



Environmental Management in the Coastal Zone ~ Cambodia
Ministry of Environment and Danida



STATE OF ENVIRONMENT REPORT KAMPOT PROVINCE



Kampot Working Group

April 2002

Phnom Penh

Preface

Emphasising the importance of Cambodia's coastline, covering the two provinces of Koh Kong and Kampot and the two municipalities of Sihanoukville and Kep and considering that the coastal and marine development is regarded as a priority by the government and encouraged in the national measures for economic improvement. In this process the well-being and sustainable development of natural environment is a very important aspect for the future of Cambodia. Today, Cambodia's coastal and marine resources support various economic activities, including marine fisheries, ports, developments of industry and tourism, marine navigation, and particularly the livelihood of people in coastal communities. It is therefore with pleasure that I introduce the present report being prepared by the Provincial Working Groups and emphasizing the cross-sectoral cooperation which is important for environmental management. The report is the first attempt to collect environmental information and evaluate the environmental conditions in the coastal zone.

It is the hope that this report through regularly updating in the future can provide the baseline by which changes in the environmental conditions can be detected and reacted on as the rapid development within fisheries, agriculture, and through different industries together with the increasing urbanization takes place without sufficient regard to our natural resources.



Dr. Mok Mareth

Minister of Environment

Chairman of the National Coastal Steering Committee

Foreword

This report on the coastal environmental situation in Kampot has been prepared as the first attempt to collect and evaluate the existing information regarding the environmental situation in the coastal provinces and municipalities. The report is one of four reports covering the coastal zone of Cambodia. The other reports covers Kep Municipality, Sihanoukville Municipality and Koh Kong Province.

The report has been prepared as part the "Environmental Management of the Coastal Zone, Cambodia, Phase 2" Project which was commenced in March 2000.

The purpose is to provide an organized structure for reporting on the environmental conditions in the coastal area. The aim would be that this report should be followed on a regular basis with updated and extended reports to assess the environmental situation in the coastal area. This will require a focused approach to provide new data for relevant environmental parameters which can be used to evaluate trends in the environmental conditions in the coastal zone.

The first report has been produced through a training process involving formal lecturers, group work, on-the-job training, and assistance from the project office. The aim has been to provide the provincial departments with an understanding of how to generate environmental information and how this information should be used in relation to spatial planning and to assess and use relevant information for conduction of environmental impact assessment.

As illustrated by the report the present information regarding the environmental conditions in the coastal zone is rather limited so the report presents the information available but as importantly also identifies the gaps in the information base and prepares for the establishment of more structured information systems and a supporting monitoring framework.

The present report has been prepared by the Kampot Provincial Working Group composed of members encompassing nine provincial departments and the governor's office as listed below. The reporting process was facilitated by the National Co-ordinator Mr. **Vann Monyneath** and the Environmental Management Advisor Mr. **Jens Erik Lyngby**.

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It is with pleasure that I introduce this report, which collects all available provincial information concerning the environmental conditions in Kampot Province. It is my hope that

the report can be of use in the daily work in the provincial departments and that the information in the report can be regularly updated to provide information regarding changes in the environmental conditions.

The preparation of the report has involved several of the provincial departments and has by this helped in strengthening the cross sectoral cooperation which is important for having a functional system protecting the environment for potential impacts from development activities in the province.



H.E Mr. Puth Chandarith

Governor, Kampot Province

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1. Introduction

Integrated Coastal Zone Management can be defined as a "dynamic process in which a coordinating strategy is developed and implemented to determine the environmental, social-cultural and institutional resources to achieve the conservation and sustainable multiple uses of coastal zones". An integrated approach requires close cooperation and coordination among the all concerned institutions in the coastal areas. The coastal zone consists of lands, shoreline and offshore areas.

The present report presents a description of the relevant environmental aspects based on existing information and provides information, which amongst others has been used for the preparation of the Physical Framework Plan for Kampot Province. It also provides information on the location of the pollution sources in the coastal areas, water sources, identification of sensitive ecosystem and natural protected areas

Kampot Province is located in the south-western part of Cambodia with a total coastline of 73 kilometers (94 kilometers if Kep coastline is also included). The coastline stretches from the border of Hatieng district, Vietnam to Koh Ses, Prey Nup district, Sihanouk Ville.

The area of the province is 4,873 km² and consists of 8 districts, 92 communes, and 104,993 households. The total population of the province is 528,405. The 8 districts are Kampong Bay, Kampot, Chhuk, Dang Tung, Chum Kiri, Kampong Trach, Banteay Meas, and Angkor Chey. Three of these districts – Kampong Bay, Kampot and Kampong Trach are located in the coastal area with 26 villages.

In the dry season, the temperature of the province is high in April with an average of 36.6 °C and the coldest month is February with an average temperature of 21.10 °C. The average annual rainfall in Kampot is 1,407 mm and the highest level of rainfall recorded is 2,604 mm.

The main resources of Kampot coastal area are seagrasses, coral reefs, fish, flooded forests, and salt fields. The biodiversity in Kampot consists among others of shrimps, crabs, snails, shells, lobsters, small and big fish, sea turtles, and dugongs.

2. Sources of pollution

2.1 Rivers

Along the 435 kilometers Cambodian coastline on the gulf of Thailand, the rivers drain westwards from the Cardamom Mountains and have catchments of approximately 15% of the land area. The coastal watershed comprises an area of approximately 18,300 km².

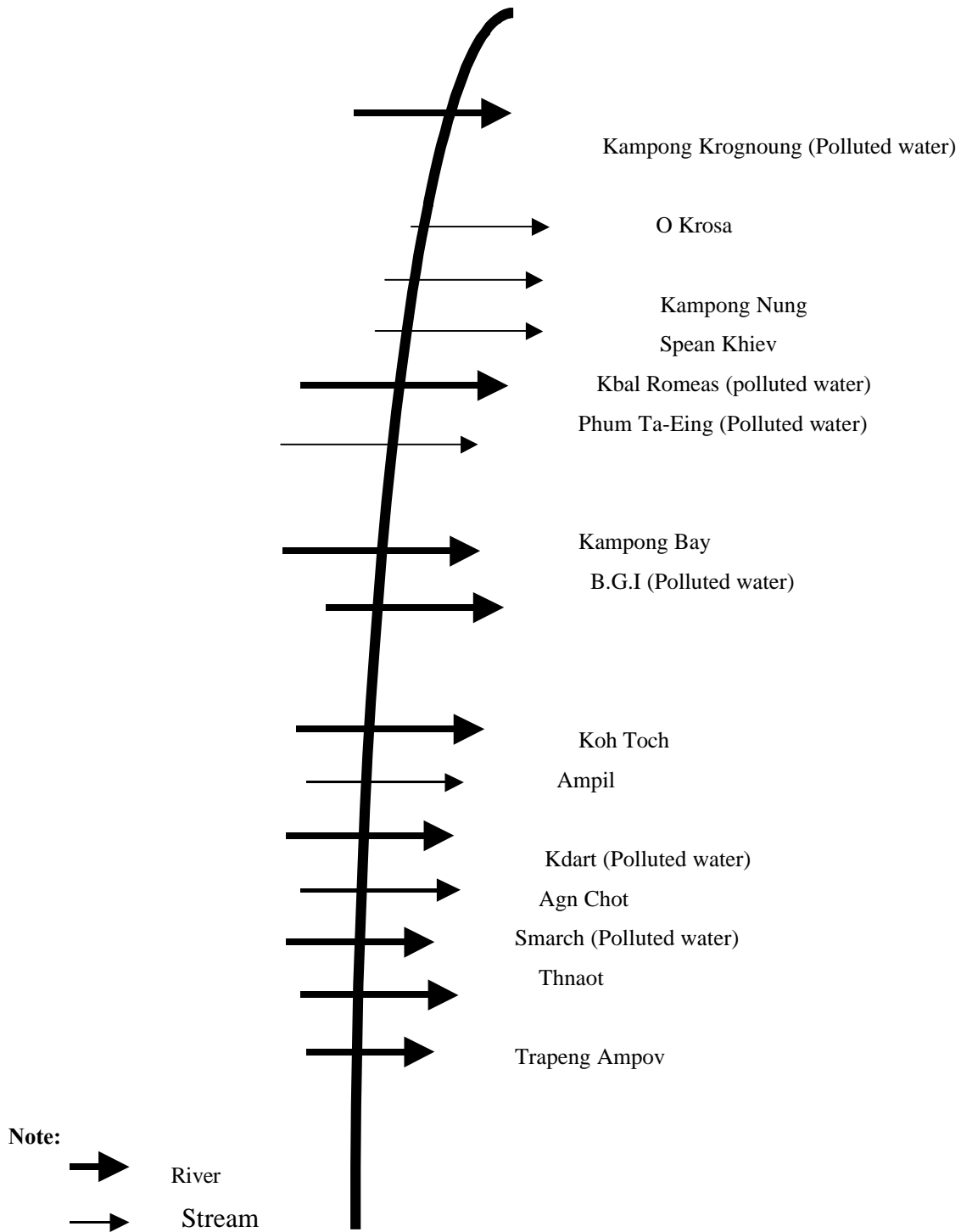
The rivers that flow into the Gulf of Thailand are relatively small with the water levels increasing and decreasing significantly with the volume of rainfall. The rivers in the coastal area are very short and have their sources in hills of about 500 to 600 meters altitude. They flow between hills and fall in cascades before reaching the plains that are located 15 to 20 kilometers from the sea. In the delta areas, the rivers divide into estuaries where the levels of turbidity are usually high and there are several marsh areas covered by mangrove forests.

There are many rivers located in the coastal areas, which usually dry up in the dry season. The sea influences most of the rivers in the coastal zone. In the dry season, the low-lying parts of the rivers are saline.

Along the coastal area of Kampot, there are 9 big rivers, which flow into the sea. These rivers are:

- 1a. Kampong Krognoung River, flowing from Voir Mountain and Kampong Trach market in Kampong Trach district.
- 1b. Kbal Romeas River, flowing from Kamchai Mountain in Kampot district.
2. Kampong Bay River, flowing from Kamchai mountain, Keo River, through Kampot Town in Kampong Bay district.
3. B.G.I river, including liquid waste from slaughterhouses, wine producing house, markets
4. Koh Toch rivers, flowing from Bokor area in Kampot district.
5. Kdart River, flowing from Bokor area and Kdart market in Kampot district
6. Smach River, flowing from Bokor area in Kampot district
7. Thnaout River, flowing from Bokor area and Prek Thnaot market in Kampot district
8. Trapeng Ropov smaller rivers, flowing from Bokor area and Trapeng Ropov market in Kampot district
9. Teouk Chhou River

Rivers and streams flowing into the sea in Kampot Province are illustrated below:



2.1.1 Small Streams

Apart from the rivers, in Kampot there are 6 smaller streams, which are listed below:

- O-Krosa stream
- Kampong Nung stream
- Spean Khiev stream
- Phum Ta-Eing stream
- Ampil stream
- Agn Chot stream

The small and bigger streams are polluted and the polluted water is discharged directly to the sea. The actual level of pollution is mainly caused by waste from households, markets, fishing boats etc. but there does not exist actual data on the pollution level and water quality conditions. The polluted rivers and streams are listed belows:

Rivers:

- Kampong Krogneung in Kampong Trach district
- Kampong Bay in Kampong Bay district
- Kdart in Kampot district
- Thnaot in Kampot district
- Trapang Ampov in Kampot district

Small streams:

- Ta-Eing in Kampong Bai district
- B.G.I in Kampong Bai district.
- Spean Khiev in Kampot district

2.1.2 Water quality condition in smaller streams and rivers

No information is available regarding parameter of water quality condition in smaller streams and rivers.

2.2 Industrial pollution from coastal installations

The industrial development in the coastal area of Cambodia is slowly increasing. According to the information from the Ministry of Industry, Mines and Energy, there are some factories and handicrafts such as garments and shoes, seafood processing, animal feeds, ice factories, fish sauce, sawmills, beers, plywood, oil and gas storage facilities, silica factories, salt industry, cements, phosphate or fertilizer factory, power plants and drinking water. According to the present information, there are 2 factories operating in Kampot province: Krey Ting Cement and Phosphate factories.

Most of the wastewater from the factories on the coast is discharged directly or indirectly into nearby waterways and then to the sea without treatment.

2.2.1 Locations of Industries in Kampot province

In the industrial sector in Kampot the priorities have been given to natural resources, mines, lime stones, construction stones, phosphate fertilizers, clean water supply, electricity and salt farming industries with a total area of 3,334 hectares.

At present, some companies have invested in a phosphate fertilizer factory in Toukmeas district and cement factory in Kampot district and another cement factory in Dorng Tung

district, which covers an area of 8 km² and is under construction (See the map). In addition, the Ministry and investment companies have planned to build three other cement factories in Banteay Meas and Kampong Trach districts. Enough cement can be produced to meet the needs of the country. Small-scale industry, handicrafts and other services are mostly done as family businesses with a total number of 1,814.

Mines

Many limestone sources are found in the Kampot province. The 3 construction stone areas are legally permitted as follows:

1. Kampong Trach district, with an area of 4 hectares and coordinates:
2. Dong Tung district, with an area of 4 hectares and coordinates:
3. Seda Oun mountain, Kampot district, with an area of 6 hectares and coordinates:

Power Plant

A private Taiwanese-owned investment company produces electricity for the provincial town consumption. There are 3 K.V.A generators producing 1,000 KVA and delivering to the provincial center.

In 2001-2003, Kampot electricity plant will be refurbished and some technological improvements will be made. The Ministry of Industry, Mines and Energy will do the work in cooperation with ADB.

Salt Farming

Salt farming has been done in the total area of 5,329 hectares of which 1,994 hectares are state-owned and the remainder is privately owned. In the year 2000, the production of salt was only 2,500 tons. This production cannot meet the requirements of the country. The frequent rain has severely affected the production and the farming season lasts only 4 months, from January to April. The estimated total demand of the country is from 80,000 tones to 100,000 tons of salt.

Need and use of clean water

There are two clean water stations serving the water supply in the province:

1. A pumping station in Teok Chhu (Teok Chhu waterfall), located 8 km from the Kampot provincial town.
2. A pumping station in the provincial town, located in the northern area of Kampong Bay river, close to the electricity plant.
 - The production of clean water in 2000 was 750,810 m³.
 - The total clean water used for consumption was 362,441 m³, which is equal to 47,5%. The targeted goal of clean water could not be met due to leaks of the main pipes because they have been lying in saline land for several years, and with very little maintenance.
 - 1 m³ is sold for 1,200 Riels.

In 2001-2004, the Ministry of Industry, Mine and Energy (Industry Department of the province) in cooperation with the provincial authority has planned to develop and improve technical aspects and expand the water supply systems in the provincial town and expand the systems to an outside area of the province to ensure the adequate water supply and reasonable prices.

2.2.2 Information regarding waste water amount and composition

No information is available regarding wastewater amount and composition.

2.2.3 Location of offshore oil and gas activities

There is no exploration on offshore oil and gas activities in Kampot sea area.

2.3 Discharge from upland and lowland activities

2.3.1 Domestic sewage

The waste water system for households in Kampot province is very weak. All larger urban centers are partly served by combined sewage and storm drainage systems that consist of conventional flush toilets, sometimes draining into a septic tank. Almost all the sewerage systems have not been maintained over the past three decades and are now in a state of disrepair with 80 per cent of the pipes being damaged. The sewage is not discharged to treatment systems, but to waterways or water bodies, which are then used for drinking water, bathing, swimming and irrigation. As a consequence of the improper discharge of sewage, waterborne diseases, such as cholera, typhoid and enteritis, are common throughout the Kampot province. Nearly two thirds of all deaths of children under the age of five are associated with waterborne diseases.

To date, the sewage from Kampot to the coastal area has been discharged through the drainage system to open canals or rivers and then to the coastal waters without treatment. The estimated amount of sewage discharged from the coastal cities and towns is shown in table 1.

Table 1: Amount of sewage discharged from Kampot Town.

Cities and Towns	Receiving Source	Population	Daily amount of sewage (m^3/day)	BOD (T/day)	TSS (T/day)	Total-N (T/day)	Total-P (T/day)
Kampot Provincial Center	Sea	30,150	2,713	1.50	3.32	0.27	0.08

Source: Ministry of Environment, Department of Pollution Control, 1997

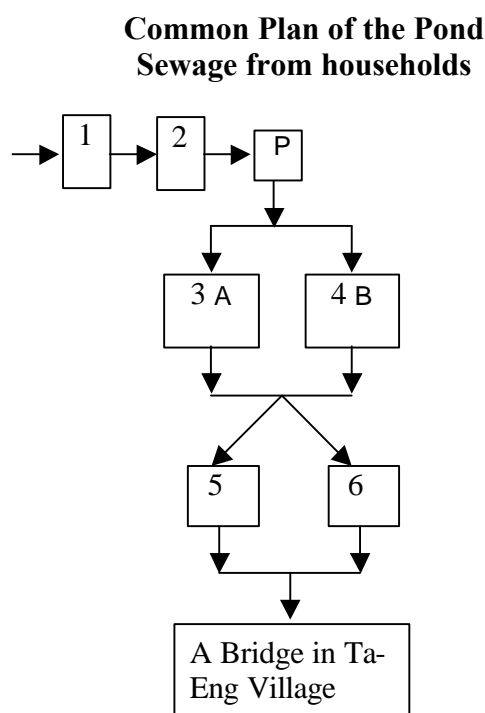
Present Situations in Kampot province

The total area of Kampot provincial center (Kampong Bay district) is 55.6 km² and its present population is 33,126 (Population Census, 1998). Kampong Bay streams into two parts, the west area and the east area divide the town. A part of the liquid waste from the eastern area flows directly into Kampong Bay River, and the other part runs down to Prey Chak (Sewage Station Project) and goes through a bridge in Ta-Eng village and finally meets Kampong Bay River at Kampong Kanda port before discharging to the sea. The drainage system was built several years ago and it is often blocked and the water floods the public road due to lack of financial resources to restore and improve the system.

In order to reduce environmental pollution, including pollution of rivers and coastal area, the Department of Public Works and Transports plan to establish a wastewater treatment plant at Prek Chark on an area of approximately one hectare. The station will be used to collect sewage produced by the population of Kampot provincial center.

The following gives a brief description of the proposed wastewater treatment system:

- **Pond 1:** collect sewage from the provincial center, flowing into the filtering pond (1)
- **Pond 2:** after being filtered in the first pond, the sewage will flow to the second storage pond (2) and goes further.
- **Ponds 3 and 4:** the sewage in the pond 2 is pumped P to the water treatment ponds 3 and 4 through a pipe buried in the ground to two deep holes (A) and (B) which treat the sewage.
- **Ponds 5 and 6:** The treated water in the water-treatment ponds 3 and 4 is discharged to fishing pond 5 and plant pond 6 for further treatment. After being treated in the fishing pond and the plant pond, the water is then discharged to the stream in Ta Eng village before discharging to Kampong Bay River or being used to irrigation of vegetables.



2.3.2 Solid wastes

The management of solid waste in the urban areas is a major environmental problem. Although Cambodia does not have a high rate of waste generation, almost all urban areas have significant waste disposal problems that are increasing. All kinds of waste are disposed of in open areas, roads, rivers, streams, and lakes, borrow pits and private properties. This contributes to unsanitary conditions in urban areas such as unpleasant smells, blockage of drains resulting in flooding, and rainwater run-off from refuse causing surface water pollution.

The estimated amount of solid waste generated, collected, uncollected, and disposed of into waterways in Kampot town is shown in table 3.

Table 2: Solid waste generation in Kampot town

Cities and Provincial center	Population	Estimated solid waste Amount (T/day)	Collected solid waste (T/day)	Uncollected solid waste (T/day)	Disposed solid waste into water system (T/day)
Kampot town	30,150	15.1	9.1	6.0	3.60

Source: Ministry of Environment, Department of Pollution Control, 1997 and provincial authority, 1996

Table 3: Daily production of Solid Waste produced in Kampot Provincial Center

Source of Solid Waste	Amount
Household waste:	18.7 tons
Market:	5 tons
Hospitals:	0.07 tons
Rubbish dumping area:	15 tons
Incinerator:	0.02 tons

The findings of recent field visits and interviews regarding solid waste and rubbish management conducted on August 1, 2000 in Kampot province, are presented in Table 4:

The total waste produced per day in the provincial center is 23.8 tons and with the composition given in Table 3.

Source: Department of Environment in Kampot, 2001

Table 4: Solid waste management arrangements

Implementing arrangements for solid waste management		Remarks
Implemented by contractor:		Contract with provincial hall
<ul style="list-style-type: none"> Contracting condition Authorities will review the work 		<ul style="list-style-type: none"> Once every year Chairman of the committee of provincial sanitation
Storage	Kind	Amount and Location
<ul style="list-style-type: none"> Public rubbish bin Household rubbish bin Plastic carrier 	<ul style="list-style-type: none"> No Basket or plastic carrier Plastic carriers bought from market 	There are two landfills: <ol style="list-style-type: none"> Direct dumping on land belonging to the contractor. It is 500 m from the Samaki market. Dumping in the former Kor Kes airport, which is 5 km away. Some households dispose of rubbish in ponds, ditches, streams or other open land.

Source: Department of Environment in Kampot, 2001

Table 5: Solid Waste Service

Regular collection	Scheduling	Actual practice
Provincial center	2 times a day	2 times a day (10 tons)
Market	Every day	Every day (5 tons)
Residence	9 times per day	1 time per day
Commercial areas	1 time per day	1 time per day
Industrial areas	1 time per day	1 time per day
Hospital	burned at incinerator (built in 1985)	
Schools, floating houses	No	
Other locations such as schools, floating houses etc.	No	
Collection facilities	Kind, Capacity, engine	Information
Truck	Truck Capacity: 5 tons	1
Pulling cart		2
Solid Waste and garbage burying area	Information	
No. of places for burying solid waste	One area in the north of Samarky market (500m away)	
No. of landfills	One area at the former Kor Kes airport, about 5 km from Kampot provincial center.	
Size of area (m ²)	Not clear, Boeng Tuok Commune	
Area reserved for expansion	No	
Solid Waste and garbage burying area	Information	

Solid waste completed	100% (landfill on the north of the market)
Volume of Solid waste (m ³)	Not clear
Incinerator for solid waste and dangerous waste (hospital).	No (There is only one incinerator in the hospital and waste from private clinics is disposed at the slope of Kor Kes).

Source: Department of Environment in Kampot, 2001

Table 6: Evaluation of the Solid Waste Present Situation

Main areas of solid waste management	Situation
▪ Roads	▪ Most areas along the roads are clean because contractor collects garbage regularly. However, there is some problems with drainage system in some areas, which results in flooding during the rainy season.
▪ Market	▪ It is not clean because garbage around the market is left uncollected. Some liquid waste is trapped in the pipes as a result of blocking. At present, the Social Fund is in the process of constructing pipes to drain rainwater from the market area.
▪ Drainage pipes	▪ Drainage pipes are dirty because of improper disposal of rubbish and illegal construction on the pipes.

Source: Department of Environment in Kampot, 2001

Table 7: Solid Waste Collection Areas and Frequency, Kampot Provincial Center

Collection Area	Collection Frequency
City center	Regularly
Market	Regularly but can not collect all waste around the market because some people living nearby also dispose of waste at the market compound.
Residence	Late, one collection every 3 days.
Commercial area	Late, one collection every 3 days.
Industrial area	Late, one collection every 3 days.
Hospital	A part of waste is collected to be incinerated but other waste is collected by the company once every two days. The service charge is 30,000 Riels.

Source: Department of Environment in Kampot, 2001

Table 8: Facility for waste collection

Usable facility	Truck and pulling carts, capacity: 4 tons and one ton is collected every day
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Source: Department of Environment in Kampot, 2001

Table 9: Dumping areas

<ul style="list-style-type: none"> • Roads leading to the dumping area • Suitability of the area • Care • Dangerous waste (solid waste and hospitals) • The compost manufacturing from solid waste 	<ul style="list-style-type: none"> • The road, which also leads to the waterfall tourist resort, located 5 km from the town center. • During the dry season, it is burned and buried near the market. Burning of waste also occurs in the dump at the airport. After burning leachates goes to Kampot river • No care • It is burned inside the hospital. At private clinics, the contractor takes waste to be disposed of at Ko Kes hill (waterfall) • It is not done in conformity to the technical method. Some waste is taken by peasants to their plantations to let them decay naturally.
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Source: Department of Environment in Kampot, 2001

Table 10: Waste collection charges

Other sectors	Information
Service charge <ul style="list-style-type: none"> • Residence • Hotels, restaurants, night clubs • Handicrafts • All stores in the market for existing maintenance and restoration 	<ul style="list-style-type: none"> • 100 to 200 Riels/month, depending on the size of houses • 10,000 to 15,000 Riels/month. Borei Bokor hotel is charged 10\$ per month • 4,000 Riels/month • 700,000 Riels per month. The money is used to maintain existing drainage system and to improve gardens, drainage system.

Source: Department of Environment in Kampot, 2001

Table 11: Solid Waste from households in Kampot Provincial Center.

Composition of solid waste	Composition (%)	Kg/day	Density/1m ³
Organic and vegetable solid waste	91	9,160	311 kg
Paper	1		
Plastic	4		
Cloths	0.2		
Broken glass	0.7		
Wood	0.4		
Shells of snail etc	0.3		
Metals and electricity appliances	2.4		

Source: Department of Environment in Kampot, 2001

Table 12: Compositions of solid waste from Samarki market, Kampong Bay District

Composition of solid waste	Composition (%)	Density/1m ³
Organic and vegetable solid waste	90	268
Paper	2.6	
Plastic	6.5	
Cans	0.2	
Broken glass	0.2	
Cloths	0.5	

Source: Department of Environment, Kampong Bay District

Table 13: Solid Waste from Hospital, Kampot Provincial Center

Types of waste	Kg/day	Others
Wet paper	2	
Dry paper	1	
Dry bandage	1	
Wet bandage	2	
Plastic tubes and infusion tubes	5	Sold to recycling collector
Needles, syringe	0.001	
Dry cotton	0.002	

Types of waste	Kg/day	Others
Wet cotton	0.002	
Dry plastic bags	5	
Blood, mucus	0.5	
Rubbish	50	
Total	67	

Source: Department of Environment in Kampot, 2001

2.3.3 Soil erosion

The major cause of soil erosion is deforestation and poor agricultural practices. Soil erosion in the mountain ranges also causes some estuaries to become shallower from year to year. However, according to information no sedimentation surveys in the rivers have yet been conducted.

Present Situation

The Kampong Bay River is becoming very shallow because of siltation, caused by deforestation in the higher areas of Bokor and Kam Chay mountains and the construction of Keo river (blocking of rivers, when building a road from Andong Khmer commune to Treuy Koh pagoda) during the Pol Pot period. This caused sediment to settle thereby lowering the depth and resulting in flooding, erosion of riverbanks, and change in water current. This is the reason that the Kampong Bay River receiving water from upland areas causes flooding in Kampot town every year.

In 1999, there was a landslide of 75-meter riverbank at the area opposite the residence of the Provincial Governor. The Department of Public Works and Transport has prepared a 5-year plan for implementation, from 2001 to 2005, to dredge and restore the river.

2.3.4 Agricultural Waste

Agricultural waste includes residues of pesticides and fertilizers used for cultivation activities, and waste generated from aquaculture activities in the coastal area.

The total cultivated area in Cambodia is about 1.9 million hectares (World Bank 1994). In order to increase production yields, farmers has been encouraged to use chemical fertilizers and pesticides. The upward trend of indiscriminate use of these chemical compounds is of increasing concern as residues of these substances are carried by surface run-off from cultivated areas to water bodies, thus causing water pollution.

To date, not much information on the use of pesticides and fertilizers, such as type and amount, is available. In addition there are no regulations on the use of pesticides and fertilizers.

Present Situation

Table 14: Pesticides provided through Department of Agriculture, Kampot (1983-1995)

Pesticide	Litres
Toxaphene	795 L
Azodrine	4,508 L
Malathion	630 L
D.D.T	60 L
Phosphordezine	2,348 L
Molipax	3,000 L
Chlozophos	4,578 L
Motophos	4,578 L
Vitagrus	25 Kg
D.D.V.P	1,320 L
Trichlophone	1,400 L
Filitox	680 L
Diazinou	1,300 L
Sumicidine	500 L
Sumition	30 L

Pesticides

From 1983 to 1995, the Ministry of Agriculture provided the amounts tabulated in Table 14 of pesticides and chemical fertilizers to the Provincial Agricultural Department to be sold to farmers.

Apart from these amounts approx. 1,000 L of Folido has been imported in the province by the private market to meet the demands of people who grow durians and vegetables in the area around the waterfall areas and Kaun Sat area in Kampot district.

Source: Department of Agriculture, forestry and Fisheries in Kampot, 2001

Chemical fertilizers

Table 15: Fertilizers provided through Department of Agriculture, Kampot (1983-1995)

Fertilizer	Amount
- 15.15.15	97 tons
- 16.20.0	4,081 tons
- UREO	10,602 tons
- 18.46.0	3,541 tons
- Amophos	4,919 tons
- D.A.P	298 tons
- Phosphate	384 tons
Total:	23,924 tons

Source: Department of Agriculture, in Kampot, 2001

From 1983 to 1995, the Ministry of Agriculture provided the amounts tabulated in Table 15 of the chemical fertilizers to the provincial Department of Agriculture. In average, about 1,495 tons of fertilizers are used every year. In addition, the private market imports about 1,500 t of 18.46.0 and 16.20.0 every year from Vietnam.

Table 16: Districts using fertilizers in rice culture

The areas where chemical fertilizer and pesticides are normally used in greater quantities is, generally, for farming land where short-term and dry seasonal rice is grown and for intensive cultivation.

Name of Districts	Short-term rice (ha)	Dry seasonal rice (ha)
Kampong Bay	5	
Kampong Trach	5,000	150
Banteay Meas	7,000	1,200
Angkor Chey	4,000	150
Chouk	3,000	200
Chum Kiri	2,495	103
Dorng Tung	3,000	
Kampot	3,000	250
Total	27,500	350

The fertilizers and pesticides used in the areas are listed in table 15.

Source: Department of Agriculture in Kampot, 2001

It is estimated that the average need of chemical fertilizers and composts every year is about 3,000 tons and 270,928 tons, respectively for rice yield improvement from 66,869 hectares to 138,146 hectares of farming land. The areas where these chemical fertilizers and composts are used are indicated on the map but it is not known if some districts use more than other areas.

Table 17: Area under cultivation by year, Kampot Province

Year	Area (hectare)
1970	40,061
1980	82,788
1981	81,070
1982	92,778
1983	96,461
1984	95,899
1985	95,531
1986	81,411
1987	85,635
1988	106,530
1989	82,450
1990	78,842
1991	113,120
1992	115,331
1993	102,297
1994	123,742
1995	129,658
1996	136,071
1997	136,500
1998	130,533
1999	135,891
2000	138,149

For seasonal rice, only little chemical fertilizer is normally used, just to add to land nutrients. The average use is 50 Kg of fertiliser (18.46.0) per hectare.

Source: Department of Agriculture in Kampot, 2001

2.3.5 Oil waste

In Kampot province, oil waste in water bodies mainly derives from navigation activities, boat washing and repairing, and daily operations related to fuel use. Another major source of oil pollution is the disposal of vehicle oil.

The major sources of oil pollution in the coastal area mainly are:

- Accidental spills and leaks from the petroleum storage facilities located along the coastal area;
- Spills, leaks and improper waste management from fuel, diesel fillings, ship decks, boats etc. When washing, oil is discharged from households, boat machine, motorbike, car repairing shops which are located in the coastal areas and moreover, the shop owners do not pay attention to oil waste.
- Spills and leaks from vessels transporting petroleum products en route to Thailand or Japan.

Present Situation

In Kampot this pollution is relatively small. In addition, the used engine-oil is also re-used by the people. However, used lubricants, which are disposed of from the fishing boats are observed in the villages of Lorb, Tropiang Sangke, Spean Khieu, Treuv Koh, Ka-dart, Prek Thnot and TroPiang La'pov. No measures have been taken to control these problems.

2.4 Ports and harbors

In the coastal area in Kampot province, there are minor harbors which are used for transit or shipping goods from other coastal provinces/municipalities and for the docking of fishing boats.

2.4.1 Location of harbors in Kampot province

Table 18: Locations of Harbors

Locations	Type of harbor	Number of boats
Tropiang Ampoeu	Fishing harbor	400
Prek Tanout	Fishing harbor	60
Prek Ampil	Fishing harbor	100
Kep Thmey	Fishing harbor	50
Ta-ang	Fishing harbor	171
Sovann Sakor	Goods harbor	5
Tropiang Sanke	Fishing harbor	90

There is one harbor, Kampong Kandal, in the province. This 10-year-old port is not being used and needs to be repaired. The Department of Public Works and Transport has prepared a plan to construct a new concrete 700-

Source: Department of Public Works and Transport in Kampot, 2001

metre square port at the same location. Kampot also has harbors for fishing boats in certain fishing villages (see the map). Table 18 indicates the locations of harbors in the coastal zone of Kampot province.

4.4.2 Environmental issues related to harbor operations

No information regarding waste discharge into the harbors is available and there is no equipment for combating pollution situations.

2.5 Seabed exploration and exploitation

No seabed exploration and exploitation activities are conducted in Kampot province.

2.6 Marine dumping and dredging activities

Dumping and dredging activities influence the marine living resources by directly burial or by reducing transparency. There are no dumping and dredging activities in Kampot sea area. No procedures exist for permitting dumping and/or disposal of waste in the sea.

3. Freshwater shortage and degradation of its quality

3.1 Sources of surface water

In Cambodia there are two major sources of surface water. The first one is rainfall, which is considered as a local source. The second one comes from the Mekong River which enters Cambodia from the Lao People's Democratic Republic and which is important for the central region of the country.

The average annual rainfall varies across the country from between 1,000 to 2,500mm. The heaviest rainfall, over 3,000mm a year, occurs along the coastal lowland in the west.

The estimated total volume of rainfall in Cambodia is about of 426 billion m³ per year, of which only 212.5-billion m³ (49.9 per cent) flows into water bodies. The remainder is subject to evaporation and evapo-transpiration, recharging groundwater. It is used for other supplies, but data on the amount are not well estimated (Irrigation Rehabilitation Study in Cambodia, June 1994).

The surface water shortage for water supply has also occurred in some urban centres of the coastal provinces in the dry season. The reason for the shortage is the lack of basins or reservoirs for surface water storage and sedimentation in existing lakes or reservoirs because of soil erosion.

3.2 Demand for its use (by sector)

The surface water is used by different sectors as follows:

(a) Agricultural sector: The demand for surface water use in this sector is the highest compared with other supplies. Rice farming is the largest water user, while other crops are the second largest water demanders in this sector. Apart from rice and crop irrigation, water is also used for aquaculture farming;

(b) Domestic sector: At present, the domestic need for water is on a small scale. However, it will grow rapidly as the development rate increases, especially in the urban areas;

(c) Industrial sector: In Cambodia, the industrial development is still weak, therefore this sector has a smaller consumption than the domestic sector.

There is no information on water supplies and consumptions by different sectors.

4. Groundwater

Groundwater may be an important resource for the economic development of the country. But its utilization is still limited to rural and urban domestic supplies, for small industries and minor irrigation, mostly in the dry season.

As far as the groundwater aquifers are concerned, there is insufficient information on this natural resource because there has not been a comprehensive investigation.

Some studies of groundwater aquifers were conducted, as follows:

In 1958, the United States geological survey group carried out the first study of Cambodian groundwater in the coastal area in Kampot province. Based on first study result, USAID developed a drilling programme from 1960 to 1963. Its purpose was to describe and evaluate the availability of groundwater. The programme uses information from a total of over 1,000 drilled and hydro-jetted holes, covering the whole country.

In 1994, a study was conducted in Kampot coastal provinces. The study result showed that drawdown tests indicated a pumping rate for individual production wells of not more than 20m³/hr to avoid over-pumping of the wells. Although not all wells have been sampled and analysed, salinity concentrations too high for drinking purposes were measured in 5 out of the 1,000 wells in Kampot.

In the period from 1983 to 1996, 674 wells have been drilled by UNICEF and non-governmental organizations in Kampot Province.

Present Situations

Based on the geographical features of Kampot province, the majority of groundwater sources come from Mekong River aquifers and mountainous watersheds, especially Angchey and Banteay Meas districts. There are 3 ways that groundwater is used:

1. Pump well
2. Cement ring wells and
3. Dug ponds

The construction of the wells and ponds has been assisted by international organizations such as UNICEF, FAO, FOOD FOR HUNGER, and WORLD FOOD PROGRAM. According to a study, from 1985 to 2000, the total number of wells in the province is 764. Their numbers by district is listed in Table 19.

Table 19: No of Wells by District in Kampot

District	No. of Wells
Kampot:	24
Kampong Trach	76
Banteay Meas	110
Angkor Chey	196
Chouk	84
Dorng Toung	34
Chum Kiri	33

Source: Department of Rural Development in Kampot, 2001

Angkor Chey districts contain limestone and Dorng Toung has black rocks of a similar structure as coal.

It is estimated that only 50% of all wells have been used. Some are inactive due to breaks of pumps and/or increased salinity. However, the main groundwater resources in Kampot are in the districts of Banteay Meas, Chum Kiri, Angkor Chey, Chhuk. The water is of good quality and usable. Water sources in other districts such as Kampot, Kampong Trach, and Kampong Bay are not of a good quality due to their proximity to the sea and high content of iron. Some areas of Chum Kiri, Chhuk and

4.1 Shortage of groundwater

The groundwater sources found in the communes of Prek Thnaot, Kampong Treng, and Chum Kriel cannot be used because of the high content of salt. The people living in these areas face a shortage of fresh water. In Trapang Pleng and Taken communes, no wells have been drilled and there is no data on shortage of water for consumption.

4.2 Identification of main groundwater resources found in Kampot

Table 20: Groundwater resources in Kampot and their classification by importance

Location	Classification
Kampot	First
Banteay Meas	Second
Dorng Tung, Kampong Trach, Chum Kiri	Third
Angkor Chey, Chhuk	Fourth

Source: Department of Rural Development in Kampot, 2001

4.3 Important data regarding groundwater

Two types of groundwater sources are found in Kampot province:

Type 1: Originating from mountainous areas and big reservoirs:

- Chum Kiri district
- Chhuok district
- Dorng Tung district
- Part of Kampot district
- Part of Kampong Bay district
- Upper part of Kampong Trach district
- Upper part of Banteay Meas district
- Upper part of Angkor Chey

Type 2: Originating from the plain (Bassac river)

- Part of low ground in Ang Chey district
- Part of low ground in Banteay Meas district

Level of rainfall

Table 21: Annual Rainfall Data

Year	Rainfall high (mm)
1983	1,433.6
1984	1,811.5
1985	1,917.6
1986	2,385.8
1987	1,563.5
1988	1,639.5
1989	1,407.5
1990	1,656.5
1991	1,946.0
1992	1,736.0
1993	1,762.6
1994	2,035.5
1995	1,682.2
1996	1,771.5
1997	2,471.2
1998	1,530.7
1999	2,603.7
2000	2,392.9

The rainy season starts from April to late November and the dry season from late November through April. The heavy rain in late July to early August causes flooding. During the dry season, there is also some rain, ensuring good growth of vegetables.

Rainfall level by year is shown in the table below:

It is noticed that from 1,200 mm of rainfall is good for rice growing.

Major water reservoirs

In Kampot, the plateau, which is like the steps of a stair, is a mountainous areas and the plain land is bordered by coast and Takeo province. The northern part of

Source: Department of Rural Development in Kampot, 2001

national route 3 is the high ground area and the southern part of the national route 3, the western and eastern parts of the province are the plain areas. The locations of major water reservoirs (indicated on the map) are as follows:

- Steung Phe, located in Phnom Thom mountain in Chum Kiri district
- Mal'ech, located in Damrey Romeal mountain in Chum Kiri district
- Ang Phum Oh, located in Phnom Thom mountain in Chum Kiri district
- Koh Sla, located in Phnom Thom mountain in Chhuk district
- Beung Nimul, located in Phnom Thom mountain in Chhuk district
- Steung Keo, located in Kos Sla dam in Kampot district
- Kaun Sat, located in Kaun Sat mountain in Kampot district
- Trapeng Kdar, located in Vor mountain in Dornng Tung district
- Koki Dek, located in Vor mountain in Dornng Tung district
- Phnum Damrey, water from Vor mountain in Kampong Trach district
- Trapeng Beung, water from Vor mountain in Kampong Trach district
- Veal Stockchouk, water from Vor mountain in Banteay Meas district
- Srer Khann, water from Vor mountain in Banteay Meas district
- Ta-Nget, water from Moraum mountain in Banteay Meas district
- Veal Tbal, water from Nireay mountain in Angkor Chey district
- Lum Pou, located in Kampong Trach district
- Anlung Veal, located in Angkor Chey district
- Sar Dambong, located in Ankor Chey district

5. Public Health

The discharges of untreated human and animal waste are the main source of the spread of waterborne diseases in Cambodia, such as typhoid and cholera. A report of the World Health Organization (WHO) in 1996 showed that nearly two thirds of deaths among children under the age of five are associated with waterborne diseases.

Present Situations

The total population of Kampot is 541,085. There are 8 administrative districts and 92 communes. In accordance with the Government's policy, aiming at an improvement of health care for the people, reform of health services started throughout the country in 1995.

Based on the reform, the Health Department of Kampot, with approval from the local authorities, has divided the province into 4 Operational Health Districts, where one reference hospital is operated in each operational health district and 47 health centers.

Each Reference Hospital is responsible for providing health services for 60,000 to 200,000 people while each health center provides service for 8,000 to 12,000 people. The health centers provide only simple health packages and transfer patients in serious condition to the reference hospitals.

The 4 Operational Districts are:

- Kampot Operational District covers 10 health centers, 9 of them have been built
- Chhuk Operational District covers 15 health centers, 9 have been built
- Ang Meanchey Operational District covers 10 health centers, 9 have been built
- Kampong Trach Operational District covers 12 health centers, 11 health centers are under control of the Operational District

Main achievements reached in 2000, ratio of skilled staff and number of people

Table 22: Health Worker Data in Kampot Province, 2000

Location	People	Doctor & Medical Assistant		Secondary Midwife		Secondary Nurses	
		Total	Ratio	Total	Ratio	Total	Ratio
Kampot OD	125,855	48	2.622	27	4.661	89	1.414
Kampong Trach OD	146,745	18	8.153	13	11.288	28	5.241
Angkor Chey OD	106,074	6	17.676	9	11.786	15	7.072
Chouk OD	162,411	9	18.045	6	27.069	30	5.414
Total in the Province	541,085	102	5.305	75	7.215	179	2.863

Source: Department of Public Health in Kampot, 2001

Table 23: Child health care, Kampot

Activity	Outreach
The immunization of children under-5-year.	
- BCG	89%
- DTC	70%
- Rovax	71%
Birth-spacing plan	20%
Consultation and Ante-natal check-up (more than two times)	30%
Birth delivery by health staff	22%
Total number of out-patients	93,501 cases
Total number of in-patients	7,811 cases
New out-patients (one person per year)	0.21%

Throughout Kampot Province, the most common diseases found with out-patients (consultation section) are respiratory inflammation, diarrhea, high blood pressure, malaria, skin infections, discharge, cuts, injuries or wounds.

Source: Department of Public Health in Kampot, 2001

Table 24: Waterborne diseases, Kampot year 2000

Type of diseases	Out-patients	Hospitalization
Diarrhea	6,227	266
Dysentery	4,243	28
Typhoid	0	215
Cholera	0	10

Types and occurrence of waterborne diseases in Kampot in year 2000 are listed in Table 24. It has not been possible to identify areas with a higher incidence of waterborne diseases.

Source: Department of Public Health in Kampot, 2001

Table 24. It has not been possible to identify areas with a higher incidence of

waterborne diseases. (*Source:* Department of Health in Kampot, 2001)

6. Aquatic resource

Living aquatic resources can be defined as resources living in water for all their life cycle, or spending their life frequently in water. The exploitation of living freshwater resources in Cambodia has been more intensive in recent years as a result of human pressure through various improper practices.

Cambodian freshwater wetlands have been renowned as one of the world's most productive ecosystems because of the great abundance of flooded forest, aquatic plants and weeds that constitute the habitats for a wide variety of wildlife species, mainly fishes, shellfish, invertebrates, small mammals, reptiles, water birds and others.

Management and conservation status

National measures or initiatives taken for the protection, management and conservation of flooded forest and valuable wetland resources are:

- Designation of some important wetlands, such as Tonle Sap, Dong Peng and Samlot, as multiple-use areas among the 23 protected areas of Cambodia (by Royal Decree of 1 November 1993).
- Law on Environment Protection (December 1996);
- National Wetland Action Plan;
- Accession to the Convention on Wetlands of International Importance (Ramsar Convention), and Biodiversity Convention.

Present Situation

There is one national park in Kampot province. The “Preah Monivong” National Park covers an area of 140,000 ha. The northern part of the park is located in Kampong Speu province and the western part in Sihanouk Ville. The national park of Preah Monivong has spectacular features such as waterfalls, rare and valuable plant species, and wildlife species such as elephants, tigers, and wild boar.

To date, the National Park faces impacts or unsustainable uses such as forest clearing for fields on slopes of Toek Chu waterfall, logging on the northern and western parts of the park. These illegal activities, though declining have not been completely stopped.

The most recent studies on freshwater capture fishery in Cambodia (Danida funded project, completed in 1997) found some 215 species of fish in Cambodian freshwater bodies. This figure was also suggested by Kottelat in 1986. Many species are still unknown and need to be identified.

Freshwater fishery production for internal market demands is larger than that for external market demands. It has been estimated that about 90% of freshwater fish caught in Cambodia is for internal consumption. Some commercial fish in a small quantity (about 10%) have been exported to neighbouring countries, mainly Thailand and Vietnam. These are freshwater lobsters, elephant fish, striped catfish and others. Most of them are transported in the form of frozen or iced fish. No study or record provides the precise level of internal and external market demands at the current time.

Table 25: Projected demand for fish in Kampot, 1998-2005

Province	Population, 1998	Demand at current consumption rate (10.6kg/capita/year)	Demand at minimum nutritional requirement (21.5kg/capita/year)
Kampot	528,500	5,600 tons	13,545 tons

Source: Ministry of Environment

7. Coastal fishery

Table 26: Total annual fish catch (tons), 1996-2000

Year	Catch (tons)	Aquaculture (tons)
1990	8,017	
1991	8,050	
1992	8,000	
1993	7,837	
1994	7,535	13
1995	6,847	83
1996	6,940	43
1997	7,543	50
1998	6,750	80
1999	7,500	130
2000	6,600	

Source: Report of total fishery, 2000

The total quantity of fish catches per year is around 33,000 tons in the coastal area. In Kampot province the average annual fish catch is between 7,000-8,000 tons. The statistics for fishing boats show a shift from smaller to bigger boats. As there are no systematic studies or scientific research on marine fish and other marine aquatic organisms, information and data on their productivity and ecology is very poor. There are no clear indications of the actual fish stock for the marine area.

Table 27: Number of coastal fishing boats, 1996-2000

Year	Boats < 5 t	Boats >5 t	Motorboat 11-30 HP	Vessels >30 HP
1996	100		30	25
1997	100		30	25
1998	100		120	25
1999	100		120	25
2000	100		120	25

Source: Fishery Office in Kampot, 2000

Present Situation in Kampot province

At present, there are 416 motor fishing boats. This number is much higher than in 1970 when there were only 27 motor fishing boats and 100 rowing boats on the sea. The common catches include fishes, shrimps, octopus.

Family-scale freshwater fishery are carried out in Ang Ma'lech pond in Chum Kiri district, Sala Damboung pond in Angkor Chey district, Sre Kan pond in Banteay Meas, and Koun Sat reservoir in Kampot.

The breeding grounds of fish in Kampot water are found in the following locations and islands as follows:

- Karaing island: crabs and fish
- Tro Ngaul island: fishes and shrimps.
- Thmey island: shrimps, fishes and young crabs.
- Ampil river: sea tortoises, dugongs, and snails
- Chung Khaus, Thnaot river: shrimps, crabs, and fishes.
- Trapang Ropov river: shrimps, crabs, snails, shells, fish
- Rosita island: shrimps, crabs, snails, shells, fish

8. Marine and coastal habitats

8.1 Coral Reefs

Coral reefs are vital marine and coastal habitats, but not much information exists regarding these ecosystems.

The sites of coral reefs are not completely identified. But based on some short surveys, coral reefs have been observed to occur in many localities in Cambodian coastal waters, generally around the inshore islands and in some rocky areas. The species composition has been preliminarily identified and is presented in table 28.

Table 28: Hard coral reef species identified in the coastal zone of Cambodia

N°	Species name	N°	Species name
1	<i>Posillopora eydouxi</i>	35	<i>Goniopora pendulus</i>
2	<i>P. verrucosa</i>	36	<i>G. sp.</i>
3	<i>P. sp.</i>	37	<i>G. sp.(burgosi)</i>
4	<i>Seriatoposa hystrix</i>	38	<i>Fungia scutaria</i>
5	<i>Montipora effusa</i>	39	<i>F. sp.(valida)</i>
6	<i>M. danae</i>	40	<i>F. sp. (Sessile)</i>
7	<i>M. digitata</i>	41	<i>Favia pallida</i>
8	<i>M. stellata</i>	42	<i>Fa. danae</i>
9	<i>M. sp.</i>	43	<i>Fa. maritima</i>
10	<i>M. stellata</i>	44	<i>Favites sp.(abdita)</i>
11	<i>Anacropora forbesi</i>	45	<i>Favites sp.</i>
12	<i>A. puertogalerae</i>	46	<i>Echinopora sp.(pacificus)</i>
13	<i>Acropora cerealis</i>	47	<i>Goniastrea pectinata</i>
14	<i>A. elseyi</i>	48	<i>Platygyra daedalea</i>
15	<i>A. humilis</i>	49	<i>Pl. sp.</i>
16	<i>A. sp.(verweyi)</i>	50	<i>Pl. sinensis</i>
17	<i>A. samoensis</i>	51	<i>Pl. ryukyuensis</i>
18	<i>A. sp.(yongei)</i>	52	<i>Leptoria irregularis</i>
19	<i>A. millepora</i>	53	<i>Symphyllia recta</i>
20	<i>A. sp.(bushyensis)</i>	54	<i>Symphyllia radians</i>
21	<i>A. danai</i>	55	<i>Sym. sp.</i>
22	<i>A. digitifera</i>	56	<i>Turbinaria reniformis</i>
23	<i>A. echinate</i>	57	<i>Turb. frondens</i>
24	<i>A. Formosa</i>	58	<i>Turb. mesenterina</i>
25	<i>A. grandis</i>	59	<i>Turb. bifrons</i>
26	<i>A. horrida</i>	60	<i>Turb. peltate</i>
27	<i>A. nobilis</i>	61	<i>Turb. sp.</i>
28	<i>A. palifera</i>	62	<i>Pavona decussata</i>
29	<i>Alveopora specie</i>	63	<i>Pav. sp.(minuta)</i>
30	<i>Coeloseris mayeri</i>	64	<i>Pav. sp.</i>
31	<i>Acropora specie</i>	65	<i>Psammocora digitata</i>
32	<i>Porites nigrescens</i>	66	<i>Psa. sp.</i>
33	<i>Porites stephensoni</i>	67	<i>Catalaphyllia sp.(jardinei)</i>
34	<i>Porites sp.(solida)</i>		

Source: Coastal Zone Management, Ministry of Environment, 1997 and Coastal Zone Management Phase 2, Ministry of Environment, March to June 2001

Table 29: Soft coral reef species identified in the coastal zone of Cambodia

N°	Species name	N°	Species name
1	Soft coral (<i>Lobophyton sp.</i>)	10	Soft coral (<i>Dendronephthya sp.</i>)
2	Soft coral (<i>Sarcophyton sp.</i>)	11	Soft coral (<i>Euplexaura sp.</i>)
3	Soft coral (<i>Simularia sp.</i>)	12	Sea fan (<i>Paracis sp.</i>)
4	Gorgonian fan (<i>Subergorgia molis</i>)	13	Sea fan (<i>Plexauridae</i>)
5	Sea fan (<i>Solenocaulon sp.</i>)	14	Yellow whip coral (<i>Ellisalla sp.</i>)
6	Red whip coral (<i>Ctenocella pectinata</i>)	15	Sponge sp. (<i>Xestospongia testudinaria</i>)
7	Red whip coral (<i>Ellisella sp.</i>)	16	Sponge sp. (<i>Haliclona sp.</i>)
8	Gorgonian fan (<i>Melithaeidae</i>)	17	Soft coral (<i>Alertigorgia sp.</i>)
9	Gorgonian fan (<i>Plumigorgia schuboti</i>)		

Source: Coastal Zone Management, Ministry of Environment, 1997 and Coastal Zone Management Phase 2, Ministry of Environment, 2001

Present situation

Coral reefs are found several places in Kampot province:

- Tro Ngaul island: variety of coral reef species
- Ampil river: different species of coral reefs
- Karaing island: three species of coral reefs

The recent survey carried out by the coral reef working team of Kampot, together with foreign experts of CZM and local consultants indicated that twenty species of coral reefs are found in Kampot water.

For the areas studied a number of coral reef species were identified, and locations are shown in the map.

Based on the findings, the areas where coral reefs occasionally are damaged by dynamite and alga culture was identified as Karaing Island, and Ampil River.

8.2 Mangrove

Mangroves are important habitats in the inter-tidal areas along the Cambodian coastline. They can be found in the estuaries, along the muddy seashore and on the swamps and river systems and some coastal areas.

Table 30: Mangroves in Kampot 1973-1993

Period	Area in coastal provinces (ha)
1973 –1976	3,800
1992 – 1993	7,900
Trend over 20 years	(+) 4,100

Source: Cambodia Land Cover Atlas, 1994, prepared by the Mekong Secretariat.

Based on information from the seventies and early nineties some indications of changes in the mangrove distribution can be deduced. According to table 30, it can be seen that an increase of 4,100 hectares has taken place in Kampot province.

Present situation

Based on a detailed study in 2001 covering some districts in Kampot province the following mangrove areas were mapped covering 1,514 ha:

Kampot district

- Koh Toch commune: 500 hectares in 4 villages:
 - Prek Ampil village: 150 hectares

- Koh Toch village: 200 hectares
- Prek Chek village: 100 hectares
- Kilometer No.12 village: 50 hectares
- Beung Touk commune: 300 hectares in 4 villages:
 - O Roluos village: 72 hectares
 - Koh Rokar village: 95 hectares
 - Beung Tuok village: 55 hectares
 - Totoeng Thngai village: 75 hectares
- Chum Kreal commune: 100 hectares in 3 villages:
 - Kampong Treak village: 34 hectares
 - Chum Kreal village: 36 hectares
 - Kampong Kandal village: 30 hectares
- Koun Satt commune: 21 hectares in 1 village:
 - Kampong Nung village: 21 hectares
- Trapeng Sangke commune: 71.93 hectares in 2 villages:
 - Trapeng Sangke village: 60 hectares
 - Prapeng Thom village: 11.93 hectares
- Kampong Samrong commune: 5 hectares in 1 village:
 - Kampong Samrong village: 5 hectare
- Prek Thnaott commune: 275 hectares in 3 villages:
 - Changhoun village: 15 hectares
 - Prek Thnoat village: 25 hectares
 - Prek Kreng village: 235 hectares

Total area of mangroves in the district was 1,273 ha.

2. Kampong Bay district

- Treuy Koh commune: 105 hectares in one village
- Beung Tapream: 105 hectares

3. Kampong Trach district

- Rusei Srok Khang Ta-bong commune
 - Thakov village: 38.28 hectares
 - Lork village: 92.25 hectares
 - Koh Sna village: 5.85 hectares

The reasons why mangroves have declined in some areas are due to land use for salt farming, shrimp farming, and char coal production by the people to provide an income.

The loss and declines of mangrove areas causes a decrease of marine resources such as coral reefs, crabs, birds, reptiles, and extinction of some species.

Measures

- Disseminate and enforce Kret Chbab (Regulations), No. 33 Kr.ch. 1987 on fishery management. The work was done in cooperation with Apheda, an organization, teaching people from 26 villages, located along the coast about the importance of mangroves.
- 5 hectares of mangrove were planted in Koh Snao, in Kampong Bay district. It is to show the people that whenever there are mangroves, there are an increase of biodiversity.

- Strict measures have been taken to arrest mangrove-cutting offenders. There is reported the following cases:
 - 10 cases, offenders were arrested and given advice at the provincial fishery office.
 - 2 cases, stopped offending activities
 - 7 cases, offenders were sent to court
 - 7 offenders were sent to Fishery Office for fine

In 2001, Danida in cooperation with the provincial Department of Environment and line departments have built provincial government officials' capacity by conducting surveys on coastal resources, identifying the problems and planning pilot projects on replanting mangroves on an area of 20 hectares. In addition, officials were sent to attend a course on multi-agriculture and mangroves in Vietnam so that knowledge and experiences could be shared and exchanged and would be applied in other areas of the province.

Aquaculture

The main types of aquaculture in Kampot are shrimp farming, clam raising and freshwater fish raising. Shrimp farming is divided into two types: extensive and intensive. Intensive farming is found in the villages, communes and districts. Apart from this, there is one shrimp hatchery, run by a private company.

1. Raising activities along the coastal area

- Intensive farming areas:
 - 250 hectares in Prek Kreng village, Prek Thnaot commune, Kampot district. The farm is active.
 - 4 hectares in Prapeng Sanke village, Prapeng Sanke commune, Kampot district. The activity has been suspended.
- Extensive farming areas:
 - 30 hectares in Koh Touch village, Koh Touch commune, Kampot district. The farming is active.
 - 19 hectares in Prapang Sanke village, Trapeng Sangke commune, Kampot district. The farming is active.
 - 61 hectares in Koh Chamkar village, Boeng Sala Khang Ta'boung commune, Kampong Trach district. The farming is active.
- 20 hectares are used for clam raising. They are located in Lork village, Rusei Srok Khang Ta'boung commune, Kampong Trach district.

2. Seaweed aquaculture

In early year 2001, seaweed aquaculture was practiced in an area of 69 ha:

- 2 hectares in Koh Ses island
- 55 hectares in Koh Touch island
- 8 hectares in Prek Thnoat river
- 4 hectares in Koh Tro'ngoul island

In late 2000, heavy rainfalls spoiled the seaweed harvest but early 2001, 552 tons of seaweeds were harvested.

Fish raising in freshwater pond

Apheda assist in fish raising activities in freshwater ponds by providing know-how, techniques, and fish stocks. The following yields were collected:

- **In 1997**
 - Banteay Meas district: 46,660 fingerlings fish were provided to the farmers for raising. Yield 8,224 kg.
 - Angkor Chey district: 13,334 fingerlings were provided to the farmers for raising. Yield 2,505 kg.
 - Chhuok district: 10,876 young fish were provided to the farmers for raising. Yield 3,224 kg.
- **In 1998**
 - Banteay Meas district: 31,455 young fish were provided to the farmers for raising. Yield 3,151 kg. Floods destroyed 85% of yield.
 - Chhuk district: 5,000 young fish were provided to the farmers for raising, No yield due to flood.
- **In 1999**
 - Banteay Meas district: 3,100 young fish were provided to the farmers for raising. Yield 1,014 kg. Floods destroyed 70% of yield.
 - Angkor Chey district: 5,950 young fish were provided to the farmers for raising. Yield 1,717 kg.
 - Chhuk district: 12,224 young fish were provided to the farmers for raising. Yield 1,811 kg. 70% were destroyed.
- **In 2000:**
 - Yields have not been completely estimated.

In 2001: trainings on fish raising techniques are conducted for:

- Chhuk district: 80 families
- Dornng Tung: 120 families, of which 90 families of handicapped, widows, women in poverty were provide with rice-for-labor for pond digging.

8.3 Seagrass beds

Seagrasses are important habitats in shallow coastal waters. They are very important for many fish, invertebrates and other marine organisms. The change in area of seagrass beds, together with species composition, is not well known because of a lack of comprehensive systematic research.

However, seagrasses can be found in most shallow waters in the coastal zone, in Kampot province. Kampot province has been seen as the most concentrated area in terms of diverse seagrasses species. Based on some surveys conducted recently, there are many localities in Kampot that are important seagrass habitats.

Important species of seagrasses identified from previous surveys are:

- *Enhalus acoroides* (dominant species);
- *Cymodocea serrulata*;
- *Syringodium isoetifolium*;

- *Halodule uninervis*.
- *Halophila decipiens*
- *Thalassia hemprichii*

Present situation

Generally, the seagrasses grow along the 95-kilometres of coastal areas. The areas where most sea grasses grow are Prek Thnoat River, Prapeng Ampeou in Kampot district, Koh Smao in Kampong Bay district, and Lork in Kampong Trach district.

In 2001, surveys in several localities in Kampot water by the CZM Project and working group indicated that five species of seagrasses are found from southern part of Phnom Daung coast to Prek Kinpung river (as seen in the map).

- *Thalassia hemprichii*
- *Halodule uninervis*
- *Enhalus acoroides*
- *Halophila decipiens*
- *Syringodium isoetifolium*

A total of 9 seagrass species have been surveyed in the coastal zone of Cambodia from February to June 2001

- *Thalassia hemprichii*
- *Halodule uninervis*
- *Enhalus acoroides*
- *Halophila decipiens*
- *Cymodocea serrulata*
- *Halodule pinifolia*
- *Cymodecea rotundata*
- *Syringodium isoetifolium*
- *Halophila ovalis*

8.4 Endangered species in the coastal area

Cambodian coastal waters are considered among the richest areas in biodiversity, including significant aquatic resources and marine endangered species, such as the dugong, green turtle, dolphins and sharks. However, there is no researched information on status situation of migration and location of these species.

9. Tourism in Kampot

Table 31: Resorts in Kampot

No	Names of Resorts	Distance from provincial center (km)
	Natural Resorts	
1	Bokor mountain	48
2	Prek Ampel	18
3	Kep Thmey	8
4	Daung mountain	7
5	Waterfall (Toek Chhuo)	8
	Resorts and cultural caverns	
1	Seida Oan mountain	8
2	Chchorok mountain	38
3	Kampong Trarch mountain	50
4	Kchorng mountain	47
5	Prasat mountain	59
6	Lung cavern	59
7	Preah cavern	72
8	Wat cavern	79
9	Preah Angkar	
	Artificial Resorts	7
1	Zoo and gardens	

There are several forests in the long ranges of mountains in Kampot province. Because of its geographical features, Kampot provides a number of valuable natural views of which some have been developed to natural resorts for tourism purpose.

In Kampot tourists could spend their time by swimming, walk along the seaside, enjoy water falls, magnificent views of valleys, climbing mountains, visit the zoo, gardens, and traditional crafts. Fresh seafood as well as fruits can be enjoyed the whole year around.

Source: Department of Tourism in Kampot, 2001

9.1. Potential of tourism development

Resorts

The province consists of 5 natural resorts and one man-made resort, 3 cultural resorts, 6 culturally historic temples, and other 10 traditional crafts.

9.2 Management Work

Referring Sub-decree, No. 34, on the organization and functioning of the Ministry of Tourism and Sub-decree, No.26, on changes of functions and responsibilities, the establishment of law expert team and the General Department for International Co-operation and Asean by the Ministry of Tourism, in collaboration with line departments, have gradually restored and improved the resorts in conformity to the to prevent from environmental degradation.

Table 32: Statistics of Visitors

Year	Number of visitors
1997	87,562
1998	96,360
1999	91,814
2000	97,780

Source: Department of Tourism, Kampot, 2001

9.3 The Goals of Tourism

The Tourism Department has the following goals for the future:

- To improve the waterfall resort
- To work with the relevant agencies to improve the number of resorts at Prek Ampil, and Kampong Trarch to serve the needs of visitors

- To co-operate and improve the management of tourist services, especially the conservation of environment
- To request the relevant Government institutions to improve road conditions leading to resorts such as Bokor and Kampong Trach Mountain.

10. Assessment of findings and recommendations

The present report has been the first attempt to collect and present relevant environmental information from the coastal provinces and municipalities. This information has been used to identify sensitive areas in relation to the parallel physical framework planning activities but also to highlight the present availability of environmental data and to identify the gaps in the present environmental management system

The marine waters function as the ultimate recipient of all residual pollutants entering the water bodies. At the same time the coastal areas function as recreational sites and the sea itself provides the economic background for a part of the society through fishery and marine transport. Based on these aspects it is important to secure a healthy freshwater, coastal and open sea environment and to be able to detect a decrease in the water quality conditions in these areas.

A well functioning monitoring system is a prerequisite for securing that the environmental authorities are able to react if negative changes takes place. The present chapter provides an assessment of the present situation for monitoring and enforcement structures in Cambodia, and provides recommendations for measures to be implemented.

It should be stated that the scope and scale of activities undertaken by the Cambodian authorities so far to create a system for enforcement of environmental legislation have been appreciated. The aim of the present chapter is, however, to evaluate these achievements critically, to point out gaps and weaknesses as well as measures to solve identified problems.

The chapter will describe how the environmental management system should function and how the ambient and compliance monitoring is part of this process. Based on the findings from the previous chapters the main gaps for achieving a functional system will be identified.

Monitoring and enforcement data from the various environmental sectors will give important information input to the Environmental Management System (EMS). Through an appropriate Environmental Information System, the necessary information from one monitoring sector can be used optimally by the other sectors. The aim is to integrate the monitoring and enforcement data between the sectors to the greatest possible extent. Furthermore, an efficient information flow from the monitoring programmes to the administration of environmental laws, decision makers, policy makers and the public is important to ensure an effective environmental management system.

In Figure 10.1, the necessary information flow in an environmental management system is shown, and this concept has been used for providing the major recommendations.

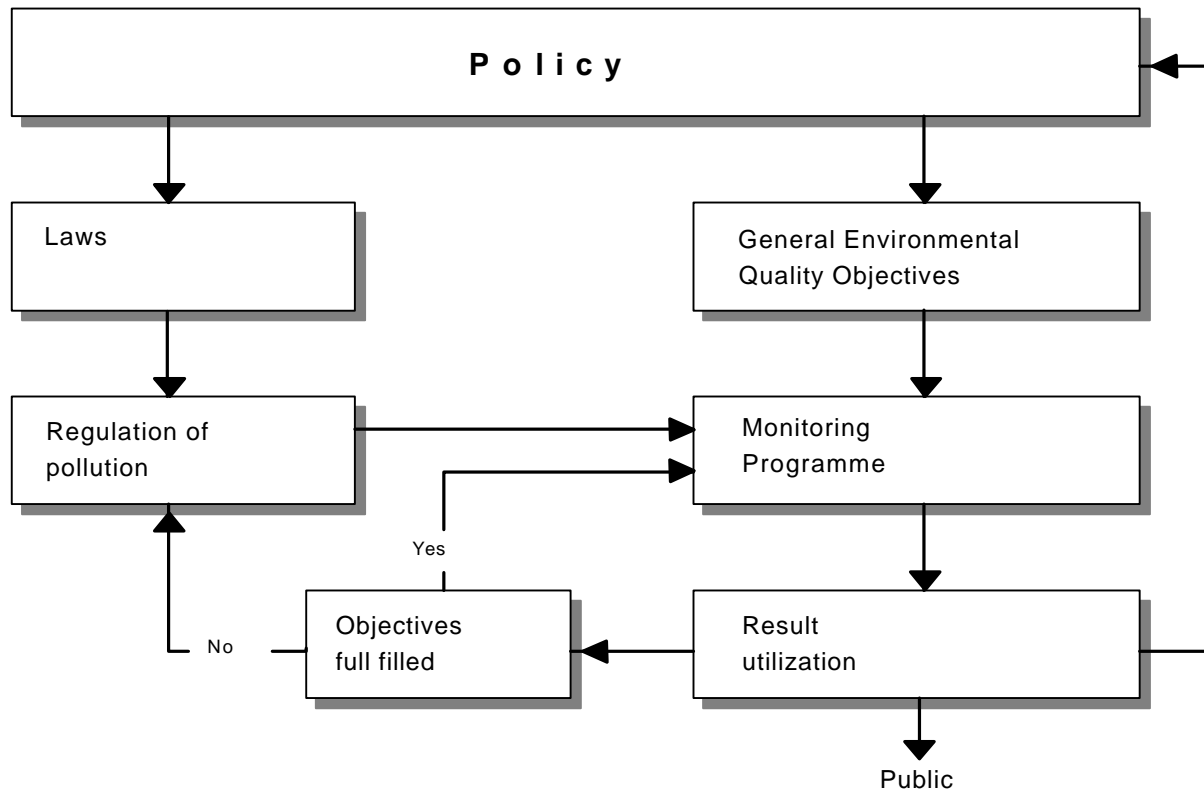


Figure 10.1 Flow of information in an environmental management system

The figure shows that based on policies, laws are developed for controlling and limiting pollution. There could also be some general policies regarding the quality of the natural environment. These policies can then be put into environmental quality objectives, which are quantifiable. To check if these objectives are fulfilled a targeted monitoring programme will be implemented and the results from the monitoring programme will be used to check if the objectives are fulfilled and providing information to different parties. If the objectives are fulfilled the monitoring cycle will continue. However, if the objectives are not fulfilled the feedback would be an active action for regulation of the pollution. As this figure illustrates the monitoring programme is a very important part of the environmental management system.

An ambient and compliance (enforcement) monitoring system is outlined in Figure 10.2 below.

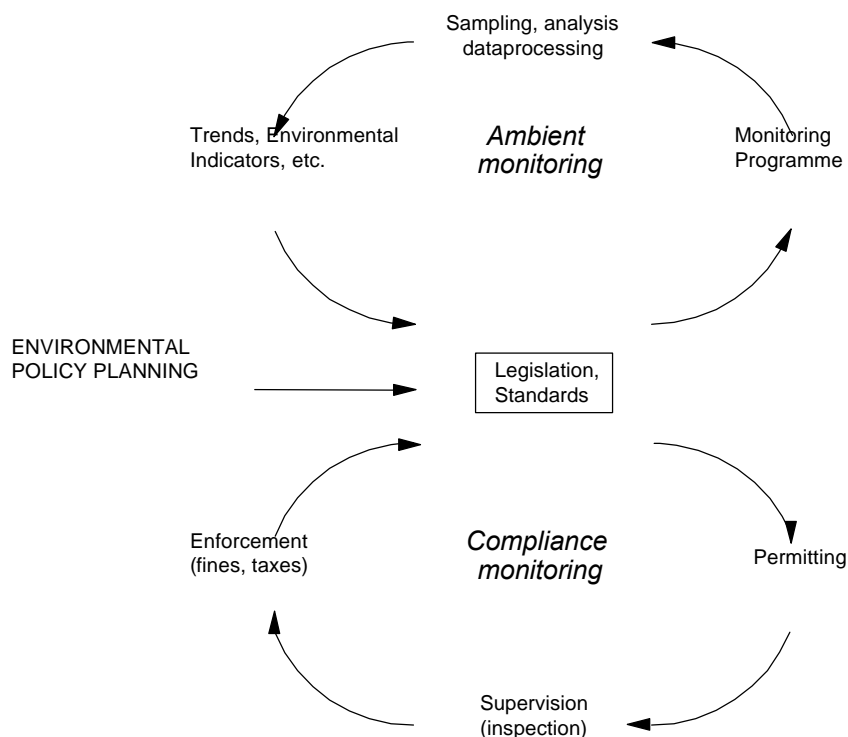


Figure 10.2 Illustration of the system for ambient and compliance monitoring

The **compliance monitoring (enforcement)** is the tool by which the society/government can ensure that the laws, standards and norms set for the environment are complied with by the users of the environment (industry, agriculture, private persons, etc.). The government may promote public awareness/pressure, industry self-regulation and make economic incentives for the public and for the industry. However, when this fails, taking measures to enforce the general compliance of the laws is necessary with a fair, systematic and effective regulatory system. If not, the government jeopardizes its own credibility and the validity of the law. This will lead to a situation where some companies and individuals can profit from not complying at the expense of those that do. The enforcement cycle includes:

- Legislation and development of standards, norms, guidelines etc.
- Permitting/licencing of the use of the environment (e.g. hunting licence, waste water permits, dumping permits).
- Supervision (inspection, control). For permits to pollute the environment with waste the inspection has the character of source monitoring (emission monitoring/pollution load monitoring).
- Enforcement. Different societies have different means of enforcement. These are often charges/taxes, fines or fees. Other means are negotiations, legal action and compliance promotion.

The elements of the enforcement cycle are interdependent. A continuous evaluation of the elements must be fed back to the policy makers.

The institutional set-up of the enforcement system varies between countries. However, a common feature is that the inspecting agency (control) is either mostly independent from the

permitting agency or that a comprehensive appeal system is included in laws regulating the enforcement.

There is a trend toward using “integrated enforcement” for industries/companies where the permit becomes a “licence to operate”. In integrated enforcement the permit contains several or all sectors: water extraction/use, waste water emission, air pollution emission, solid waste handling permits, noise permits, etc. There are several advantages achieved by this. Pollution loads will not be moved uncontrolled between sectors. The permit holder (often an industry) has only one permit to consider, reducing the number of visits from inspectors and the necessary paper work. Overall integrated enforcement will promote the use of cleaner technology.

The **ambient monitoring** cycle shown in Figure 10.2 is the tool the society /government has to verify whether the laws, standards etc. they submit have the planned effect. For the environment this monitoring will often be e.g. monitoring of the quality of air, surface water, groundwater, the number of species at a given location, etc. The monitoring may also have the character of transport control, e.g. monitoring of pollution loads to the coastal area or transport of air pollutants across the borders.

The monitoring cycle includes:

- Legislation and development of standards, norms, guidelines etc.
- Monitoring Programme. Definition of a monitoring programme that will supply the data and information which is necessary to verify if the intentions of the laws are met.
- Implementation of the monitoring program. Sampling, analysis and processing the results to obtain:
- Environmental indicators, check of quality objectives, time series, analysis and evaluation of trends and reasons for these etc.

Also, the elements of the enforcement cycle are interdependent. A continuous evaluation of the elements must be fed back to the policy makers. Implementation of a monitoring programme should also be used for the general information to the public of the state of the environment and trends.

Based on the findings described in the previous sections it can be seen that monitoring programmes in the coastal area seem to only function fragmentary due to limited availability of capacity and budgetary constraints and do not as such fulfil the obligations of a functioning monitoring system.

The present activities do not include a reasonable frequency of sampling at intensive monitoring stations for selected variables to make analysis of trends or to check fulfilment of environmental quality objectives, which is one of the major aims of the monitoring programme.

Environmental quality objectives

At present no quality objectives are defined for e.g. freshwater and marine areas. This makes it extremely difficult to illustrate for decision-makers if the environmental conditions in a certain area is acceptable or not, or if conditions has improved. There is a need for development of specific and precise objectives. The objectives should be developed so that they fulfil the information needs and requirements of the environmental authorities. It is recommended that the objectives be formulated in a quantitative way, for instance on a statistical basis. Furthermore, the objectives should be based on variables which are known to react to changes in e.g. pollution load.

Development of quality objectives is also necessary for the proper management of the environment. Otherwise, there is a risk that certain big polluters will use up the "assimilative capacity" of e.g. the surface waters not leaving any room for future discharges.

Based on the above it is recommended that environmental objectives should be established and statistical criteria developed to assess if the environmental conditions fulfil the objectives developed.

Legal and organizational conditions

At present there seems to be no clear link between the conduction of an environmental impact assessment and the issuance of permits. Judged from the information obtained the present permit system does not ensure that monitoring routinely implemented for new discharges. Due to this it is not possible to detect or respond if the impacts for a certain activity exceed the predicted impacts or to be able to evaluate to what extent this might occur.

It is recommended to develop a system that in the issuance of new discharge permits or with revision of old permits states the required monitoring activities in the receiving water. The permit should specify the monitoring activities requested, including the variables and time intervals of the monitoring and be an integrated part of the environmental impact assessment.

Source monitoring

As mentioned above it is recommended that a source monitoring programme should be conducted at the pollution sources to verify that the pollutants discharged do not exceed the limits given in the permit and that the impacts predicted in the environmental impact assessment are not exceeded. It is recommended that the discharge permits should establish requirements with respect to obligation to perform measurements, their frequency as well as monitoring activities.

Ambient monitoring

No or only few measurements of environmental quality conditions exist from the coastal area and as pointed out previously it is extremely important to establish background conditions for the environment before a significant number of development activities have been started.

It is recommend that monitoring activities should be initiated focusing on key variables expected to show change due to human impact. The strategy for location of stations should put emphasis on monitoring in areas where impacts is to be expected first.

It is recommended that an assessment should be made to identify which variables is most sensitive to detect changes and which is not too time-consuming or require too advanced equipment to measure.

Information system

It is recommended that a regular reporting system should be established to assess the state of the environment. On this basis it will be possible for the environmental authorities to evaluate if the pollution controlling measures implemented have the expected effect. There is a need to establish the capacity which can provide an integration and synthesis of the monitoring data to produce a report based on the use of environmental quality objectives and indicators. This report should then provide the overview for the environmental authorities on the overall development of the environmental situation in the coastal zone.

Laboratory conditions and technical capacity

At present there are no laboratories in the coastal area, which can carry out environmental analyses. There is a clear need for the establishment of such a facility in the coastal area to be

able to provide some of the basic environmental data needed for making environmental management decisions based on available relevant information.

It is strongly recommended that an analytical facility be established in the coastal area which can produce environmental data to be included and assessed in the reporting of the environmental conditions in the coastal area.