highly suitable for ecotourism' category involves the most sensitive areas and development activities within these areas will lead to disaster and threaten the natural characteristic of the areas. Likewise, ecotourism development must control and manage the resources in order to retain their original conditions as far as possible, and to avoid or to abstain from travelling in sensitive areas which are easily adversely affected and are difficult to rehabilitate. In addition, ecosystem protection is the first issue for ecotourism development in environmentally sensitive areas. The negative environmental impacts are also minimized. Therefore, these areas could serve as main ecotourism attractions but with the use of certain limitations and guidelines. These areas

should be preserved or conserved and managed in sustainable way, unless the existing of ecotourism resources in sensitive areas is still usable. More specifically, the key element of ecotourism management is sustainably managed and environmental responsibility is promoted. The example of guideline to be used to limit the number and duration of access to the areas is the code of conduct. The area is characteristically endowed with lush green forests, wildlife sanctuary, as well as rich cultural heritage. Its high value of natural resources is suitable for research and education as well as conservation of biodiversity and maintenance of the ecosystem. The destination has nature attractions and unique qualities for ecotourism. Visitors are educated about the environmental and ecology of the site. Activities suggested for these areas include education and research related activities for sightseeing and trekking for limited the number of tourists as described by Yaakup et al. (2006).

5.7.2 Moderately Suitable for Ecotourism (S2)

'Moderately suitable for ecotourism' category allows for mild development but with highly consideration on construction work and detail assessment of environmental impact. The S2 areas have moderate potential for ecotourism. These are largely free from urban settlements with green area, vegetation cover and great tourism potential with unique natural resources. So this area can be developed as ecotourism destination by facilitating proper ecotourism infrastructure and services under policy guidelines. Environmental awareness is raised among tourists and stakeholders. The management system is comprehensive and addresses issues of resource conservation, environmental management, pollution control and disposal, and the control of tourism development.

Profits from tourism contribute to the development of the destination. Furthermore, most of them are located in the protected areas, where there is active recreation such as boating, parks and natural zoological parks. Therefore, these areas can still be considered for ecotourism attractions particularly for passive tourist activities such as camping, trekking, bird watching, sightseeing and any activities with minimum development or inference to the site includes educational method.

5.7.3 Marginally Suitable for Ecotourism (S3)

'Marginally suitable for ecotourism but suitable for tourism development' category involves areas with low sensitivity and available for exploitation. These areas are validating for usage, and they are both of the areas that already have a concession and concession requesting process. Therefore, the S3 areas which are suitable for tourism development generally can be control and promote tourism services and the use of natural resources. Still, development should be conducted in an appropriate manner for ecotourism with respect to minimizing development impact. The most appropriate areas are mainly located in urban area. These areas could provide ecotourism services which take into account the condition of the natural environment, local society and culture. Therefore, these areas can accommodate physical structure to support ecotourism activities such as green hotels, eco-lodge, restaurants and public convenience facilities. These will increase opportunities for local people and communities to participate in ecotourism and will help to distribute income to them.

5.7.4 Not Suitable for Ecotourism (N)

The areas with about 10,928.86 ha (or 0.87 %) of total areas was classified as not suitable for ecotourism. The category involves having limitation which may be appears, as severe as to preclude any possibilities of successful sustained use of the land in the given manner. These are included the areas with several impacts of development and degraded environment. Such areas are high risk for dealing with the problems; some are in a deteriorated condition or have been destroyed. As concerns their utilization, they may have some environmental problems but those are controllable.

CHAPTER 6

CONCLUSIONS

The purpose of this study was to identify and prioritize the potential ecotourism sites in land ecosystems of Surat Thani province, Southern Thailand. This study presents an integrated approach of GIS with AHP combination to assess the ecotourism suitability by matching the characteristics of an area with those attributes most appropriate for ecotourism. These integrated approaches were able to handle complex and universal issues like sustainable development of ecotourism, biodiversity conservation and protected area management in a tropical and developing country such as Thailand.

The main contribution of this study was the identification criteria and factors of ecotourism by applying the hierarchical structure of AHP in geospatial environment. It was started by the calculation of weighting and rating from the AHP analysis where experts were asked to determine the relative importance of each criterion and factor. The determination of criteria and classification of factors for the identification of ecotourism potential areas which were divided into 2 main categories: bio-physical and socio-economic sections. There were five criteria and nine factors in the form of nine GIS-based layers incorporated for land suitability evaluation for ecotourism. These are landscape or naturalness (visibility, land use/cover), wildlife (reservation/protection, species diversity), topography (elevation, slope), accessibility (proximity to cultural sites, distance from roads), community characteristics (settlement size). These important

criteria and factors in determining what areas are best suited for an ecotourism development.

This study has been successful in developing a methodology that identified and prioritized the potential ecotourism sites using GIS and AHP techniques. The criteria and factors developed in this study should then be used in monitoring ecotourism potential and biological diversity conservation in the areas. Those criteria and factors are very important components in achieving ecotourism development as an integral part of the sustainable development in the province of Surat Thani. However, the same principles may be also applicable elsewhere. Beneficially, the final outcome of this study was the prioritization of the area which is best suited for ecotourism in Surat Thani. This can also have its implication at the site level environmental management of ecotourism activity based on ecotourism attractively, ecological fragility and environmental resilience.

Surat Thani appears to have many attributes and potentials that can be explored and utilized for a successful ecotourism development. The basic economic system of the province emphasizes agriculture. Therefore, the major land use/cover was employed as plantation (53.21 % or 665,634.10 ha) and dense forest (30.49 % or 381,372.70 ha), respectively. Likewise, Surat Thani has the most rubber plantations in Thailand and the second largest oil palm growing province. However, these areas should be properly monitored and protected form and any encroachment. Therefore, the model of further research work must be applied to determine land evaluation for agricultural lands as well. On the other hand, dense forest is highly important for ecotourism. Dense forest

consists of the main natural forest which includes evergreen forest, swamp forest and mangrove forest. These areas should be considered in order to develop the successful ecotourism in Surat Thani province.

Based on the results of the analysis, the areas of highly suitable for ecotourism are mostly located in the park which involves the most prominent in the study area. The characteristic of this area is endowed with lush green forests, wildlife sanctuary as well as rich cultural heritage. It could serve as main ecotourism attractions but with the use of certain limitations and guidelines. According to some limitation of those areas such as containing outstanding natural resources or heritages, therefore the areas should be preserved, unless the existing ecotourism resources in sensitive areas are still usable. The total preserved areas are 4,995.43 ha (or 0.40 %) of total areas. They are mainly located at the districts of Khiriratnikom and Ban Nasan. Therefore, these areas can be used for education as well as conservation, in order to protect and preserve environmental condition in ecotourism areas. Secondly, the areas of moderately suitable for ecotourism are mainly located at the districts of Ban Takhun and Phanom. It is largely free from urban settlements with a unique natural resources and a great tourism potential. The total areas are 361,525.77 ha (or 28.90 %). Most of which are located in the protected areas with active recreation as boating, park and natural zoological park. Therefore, these areas can still be considered as moderately attractions for ecotourism. While, the area of marginally suitable for ecotourism involves the areas are validating for usage. They are the most appropriate areas for development. The approximated areas of marginally suitable are 873,507.55 ha (or 33.52 %) of total areas. The most appropriate areas are mainly located in urban area at Punpin, Karnjanadit and Tha

Chang districts. These areas are suitable for eco-tourist facilities development. Finally, the areas with about 10,928.86 ha (or 0.87 %) of total areas was classified as not suitable for ecotourism. These areas are highly risky for leading the problems; some are in a deteriorated condition or have been destroyed. They are mainly located in Punpin and Chiya districts. In case of utilization, they may have some environmental problems but those are controllable.

In conclusion, a result of this study appears practically useful for the development of tourism facilities and ecotourism resource utilization. Additionally, final output of this study could be used for generating alternative scenarios of ecotourism management based upon resource management and biodiversity conservation. In the same way, tourism is a complex phenomenon involving besides its spatial dimension, social and environmental implications. Thus, a further study should be done with the implementation of other related sub models such as the carrying capacity model in establishing a comprehensive ecotourism resources management plan. This study should provide the stimulus for the continuation of research and future investigation on sustainable development of ecotourism in Thailand. These integrated approaches were able to handle complex and universal issues like sustainable development, ecotourism, biodiversity conservation and protected area management in a tropical and developing country such as Thailand.

More specifically, the recommendations for ecotourism resources, facilities and services, marketing, and administration are summarized as follows:

1) Since, tourism in Surat Thani is largely dependent on and a major user of natural resources and biodiversity, and it is recommended that tourism be specifically addressed by regional policies that deal with biodiversity and conservation.

2) Provincial level planning should be developed and adopted for ecotourism. This should take into account both impacts on natural resources and local communities. In addition, villagers should be empowered to manage natural resources within the boundary of the village.

3) Facilities and infra-structure development in the province should be in harmony with the local identity and with nature.

4) A monitoring and reporting program to determine the effectiveness of rehabilitation should be developed; the data concerning ecotourism resources should be integrated into this. In addition, assistance should be given for the development of ecotourism enterprises. Such assistance could include business planning, training, product development and marketing.

5) Preparation of guidelines or frameworks for workshops to specifically address issues related to resource management, biodiversity conservation and ecotourism market planning should be arranged by the Tourism Authority of Thailand (TAT).

6) It is very important that more people, especially Surat Thani's visitors, are educated on the concept of sustainable development and the principles for sustainable living (IUCN/UNEP/WWF 1991). Therefore, the issues of ecosystem management and conservation of biodiversity (WCMC 1992, Maser 1994, Ceballos- Lascurain 1996) should be addressed with the local communities and stakeholders in protecting ecosystem and biodiversity.

Since a small number of socio-economic factors have been considered for the evaluation of land suitability, it is recommended to incorporate more factors to represent a holistic view of the actual process, such as distance from local community, distance from protected areas, i.e. Moreover, the research can be extended to explore the application of other information sources like remote sensing images, Global Positioning System (GPS), etc should be encouraged because it will help on bringing real time change in land use and management strategy.

With respect to the techniques implemented in this study, the integration of AHP in GIS techniques has been proven beneficial for supporting decision-making. The methodology is useful for identifying priority areas for ecotourism. The development of ecotourism is further enhanced by geospatial approaches; which have proved beneficial for supporting decision-making and tourism planning. Moreover, ecotourism is an activity which strongly implies the geographical dimension. Makropoulos et al. (1999) assume that GIS has a significant potential as a tool for site specific source control implementation, analysis and quantification. GIS appears to be a significant tool for planning and monitoring of natural resources in Surat Thani. The study found that GIS technology provides a set of effective tools for ecotourism planning in Surat Thani. GIS-based modeling techniques can then subsequently evaluate dynamic patterns of land use/ cover and identify the socio-economic and bio-physical sources that drive the observed change processes. In addition, it is recommended that GIS should be used in the ecotourism development planning for sustainable development and policy making.

Finally, the application of this paper can be useful for managers and planners working in the local and central governments and other non-governmental organizations. GIS can play a key role in documenting natural conditions, developments and documenting the suitability of resources for tourism, exposing conflicts, and revealing cause-effect relationships (Dye and Shaw, 2007). In light of this, GIS is providing new tools for advanced ecotourism management (Tewodros, 2010). The use of GIS is not only ideal for reducing the time and cost of site selection, but also provides a digital data bank for long-term and beneficial monitoring of sites (Mazaher et al., 2010).

In addition, AHP analysis provides reflection of real situation of study area. This analysis was effectively used to calculate the details of the factors and class weights for ecotourism. Therefore, the integration of the GIS with AHP combines decision support methodology which in turn facilitates the creation of land use suitability map for ecotourism. Furthermore, this study should be useful to those who are interested in the GIS technique, mapping and ecotourism suitability analysis. This study can be used as a basis for evaluating the suitability of other areas for ecotourism. Additionally, it may also serve as a starting point for more complex studies in the future taking into consideration those limitations encountered in this study.

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