Field Study: Thailand

Rayong and Chanthaburi provinces

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Section 1

Introduction

1.1 Approach to the study

The key preparatory tasks undertaken for the study included desktop collation of relevant reports, data, statistics, maps, and other information to familiarise the field mission leader and team with the study area. Initial consultations were carried out with central and local government representatives and agreement was reached on the main directions of the study.

A general work plan was established and team members made an initial visit to the site. They held discussions with local and national stakeholders and persons familiar with the study area and identified issues relevant to protected areas and economic development in the study area of local and/or national significance.

Background papers on water, agriculture, coastal resources and other sectoral issues were prepared and used as references and checklists for information gathering. Approaches and techniques for interpreting and analysing the data were also determined. A second field mission was held, which resulted in a draft report. This was widely circulated for review and comment. After completion of the third field mission the field study final report was prepared.

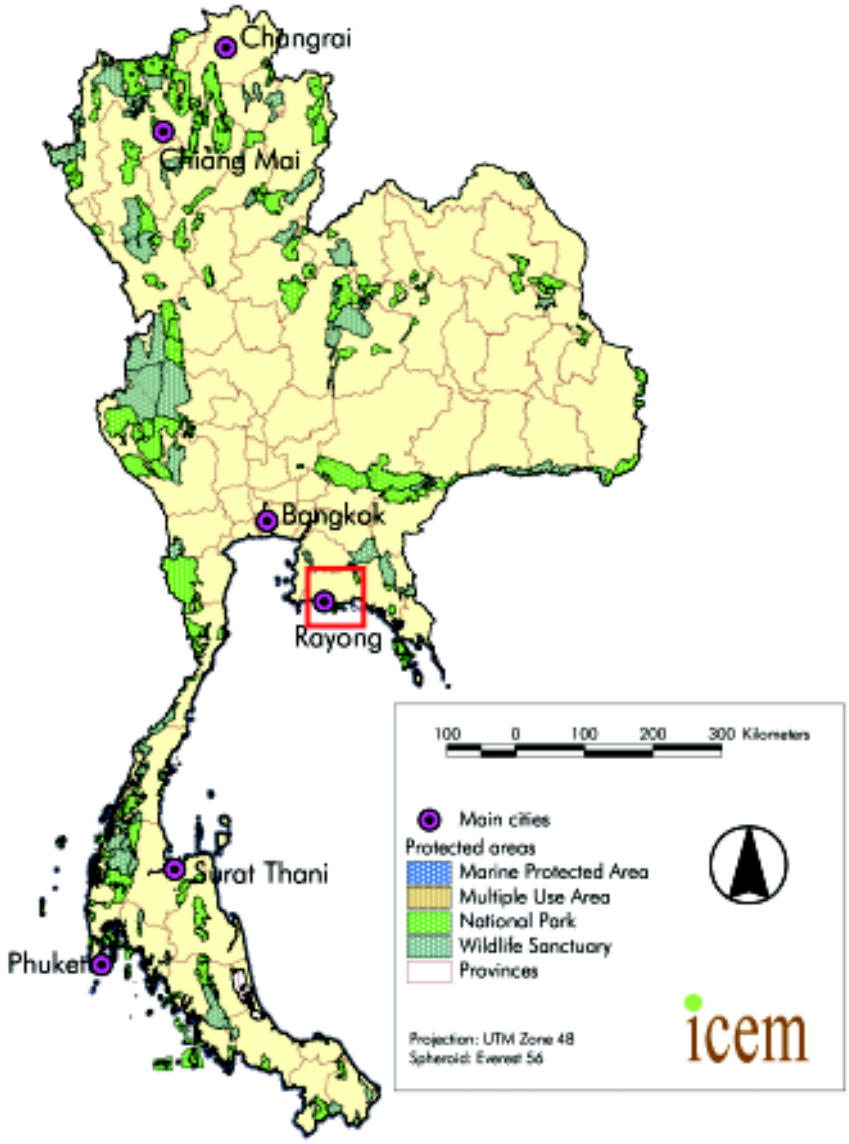
1.2 The study area

The study area lies within the Eastern Region of Thailand (Figure 1), and focuses on Rayong and Chanthaburi provinces. Three sites are analysed in detail to show how protected areas (PAs) support socio-economic activity and development:

- a river sub-basin containing Khao Chamao-Khao Wong National Park, with the focus on tourism and water supply and quality;
- a near-shore marine environment, involving marine protected areas (MPAs) along the southern boundary of Rayong Province and Koh Samet National Park, with an emphasis on fisheries and tourism;
- the Kung Krabaen Royal Development Project, a terrestrial-coastal development featuring shrimp production, oyster production and fisheries and their interaction with PAs and the natural environment.

These three examples involve different geographic scales, different types of environments and/or natural resource systems, and different categories of PAs. They are not intended to produce comprehensive valuations of economic benefits provided by PAs within the local area. They do, however, provide examples of the various kinds of environmental products and services that can be supplied by PAs. The report also explains the natural mechanisms that deliver these products and services to dependent communities and economic sectors, and demonstrates the economic importance of PAs in underpinning economic and social development.

Figure 1. Location of the field study area



Section 2

Regional context

The Eastern Region consists of eight provinces: NaKohnayok, Chachengsao, Sa-keaw, Prachenburi, Chanthaburi, Trat, Rayong and Chonburi. The region has a total area of 36,546 sq. km and a population of about 4.1 million.

2.1 Geo-economic sub-regions

The Eastern Region includes coastal plains, valuable minerals, forests, and fertile soils. Degradation of natural resources, particularly forests, is becoming a major problem. Forests were once an important resource but they can no longer be exploited because of harvesting restrictions.

Table 1 describes forests, agriculture and water resources in the provinces of the Eastern Region. Forest cover ranges from 5.8 per cent of the total area for Rayong Province to 56.7 per cent for Chanthaburi Province. Rayong is a rapidly industrialising area, with an emphasis on exporting, and much of its formerly forested area has given way to industrial development.

Agricultural areas cover approximately half of the total area of the Eastern Region. While there are numerous reservoirs, weirs and other water resources, water supplies for consumptive uses and agriculture are limited; storage ponds are shallow and are affected by pesticides and other contaminants.

Natural resources and the environment are rapidly degrading (Kaosa-ard 1999), as is the quality of air and water. Many factories were established without planning for environmental protection, causing destruction to natural resources and the environment. All stakeholders need to combine their efforts to promote the value of natural resources in the region, and to undertake effective restoration and land-use zoning.

The region can be divided geographically into the Upper Eastern Region and the Lower Eastern Region. Each of the two areas has different natural resources. The upper region, which is inland, contains the Bangpakong watershed, covering Chachengsao, NaKohnayok, Prachenburi and Sa-keaw provinces. Most of this area is forested, and includes part of the Eastern Forest Complex.

The lower region contains coastal areas as well as highland and valley areas. There are many small watersheds, but most of them are found in coastal areas and do not have the potential for consumptive use (Bundprasirichot, 2000).

Table 1. Natural resources and the environment in the Eastern Region

	Prachinburi	Rayong	Sa-keaw	Chanthaburi	Chachengsao	Chonburi	Trat	NaKohnayok
% of forest area in province	47.9	5.8	16.7	56.7	22.3	33.6	47.7	22.7
% of agricultural area	45.7	50.5	53.8	48.1	56.3	42.2	23.8	55.3
Medium-scale reservoir	3.0	2.0	9.0	2.0	2.0	14.0	4.0	0.0
Small-scale reservoir	6.0	10.0	38.0	23.0	26.0	70.0	33.0	4.0
Concrete weir	11.0	39.0	34.0	55.0	50.0	60.0	10.0	1.0
Dike	0.0	2.0	6.0	0.0	0.0	n/a	5.0	4.0
Pond, marsh, swamp	63.0	59.0	64.0	62.0	28.0	126.0	88.0	31.0
Canal	42.0	n/a	55.0	34.0	n/a	102.0	4.0	187.0

n/a: not available; Source: Adapted from Local Community Development Institute, 2000

2.2 Protected areas in the Eastern Region

The Eastern Forest Complex (EFC) is the main system of terrestrial protected areas in the region (Royal Forest Department 2000, Prayoonsit, Chaiwattana and Napom 1999), with a total area of 2,316 sq. km (1,447,954 rai). It is bounded by five provinces: Chachengsao, Chonburi, Rayong, Chanthaburi and Sa-keaw.

The EFC contains three national parks and three wildlife sanctuaries:

- Khao Chamao-Khao Wong National Park in Rayong and Chanthaburi provinces (0.8368 sq. km);
- Khao Kichakut National Park in Chanthaburi Province (0.5831 sq. km);
- Preaw Waterfall National Park in Chanthaburi Province (1,3450 sq. km);
- Khao Ang-ru-nai Wildlife Sanctuary in Chanthaburi, Prachenburi, Chachengsao, Chonburi and Rayong provinces (10.3000 sq. km);
- Khao Soidao Wildlife Sanctuary in Chanthaburi Province (7.4496 sq. km); and
- Klong Kuawai Wildlife Sanctuary in Chanthaburi Province (2.6527 sq. km).

The EFC contains many species of plants and animals, and is a national heritage site. A range of forest types, including moist evergreen forest, dry evergreen, hill evergreen, dry dipterocarp forest and mixed deciduous forest, is found there. Important plants include *Irvingia Malayana Olive. Ex A. Benn.*, *Afzelia xylocarpa Craib, Dipterocarpus spp.* and wild orchids. Most of the EFC is designated as a wildlife sanctuary; wildlife includes elephant, guar, banteng, mouse deer, leopard, hyena and fresh-water crocodile.

Forest area has decreased dramatically in recent years. Encroachment of the forest by villagers is still taking place, as is illegal logging, poaching and harvesting of non-timber forest products (NTFPs). The need for improved conservation management has been highlighted by Chetamash et al. (1991) and others.

EFC provides important watershed protection and regulation of water supply for agriculture, domestic consumption and industrial use. Forested areas help protect watersheds above reservoirs, and help to maintain environmental flows and water quality. This reduces the costs of water treatment, prevents salinity in the downstream reaches of rivers, and facilitates shrimp production in the coastal area.

Other benefits related to the Eastern Forest Complex include tourism and recreation, provision of non-timber forest products (NTFPs), groundwater recharge and discharge, flood control, sediment and nutrient retention, habitat protection, biodiversity conservation, biomass production, and preservation of genetic stocks.

MPAs have also been established in the Eastern Region. The entire Thai coastline along the Gulf of Thailand has an MPA extending three km from the shoreline. Rayong, Chanthaburi and Trat provinces are classified as a Zone 1 MPA. Some areas, i.e. the marine park surrounding Koh Samet, have been established to protect particular marine environments, such as islands and reefs.

MPAs support fisheries production by providing protective habitat. Adult fish and fry migrate from these areas, supporting artisanal and commercial fisheries. MPAs are also economically important for other uses, especially recreation and tourism.

2.3 Economic development in the Eastern Region

Economic development in the Eastern Region is diverse, and has gone through several stages (Bundprasirichot, 2000).

First stage (1956–1966)

Agriculture expanded, especially monocrop rice cultivation. Irrigated agriculture (in approximately five per cent of agricultural areas) was carried out in the central plain of Chachengsao, Chonburi and Rayong.

Second stage (1967–1978)

Agriculture changed from monocrop rice cultivations to plantation crops for export (mainly cassava and sugar cane). Other new crops included perennial plants (such as fruit) and annual crops (such as vegetables). The region was also important for the expansion of orchards. Forested areas were cleared for agriculture land. People migrated to the area to work on farms or in orchards, especially in Chachengsao, Chonburi and Rayong provinces. In coastal areas, fishing methods changed. The introduction of otter trawl fishing, suggested by the Department of Fisheries, increased fishing effort and led to increased catches. The commercial fishery expanded significantly, although community fisheries continued to survive. Fisheries began to be affected by environmental problems, such as increased water pollution, destruction of mangroves and degradation of fishing grounds.

Third stage (1979–1991)

Major changes took place in land use, chiefly the conversion of land for infrastructure, industrial development, tourism and residential housing. Resources, especially water and land required for new economic activities, became scarce. Large-scale fisheries and deep sea fisheries were developed. In coastal areas, mangroves were converted to shrimp farming. People previously engaged in community fisheries along the coastal strip were forced to work in other sectors, such as tourism and industrial activity.

Industrial activity has expanded rapidly in some provinces. The Eastern Sea Board Project, introduced in the Fifth National Economic and Social Development Plan, spans three provinces (Rayong, Chonburi, and Chachengsao) and incorporates the largest industrial estates in Thailand. Major ports and industrial complexes have been developed at Lam-Cha-Bang (10,000 rai) in Chonburi Province and at Marp-Ta-Put (20,000 rai) in Rayong Province.

The region is also a centre for fruit production, for both domestic consumption and export. Fishery production and fish processing are also important. Large scale fisheries are found in Rayong, Chonburi and Chanthaburi provinces. Community fisheries are threatened by degradation of fish habitat, especially the destruction of mangroves to support shrimp production.

Key economic statistics for provinces in the Eastern Region are shown in Table 2. Per capita income is high in most provinces. Welfare payments are made to more than 50 per cent of the population, mainly to care for children and the elderly. The unemployment rate is low, except in Sa-keaw Province.

Table 2. Economic statistics for Eastern Region

	Prachenburi	Rayong	Sa-keaw	Chanthaburi	Chachengsao	Chonburi	Trat	NaKohnayok
million baht:								
GPP[1]	25,624.0	112,408.2	15,007.8	23,430.0	55,274.7	208,047.0	8,898.2	9,329.8
Budget distribution	4,608.0	8,595.9	6,385.0	8,597.0	5,219.1	12,540.0	n/a	n/a
baht:								
Per capita income[1]	54,059.0	223,475.0	37,333.0	53,978.0	91,363.0	218,997.0	75,076.0	37,926.0
Saving rate[2]	11,459.0	34,122.8	n/a	n/a	35,480.8	103,429.3	83,447.5	7,464.4
Per capita saving	25,820.0	68,555.0	n/a	n/a	56,050.0	98,183.0	77,511.0	30,683.0
%:								
Dependent population	61.0	68.3	51.9	48.6	58.6	45.8	41.4	49.8
Unemployment[3]	1.9	3.4	18.5	1.2	2.5	2.0	0.9	2.8
Low income level	8.5	0.8	22.8	0.1	4.5	2.0	12.1	2.3

n/a: not available; 1. in 1995; 2. in 1998; 3. in 1998
Source: Adapted from Local Community Development Institute, 2000

Section 3

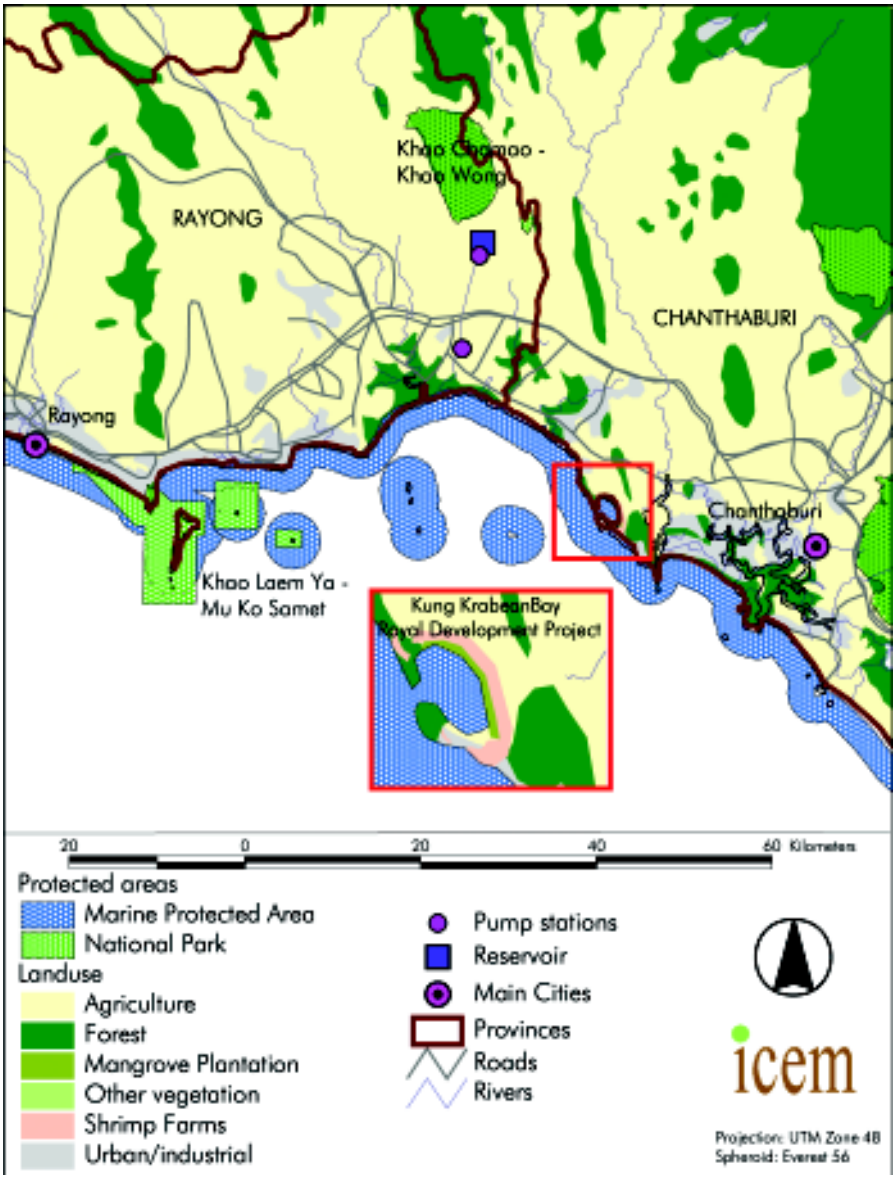
Rayong and Chanthaburi provinces

3.1 Geographical features

Figure 2 shows the study area, including its protected areas. Parts of the Eastern Forest Complex lie within the study area; those areas of the complex outside the boundaries of the two provinces are still relevant, as they generate benefits within the study area. The study area contains marine protected areas, including protected fishing zones, marine national parks and protected foreshore habitats (particularly mangrove areas).

Sub-basins of the East Coast-Gulf River Basin are found within the study area. Many catchments and sub-catchments are specially managed as protected watersheds. Some watersheds within the study area drain into the Mekong River system.

Figure 2. Map of the field study area



3.2 Demographics and economics

In 2001, the population of Rayong was 558,000 with an annual growth rate of 2.56 per cent; Chanthaburi's population was 482,000, with a growth rate of 1.54 per cent. Population densities for Rayong and Chanthaburi are 138 per sq. km and 76 per sq. km respectively.

The economic structure of the two provinces is shown in Table 3. Rayong's economy is more developed, more affluent and growing faster than Chanthaburi's, due to a large extent to rapid industrialisation (Thailand's largest industrial estate is located in Rayong). Manufacturing accounts for 62 per cent of Gross Provincial Product (GPP) in Rayong. Chanthaburi is more heavily dependent on primary industries such as agriculture, aquaculture and fisheries; manufacturing accounts for only 13 per cent of its GPP.

Table 3. Gross Provincial Product (GPP) in 1988 prices (million baht)

	1993		1996		1999	
	Rayong	Chanthaburi	Rayong	Chanthaburi	Rayong	Chanthaburi
Agriculture	6,796	3,741	5,684	3,805	4,582	3,401
crops	2,040	2,010	2,274	2,446	2,264	2,491
livestock	253	114	499	177	368	157
fisheries	3,688	1,370	2,135	889	1,239	478
forestry	44	1	3	2	1	1
agricultural services	48	41	33	41	27	39
simple agricultural processing	663	205	740	250	683	235
Mining and quarrying	14,325	18	18,963	48	29,845	98
Manufacturing	9,828	1,838	52,044	1,914	98,566	1,751
Construction	1,994	413	2,086	1,155	665	369
Electricity and water supply	5,077	451	6,962	491	10,815	506
Transportation and communication	1,976	776	4,183	1,120	4,963	996
Wholesale and retail trade	2,972	2,470	3,624	3,125	3,269	2,869
Banking, insurance and real estate	1,336	1,007	2,474	1,125	1,010	610
Ownership of dwellings	757	700	998	847	1,204	953
Public administration and defence	932	460	1,342	666	1,416	705
Services	1,976	1,268	2,603	1,363	2,825	1,405
GPP	47,909	13,141	100,964	15,659	159,160	13,662

Source: NESDB 2001

The differences in economic development in the two provinces is reflected in their per capita income levels. Per capita GPP for Rayong (measured in 1988 prices) is 285,000 baht (US$6,600) while in Chanthaburi it is only 28,000 baht (US$651).

3.3 Development planning and protected area management

Responsibilities for planning and management of PAs in the study area are similar to those in the rest of Thailand. The Royal Forest Department has the main responsibility for terrestrial PAs and MPAs. The Department of Interior manages minor catchments, and the Royal Irrigation Department manages major reservoirs. The Department of Fisheries in the Ministry for Agriculture and Cooperatives regulates fishing activities.

Broad directions for economic development are provided by the National Economic and Social Development Board, in collaboration with other government agencies and stakeholders, through five-year National Economic and Social Development Plans.

Provincial governments are also important in economic development planning. In Rayong Province, for example, planning and administration are carried out by the provincial administration and three municipalities (there are seven districts, 56 sub-districts and 381 villages).

Section 4

Management of river sub-basins

4.1 Water resources in the region

Water supplies are critical to the region's development. Sub-basins in the study area are part of the Eastern Gulf River Basin; reservoirs in the study area supply water for crops, orchards, livestock, industry and domestic consumption. PAs in the study area are important in providing catchment protection, stabilising flows and maintaining water quality.

The demand for water is high, due to the rapid growth of industry and the increasing requirements of hotels, households and village areas. According to Deephrom (1999), average annual water requirements in 1996 were 301.44 million cubic m, 33 per cent of which was for domestic, commercial and industrial consumption and 67 per cent for agricultural irrigation. Water requirements are predicted to increase to 688.77 million cubic metres per year.

Major reservoirs (Dok Kray, Nong Plalai and Nong Khlo) are located within or just outside Rayong Province. Ra Ok Reservoir is located in Chanthaburi Province. In 1996 the storage capacity of large and medium-size reservoirs in the region was 254.15 million cubic metres.

Plans have been made to construct three major new reservoirs: Klong Yai, Prasae and Klong Nam Keaw. This will increase storage capacity to 559.75 million cubic m by 2016, and will capture 39.26 per cent of the total natural water available (Department of Water Resource Engineering 1995a, 1995b).

4.2 Management of water resources

The National Water Resource Law organises water resource management into five levels:

1. National Water Resources Committee: This is the government's central agency, with the main responsibility for planning and policy-making for the national water resource. It oversees control and monitor watershed committees; controls and monitors national water resource consumption; conserves the national water resource; and collects data on national water resource sites and national water resource consumption.
2. Watershed Committee: The committee's main function is to organise local and watershed water resource management according to the plans and policies of the National Water Resources Committee.
3. Regional Water Resource Committees: These committees operate at watershed sites on a smaller scale than the Watershed Committee.
4. Office of National Water Resource Committee: This provides administrative support to the National Water Resource Committee.
5. Organisation of Water Resource Consumers: This organisation was established and managed in Cupertino with Watershed Committees.

In the study area, PAs and watersheds are managed by the Royal Forests Department. The Royal Irrigation Department is responsible for managing major reservoirs, while the Regional Offices of the Department of Interior treat and distribute water. Regional Offices oversee the operations of 17 provincial

waterworks units in the Eastern Forest Complex. A private water supply company (Eastern Water) also treats and distributes water via reticulated systems.

4.3 Khao Chamao-Khao Wong National Park

The park, located in Chanthaburi Province, is part of the Eastern Forest Complex. It covers the area of Khao Chamao Sub-district in Rayong Province and Hang Meaw District in Chanthaburi Province. The parks's total area is 83.68 sq. km (52,300 rai). Khao Chamao covers 79.28 sq. km (49,550 rai), Khao Wong covers 4.40 sq. km (2,750 rai).

The physiographic features of the park include high mountains and ridge tops. The highest elevation is Chamao peak (1,024 metres ASL), the watershed of canals and streams such as Klong Ra Ok, Klong Phloe, Klong Hing Ploeng.

The national park is influenced by the northeastern and southwestern monsoons. During the northeastern monsoon, from mid-October to mid-February, the weather is cold and the sky is clear. During the southwestern monsoon, from mid-May to mid-October, the humidity increases and heavy rains fall. According to the Chanthaburi Meteorology Office, the average annual rainfall per year is 2,894.7 mm and the average temperature is 26.9 degrees C.

Geologically, the park contains pyrite rock, quartzite, sedimentary rock and limestone. Caves and waterfalls are major attractions.

The high mountains in the park are covered by natural forest and tropical evergreen forest. Dry evergreen forest is found on the western side, flanked by rubber forest. The most fertile tropical forest is found in the Wang Sai area; the forest is less fertile around Khao Chamao waterfall because of illegal timber harvesting.

The park has more than 137 animal species, 113 families and 70 orders of animals. These comprise more than 10 species of amphibians, 12 species of reptiles, 68 species of birds, including migratory species, and more than 35 species of mammals, from elephants to small mammals.

The Royal Forest Department is responsible for park management. The park employs two officials and has a support staff, including temporary employees.

4.3.1 Tourism benefits

The park is a popular tourism and recreation site. The natural surroundings, including waterfalls, vegetation and animal life, are major attractions. The entry fee structure is the same as in the rest of Thailand: 20 baht for Thai adults, 10 baht for children, and 200 baht (US$4.65) for foreigners. In 2001 there were 314,071 visitors; however, income from entry fees was only 583,670 baht (revenues from entry fees are sent to the government's consolidated revenue fund and only an allocated amount is returned to the park).

In addition to entry fees, visitors to the park spend another 200 baht per visit, consisting of approximately 100 baht for food, drink and souvenirs within the park and 100 baht in nearby shops and facilities. These expenditures amount to about 77 million baht per year.

The economic value of the park, however, is greater than these expenditures. Visitors are usually prepared to pay more than the actual costs incurred (this additional willingness to pay is known in the economics literature as consumers' surplus). In addition, the estimates of expenditures do not include the non-use values of the park.

Box 1. Economic value of Khao Chamao-Khao Wong National Park

A method known as the benefit transfer technique can be applied to infer the economic value of Khao Chamao-Khao Wong National Park. This approach involves using economic estimates from a site where a study has been done to extrapolate the economic values of comparable sites.

Economic values have been estimated for Khao Yai National Park by the Thailand Development Research Institute and Harvard Institute for International Development (TDRI-HIID 1995). The researchers used several methods in the study. To estimate the direct use value of Khao Yai NP, they used the travel cost method. Depending on the statistical form of the model applied, they derived estimates of consumer surplus per traveller of 868.8 baht or 1,190.8 baht per year. They also applied a contingent valuation model, and estimated the total willingness to pay by users of the park at 1.6 billion baht per year. Non-use values were estimated at 1.0 billion baht per year.

The benefit transfer technique can be applied to calculate the total use value of Khao Chamao park. The use value per visitor at Khao Yai (1,109.8 baht per year) is multiplied by the number of visitors to Khao Chamao-Khao Wong National Park (385,000 per year) to derive a total use value of 427 million baht per year. Non-use values can be calculated using the same ratio of non-use to use values estimated for Khao Yai (0.59), yielding an estimate of 252 million baht per year.

The TDRI-HIID estimates can also be used to calculate use values and non-use values on a per-ha basis. Using the area of Khao Chamao-Khao Wong NP, and given the two parks' similar environmental attributes, values per ha can be transferred from one site to the other. These calculations suggest that the use value of Khao Chamao-Khao Wong National Park is 65.5 million baht per year and the non-use value is 38.9 million baht per year. This approach has methodological limitations, however (i.e. park values depend on attributes other than mere area) and gives a much lower estimate than the first method.

All the estimates above are in 1995 prices. Inflation in the Thai economy has averaged five per cent over each of the last seven years; to convert these estimates to current levels, they should be increased by 40 per cent.

At Khao Chamao-Khao Wong NP, park managers have recognised that pressure from tourism is making it difficult to maintain the quality of ecosystems. To maintain the ecological and economic values of a park, it is essential to prevent visitor numbers from exceeding the park's carrying capacity. The park managers aim to divert some tourism to alternative sites.

4.3.2 Consumption of NTFPs by local communities

Local people's socio-economic dependence on the forest resources around the park was documented in a study by Nhuchaiya (1999), which involved 18 villages with a population of 12,082 (2,727 households) living in a five-km area surrounding the park (Table 4). The sample covered 168 households from 12 villages. The main occupation was agriculture; average income per household was approximately 101,718 baht per year. A similar study was conducted by Piyavatin (1999) on socio-economic land use and dependency of the community surrounding Khao Kitchakut NP in Chanthaburi Province.

Table 4. Consumption of NTFPs in area surrounding Khao Chamao Park, 1998

	Household consumption kg/yr	Total consumption kg/yr	Total consumption baht/yr
Herbs	0.234	638	32,464
Wild fruits	0.714	1947	58,435
Wild vegetables	1.250	3408	34,087
Bamboo stems	0.756	2061	103,074
Bamboo shoots	0.732	1996	19,965
Mushrooms	0.119	324	12,823
Insects	0.012	32	4,869
Total			265,717
Average per household			97

Source: Nhuchaiya 1999

The total value of NTFPs collected by all 2,727 households was estimated to be 265,000 baht per year. This is only a very small amount compared with the estimated total income of 277 million baht per year for all households in the area surrounding the park. Products harvested from the park are collected illegally, as Thai legislation prohibits such activities in national parks.

4.3.3 Catchment protection

The national park is the headwater of the Prasae, Mae Phang Rat and Klong Ta Node watersheds. The sub-watersheds comprise Klong Ra Ok, Klong Ploe, Klong Yai Arm, Klong Hin Ploeng and Klong Wa Phlne, each with its own geological characteristics. The Prasae watershed has been selected as an example for the field study.

Prasae watershed covers an area of 2,067.8 sq. km, including 1,164 sq. km of water storage. Ra Ok Reservoir is located in a sub-catchment of the Prasae River, below Khao Chamao-Khao Wong NP. The reservoir supplies high-quality water, with a reliable flow, for a number of purposes.

Fruit, including mangosteen, durian and rambutan, is produced in areas surrounding the reservoir. The reservoir supplies water to local orchards, which also draw from groundwater supplies. Farmers are not charged for water.

Under a new plan for water supply and irrigation in the area, 7,500 rai (1,200 ha) of irrigated land will be developed in the vicinity of Ra Ok Reservoir. This is expected to support a major increase in agricultural production, mainly fruit and other perennial crops.
The gross value of the expected fruit yields can be calculated as follows: average annual yields of mangosteen, durian and rambutan elsewhere in the province are 638 kg/rai, 1,756 kg/rai and 1,865 kg/rai respectively, with market values of 31 baht/kg, 16 baht/kg and 11 baht/kg. If 60 per cent of the area is planted with orchards and this area is divided equally among the three kinds of fruit, the expected gross returns from the irrigated area would be 105 million baht per year.

Khao Chamao's contribution to this value depends on the quantity of water supplied, the continuity of supply, the contribution of irrigation to crop productivity (compared with a rain-fed situation), and the extent to which forested areas in the park influence water supply over time. The prevention of premature silting of Ra Ok Reservoir is another important environmental service provided by the park. Detailed hydrologic studies are required to make more tangible estimates of the park's economic value to orchardists in the newly irrigated area.

Fish are produced in Ra Ok Reservoir. However, this activity supports only eight people and there are plans to discontinue it, as it poses a threat to water quality.

Piped water, which is supplied to consumers in downstream urban areas, is not drawn directly from Ra Ok Reservoir. At present, a pumping station is operated by the Khao Din Water Supply Unit of the Provincial Waterworks Authority downstream from Ra Ok, on the Prasae River. The water is treated and then distributed to urban consumers, industry and farmers. Urban consumers and factories pay 10 baht (US$0.23) per kL. Irrigators pay a user charge based on the area irrigated, at the rate of five baht per rai (US$0.02 per ha).

The Provincial Waterworks Authority can take water from the river free of charge. Water quality has deteriorated significantly, however, due to sediment loads and discharges of pollutants by industries located along the stream, and an alternative low-cost source of high-quality water has to be found.

A new plan to enhance reticulated water supplies in the sub-region is being implemented. A pipeline will be constructed connecting the downstream pump station directly to Ra Ok Reservoir, allowing high-quality water from Ra Ok to be treated and distributed instead of using river water. The water supply capacity will be doubled, to serve a much larger urban customer base. A new pump station at Ra Ok Reservoir is also being constructed as part of the plan.

The park provides watershed protection for Ra Ok Reservoir, which helps to prevent sedimentation of the reservoir and maintain high standards of water quality. When the new water supply system is complete, treatment costs per unit of water supply under the new scheme are expected to be lower because the raw water will be of higher quality.

Box 2. Economic benefits of catchment protection

The economic benefits of water treatment can be estimated. The Water Supply Unit currently supplies 660,000 kL per year; annual expenditures (capital costs, operating and maintenance costs, and costs of chemicals for water treatment) are estimated to be 2,536,000 baht per year. With a doubling of capacity at Ra Ok Reservoir and the same cost structure (i.e. with water being withdrawn from the river and treated as at present) the costs would be 5,072,000 baht per year. If these costs were reduced by 25 per cent because of the higher quality of raw water from Ra Ok, the cost savings would be 1,268,000 baht per year. (The actual rate of cost reduction needs to be estimated from cost engineering data.) Some — possibly all — of these cost savings can be attributed to the catchment protection above Ra Ok provided by Khao Chamao-Khao Wong NP.

Catchment protection provided by the park also enhances the reliability of water supply for irrigated agriculture. When the irrigation expansion project is completed, gross and net revenues from agriculture in the area are expected to increase significantly. Part of this expected increase can be attributed to the water supply functions of Khao Chamao-Khao Wong NP (estimating the proportion would require extensive hydrologic modelling and agronomic studies).

4.3.4 Salinity control

Runoff from Khao Chamao-Khao Wong NP flows into a tributary of the Prasea River and the Ra Ok Reservoir. This runoff, combined with releases from Ra Ok Reservoir, enhances river flows and helps assimilate the wastes discharged into the river by downstream activities. It also helps control salinity levels in the lower reaches of the river (approximately one million cubic metres of water are released annually for this purpose). Shrimp farming, which is affected by salinity levels, takes place in the estuarine section of the Prasae River. The total area farmed is 4,511 rai; shrimp production is 3,094 tonnes per year, with a gross value of 758 million baht per year and a net value of 61 million baht per year (Department of Fisheries 2001b).

4.3.5 Wetland protection

Wetlands in the downstream area also depend on adequate water flows. Numerous studies have documented the economic values of environmental products and services provided by wetlands, including biological water treatment, provision of habitat for fish species and water birds, recreation and education benefits.

Section 5

Near-shore marine ecological systems

5.1 Marine protected areas in Rayong and Chanthaburi provinces

Marine protected areas in Rayong and Chanthaburi provinces include areas surrounding various islands and reefs and three km from the shoreline. The coral reef of Kohn Leamya-Koh Samet NP contains several islands, including Koh Samet, Koh Kudi, Koh Chan and Koh Platian. The area has 42 kinds of coral, most of which is still in good condition. Many marine species are found in this area, including crab, various kinds of shellfish and sea flower.

MPAs support fish stocks by providing safe habitat for fish species, restricting fishing (especially by commercial operators) and releasing eggs and fry into adjacent waters. The construction of artificial reefs is an important means of enhancing fish habitat within the MPAs.

5.2 Fishing

Fisheries are important economic contributors in Rayong and Chanthaburi provinces. The gross value of the commercial catch is approximately 87 million baht per year and the net value is 54 million baht per year. Landed marine catches (which are not necessarily taken in the local area) are shown in Table 5.

Anchovies are harvested in large quantities and are especially important to the local economy. The gross value of the local anchovy catch is estimated at 2.5 million baht per year. To calculate the value of MPAs in terms of fish catch, it would be necessary to conduct biological studies to determine which species spawn within the areas and are subsequently harvested for commercial or subsistence purposes.

Although Chanthaburi has a relatively small marine catch, aquaculture is a major activity that provides livelihoods for many local people (Table 6). Shrimp culture produces more than 26,000 t/yr. With an average price for shrimp of 240 baht per kg, the total market value of shrimp produced in Chanthaburi would be about 62.4 million baht per year. Grouper, cockles and oysters are also produced in significant quantities. Gross revenue from grouper is approximately 540,000 baht per year (net 334,000 baht).

Table 5. Quantity of marine fish landed in Rayong and Chanthaburi (t/yr)

	Rayong	Chanthaburi
Food fish	55,988	666
Trash fish	18,388	979
Subtotal, fish	74,376	1,645
Shrimp and prawn	70	205
Lobster	0	0
Crab	74	22
Squid and cuttlefish	2,984	154
Shellfish	0	19
Total	77,504	2,045

Source: Department of Fisheries (2001a)

Table 6. Yields from coastal aquaculture, Rayong and Chanthaburi (t/yr)

	Rayong	Chanthaburi
Shrimp (mainly tiger prawns)	4,845	26,627
Sea bass	3	4
Grouper	8	148
Cockle	0	431
Oysters	0	231

Source: Department of Fisheries (2001a)

Table 7 provides information on fishing establishments, and indicates the importance of marine and coastal aquaculture as a source of income and employment in the two provinces. Chanthaburi has a large number of relatively small establishments. The average farm size in Chanthaburi is 20 rai; in Rayong it is 40 rai. Social well-being, especially for small-scale producers, is highly dependent on the sustainability of aquaculture in Chanthaburi Province.

Table 7. Number of fishing establishments in Rayong and Chanthaburi

	Rayong	Chanthaburi
Farms	175	2,104
Area (rai)	7,020	44,360
Fishing establishments (marine)	1,265	1,850
Fishing establishments (aquaculture)	276	3,237
Fishing establishments (marine and aquaculture)	24	558
Total fishing establishments	1,565	5,645
Employment in marine capture fisheries, peak season	5,684	4,239

Source: Department of Fisheries (2001a)

Fishing is important economically not only in terms of the direct employment and income it generates; fish processing generates further economic opportunities. Rayong reaps most of the downstream processing benefits, as shown in Table 8, with 139 fish processing factories (compared with Chanthaburi, which has only 19). Anchovy is an important local catch, and many women are involved in small-scale activities that produce a range of goods from the anchovy catch.

Fishing and fish processing also create important flow-on effects in the local economy. Expenditures extend throughout the local economy; this provides support for other sectors, including services and infrastructure.

Table 8. Number of fish-processing factories in Rayong and Chanthaburi, 1998

	Rayong	Chanthaburi
Freezing	5	n/a
Canning	1	n/a
Fish sauce	26	3
Steaming	5	n/a
Salted fish	30	3
Dried shrimp	2	6
Dried squid	60	1
Dried shellfish	0	0
Fish ball	7	2
Shrimp cracker	0	0
Reduction	2	4
Total	138	19

Source: Department of Fisheries (2001a)

Any threat to the sustainability of marine catches and aquaculture will have serious implications for local economies and communities. The Department of Fisheries is already concerned about declining catches of marine species; although anchovies are still abundant, sustainability is threatened by poor management and the introduction of new fishing gear. Fishing pressure is increasing and illegal fishing still occurs. Fish habitat, especially mangroves, has been seriously degraded. There are also concerns about possible adverse impacts on fish stocks caused by pollution from the rapidly expanding industrial estates in the area. The Industrial Estates Authority of Thailand is endeavouring to overcome pollution problems by transforming industrial estates into eco-industrial complexes, which employ high rates of recovery and reuse of materials and effluents.

5.3 Koh Samet National Park

Koh Samet is an island lying off the coastline in Chanthaburi Province. The MPA contains the island and the three-km restricted zone along the mainland coast. The island is 18.4 km in length. Its east coastline has moderate slopes, a small gulf, and a coastline featuring rocky reefs. Most of the west coastline comprises cliffs and rocky reefs. Aoa Praw is the only beach in the area. At the head of the island, Mae Lumpeng Beach at Kohn Leamya is a sandy coastline with moderate slope.

At the end of South Cape, there are three small islands: Koh Chan, Koh Sunchalarm and Koh Hin Kae. Another eight islands are located near the coast.

The climate is monsoonal. The southwest wind blows regularly during May-September; the northeast wind is prevalent from October to January; in the summer, the prevailing wind is from the south. Wind speeds are typically 6–14 knots and water temperature averages 28 degrees C.

The main type of vegetation is dry evergreen forest. Forest cover is light; large trees, which were used for agriculture, house construction and charcoal production, have disappeared. Small plants and pioneer species have replaced most of the original forest.

There is a wide variety of animal life, including mammals such as *Paguma Larvala, Pleropus hypomelanus, Callosciurus finlaysoni, Menetes berdmorel, Tupaia belangeri* and *Tragulus javanicus*. Birds include *Himantopus himantopus, Charadrius leschenaltii, Egretta garzetta* and *Acipiter trivirgatus*. There are also reptiles, such as *Leiolepis belliana, Varanus nebulosus* and snake, and amphibians, such as *Bufo melanostictus, Polypeucomystax* and *Kaloula pulchra*.

5.3.1 Management responsibilities

Marine resources are managed by the Department of Fisheries for conservation purposes. Commercial fishing is prohibited within MPAs, although artisanal fishing is permitted within the boundaries of the MPAs, especially along the mainland coastline, to support fishing communities and families that live along the coastal beaches. On Koh Samet, three government agencies have ownership and management responsibilities: the Royal Forest Department, the Ministry of Finance and the navy.

5.3.2 Fisheries

MPAs are important habitats for fish breeding and growth. This environmental protection supports artisanal fishing within the PAs and commercial fishing outside the PA boundaries. The economic value of this contribution is difficult to determine accurately because of data deficiencies.

Commercial fisheries sell their output in national and local markets and also export abroad. The main species harvested are anchovy, Indo-Pacific mackerel, Indian mackerel, King mackerel and sardinellas. Large investments are required for commercial fishing; boats are more than 10 m long. While the commercial returns from fishing are generally high, very little of the total catch is caught in the vicinity of the Kohn Leamya-Koh Samet NP. Commercial fishing generally takes place far from the coast.

Subsistence fishing is more important at the local scale. It mainly takes place near the coastline and its main purpose is to feed families, although some of the catch is sold to generate income. Equipment and boats are small. The main species caught are *Dascyllus marginatus, Mugilidae, C. Leptolepis, Lutjanus, Scarus sp.*, grouper, rays, bigfin reef squid, squid, crab and other shellfish.

Approximately 30 per cent of local fishermen are employed in the commercial fisheries and produce 70 per cent of the catch. By contrast, 70 per cent of fishermen are in subsistence fisheries but produce only 30 per cent of the total catch.

5.3.3 Tourism and recreation

The highest economic values related to the park and MPA are associated with tourism and recreation. The beach areas on the mainland receive many visitors, especially on weekends. The small coral islands near Koh Samet are protected and are popular for skin-diving. Expenditures by visitors at local eating places and retail outlets help to sustain the local economy.

Entry fees for the park follow the standard pattern for Thailand: 20 baht for Thai adults, 10 baht for children, and 200 baht (US$4.65) for foreigners. Although revenue from entry fees amounts to about 9.2 million baht

per year, it is paid to the treasury; only 10 per cent is returned to the park. As a consequence, it is difficult for the park managers to implement effective management plans.

Large numbers of people visit Koh Samet. According to a study conducted by Israngkura (2001), approximately 250,000 visits are made to the island each year. Half the visitors are Thai nationals and half are international tourists. Using a travel cost model, Israngkura estimated that the recreation benefits of the park amount to 2,709 baht per person per year for Thai visitors and 12,808 baht per person per year for foreign visitors. This works out to an average of 7,759 baht per visitor per year. The total estimated recreation benefits are thus 1.94 billion (one billion=1,000,000,000) baht per year.

Israngkura, applying the contingent valuation method, also discovered that foreigners were willing to pay an entrance fee of 452 baht, while Thai visitors were willing to pay 95 baht. This is significantly higher than the entrance fees presently charged.

In an earlier study, Limprauen (1994) estimated economic values for Koh Samet using a travel cost model for use values and a contingent valuation model for use, option and non-use values. The travel cost model indicated that use values were 27.15 million baht per year, while the contingent valuation model gave estimates of 23.06 million baht per year for use values, 108.53 million baht per year for option values, and 3.6 billion baht per year for non-use values. The total value of Koh Samet national park was thus estimated to be 3.7 billion baht per year.

5.3.4 Environmental management and economic benefits

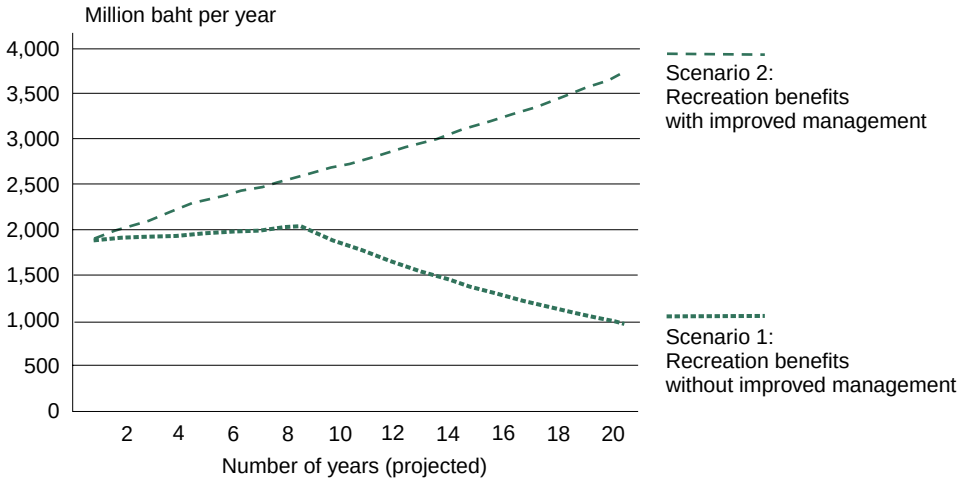
In recent years Koh Samet has undergone intensive development, mainly to support tourism and recreation, with adverse impacts on the natural environment (Jankaew et al. 1988). There are 49 hotels and resorts as well as numerous food stalls, restaurants and eating places. Many buildings were established illegally within park boundaries. Uncontrolled development of shacks, lodgings, eating places and retail outlets has taken place in the beach areas, especially along the eastern flank of the island. Some high-end resorts have been established on the western shores, with access to relatively unspoiled beaches.

Pollution is a major and increasing problem. Untreated or partially treated sewage is discharged to the waters on the eastern shores of the island. Solid waste is poorly managed. The refuse dump is located in the same catchment that is used for water supply.

Pattanagosai (2001), among others, have documented the effects of environmental degradation on tourism and recreation and regional development in Koh Samet and the benefits that can be achieved through sustainable management of the park.

The differences in economic terms between “business as usual” park management and sustainable development management strategies can be demonstrated by means of a simple simulation model. Figure 3 illustrates the differences in the pattern of economic growth and benefits if an uncontrolled or management approach is undertaken (scenario 1), compared with improved management of tourism and recreation (scenario 2).

Figure 3. Economic benefit scenarios, Koh Samet National Park



Scenario 1 assumes a management regime with unrestricted growth of tourism and development on the island. Current trends continue, with increasing visits to the park and accelerating environmental degradation. Visitor numbers increase rapidly, but a point of maximum carrying capacity is reached at some stage, bringing serious congestion, deterioration of beaches, bathing places, sewage treatment, waste disposal and scenic quality. Beyond that point, visitor numbers decline. The value of visits also decreases because of the degrading environment. Thus, recreation benefits increase initially, reach a high point, then decline over time.

Scenario 2 assumes that improved management is undertaken. Visitor numbers are controlled, with a maximum limit in place. In addition, specific measures are implemented to protect and enhance the natural environment. As a result, the willingness to pay for the park's environmental amenity — and the level of economic benefits — continues to increase over time.

The two scenarios are modelled over a projected future period of 20 years; the starting point is the present situation. Appropriate estimates of visitor rates and economic values are from Israngkura (2001). Rates of change applied within the model (e.g. numbers of visitors, rates of environmental degradation) are simply assumed, but are reasonably representative of the changes that could be expected under alternative sets of conditions.

The present value of benefits for each time path is calculated by applying a discount rate to the projected benefits. In Figure 3, the present value of benefits is assumed to be 15.5 billion baht for Scenario 1 and 22.3 billion baht for Scenario 2. The improved management regime results in an increase of 43 per cent in recreation benefits over the 20-year period.

Other economic values can be inferred from this; for example, as mentioned above, economic studies of natural areas indicate that non-use benefits are usually about twice the magnitude of direct use benefits. The incremental gain in non-use benefits resulting from improved management under Scenario 2 would thus be in the order of 13.6 billion baht, expressed in present values over the 20-year period.

The model can also be used to simulate likely differences in tourism expenditure in the region under the two scenarios. As well as spending directly associated with the park, such expenditure includes spending on the mainland for accommodation, shopping, various services and transport.

In 2002, the average international tourist spent about 30,000 baht on each visit to Thailand. For visits to Koh Samet, the amount foreign visitors are willing to pay is about 4.7 times that of Thai visitors (Israngkura, 2001). Tourism expenditures by Thai visitors would thus be about 6,350 baht per visit. The weighted aver-

age expenditure for visitors to Koh Samet can be calculated as approximately 18,000 baht per visit.

The projected time paths for tourism expenditure under the two scenarios would be similar to those for recreation benefits. Under scenario 1, tourism expenditure would be expected to decline in the longer term; it would tend to increase under scenario 2. Under Scenario 1 the present value of tourist expenditure, measured over a period of 20 years, would be 36.5 billion baht, while for Scenario 2 the expenditure would be 52.4 billion baht. Improved environmental quality of the park would result in additional tourism expenditure of 15.9 billion baht in the region.

This estimate refers only to direct expenditures. Flow-on effects to other industries in the region could be expected to roughly double the overall impact on output, income and employment. Wide experience with economic input-output models for regional analysis typically indicates that tourism expenditure multipliers range from about 1.8 to 2.5. The total increase in the value of output for the regional economy resulting from increased tourism expenditure would be 31.8 billion baht.

These estimates give an indication of the potential gains — both in terms of recreation and tourism benefits and in regional economic development prospects — from improved management of the island's environment and its use by visitors.

Section 6

Kung Krabaen Royal Development Project

6.1 The Royal Development Study Centre

Kung Krabaen Bay is located on the coastline of Thamai District in Chanthaburi Province. The central part of the Royal Development Project, with a total area of 640 ha, covers the area around the shoreline of the bay. The outer area comprises 5,120 ha and contains agriculture and fishery villages. In 1981 His Majesty the King initiated establishment of the Kung Krabean Bay Royal Development Study Centre, in order to conduct study, research and experimentation on appropriate development methods suitable for the development needs in the coastal area of Chanthaburi Province. The centre's objectives are as follows:

- to promote the effective management of the coastal fishery, and of agricultural and occupational development along the eastern coastline;
- to provide an effective program of environmental conservation, to examine problems and to find solutions related to mangrove destruction in the coastal environment, using an integrated approach;
- to increase the income of the surrounding villagers and farmers and improve their standard of living; and
- to promote the dissemination of knowledge, skills and techniques related to aquaculture, coastal environment protection and conservation, agriculture and animal husbandry, through the use of demonstration projects and by providing training based upon the study, research and experimentation work conducted at the centre.

A large number of government agencies and organisations have been involved in integrated planning and management of the project. This level of commitment is required to design, implement and operate such projects.

6.2 Protected and conservation areas

The Royal Development Project site is flanked by a hilly forested area, the Kung Krabaen Non-hunting Area. There are 97.6 ha of mangrove forest in the bay, and an additional 160 ha have been restored. Approximately 116.5 ha of degraded mangrove forest and paddy field were converted to shrimp production as part of the project.

Mangroves provide a wide range of environmental products and services, including shoreline stabilisation, biomass production, recreation/tourism, control of sedimentation, food chain support, timber nutrient retention, gene banks, firewood, biological water treatment, fish nursery and habitat and NTFPs.

Villagers participating in the project are made aware of the ecological and economic value of the natural system; they engage in restoration and maintenance activities to preserve the bay's mangrove and seagrass resources.

6.3 Production

The main economic activities in the study area are shrimp production, oyster production and near-shore fisheries. In earlier years, 113 families participated in the project; 93 families now take part.

The total shrimp production area is 170.2 ha, including infrastructure; of this, 351 shrimp ponds account for 137.6 ha. Each shrimp production unit covers an area of 1.6 ha, with 0.96–1.12 ha for shrimp cultivation and 0.48–0.68 ha for a house plot and afforestation.

Shrimp output has historically ranged from 350 to 550 tonnes per year. Two crops are raised each year, yielding 3.5–4.1 tonnes per ha. At a price of 240 baht per kg, the market value of shrimp output from the project ranges from 84–132 million baht per year. Gross revenue per household from shrimp production averages 743,000–1,168,000 baht (approximately US$17,000–$27,000) per year. Household income (i.e. net returns), which incorporates the cost of production inputs, is lower. According to the Office of the Royal Development Projects Board, in 1995 shrimp farmers earned an average of about 150,000 baht (US$3,500) per household per year, well above the poverty line.

Oysters generate additional income for shrimp farmers. Fish catches are indirectly linked to the project, due to the protected marine habitat — mangroves and seagrass — surrounding and within the bay. Fertilizer is produced from sludge obtained from the shrimp ponds.

6.4 Contribution of the protected areas

The project is managed as an integrated ecosystem on a sustained yield basis:

- the protected forested watersheds in the non-hunting area supply fresh water to shrimp production;
- oysters absorb nutrients from discharge water;
- mangrove areas absorb further nutrients and suspended solids and act as nurseries for fish species; and
- seagrass beds provide natural habitat for fish.

Further benefits to fisheries result from the release of marine seeds from tiger prawns, white shrimp, seabass, grouper and oysters into the bay and surrounding coastal areas.

Shrimp productivity is highly sensitive to salinity levels. Sea water typically has a salinity concentration of 35 parts per thousand (ppt), a level too high for shrimp, which require brackish water. The greatest yields per ha are obtained when the salinity level is around 15–20 ppt. Outside this range, output diminishes significantly; above 25 ppt production is not economically worthwhile. This is supported by statistics in Table 9 (the number of shrimp farms operated in the project in 2000, as a function of salinity levels).

Table 9. Number of active shrimp production ponds according to salinity level

Month	Salinity (ppt)	No. ponds
January	31.4	57
February	36.8	34
March	38.0	55
April	33.2	70
May	29.6	89
June	20.8	142
July	17.0	120
August	15.5	126
September	16.2	118
October	18.4	105
November	18.6	104
December	27.6	88

Salinity is lower during the rainy season. Fresh water is pumped into the ponds from surface runoff and from diluted water along the coastal strip. Much of this water comes from the protected forested area surrounding the project. The extent to which the non-hunting area contributes to dilution — and its economic value to shrimp production — could be determined through detailed hydrologic studies.

The project is developing a seawater exchange process, by which seawater will be pumped into the ponds from the coastal strip outside the bay area itself. This should ensure that the seawater is of good quality and will help to prevent disease in the shrimp population. In other parts of the world, pumping is used to maintain high water quality in shrimp ponds, although it is expensive. Presumably, some fresh water would need to be added to the intake to keep the salinity at optimal levels.

Fresh water for domestic use is obtained directly from springs in the non-hunting area and is delivered by truck during the dry season. Households in the project spend an average of 300 baht per day for this water. Extraction rights have been granted to collect it.

An additional benefit of the non-hunting area is soil stabilisation and flood mitigation. Some years ago, deforestation of an area to the east of the study site contributed to severe flooding and land slumping, causing significant damage and threat to life.

Section 7

Summary and conclusions

7.1 Protected areas and development

The field study has provided persuasive evidence of the relationships between PAs and socio-economic activities, from the broad regional scale to site-specific examples. For the Eastern Region as a whole, a wide range of benefits can be linked to terrestrial and marine protected areas. In Rayong and Chanthaburi provinces, natural resources and PAs clearly underpin key economic sectors, including tourism, agriculture, fisheries, aquaculture, water supply and food-processing industries (Table 10). Benefits such as carbon sequestration by forests and existence values relating to biodiversity conservation are not shown in the table but have global significance. Indicative values of these benefits are provided in the field studies for Cambodia and Lao PDR.

Table 10. Regional benefits of PAs

Eastern Forest Complex	Marine Protected Areas
Habitat protection	Habitat protection
Biodiversity conservation	Biodiversity conservation
Preservation of genetic stocks	Preservation of genetic stocks
Tourism and recreation	Tourism and recreation
Watershed protection and water supply	Fish spawning and growth
Sediment and nutrient retention	Environment for aquaculture
Biomass production	
Stabilisation of flows	
Groundwater recharge and discharge	
Non-timber forest products (NTFPs)	
Flood control	
Protection of water quality	

The contributions of PAs to social sustainability and development closely parallel their contributions to economies. Environmental products and services provided by PAs are important in supporting small-scale economic enterprises and village-level activities, including subsistence livelihoods outside the formal market economy (benefits associated with specific sites are summarised in Table 11).

Table 11. Specific site benefits

Khao Chamao National Park	Koh Samet Park and environs	Kung Krabean Bay
Recreation value: 427 M baht/yr	Recreation value: 1.9 B baht/yr	Shrimp: 84–132 M baht/yr
Local consumption of NTFPs: 0.265 M baht/yr	Fisheries (n/v for specific site)	Oysters (n/v)
Non-use value: 252 M baht/yr	Aquaculture (n/v)	Fish (n/v)
Gross value of shrimp: 758 M baht/yr		Compost (n/v)
Other visitor expenditure: 77 M baht/yr		Biodiversity (n/v)
Irrigated agriculture: 105 M baht/yr		Tourism visits (n/v)
Flood control (n/v)		Education and research (n/v)
Wetland ecosystems (n/v)		Diffusion effect (n/v)

n/v: not valued

7.2 Lessons for protected area planning and management

National, regional and sectoral planning agencies need to look beyond the boundaries of their own planning and investments, first to recognise that all natural systems have limits and can easily be overexploited or damaged, and second, to appreciate that natural systems can support development and enhancement of community well-being if they are properly planned and managed.

Planners and managers of PAs, in turn, should be more aware of the economic values of the natural assets for which they are responsible. They need to explore and apply techniques that will enable them to assess more exactly the values that the community places on PAs and natural assets and use this information to ensure that monetary flows returned to PAs — budget allocations, revenues from user fees and other market-based mechanisms — are adequate to implement protective management plans and strategies.

Effective planning and ongoing management of PAs must be carefully coordinated with development planning and natural resource management to protect the ecological sustainability and productive capacities of natural systems, of which PAs are an important and integral part.

7.3 Rapid economic assessment techniques

The field study provided an opportunity to demonstrate some of the rapid assessment methodologies that economists use to derive the economic values of PAs and natural resources. The productivity approach was applied in cases where the level of output increases or the quality of output is enhanced because of PAs. In some instances, benefits were identified in terms of reduced costs.

The benefit transfer technique allowed values from other sites and studies to be applied. Economic use values of PAs for recreation and tourism were valued in other studies using the travel cost method.

Existence values (or the relationship between non-use and use values) could be estimated by using the results from studies that applied the contingent valuation technique.

The benefit transfer technique, while having a number of limitations, does at least give some indication of economic values at a particular site. Benefit transfers are probably the only means of deriving economic values of PAs and natural environments when time and research resources are limited and it is not possible to carry out detailed analyses. Benefit transfers, by using ratios of non-use to use values taken from other studies, also allowed estimates to be made about the non-use values of PAs.

Simulation modelling provided scenarios for future management options, incorporating trends and assumptions reflecting different sets of conditions, and quantifying the levels of economic benefits that could be expected

Economic impact analyses, based on regional multipliers drawn from economic input-output models, were useful in making rough estimates of flow-on effects of PA-related expenditures in the local or regional economy. The same technique can be applied at the national scale.

7.4 Scientific and technical analysis

To determine the contribution of PAs to development, an essential first step is to assess the study site in scientific and/or technical terms. Only when the attributes and environmental processes of the site are known is it possible to derive economic values for environmental products and services and use these values for planning or management purposes.

The field study has shown that difficulties in assessing the economic values of PAs often relate to problems of scientific and/or technical analysis rather than economic analysis. In the site-specific field study examples, where it was not possible to estimate the full economic values of products and services provided by PAs, the deficiencies in information mostly related to physical, chemical or biological processes in natural systems rather than economic data. In principle (and in practice, given sufficient time and research resources) more detailed scientific investigations could be undertaken, providing a firmer base for these economic assessments.

7.5 Capacity building

Further experience in the kinds of economic assessment techniques described above would improve the capacity of economists and PA planners and managers to work together more effectively and formulate strategies that better integrate PAs with the broader processes of sustainable development. It is hoped that the field studies undertaken for the Review of Protected Areas and Development will give some indication of directions that might be taken.

Section 8

References and selected reading

Bundprasirichot, C. 2000. *The Dynamics of Community for Resource Management: Thailand Situation.* Thailand Research Fund (TRF), Bangkok.

Chetamash, S., U. Kut-inn, S. Itviranon, R. Sriwantana, P. Makarapirom and N. Thanakarn. 1991. *Final Report on Conservation Forest Area and Management Policy.* Presented to The National Economic and Social Development Plan, Faculty of Forestry, Kasetsart University, Bangkok.

Deephrom, P. 1999. *Management of Irrigation System Use in Kham Phang Sane Irrigation Service and Maintenance Project.* Department of Political Science, Faculty of Political Science and Public Administration, Kasetsart University.

Department of Fisheries. 2001a. *Fishing Commumunity Production Survey in 1999.* Fisheries Economics Division.

Department of Fisheries. 2001b. *Shrimp Aquaculture Statistics 1999.* Fishery Statistics and Information, Fisheries Economics Division.

Department of Water Resource Engineering. 1995a. *Final Report of Water Resource Development and Management in Chanthaburi Province.* Faculty of Engineering, Kasetsart University, Bangkok.

Department of Water Resource Engineering. 1995b. *Final Report of Water Resource Development and Management in Rayong Province.* Faculty of Engineering, Kasetsart University, Bangkok.

Israngkura, A. 2001. *Economic Evaluation of Natural Environment: Case Studies of Khao Yai and Kho Samed National Parks.* Environment and Social Development Department Japan Bank for International Cooperation (JBIC).

Jankaew, K. et al. 1988. *Environmental Impact Assessment of Tourists to Koh Samet.* Department of Conservation, Interdisciplinary Graduate Program, Kasetsart University.

Kaosa-ard, M. 1999. The Degradation of Thailand's Resource Basis. In *From Economic Crisis to Public Ecology Crisis.* Faculty of Economics, Thammasat University, Bangkok.

Limprauen, N. 1994. *Value of National Parks: Case study of Koh Samet.* Masters Degree Thesis, Thammasat University, Bangkok.

Nhuchaiya, P. 1999. *The Correspondence Between Socio-Economics and Dependency on Forest Resources in Communities around Khao Chamao-Khao Wong National Park Area of Rayong and Chanthaburi provinces.* Master's Degree Thesis, Kasetsart University, Bangkok.

Office of National Economic and Social Development Board. 2001. Gross Domestic Product, Statistical Series.

Pattanagosai, V. 2001. *Strategy of National Park Sustainable Management: A Case Study of Khao Leamya-Koh Samet National Park.*

Piyavatin, S. 1999. *The Correspondence of Socio-Economic Land use and Dependency on Natural Resources in Communities around Khao Kitchakut National Park Area in Chanthaburi Province.* Master's Degree Thesis, Kasetsart University, Bangkok.

Prayoonsit, T., S. Chaiwattana and S. Napom. 1999. *Forest Complex in Thailand.* The Office of Committee for Forest Biodiversity, Natural Resource Conservation Bureau, Royal Forest Department, Bangkok.

Royal Forest Department. 2001. *Khao Leamya-Koh Samet National Park Master Plan*.

Royal Forest Department. 2000. *Thailand Forest Statistic 2000.* Information Department, Royal Forest Department, Bangkok.

TDRI/HIID. 1995. *Green Finance: A Case Study of Khao Yai, Natural Resources and Environment Program.* Thailand Development Research Institute and Harvard Institute for International Development.

Tourism Authority of Thailand. *Annual Reports.*

Annex: Data derivation and sources, Figures 1 and 2

Protected Areas: Department of Forestry (2000).
The three-km Marine Protected Area for Thailand coastal regions was generated by ICEM and integrated with the existing GIS dataset provided by the Department of Forestry.

Airports: UNEP (1999)

Cities: UNEP (1999)

Dams: UNEP (1999)

Ports: UNEP (1999)

Roads/railways: UNEP (1999)

Land use: Department of Forestry (2000)

Rivers: Department of Forestry (2000)

Land use

Land-use categories have been generalised to achieve cross-country land-use categories. These are as follows:

Old Land use	New Land use	Old Land use	New Land use	Old Land use	New Land use
A0100	Agriculture	A0600	Agriculture	G0000	Other vegetation
A0101	Agriculture	A0609	Agriculture	I0000	Urban/industrial
A0102	Agriculture	A0700	Agriculture	M0100	Urban/industrial
A0200	Agriculture	A0902	Agriculture	M0101	Urban/industrial
A0201	Agriculture	A2309	Agriculture	M0102	Urban/industrial
A0202	Agriculture	F0000	Forest	M0200	Urban/industrial
A0203	Agriculture	F0100	Forest	M0202	Urban/industrial
A0204	Agriculture	F0101	Forest	M0300	Urban/industrial
A0205	Agriculture	F0102	Forest	M0301	Urban/industrial
A0209	Agriculture	F0105	Forest	M0302	Urban/industrial
A0300	Agriculture	F0106	Forest	M0500	Urban/industrial
A0301	Agriculture	F0107	Forest	M0600	Urban/industrial
A0302	Agriculture	F0200	Forest	U0101	Urban/industrial
A0303	Agriculture	F0202	Forest	U0102	Urban/industrial
A0305	Agriculture	F0300	Forest	U0103	Urban/industrial
A0400	Agriculture	F5000	Forest	U0104	Urban/industrial
A0401	Agriculture	F5001	Forest	W0000	Water
A0405	Agriculture	F5002	Forest	W0100	Water
A0408	Agriculture	F5101	Forest	W0200	Water

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