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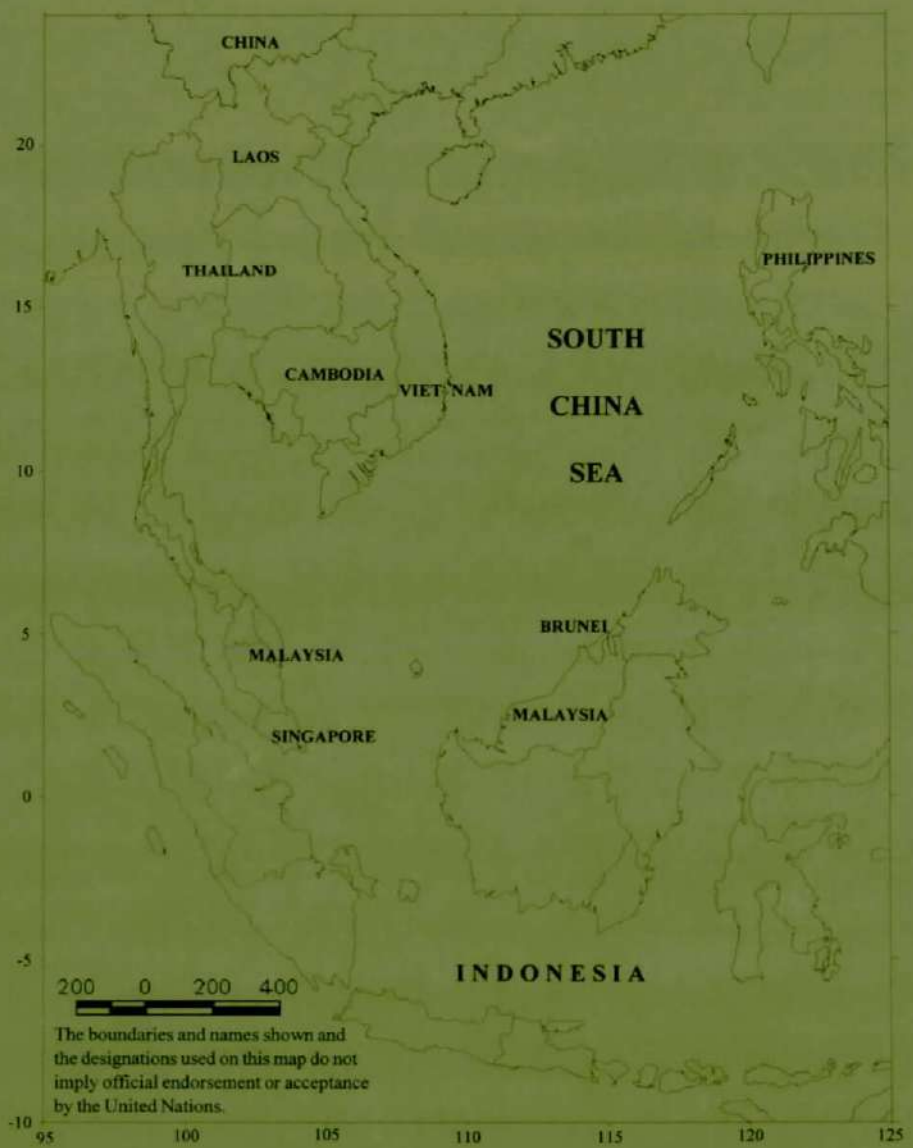
Strategic Action Programme for the South China Sea

(Draft Version 3, 24 February 1999)



East Asian Seas Regional Coordinating Unit

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PREFACE

Development of the Strategic Action Programme

The South China Sea is a unique environment with rapid economic development and rapid population increase in the coastal areas during the part two decades and with rapid degradation of marine and coastal environments. The South China Sea is shared by many countries, and the environmental problems they have are common and of a transboundary nature with similar root causes.

Recognising that actions are urgently needed to halt degradation of the environment of the South China Sea, the countries of the region sought the assistance of UNEP and the Global Environment Facility (GEF) in preparing a Transboundary Diagnostic Analysis of the issues and problems and their societal root causes as the basis for development of this Strategic Action Programme. The Twelfth intergovernmental meeting of the Coordinating Body for the Seas of East Asia (COBSEA) in December 1996 endorsed the proposal and the GEF made available a project preparation and development facility grant (PDF-B) to enable countries to prepare the necessary analyses and reviews.

In accordance with the GEF Operational Strategy these analyses and reviews included the preparation of a Transboundary Diagnostic Analysis (TDA) (UNEP SCS/TDA ver. 3) and Strategic Action Programme (SAP, this document). In preparing the Transboundary Diagnostic Analysis, national committees were formed in each participating country. Headed by a coordinator, each committee prepared a comprehensive, country-based analysis of water-related environmental problems and concerns. An outline for the content of these reports was agreed at a first meeting of coordinators held in March 1997. The first drafts of the national reports were submitted and evaluated prior to a second meeting of national coordinators in June, 1998. During this meeting, and on the basis of the causal chain analysis done by each country for each identified water-related problem, a weighting of all identified major issues was prepared by the national coordinators and invited experts from the region. The identified regional concerns and principal issues became the focus for the regional TDA, which was discussed and agreed by the national coordinators and regional resource persons.

This draft Strategic Action Programme is based on the findings of the regional Transboundary Diagnostic Analysis (TDA) that represents a regional synthesis of issues identified from the national reports. The TDA identifies the priorities among water-related problems and concerns, their socio-economic root causes, the sectoral implications of actions needed to mitigate them and the extent to which the problems are transboundary in either origin or effect.

The National reports, the draft Transboundary Diagnostic Analysis, and the draft Strategic Action Programme were all submitted to The Third Meeting of National Co-ordinators and regional experts for review and endorsement prior to their submission to the Thirteenth Intergovernmental Meeting of COBSEA (document UNEP/(WATER)/EAS IG9/3). This meeting endorsed the draft SAP and requested UNEP to formulate a project brief for submission to the GEF that addresses the priority actions identified in the SAP. A key element of this project must be actions that will lead to the further elaboration

and development of the present draft Strategic Action Programme. It is the intention of participating governments that this process of elaboration be undertaken over the next two years with a view to governments endorsing a final draft during the next intergovernmental meeting of COBSEA to be held in December 1999.

The actions proposed in the framework of the draft Strategic Action Programme are wide ranging in both context and proposed areas for action. Successful implementation of the Programme will depend upon co-ordination of actions by diverse organisations, agencies, non-governmental organisations, private sectors, and stakeholder groups at both the national and regional levels. Recognising the mandate of the United Nations Environment Programme to co-ordinate environmental actions across the United Nations System, the widest possible range of appropriate partners at national and regional levels will be encouraged and assisted to participate in the execution of the Programme. It is the intention of the participating countries that all actions be undertaken in a spirit of collaboration and partnership, to enhance synergy between on-going initiatives at national and regional levels, and eliminate duplicative and conflicting actions.

1 BACKGROUND & RATIONALE:

1.1 Global and Regional Significance of the South China Sea (SCS) and its Associated Freshwater Catchments

The South China Sea is a strategic body of water, surrounded by nations that are currently at the helm of industrialisation and rapid economic growth in the Asia-Pacific region. Bordered by the People's Republic of China to the north, the Republic of Philippines to the east; Malaysia, the Republic of Singapore, The Republic of Indonesia and Brunei to the south; and the Kingdom of Thailand, the Kingdom of Cambodia and the Socialist Republic of Viet Nam to the west; the South China Sea has always been central to issues of economic and political stability in Southeast Asia and adjacent regions (Fig. 1.1). Today, it is central to environmental sustainability and food security for rapidly expanding populations of these coastal and archipelagic nations.

The coastal subregions of these nations are home to 270 million people or 5% of the world's population. About 125 major rivers drain 2.5 X 10^6 km^2 of catchment area and deliver, water, sediments, nutrients and pollutants to the South China Sea.

The South China Sea lies at the centre of the Indo-West Pacific biogeographic Province the world's most diverse shallow-water marine area. Such richness in flora and fauna contributes to the area's high natural rates of primary and secondary production. Capture fisheries from the South China Sea contribute 10% of the world's landed catch at around. 5 X 106 tons year-1. From the standpoint of aquaculture, five of the eight top shrimp producers in the world, are countries bordering the South China Sea, namely: Indonesia, first, Viet Nam, second, China, third, Thailand, sixth, and the Philippines, eighth.

Forty-five mangrove species out of a global total of 51 (Spalding et al. 1997); 50 of 70 coral genera (Tomascik et al. 1997); 20 of 50 seagrasses species (Sudara et al. 1994); and 7 of 9 giant clam species (Tomascik et al. 1997), are found in the nearshore areas of the South China Sea. Compared to the Atlantic, the tropical Indo-West Pacific is highly diverse. Only 5 mangrove species and some 35 coral species are found in the Atlantic compared with 51 mangrove and over 450 coral species are recorded from the Philippines compared with 200 species from the Red Sea, 117 from South East India and 57 from the Persian Gulf.

The richness and productivity of the natural environment of the South China Sea are, however, seriously threatened by high rate of population growth, pollution, excessive harvesting and habitat modification, resulting in rapid loss of habitat and impairment of the regenerative capacities of living systems. The socio-economic impacts of environmental deterioration are significant for the newly developed economies of this region. While the economy of these countries is becoming increasingly dominated by developments in the industrial and service sectors, food consumption patterns rely heavily on cheap protein derived from fishery resources. The agriculture sector (including fisheries) remains not only a significant source of revenue but also an important basis for food security in the countries of the region.

An economic crisis in mid 1997 caused development to slow and a reduction in funding to non-essential services. Under conditions of fiscal restraint environmental protection tends to receive priority.

1.2 Basis for Preparation of the Strategic Action Programme

The Transboundary Diagnostic Analysis [UNEP SCS/TDA ver.3] is based on national reports prepared by Cambodia, China, Indonesia, Malaysia, the Philippines, Thailand and Viet Nam. The national reports present the key national priorities amongst the many issues and concerns relating to the aquatic environment of the South China Sea basin. The TDA provides an assessment of the regional and wider significance of these issues; an analysis of the socio-economic causes of environmental degradation; an evaluation of the sectoral implications of actions needed to mitigate them; and an analysis of priorities from the national and regional perspectives.

The Strategic Action Programme (this document) is based on the preliminary findings of the regional Transboundary Diagnostic Analysis and in particular upon the priorities identified by the second meeting of National Co-ordinators and regional experts. This preliminary ranking is presented in Table 1. 1.

This Strategic Action Programme was prepared in collaboration and cooperation with other regional institutions, organisations and bodies having interests in many issues in the region, including:

- Food and Agricultural Organisation of the UN;
- South East Asia (START) Regional Centre;
- The South China Sea Informal Working Group at the University of British Columbia;
- IOC Sub-Commission for the Western Pacific (WESTPAC);
- GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas.

Table 1.1 Ranking of Importance of Various Issues by Country

ISSUE	Cambodia	China	Indonesia	Malaysia	Philippines	Thailand	Viet Nam	TOTAL	RANK
Litter/Solid waste	3	1	3	1	3	1		12	7
Nitrate - domestic	1	3	2	3	3	3	1	16	3
Nitrate Rural	n.a.	3	1	1	2	2	1	10	9
Phosphate domestic	1	3	1	3	3	3	1	15	4
Phosphate rural	n.a.	3	-	1	2	2	1	9	10
Sediments mining	2	1	2	1	1		3	10	9
Sediments Rural	3	1	3	3	2	1		13	6
Hydrocarbons	n.a.	3	3	2[1]	2	2	2	14	5
Organics domestic	3	2	3	3	3	3	1	18	2
Organics Rural	2	2	1	2	2	2		11	8
POPs	n.a.	1	1	1	1	1		5	12
E. Coli	n.a.	1	3	3	3	3	1	14	5
Heavy metals domestic	n.a.	1	1	1	1			4	13
Heavy Metals Industrial	2	1	3	1	3	1	1	12	7
Harmful Algal Blooms	n.a.	3	1	1[2]	3			8	11
Industrial Chemical	2	1	2	2	3	2	1	13	6
Natural Catastrophes	1	2	2		3		2	10	9
Overfishing	3	1	3	3	3	3	3	19	1
Habitat loss	2	2		3	3	3	3	16	3

A	Overfishing
B	Sewage municipal
C	Habitat loss
D	Hydrocarbons
E	Industrial chemicals & HM
F	Rural (N, P, sed.org.)
G	Solid waste/litter
H	Natural catastrophes
H	Mining Sediments
I	Harmful algal blooms
J	POP's

[1] Potential problems in future
[2] Sabah & Swak only
n.a – not available

2 CAUSES OF DEGRADATION AND THREATS TO THE AQUATIC ENVIRONMENT AND RESOURCES OF THE SOUTH CHINA SEA

2.1 Causes of Environmental Degradation

The root causes of the degradation of marine habitats and environment in the South China Sea are the increased populations and the demands made upon the marine environment as the population strives to achieve higher levels and standards of living. These socio-economic causes are manifested in overexploitation of resources, human and industrial waste dumping and destruction of habitat during development. These causes have resulted in large losses of mangrove and seagrass area and destruction of coral reefs.

For instance, as indicated in the TDA, Table 2.1 shows that mangroves in the seven participating countries constitute 10% of the current global area of slightly over 18 million ha. The total amount of area lost over different time spans (70 years for the Philippines) is estimated to be 4.3 million ha or 24% of the current global mangrove area. The causes for mangrove destruction include conversion to pond culture, tree felling for woodchip and pulp production, urban development and human settlements, and harvest of products for domestic use. The impact of each economic activity is difficult to quantify for each country. Nonetheless, shrimp culture would seem to be the most pervasive economic imperative for mangrove conversion. However, the rate of destruction wrought by each cause must be taken into account when known, for a more thorough analysis.

Table 2.1 Loss and Causes of Mangrove Destruction

Country	Area before (ha)	Area now (ha)	% Area lost	Causes of mangrove destruction			
				Shrimp culture	Wood-chip and pulp	Urban development/Human settlements	Domestic use
Cambodia	170,000	85,100	50	✓			✓
China	42,001	14,749	65	✓		✓	
Indonesia	4,254,312	733,000	83	✓	✓	✓	
Malaysia	505,000	446,000	12	✓	✓	✓	
Philippines	400,000	160,000	80	✓		✓	✓
Thailand	550,000	247,000	70	✓			
Vietnam	400,000	252,500	37	✓			✓
TOTAL	6,321,313	1,938,349					
GLOBAL TOTAL		18,107,700					

Sources: Spalding et al., 1997; ISME 1993.

The immediate causes for degradation in coral reefs in the participating countries and in Southeast Asia in general are varied, but the major ones are commonly identified in the national reports. Regional assessments like those of Wilkinson et al (1994) state that pollution and sediments are major causes in countries of the Sunda shelf, and in the shallow areas of the Philippines and Indonesia. However, overfishing causes greatest degradation in the deeper areas of the archipelagoes including those in the oceanic shoals. Bryant et al. (1998) enumerates overfishing, destructive fishing practices, sedimentation and pollution associated with coastal development as the major culprits. These causes were weighted in determining the three risk levels used in their evaluation.

Catchment areas are not managed with an eye to marine environments and the forest fires, deforestation and inappropriate agricultural practices which occur in the region considerably degrade the marine environment, particularly by allowing excess runoff of soil and sediments into the rivers and hence, the sea. Rivers are dammed and their courses changed which alters the stream flow and the erosion or accretion of sedimentary loads.

It is not clear, for underwater habitats, how much damage has been done as there is no complete map of underwater habitats. Fisheries catch records and stock assessment are not available for the South China Sea It is obvious that monitoring of marine resources and habitats is not adequate. Monitoring should be to determine what the situation is, detect the damage done and to test whether remedial efforts are successful.

Land based pollution is another priority area identified by the countries involved in this project. Table 2.2 summarizes the sources of pollution among the participating countries in the South China Sea, the quality of the database, and the perceived contribution of these sources to the state of aquatic environments in each country. Wastes from domestic, agricultural, and industrial sources, along with sediments and solid wastes are the major sources of pollutants that impinge on both freshwater and coastal systems in the seven countries. Land-based sources play a major role in both inland and coastal pollution. Ship-based sources contribute relatively small amounts, but may have severe impacts when large volumes are released such as during major oil spills. Atmospheric inputs may seem innocuous at the present time because of a very poor database and because their impacts are harder to establish given the nature of atmospheric chemistry and the larger scales needed to carry out appropriate studies of air sheds. It must be pointed out however, that atmospheric pollutants are most potent in being transported across national boundaries. This was made evident during the extensive forest fires that occurred in Indonesia that caused haze to shroud Malaysia and western Philippines. On a global scale, the ashfall debris injected into the stratosphere by Mt. Pinatubo's eruption caused major weather anomalies worldwide.

The Transboundary Diagnostic Analysis provides more detailed information on the root causes and sources of the problems identified.

Table 2.2 Ranked Sources of Pollution Among Participating Countries in the South China Sea[1]

Source	Rank & Data base	Contribution to pollution of national aquatic environments (L = Low, M = Moderate, H = High)						
		Ca	Ch	Indo	Mal	Phil	Tha	Viet
• Domestic waste	1-Fair	M	H	H	M	H	H	H
• Agricultural waste	2-Poor	M	H	H	M	H	H	H
• Industrial waste	2-Poor	M	H	H	H	H	H	H
• Sediments	3-Poor	M	H	H	M	H	H	H
• Solid waste	4-Fair	H	H	H	M	H	H	H
• Hydrocarbons	5-Poor	L	M	H	M	M	M	M
• Ship-based sources	6-Poor	L	M	M	M	M	M	M
• Atmospheric	7-Poor	L	M	H	M	H	M	M

[1]*Ranking of pollution sources was done during the Second Meeting of National Coordinators (June 1998).*

2.2 Future Threats to the South China Sea

Unless countries realise that there is unsustainable exploitation and irreversible damage being done to marine ecosystems the current situation of losing habitat will continue. Inventories of what is there, records of the state of the marine environment determined by monitoring and a realistic outlook on exploitation of resources will give countries a guide as to what should be done to relieve the current situation. To this end the TDA and the SAP are leading documents. The population of most countries of the South China Sea is growing and in 50-100 years time, however well managed the marine environment is, it will not be able to support the predicted number of people.

As analysed in the TDA, the future treats for mangrove as an example mainly include:

(i) *Loss of biodiversity.* The incomplete inventory of associated flora and fauna in the seven participating countries nonetheless indicates the high biodiversity associated with mangrove areas in the South China Sea region. The rich species diversity is reflected in the high number of mangrove trees, finfish and penaeid shrimps, among others, that are associated with mangrove swamps. Because of the severe pressure exerted on mangroves, a number of associated species are among those classified as endangered. These include the proboscis monkey, *Nasalia larvatus*, which eat young shoots and growing tips of *Sonneratia* and *Avicennia* trees, the crocodile *Crocodilus porosus*, swamp birds like *Ardea* and *Egretta*, among others (Low et al., 1994).

(ii) *Loss of fisheries productivity.* Mangroves act as nursery and feeding grounds for finfish and shellfish at some stage or throughout their life cycles. Singh et al. (1994) obtained studies that show high correlation between catch in coastal fisheries and the area of adjacent mangroves in study sites such as Indonesia, Malaysia, Philippines, Australia and the US. Although correlation does not imply causation, ecological studies have established the connectivities among mangroves, coral reefs and seagrass as far as supporting the life cycles of coastal organisms (Robertson and Duke, 1987; Twiley 1988). Based on the precautionary principle, it is not necessary to unequivocally prove that mangrove destruction will cause a decline in the productivity of dependent biota,

and consequently a decrease in their yields. There is sufficient evidence to believe that it will and does.

3 ESTABLISHMENT OF TARGETS FOR ENVIRONMENTAL QUALITY IN THE SOUTH CHINA SEA

3.1 General

The national reports and the transboundary diagnostic analysis identified the priority problems of the South China Sea as being, environmental pollution, over exploitation of biotic resources, and ecosystem loss. Associated with these issues are the growing problems of freshwater quality and quantity for human use. For a number of these issues and problems quantitative indicators of loss or degradation are not available, or the data and information are not uniform throughout the region, thus, further studies are required in order to establish definitive targets for protection and management of the environment and its resources. Nevertheless, recognising the urgency of the issues and problems, the Governments agreed to establish preliminary targets for the key issues identified for priority action in the immediate future.

Underlying the process of degradation of the various resources described in the TDA is the lack of an effective institutional framework at national and regional levels, for collective management of the environment and resources. This problem is addressed among the priority actions outlined in this draft Strategic Action Programme.

3.2 Objectives, Rationale and Priorities for the SAP

The ultimate goal of the Strategic Action Programme is to halt or slow the current rate of environmental degradation and as such it contains priority actions that need to be undertaken at both national and regional levels. It is designed to assist participating states in taking actions individually or jointly within their respective policies, priorities and resources, which will lead to the prevention, reduction, control and/or elimination of the causes of degradation of the marine and freshwater environment. Achievement of the aims of the SAP will contribute to the protection of human health; promote the conservation and sustainable use of marine living resources; and contribute to the maintenance of globally significant biological diversity.

The general objectives of the SAP are:

- Formulation of principles, approaches, measures, timetables and priorities for action;
- Preparation of a priority list for intervention and investments;
- Detailed analysis of expected baseline and additional actions needed to resolve each transboundary priority problem;
- Identification of the elements and preparation of guidelines for the formulation of national action plans for the protection of the marine environment and rational use of marine and coastal resources consistent with the regional SAP;
- Foster the involvement of regional and, where appropriate, national Non-Governmental Organizations and the private sector in the implementation of the SAP;

- Foster collaboration and co-operation between all regional entities having interests in the environment of the South China Sea in an attempt to reduce or eliminate duplication of effort and waste of scarce human and financial resources.

The countries of the South China Sea region are at different levels of socio-economic, scientific and technological development. However, the basic infrastructure for the protection of the environment and for the sustainable use of marine resources exists in all countries of the region, including competent institutions having authority for protection of the environment, and adopted legislation and regulations. However, the governments of the region have recognised that past actions at national and regional levels have not been adequate to halt the rate of degradation and that a more strategic approach is required. Consequently, targets have been defined and endorsed by the governments, for each of the priority areas of concern identified in the TDA, namely:

- Habitat conversion and loss
- Unsustainable exploitation of living aquatic resources
- Land-based pollution
- Freshwater shortage and low water quality

3.3 Targets and Priority Actions

Habitat Conversion and Loss

The loss of important habitats is a priority in the region. This is a concern in the case of mangroves, coral reefs, seagrass and coastal wetlands. In most countries, laws and regulations concerning land use planning and coastal development exist and important areas of habitat have been declared as protected areas. The enforcement of these legal measures is not effective in the face of continued economic–pressures for the conversion of these areas to alternative uses. The main reasons for continuing habitat loss are the failure to deal with the socio-economic pressures for development and a failure to integrate environmental concerns into the development process. The national reports identified the need to prepare master plans of institutional and legal reform and action to deal with these problems in an integrated way.

3.3.1 Mangroves

Over the last 70 years the area of mangrove bordering the South China Sea has decreased from 6,321 km^2 to 1,938 km^2 a loss of nearly 70% of the original area. Continuation of losses at the present rate will result in all mangrove being lost by the year 2030. The present distribution of mangrove forests is illustrated in Figure 3.1. Ecologically, mangroves provide valuable habitat for juvenile fish and crustacea of commercial and recreational value, protect the shore from erosion, and provide timber and other products for human use. The value of the products and ecological services provided by the mangrove systems of the South China Sea is estimated at about US$ 15,984 million per year (based on total area of 1.6 million ha as indicated in TDA, and a value of US$ 9990 ha^{-1} $year^{-1}$).

The main causes of mangrove loss result from conversion of the land to other uses, such as shrimp farms, urban development and logging for timber and woodchips.

As the global centre of mangrove biodiversity such losses in this region have both global and wider regional significance. Loss of biodiversity and fisheries productivity are major transboundary issues at a regional scale but trading in mangrove wood products i.e. pulp, charcoal, woodchips and building materials, are also transboundary being driven by international trade in such products. The countries of the region dominate the mariculture production of shrimp which results from high prices on the world market that encourage low capital, extensive farming systems dependent on tidal regimes for water and natural food inputs, in cleared mangrove areas.

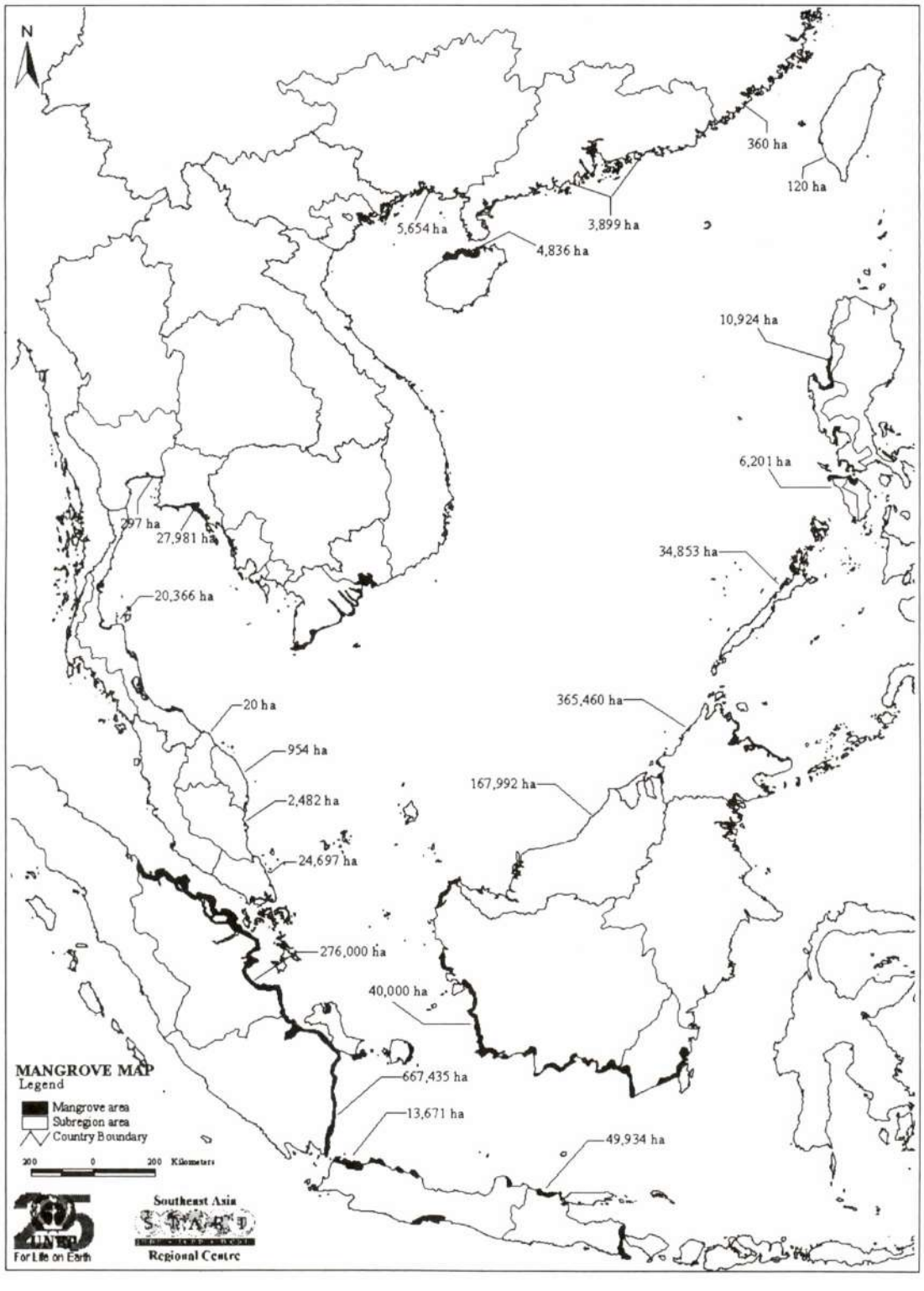

Figure 3.1 Distribution of Mangroves in the South China Sea

Proposed Targets

By 2010, to maintain the area of mangroves in the region at no less than 90% of the present (1998) area.

Proposed Activities at the Regional level

- Develop criteria for selection of mangrove areas for protection/sustainable management, particularly those of transboundary importance;
- Identify and prioritise specific areas for future management and protection and develop regional and national action plans to maintain regionally important mangroves areas;
- Develop and establish management regimes for the identified areas;
- Establish a regional mangroves database;
- Build the capacity of the governments of the region to understand the issues concerning mangroves and to raise public awareness concerning the national and regional importance of such ecosystems.

Proposed Activities at the national level

- Carry out and/or update inventories of mangrove areas and classify them according to potential ecological functions, using a GIS database;
- Prepare national legislation and action plans for mangrove management;
- Implement and coordinate mangrove restoration projects wherever relevant;
- Study and assess the techniques and methods of mangrove restoration currently in use in the Region with a view to improve restoration projects;
- Build the national capacity to understand the issues concerning mangroves and raise public awareness.

3.3.2 Coral reefs

Coral reefs are habitats for marine life, for sequestration of carbon, and provide economic return for fisheries and tourism. Coral reefs are one of the most diverse habitats on earth. They also act as a barrier to swell waves and storm surges thus preventing erosion of other inshore ecosystems and the coast.

Twenty seven percent of the world's mapped coral reefs are in South East Asia (Fig. 3.2) and 84% of these fringe Indonesia and the Philippines. All countries in the South China Sea have degraded reefs, from 95% in Hainan to an unknown amount in Viet Nam. They all identified overexploitation as an immediate cause of degradation, five cited destructive fishing and sedimentation, and coastal development was also a cause of damage.

A more insidious cause of destruction is high nutrient and/or suspended solids in the water either favoring seaweed to overgrow the coral or smothering the zooxanthellae (the synergistic plants that grow in coral polyps). There is also coral bleaching occurring in the region which may be caused by slightly higher water temperatures. The status of coral bleaching is currently being examined.

Loss of coral reefs has long-term implications because of the time that they take to recover. Protection of coral reefs is best carried out by means of declaring protected areas, such as marine parks. A lack of data on the location and status of existing reefs hampers efforts in controlling and preventing further damage.

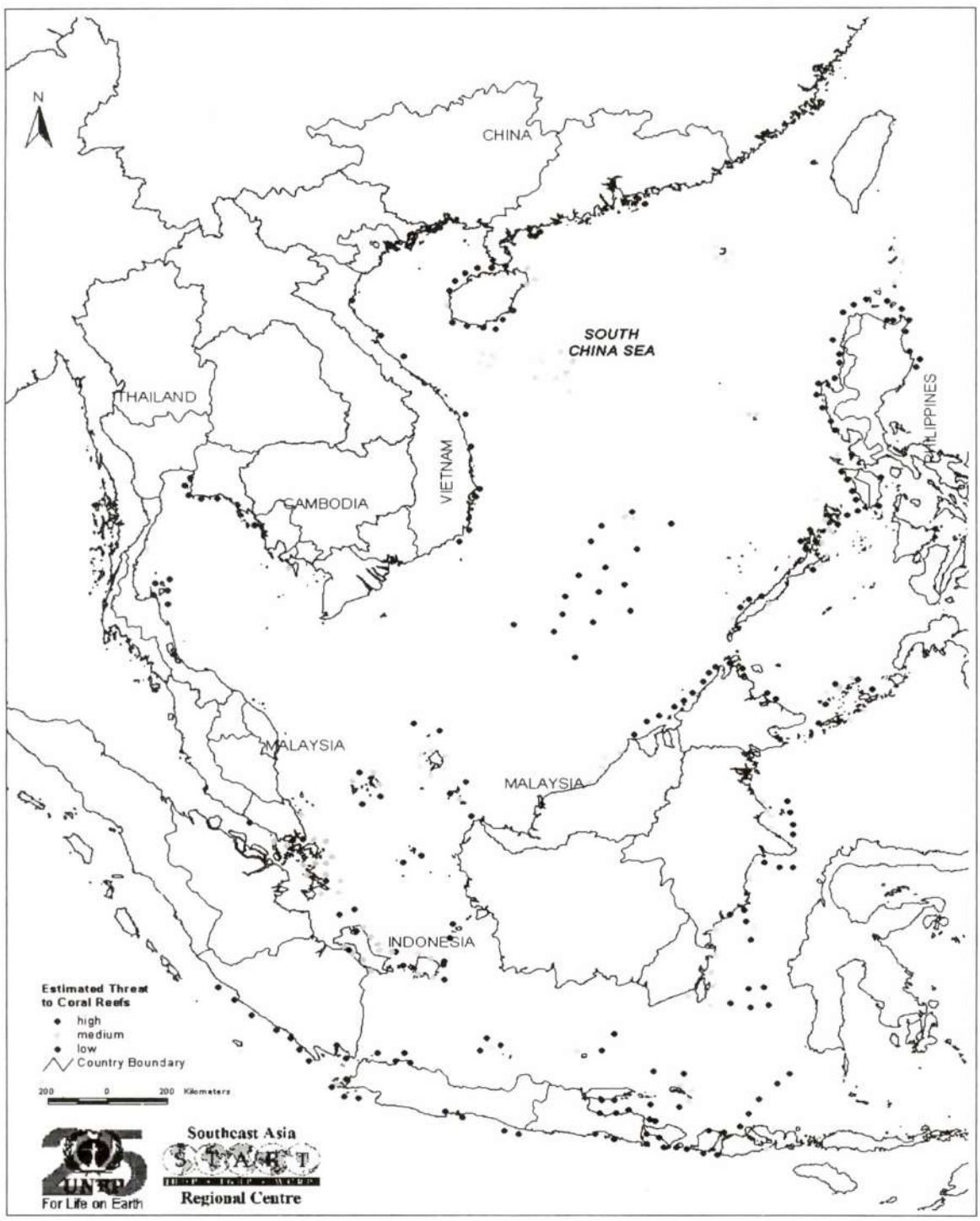

Figure 3.2 Distribution of Coral Reefs in the South China Sea

The value of the products and ecological services provided by the coral reef systems of the South China Sea is estimated at US$ 13,792 million per year (considering one third of coral areas of the South East Asia are located in the South China Sea, and have value of US$ 6076 ha^{-1} $year^{-1}$)

The transboundary issues associated with coral reef degradation are: loss of biodiversity, reduction in reef fisheries, coastal tourism, threatened or endangered species, and trade in coral, shells and associated biota. There is biodiversity connectivity when ocean currents move planktonic larvae to recruit fringing reefs and oceanic shoals, suggesting the strategic establishment of marine protected areas between interconnected reef systems.

Proposed Targets

- By 2010, to maintain the area of coral reef with more than 50% live cover at the present (1998) level.

Proposed Activities at the Regional level

- Develop criteria for selection of coral reef areas for protection/sustainable management, particularly those of transboundary importance;
- Identify and prioritise specific areas for future management and protection and develop regional and national action plans to maintain regionally important coral reef areas;
- Establish demonstration sites for implementing management models, based on the agreed model of management for the rest of the Region to study;
- Develop and agree on scientific and technical guidelines on the economic evaluation of coral reefs as resources;
- Develop, agree on and implement guidelines on the preparation of national legislation and action plans for preservation of coral reefs;
- Coordinate with other organizations standardising and regionalising coral monitoring, mapping and status and ensuring these are updated on a regional database;
- Build the capacity of the governments of the region to understand the issues concerning coral reefs and to raise public awareness concerning the national and regional importance of such ecosystems.

Proposed Activities at the national level

- Map and describe the status of coral reefs using, where appropriate the organizations currently performing these tasks;
- Establish coral reef protection areas and to implement proper management of coral reef resources;
- Prepare and implement national legislation and action plans for preservation of coral reefs, such as legislating marine parks in the region;
- Actively participate in activities organized by the relevant coral reef monitoring networks and provide information for the use of interested parties;
- Build the capacity of each nation in understanding coral reef based issues.

3.3.3 Seagrass

Seagrasses form the basis of many complex marine ecosystems and provide a valuable nursery for commercially important fish and crustaceans such as crabs and shrimps. When the seagrasses decline the links in the productivity chain are broken and the whole ecosystem collapses. Seagrasses also play an important role in the cycling of marine nutrients. Dugong and green sea turtles graze on seagrass leaves and rhizomes but other fish do not generally eat seagrasses.

Seagrasses have rhizomes that hold the sediments and form a mat over the bottom preventing erosion along the coastal fringes where they grow. The leaves slow the water movement over them thus causing particulate matter in the water to fall out into the seagrass meadow. Some of this particulate matter is organic and provides food for animals dwelling in the meadows.

Under natural conditions seaweeds (epiphytes) grow on seagrass leaves and stems, but when excessive amounts of nutrients are introduced to the coastal waters this seaweed can bloom (grow unnaturally rapidly). Under bloom conditions the seaweed can smother the seagrass host by blocking out the light the plants need to survive. Without photosynthesis the plant quickly uses up its stored food and dies. Light is also reduced by excessive suspended solids in the water coming from runoff from the land due to deforestation, forest fires, poor agricultural practices and inappropriate engineering works. Seagrass meadows are also damaged in the region by inappropriate fishing methods such as push nets and trawling which mechanically uproots the seagrass.

Seagrass meadows growing in shallow waters close to the shore renders them very susceptible to unplanned and unmanaged urban and industrial development and tourism. These problems are compounded by a lack of environmental assessment procedures for developments, awareness about the importance of seagrasses, and information on their distribution.

Seagrasses are the least studied marine habitats compared to coral reefs and mangroves. An assessment of the extent of habitat modification in the South China Sea is based on a few studied areas in some countries. Anywhere between 20 and 50% of seagrass areas in Indonesia, Malaysia, Philippines and Thailand are damaged. Main seagrass meadows in the region are shown in Fig. 3.3.

As with the other marine ecosystems the main transboundary issues are losses of biodiversity and fisheries productivity. The seagrass nursery areas provide commercial fish for fishing grounds a long way from the habitat of the juveniles. There is also a trade in seahorses and green turtles that live in seagrass meadows.

The best ways to preserve seagrass is by leaving it undisturbed, mainly by preventing trawling, maintaining water quality by reducing nutrient and suspended solids loads and by using appropriate fishing gear.

The value of the products and ecological services provided by the seagrass systems of the South China Sea is estimated at US$ 22,400 ha^{-1} $year^{-1}$. (The area of seagrass is not known. To determine this area is one of the aims of the project).

Proposed Targets

- By the year 2010, to maintain at least 80% of the present area of seagrass in good condition.

Proposed Activities at the Regional level

- Develop criteria for selection of seagrass areas for protection/sustainable management, particularly those of transboundary importance;
- Identify and prioritise specific areas for future management and protection and develop regional and national action plans to maintain regionally important seagrass areas;
- Develop and establish management regimes for the identified areas;
- Establish an accessible database containing maps and status of environmental health of sea grass beds in the South China Sea;
- Conduct training workshops on seagrass management;
- Build the capacity of the governments of the region to understand the issues concerning seagrass and to raise public awareness concerning the national and regional importance of such ecosystems.

Proposed Activities at the national level

- Provide and implement national legislation and action plans for the preservation of seagrass areas;
- Establish seagrass protection areas and implement proper management;
- Encourage monitoring, mapping and research on seagrass for a better understanding of the economic and ecological implications of conserving seagrass beds;
- Conduct economic valuation of seagrass areas as a resource;
- Conduct training on seagrass management.

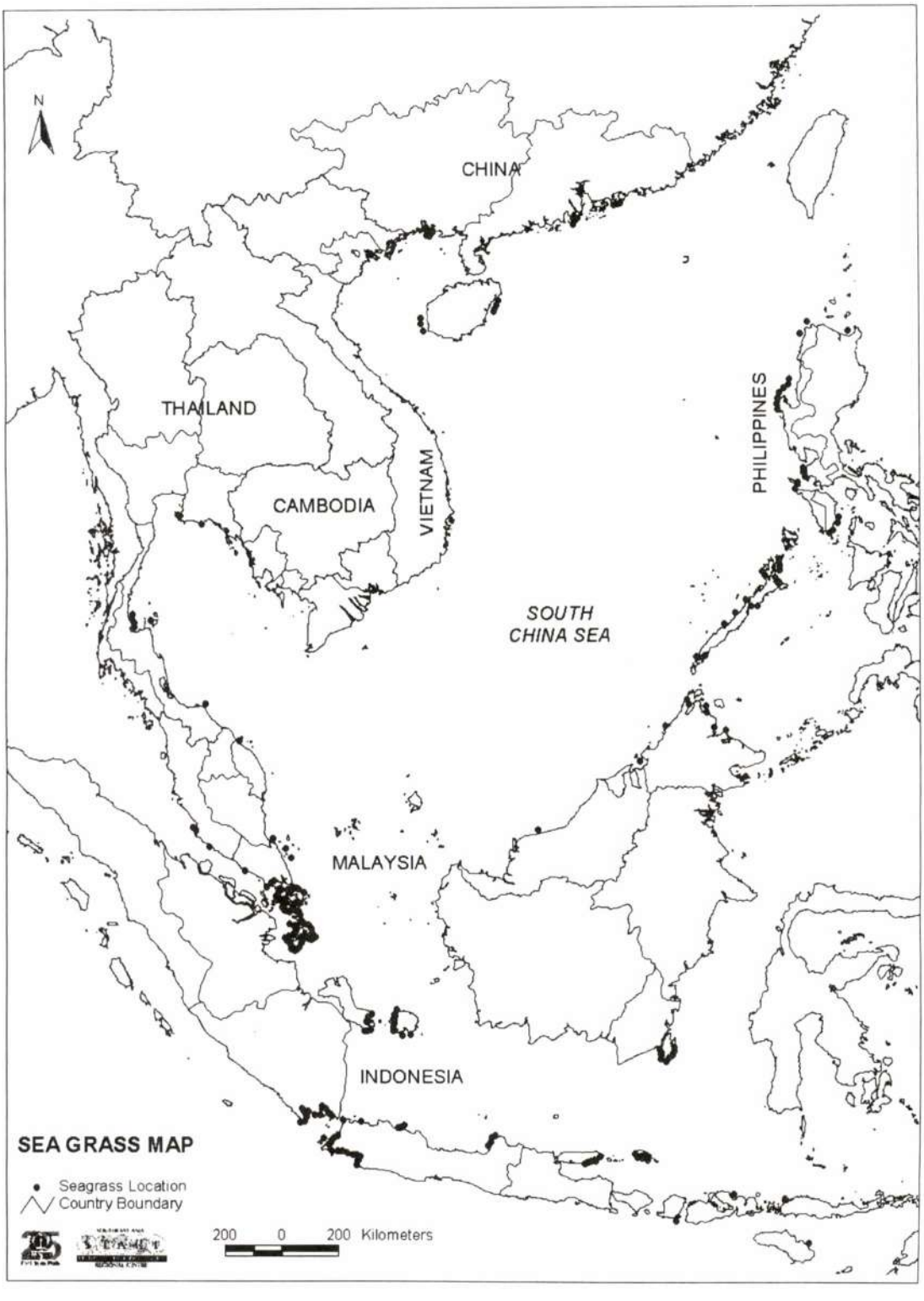

Figure 3.3 Distribution of Seagrass in the South China Sea

3.3.4 Estuaries and Wetlands

Wetlands are defined by IUCN in the "Ramsar Convention on Wetlands of International Importance" as "areas of marsh, fen, peat, land or water whether natural or artificial, permanent or temporary, in which water is static or flowing, fresh, brackish or salt including areas of marine water the depth of which at low tide does not exceed six metres." There is no simple definition of the wetlands that do not include mangrove forests, seagrass meadows and coral reefs to six m deep. In this report we will refer to wetlands as peat swamps, swamps, fens and saltmarshes.

Wetlands are the seasonal home to many migratory birds, they have their own suite of animals and plants of great diversity and are the nursery area of some commercial fish and crabs. They function as nutrient traps and some wetlands are used for aquaculture.

Wetlands are under threat from urban expansion (land reclamation), pollution from urban sources, and changes to coastal morphology from up stream development (dam building causing downstream erosion through lack of replacement sediment). Their small size makes them especially vulnerable to pollution. Those that are easily accessible or have a high concentration of birds and mammals, tend to attract large numbers of visitors, whose wastes are deleterious to the wetlands. Straightening the meanders of wetland streams and rivers changes the hydrology and/or salinity regime that is deleterious to wetlands. Introduced plants may dominate some wetlands and the classic example of this in many parts of the world is water hyacinth.

The value of the products and ecological services provided by the wetlands systems of the South China Sea is estimated at US$ 190,726 million per year (from Table W1 of the TDA, the total area of wetlands is about 12.9 million ha, and US$ 14,785 ha^{-1} $year^{-1}$ is its estimated ecological and economic value).

Proposed Targets

- By the year 2005, to have management plans for all wetlands, excluding mangroves, in the Region, with emphasis on those in the coastal zone.

Proposed Activities at the Regional level

- Develop criteria for selection of wetland areas for protection/sustainable management, particularly those of transboundary importance;
- Identify and prioritise specific areas for future management and protection and develop and implement regional and national action plans to maintain regionally important wetland areas;
- Develop, establish and implement management regimes for the identified areas;
- Develop and agree on scientific and technical guidelines on the economic valuation of wetlands as resources;
- Establish a GIS-type database providing the necessary information on wetlands in the Region;
- Build the capacity of the governments of the region to understand the issues concerning mangroves and to raise public awareness concerning the national and regional importance of such ecosystems.

Proposed Activities at the national level

- Develop and implement guidelines, standards and measures to control development impinging on wetland areas;
- Establish and implement management plans for wetland "hot spots" to conserve their ecological and economic functions, including encouraging nations to ratify the International Convention on Wetlands (Ramsar);
- Enhance public awareness of wetlands and assist with capacity building.

3.4 Over exploitation of fisheries

The problem of unsustainable exploitation of living aquatic resources is found in all the national reports. Almost all countries bordering the South China Sea suffer from an ineffective fisheries management system, allowing the non-sustainable use of living marine resources.

The deteriorating resource base, as described in 1.1 and 2.1, is compounded by socio-economic problems. Typically, many small-scale fishermen compete for resources with a few large-scale more capitalised entrepreneurs. Current management policies may exacerbate the problems by providing incentives for over-exploitation, e.g. subsidies for capital investment or fuel, and provision of infrastructure and industrial incentives.

Different levels of development in the countries of the South China Sea lead to uneven resource capabilities. Some countries have large fleets of large vessels that have depleted local resources and are now encroaching on others which have not had the means to fully exploit their resources. This transboundary movement of fishing fleets results in conflicts among countries where territorial water limits are violated.

Where the level of exploitation is now excessive, guidelines to reduce that level to a more sustainable one should be prepared. This sustainable level of fishing can be at many optimal levels, from open access, where a limit on the amount of fish caught is laid down but not on the effort required to catch them, to maximum economic yield, where the catch is limited by the economic return. The maximum ecological yield lies somewhere between.

The prevailing situation is one of open access, where the level of exploitation is in access of the ecological and the economical optimal levels. The choice is thus between whether to continue with open access or to reduce the level of exploitation to either ecological or economic optimum. Economic theory does not provide a clear-cut answer; rather, the choice is between social preference, and the likely response of the ecosystem productivity.

From the perspective of welfare, the main concern is with the maximisation of valued-added product, and the aim of the intervention should be to achieve the level of long-term exploitation that is maximising welfare with maximum economic yield. The target should take into account costs of effort and the productive potential of the ecosystem.

The target for the issue of excessive exploitation should be to reduce the level of effort to the level that is economically welfare-maximizing and still preserve the

resource base. The decisions on the form and amount of intervention should establish the actual target levels of exploitation for these resources, and the economic cost to capture them. It should concentrate on the targeted living aquatic resources of each country, and consider the social implications. The question of large versus small-scale fishermen has to be thoroughly recognised and dealt with in these studies realising that the removal of fishing boats and employment will cause hardship and short-term problems. These issues must be included in the action programme.

Proposed targets

- By 2005 to determine regional catch levels of key economic/commercially important species according to levels that are economically welfare maximising, while still preserving the resource base;
- By the year 2005, to have established a regional system of marine protected areas for fishery stock conservation and care for endangered species;
- By the year 2005 to have prepared and implemented at chosen sites, a management system that will sustain the exploited resources.

Proposed activities at the Regional level

- Develop criteria for selection of marine habitats and areas critical to the maintenance of regionally important fish stocks, particularly those of transboundary importance;
- Identify and prioritise specific areas for future management and protection and develop regional and national action plans to develop a regional system of refugia for maintenance of regionally important fish stock;
- Develop and establish management regimes for the identified areas;
- Review destructive fishing activities with the aim of removing and replacing them;
- Review fisheries management systems;
- Review compliance to international fisheries conventions.

Proposed activities at the national level

- Establish marine protected areas in areas identified as critical habitats for fish stock conservation and protection of endangered species;
- Implement programmes to provide information on fish stock conservation and sustainable fishery practices among small and artisanal fishing communities;
- Conduct resource assessment of fishery resources to determine the level of optimal catch and effort for different fishing grounds in the Region;
- Develop educational and public awareness materials on sustainable fishery practices for dissemination in countries;
- Establish in selected pilot sites a good management system which can be tested to determine if it is leading to sustainable exploitation of resources;
- Promote the Code of Conduct for Responsible Fisheries through workshops, awareness building, translate into local languages and educate people about the Code.

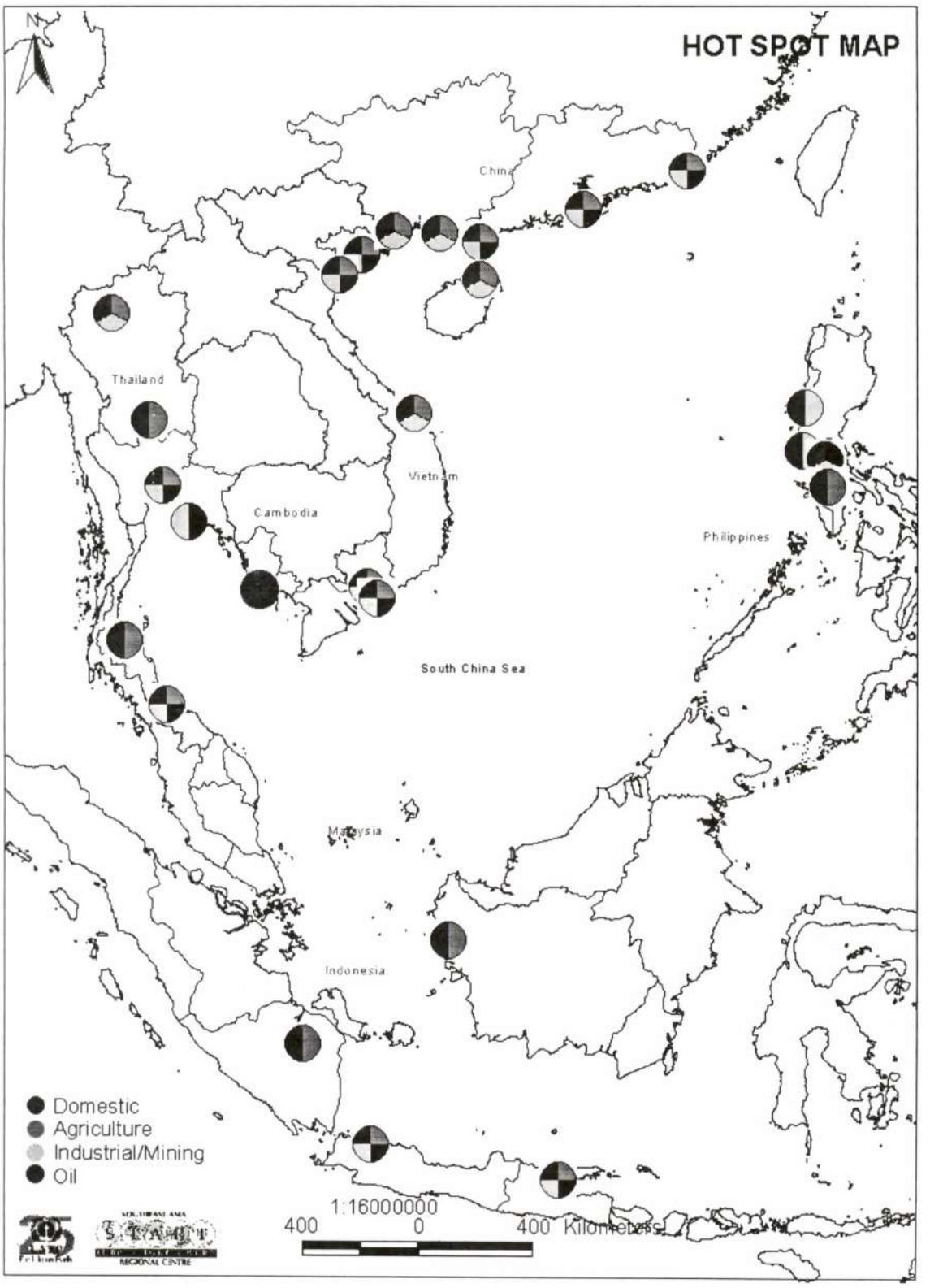

Figure 3.4 Distribution of Pollution "Hot Spots" in the South China Sea

There should be close co-ordination and co-operation with the Regional Office of Food and Agriculture Organization (FAO) for the implementation of the actions identified.

3.5 Land-based Pollution

Most of the polluting elements that occur in the sea come from the land, waste from large cities includes sewage, industrial waste and hydrocarbons, while agricultural runoff has nutrients, pesticides and sediment that may pollute the marine environment. The "hotspots" or areas of most concern are shown in Fig 3.4.

3.5.1 Urban/Municipal Waste

Urban waste consists of solid waste, such as plastic, glass, cans etc.; and sewage consisting of organics which increase BOD, nutrients and bacterial coliforms that can damage human health. Solid waste is unpleasant to the eye, can choke marine life and may calm water to such an extent that alga blooms are allowed to concentrate in the mass of floating debris. High BOD loading reduces dissolved oxygen available to fish and other marine life. Usually the pelagic fish swim away from these areas but demersal fish, worms, crustaceans and sessile animals are killed. Lowered oxygen in the water also kills plants such as seaweed and seagrasses. The populations of the seven countries of the South China Sea generate about six million tons per year of organic matter. Only 11% of this is removed from four countries with treatment plants. The main producers of BOD are shown in Fig 3.5.

Nutrients from treated or untreated sewage enhance the growth of phytoplankton that may concentrate to such an extent that they form algal blooms. Sometimes these algal blooms are toxic and fish kills and worse, human poisoning, may occur. Excess nutrients in the water column may also be harmful to seagrass meadows. Epiphytes on the seagrass leaves adsorb the nutrients, grow quickly and shade the seagrass so that it can no longer photosynthesise enough food to sustain it. Storage material is used up and the seagrass dies. With the death of the seagrass the organic matter, made up of epiphytes, seagrass detritus and associated flora and fauna, fall to the bottom, use up oxygen as they decay and the BOD rises, eventually leading to anaerobic conditions and virtual desertification of the seafloor. This excess of nutrients is called eutrophication.

Usually, in the sea, nitrogen is the limiting nutrient to plant growth so it is usually monitored in preference to phosphorus if monitoring facilities are limited. Total nitrogen includes organic nitrogen as well as the inorganic form taken up readily by plants. Total nitrogen from different sub-regions or districts of the South China Sea is shown in Fig. 3.6. Untreated sewage contains much organic matter that has a deleterious effect on demersal communities. The organics from sewage are most easily removed in the treatment plant and can be used for mulch and organic fertilizer. High coliform counts in rivers, estuaries and coastal waters cause health problems to users of the water bodies. *E. coli* is killed by sunlight and settling ponds usually reduce coliform counts. Another sources of bacteria in coastal waters is urban runoff from roads, gardens and footpaths where domestic animals' faeces are washed into the drains, rivers and out to sea.

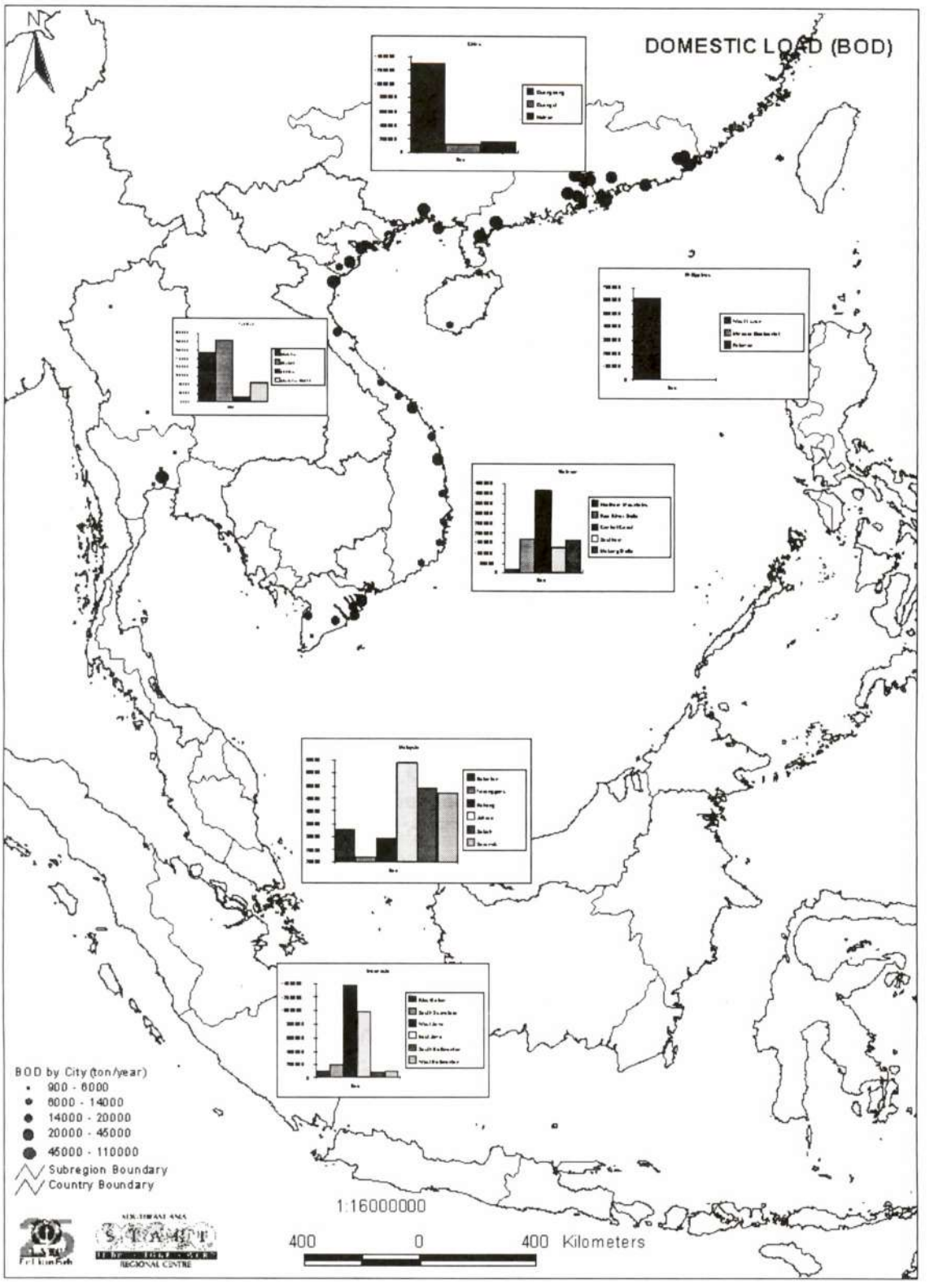

Figure 3.5 Biological Oxygen Demand from Domestic Sources in the South China Sea

Cities in the coastal areas of the South China Sea are large and growing, e.g. Guang Zhou, Hong Kong, in China, Ho Chi Minh City in Viet Nam, Bangkok in Thailand, Manila in Philippines, Jakarta in Indonesia and Singapore. Few have sewage treatment facilities, so that waste is released directly into the rivers and seas. This inappropriate management results in severe pollution through high BOD loadings, eutrophication, fish kills, red tides, damage or loss of seagrass habitat and public health hazards.

Some of these problems can be addressed by installing waste treatment facilities. However, this approach has been hampered by lack of finance and cost recovery of facilities. Information on the damage caused by sewage pollutants and the economic loss due to pollution should be provided to the governments and public. There are alternatives to coastal dumping, such as using the two scarce commodities, freshwater and fertilizer, in forestry, crop growing or playing field management.

3.5.2 Industrial Waste

Urban centres are also the location for major industrial agglomerations, e.g. Bangkok, Maptaphut, Guang Zhou, Haiphong, with significant discharge of industrial wastes to the marine and coastal environments, which can be highly toxic and damaging to marine life. Causes of industrial pollution are lack of or poor enforcement of industrial pollution laws and regulations, poor facilities and the desire of factories to promote competitiveness in the international market by ignoring environmental and social costs. These problems can be reduced by incentives and regulations to recycle wastes.

One of the environmental services provided by the oceans is its capacity to assimilate or absorb wastes. However this capacity is being exceeded in many coastal areas in the South China Sea region. The pollutants from industrial waste range from nutrients to specific persistent organic pollutants that will, in most cases, be toxic.

3.5.3 Agricultural Waste

The reliance of countries of the South China Sea on agriculture for food and exports means that much of the land surface is used for growing crops or rearing animals. Successful farming relies on adequate applications of fertiliser to enhance plant growth and the use of herbicides and insecticides to reduce pests that lower crop or animal yields.

Far too often fertiliser is over applied and applied at the wrong time thus making it available to be washed away. Apart from the economic waste of losing fertiliser to runoff after rain, there is a major problem of high nutrient levels in the marine environment once the runoff enters rivers and hence the sea. Animal waste from piggeries and poultry farming and the effluent from aquaculture also contain nutrients which can damage marine ecosystems. Very often these wastes are allowed to run into waterways in times of flood or rainfall. Shrimp and fish farms are major sources of nutrients to the marine environment as they are usually close to the sea and excess feed and faeces are not treated in settling ponds. These non-point sources of nutrients enter the sea and may cause transboundary problems if they are not immediately absorbed by plants (phytoplankton, seagrasses, seaweed or mangroves).

Economic loss due to poor water quality, loss of nursery habitat for commercial species and disease in fish and shrimp ponds, means that attempts should be made to reduce loss of nutrients to the marine environment.

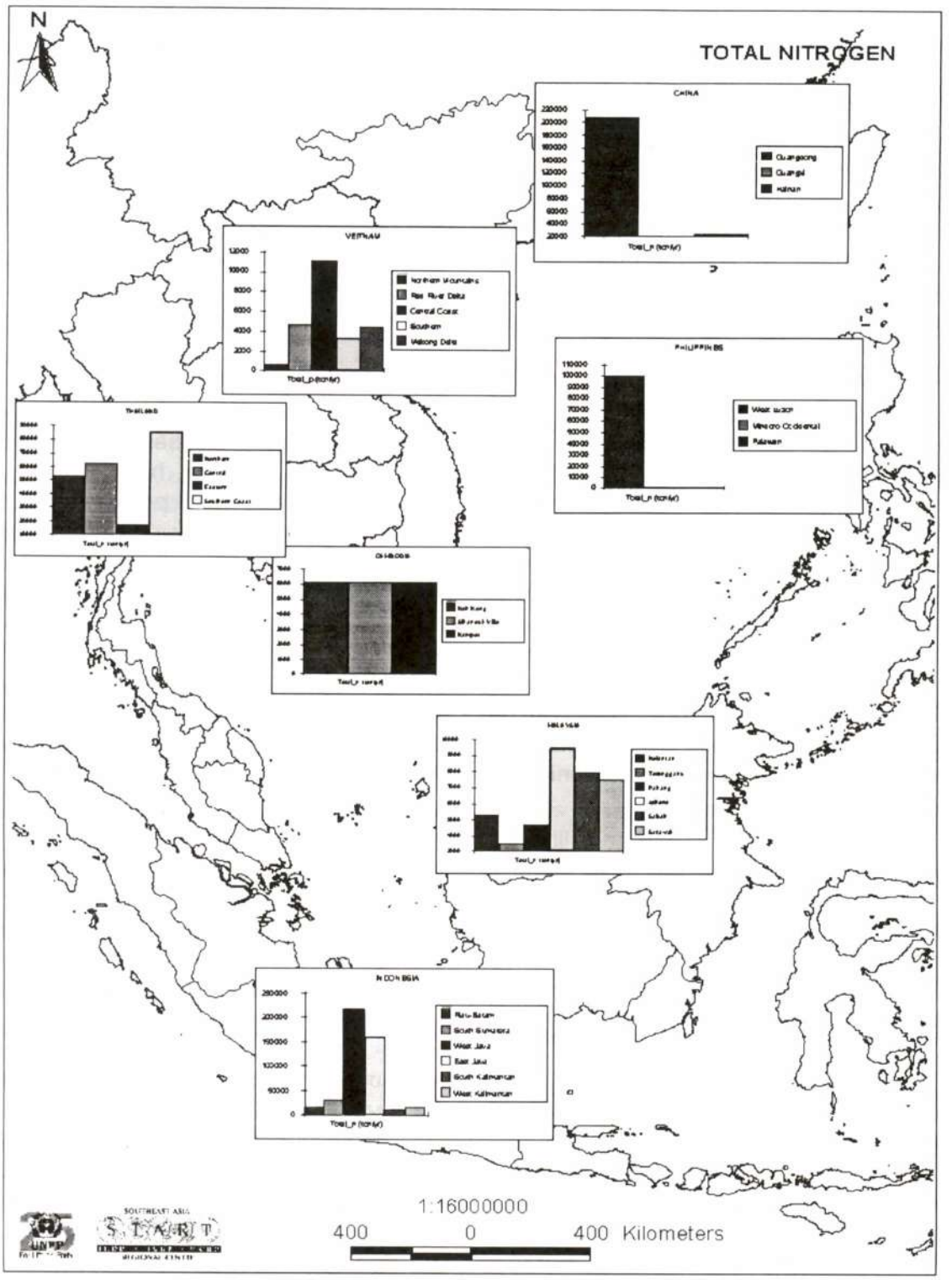

Figure 3.6 Total Nitrogen in the South China Sea

As insects and weeds become more immune to chemicals, larger applications are made. Cost benefit analysis often suggests that applying the extra pesticide to kill the last 5-10% of a pest is not economic and the extra pesticide is often wasted by also entering waterways. These pesticides have varying effects on the marine environment. Some may be persistent and accumulate in animal or plant tissue, others may accumulate in the sediment and be released during storms. The damage they do is also variable and ranges from causing impotence in gastropods to moving up the food-chain to human food.

3.5.4 Hydrocarbons

Oil-spills from wrecked ships are not the major cause of oil pollution in the sea. The UNEP *The State of the World Environment 1987* states that half a million tonnes of the 1.6 million tonnes annually discharged into the sea by shipping is released accidentally: The remainder results from regular discharge by ships of contaminated ballast water and water used for flushing out tanks. Later figures estimated total marine pollution at 3.5 million tonnes, with 48% coming from land (*World Resources, 1987*). Municipal and industrial wastes represent the single largest source.

Marine sources of hydrocarbon pollution in coastal and marine waters are ships and oil and gas exploration and production platforms. The high risk areas for oil pollution from marine sources are shown in Fig. 3.7. The amount of ship traffic - commercial, fishing, leisure and bulk oil carriers, is likely to increase in the region and with it the risk of pollution from ship-based oil. Hydrocarbon pollution may be limited in extent but have severe consequences for the marine environment because some of the substances are not easily biodegradable and highly toxic. Methods exist to contain the effects of major oil spills and there are standards established for oil and gas exploration and production activities to reduce pollution. These need to be followed and monitored. Yet, in spite of precautions, accidents will occur, and countries need to be prepared to deal with these emergencies in order to contain the damage.

The main difficulty of preventing marine-based sources from polluting the sea, however, is in dealing with dispersed sources of pollution from small boats because they are small scale and widespread, but the effect can be cumulative. The best way to deal with this is to encourage people to adopt good practices in dealing with oil based substances through education and provision of adequate facilities to dispose of waste oils etc. at landing sites.

Land-based activities like oil refining, oil-well blow-outs and leakages, and fallout from the atmosphere are sources of hydrocarbons in the sea, but most comes via run-off from rivers and city drains. More oil enters the coastal areas from car exhausts and oil-changes in city garages that are then dumped down the drain, than from any other source (*Elsworth, S. A Dictionary of the Environment, 1990.*).

Because of its persistence, oil in the marine environment is a transboundary issue. Oil is driven by both currents and wind action across the sea surface. For large oil-spills from wrecked tankers or blowouts from sea-based oil exploration platforms the responsible companies usually have oil-spill contingency plans. Often the companies have not co-ordinated these operations among themselves. For a large spill there is not

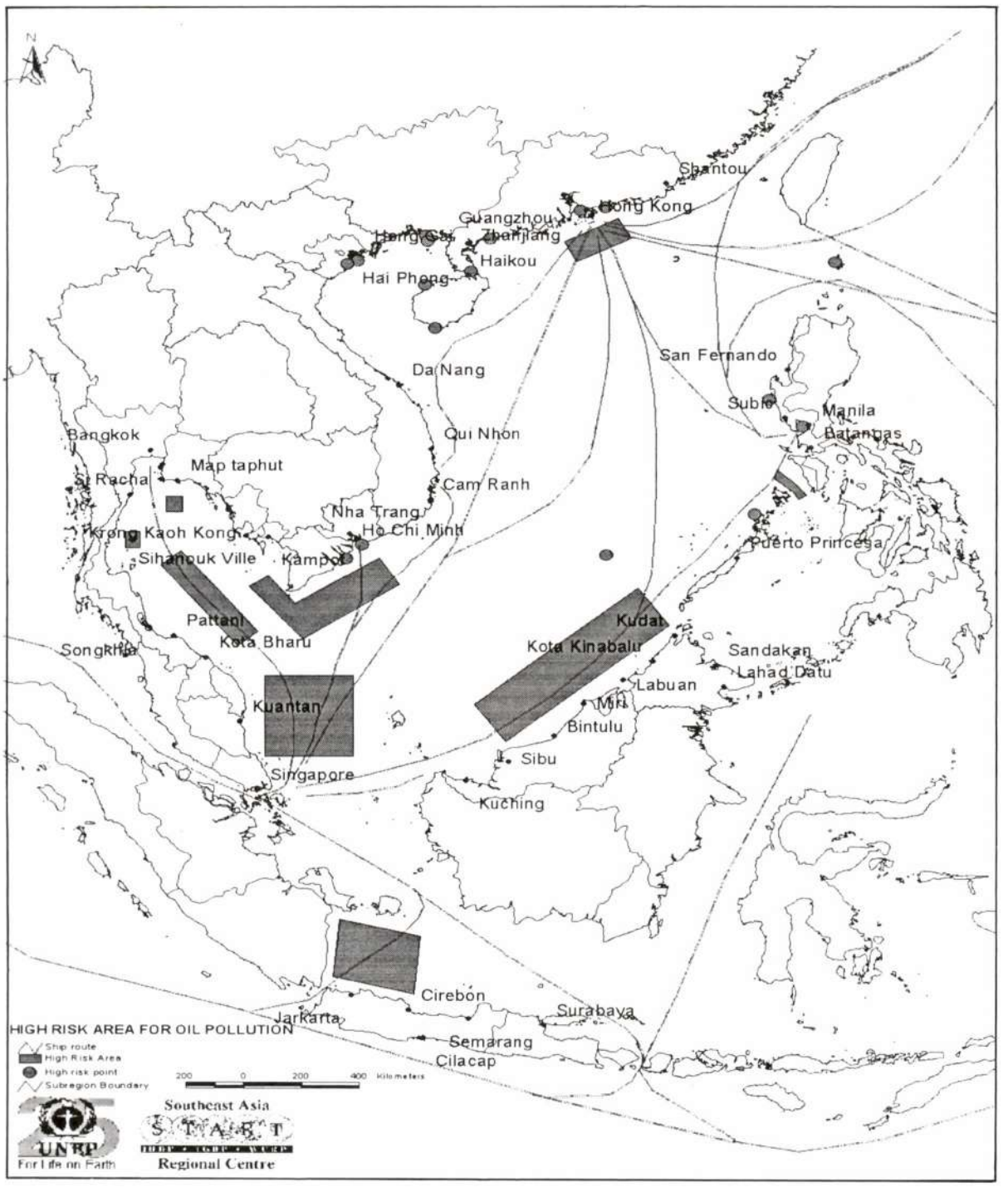

Figure 3.7 High Risk Areas for Oil Pollution in the South China Sea

enough equipment to contain the oil and not enough is known of the whereabouts of vulnerable areas to make decisions on where to place limited clean-up equipment. A mapping program to map vulnerable underwater habitats would be useful if seagrass meadows and coral reefs are to be saved. Co-ordination between companies and countries within the Region may help save some of the more valuable ecosystems if a large spill occurred.

3.5.5 Suspended Solid/Sedimentation

Inappropriate agricultural practices and deforestation may leave bare soil available to erosion by wind and rain. Land clearing of forests for agricultural crops is a major supply of suspended solids and silt in rivers and coastal areas. The recent floods in China, although the largest on record did not result from the largest rainfall on record, rather, the amount of deforestation caused vast areas of loose sediment to be removed which silted up rivers and hence river water broke over the rivers' banks and flooded the land.

Inappropriate engineering practices also lead to large volumes of sediment being washed into rivers and the sea. The slope of unprotected earth walls in shrimp farms, causeways, bridge approaches and roadsides are potential sites for erosion. With long-term planning it should be obvious to engineers that repairs will be needed after a few years of erosion. Artificial coverings such as Geotextile can be used, or slopes and banks can be revegetated using seed of a fast growing annual which will stabilise the bare soil long enough for more robust perennials to take over.

Eroded soil is washed into waterways and this suspended solid material reduces water quality. Reduced water quality in this case means less light to benthic plants and may result in a loss of benthic vegetation. Many of the rivers of the South China Sea are heavily laden with suspended solids and some of these rivers have picked up these solids in countries other than that in which the river enters the sea, thus a transboundary problem occurs. Rivers that discharge large volumes of water often have plumes of suspended solids which cross ocean boundaries and are therefore transboundary on their effect on the marine environment.

There is an amount of suspended solids which has always washed out to sea caused by floods and natural erosion, in recent years this natural loss of soil and sediment has increased due to human activities. It is necessary to determine what is an acceptable flow of suspended solids and what is caused by inappropriate human activities. Some of these activities may be irreversible and this should be identified before attempts are made to change the situation.

River-borne sediments are a major contribution to the water bodies in the South China Sea region. Sediments perform useful functions by replenishing the coastline, maintaining the land area for human habitation and supplying nutrients to the water bodies. However, human actions in the upstream regions significantly affect the process of river sedimentation. Dam construction can trap the flow of sediments and reduce the supply to replace the beach material eroded by tidal action, resulting in eroding shorelines and threat to coastal structures.

Proposed Targets

- By 2003 develop and agree on regional water quality objectives; make recommendations for water quality standards for use in coastal waters; make recommendations for effluent standards/or mitigation measures for municipal, industrial and agricultural (including aquaculture) activities;
- By 2003 develop guidelines for monitoring coastal waters, taking into account already published guidelines;
- By 2003 determine principal pollutants in the region, estimate the carrying/assimilative capacity of relevant ecosystems for relevant pollutants - BOD, nutrients, metals, sediments etc.
- Establish a regional contingency plan for South China Sea to handle incidents of oil and chemical or hazardous waste spillage;
- By 2004 develop a regional South China Sea Plan of Action for land-based activities to meet regional water quality objectives;
- By 2005 identify 10 Priority Discharge Sites for action and develop appropriate mitigation activities;
- By 2005 develop regional funding mechanisms for mitigation activities;
- By 2006 initiate mitigation activities on the Priority Discharge Sites;
- By 2008 review recommended water quality standards in national legislation.

Proposed Activities:

Determine regional water quality objectives and water quality and effluent standards:

- First meeting to review and assess existing knowledge of regional water quality, determine information gaps, set a programme for carrying/assimilation capacity evaluation, discuss GPA-land-based activities guidelines/action programmes (2002);
- Second meeting to agree on water quality objectives, determine a regional South China Sea Plan of Action (based on GPA-land-based activities);
- Third meeting to agree on regional water quality and effluent standards;
- National meetings for endorsement of South China Sea Plan of Action (2005);
- International organisations, such as UNEP EAS/RCU, will initiate the production of package programmes to help member countries facing problems associated with land-based activities that pollute the South China Sea.

Determination of Regional Priority Hot Spots (2005)

- Discuss and agree on criteria for evaluating the regional importance of nationally identified pollution "hot spots" (severity of pollution, feasibility/ease of mitigation, transboundary effects);
- Assess and evaluate data relating to national "hot spots" and prepare and agree on regional priorities;
- Conduct a preliminary evaluation of the costs and benefits of alternative mitigation measures for selected "hot spots";
- Develop and agree on a South China Sea strategic approach to mitigating regional "hot spots", including priority investment portfolio, cofinancing arrangements, national and regional actions.

- Carry out capacity building activities that lead to improvement in water quality testing and hence cleaner water. Determine the carrying capacity of ecosystems for specific pollutants, realising that the carrying capacity of a human-made toxic chemical is zero. Analyse secondary data and, where appropriate, carry out some primary studies to improve water quality testing and hence water quality. (2003)

3.5.6 Regional Cooperation

To achieve collaboration and co-operation among countries it is usual to have legal frameworks that cover the areas of interest between the interested parties. However, there is no legal framework that directly relates to forming a marine environment protection co-ordinating body and few that relate to the marine pollution problems prioritised by the member countries of the South China Sea. The development of a legal framework between member countries requires negotiation and compromise at the highest level. The objectives of a legal framework (or protocol) are to protect and manage the marine environment and coastal areas of the South China Sea region, including actions on:

(a) Taking all necessary measures to prevent, reduce and control pollution of the South China Sea area, particularly dumping, land-based sources, activities causing habitat loss and airborne pollution;

(b) Protecting and preserving rare or fragile ecosystems as well as the habitat of depleted, threatened or endangered species and other marine life in specially protected areas;

(c) Co-operating in dealing with pollution emergencies in the South China Sea area;

(d) Co-operating in assessing environmental impacts in the South China Sea area and in exchanging data and other scientific and technical information;

(e) Establishing rules and procedures for the determination of liability and compensation for damage resulting from pollution in the South China Sea area.

There are some global and regional conventions/protocols that cover these issues but none that directly apply to pollution from land-based sources in the South China Sea or the East Asian Seas. Table 3.1 Global and Regional Conventions/protocols on the Protection of Marine Environment.

Proposed Targets

- Further develop the SAP by holding national expert and intergovernmental consultation by the year 2001;
- By 2002, convince a high level meeting of government officials and experts to formulate a legal framework for regional co-operation for the protection and sustainable management of the marine and coastal environment of the South China Sea;
- By 2005, complete a draft agreement on the legal framework for regional co-operation for the protection and sustainable management of the marine and coastal environment of the South China Sea.

Proposed Activities at Regional Level

- Initiate negotiations on the establishment of a legal framework for regional co-operation for the protection and sustainable management of the marine and coastal environment of the South China Sea;
- Prepare a draft legal framework for regional co-operation for the protection and sustainable management of the marine and coastal environment of the South China Sea, taking into account existing expertise within UNEP, and national institutions;
- Discuss a draft legal framework for regional co-operation for the protection and sustainable management of the marine and coastal environment of the South China Sea; and
- Submit a draft legal framework to the national focal points for their consideration on its adoption.

Proposed Activities at National Level

- Provide necessary information and expertise on the negotiation and establishment of a legal framework for regional co-operation for the protection and sustainable management of the marine and coastal environment of the South China Sea;
- Assist in preparation of a legal framework by active participation in the whole process of negotiation;
- Co-ordinate with relevant national institutions concerned in preparation, negotiation and adoption of a legal framework.

4 COST BENEFIT ANALYSIS OF PROGRAMME ACTIONS

In this section the evaluation is focussed on:

- The economic and ecological valuations of the resources;
- The costs of the actions to meet the targets as identified in Section 3;
- The value saved by meeting the targets identified by specific actions of the project;
- The benefits obtained after the GEF project is complete.

4.1 Valuation Considerations

The valuation of the resources of the South China Sea estimates the value of ecosystems in terms of ecological functions and economic values which follows that used in Costanza *et al.* 1997 (The value of the world's ecosystem services and natural capital. Nature, 387, 253-260).

Ecological functions include: regulation of atmospheric gas concentrations, climate, protection of other ecosystems from disturbance, water supply, erosion control, soil formation, nutrient cycling, waste treatment, pollination, biological control and provision of habitat/refugia.

Economic values include food and fibre production, raw materials, genetic resources, recreation and cultural values. Constanza *et al.* (1997) estimates the value in terms of flow of services per unit area per year, hence the area estimations for the different ecosystems reported in the TDA are used. The reason we used the Constanza

approach is that this is the first global attempt to give values to ecosystems and, to be consistent, we used the same methods for each of the ecosystems.

The base line for the cost benefit evaluation is that if nothing is done, then habitat loss will continue. The rate of habitat loss is based on the findings reported in the TDA, and takes into consideration the future threats, also reported in the TDA. Rates of loss have varied in the past for the different periods given by each country. These rates also change with economic conditions so that each scenario we have used reflects differing future socio-economic conditions. The "with project" scenario is based on the targets for each ecosystem laid out in Section 3, and the details are provided in the relevant sections.

4.2 Valuation of Resources

The relevant economic and ecological values for the four marine ecosystems of particular interest in the South China Sea are shown in Table 4.1. The seagrass values include a figure for commercial fish caught over seagrass from Virnstein and Morris (1996). Most of the value in seagrass and mangrove is from waste and nutrient cycling and this is a third of the value of wetlands. Tourism is a large component of the value of coral reefs. One of the activities identified in the SAP is to improve these estimates of values for ecosystems in the South China Sea.

Table 4.1 Valuation Of Ecosystems *(In US Dollars, Adapted From Constanza et al.)*

	Mangroves	Coral Reefs	Seagrass	Wetlands
Gas regulation				133
Disturbance regulation	1,839	2,750		4,539
water regulation				15
water supply				3,800
nutrient cycling			19,000	
waste treatment	6,696	58		4,177
biological control		5		
habitat/refugia	169	7		304
Sum ecological	**8,704**	**2,820**	**19,000**	**12,968**
food production	466	220		256
raw materials	162	27	3,400	106
recreation	658	3,008		574
cultural		1		881
sum economic	**1,286**	**3,256**	**3,400**	**1,817**
sum total	**9,990**	**6,076**	**22,400**	**14,785**

For the analysis of actions programmes we define two scenarios. The first is for low destructive pressure on the particular ecosystem and the second is for high pressure. When there is a demand for high export earnings and population pressure is great the higher scenario is the most likely. Under better economic conditions and with population increases slowing, the lower scenario can be used (Table 4.2).

Table 4.2 Rates and amounts of Habitat Loss Under High and Low Pressure on the Habitats

HABITAT	TARGET *(in thousand ha)*			ANNUAL RATES OF HABITAT LOSS %		
	1998	2010 Low	2010 High	Target	Low Pressure	High Pressure
Mangrove	1754	1556	1022	0.88	1.0	4.5
Coral Reef	2219	2090	1664	0.00	0.5	2.4
Seagrass	1652	1153	498	1.86	3.0	10.0

There is a number of assumptions made about the rate of loss for a particular scenario. Under low human pressure, loss is at a lower rate therefore if the target is achieved the benefit will be relatively small compared with that at a high human pressure. The benefit under low pressure will, however, be significant because, at a high discount rate, the benefits from saving habitats at low pressure are $2.7 billion at a 50% discount rate (Table 4.5). The low pressure scenario in each ecosystem type is the most likely because of attempts underway now by governments and other institutions to conserve marine ecosystems. The regional approach suggested by this GEF proposal will improve these attempts. If governments do not continue efforts at conservation and remediation and the ecosystems deteriorate further the value of this programme will rise.

4.2.1 Mangrove

The target of the programme to preserve mangroves is to maintain the area of mangrove at no less than 90% of the existing (1998) level by the year 2010.

The threats to mangrove come from conversion to other uses, such as shrimp farming and urban development. There is almost unlimited access to mangrove for conversion in most areas. Where zoning is implemented, there may be enforcement problems. The key way to maintaining the area of mangrove in the face of the economic pressure for conversion is to adopt a land use zoning approach taking into account the relative value of the mangrove in each area from a national, Regional and global perspective. Areas of national, regional or global significance should receive a high priority in national policies aimed at sustainable management of mangrove systems. Examples of transboundary significance are the areas between Malaysia and Thailand, and between Thailand and Cambodia. Important areas should be chosen for developing management plans and then these plans implemented. Actions to value mangroves in this region should be implemented. Monitoring is needed at national and Regional levels. National and regional data, experiences and inventories should be collected in a regional data network.

Where necessary, mangroves can be restored by replanting, though the time required to reach a mature stand may be considerable (10-20 years). The investment in replanting mangrove areas provides benefit in services provided from the mangrove, and ecosystem functions such as protection of coastal habitat and beaches.

National actions should take advantage of experiences gained from similar programmes elsewhere. Information exchange among mangrove area managers, such as replanting successes, management by local populations, and the technical aspects of silvicultural, should be supported. Various management models can serve as pilot sites to demonstrate techniques that can be tried in other areas and can provide a training ground from which others can learn.

Without intervention, it is likely that mangrove area will continue to be lost. In this section we present two scenarios. A low pressure scenario assumes a 1% annual loss of mangrove, derived from the current rate of loss from 1.9 million ha in 1990 to around 1.6 million ha now (TDA Report) (Table 4.3). There was a concomitant decline in fishery productivity (economic) and an increased incidence of beach erosion (functions). By far the main loss was in terms of ecological function, accounting for almost 90% of the total value of the annual flow of value of mangroves. The total present value of mangrove saved by intervention and assuming the target was met, is $0.9 billion in 2010 if 1% were saved. This is a saving of $118 million at a discount rate of 50% (Table 4.5).

Table 4.3 Calculation of Areas Saved by Action Programme: Low Pressure Scenario
(in thousand ha)

Area without action programme		1	2	3	4	5	6	7	8	9	10	11	12
mangrove	1,754	1,736	1,719	1,702	1,685	1,668	1,652	1,635	1,619	1,603	1,587	1,571	1,556
coral reef	2,219	2,208	2,197	2,186	2,175	2,165	2,154	2,143	2,132	2,122	2,111	2,101	2,090
seagrass	1,652	1,603	1,556	1,510	1,465	1,422	1,380	1,339	1,299	1,261	1,224	1,188	1,153
Area with action programme													
mangrove	1,754	1,739	1,723	1,708	1,693	1,679	1,664	1,649	1,635	1,621	1,606	1,592	1,579
coral reef	2,219	2,219	2,219	2,219	2,219	2,219	2,219	2,219	2,219	2,219	2,219	2,219	2,219
seagrass	1,652	1,621	1,592	1,562	1,534	1,505	1,478	1,450	1,424	1,397	1,372	1,346	1,322
Area saved by action programme													
mangrove		2	4	6	8	10	12	14	16	18	19	21	23
coral reef		11	22	33	44	55	66	76	87	98	108	119	129
seagrass		18	36	53	68	83	98	111	124	136	148	159	169

Table 4.4 Calculation Of Values Saved By Action Programme: Low Pressure Scenario

Action	year 0	1	2	3	4	5	6	7	8	9	10	11	12
Habitat conservation													
mangrove area saved		2	4	6	8	10	12	14	16	18	19	21	23
coral reef area saved		11	22	33	44	55	66	76	87	98	108	119	129
seagrass area saved		18	36	53	68	83	98	111	124	136	148	159	169
Value of habitat saved (*million USD)													
Ecological													
mangrove		18	37	54	72	89	106	122	138	154	170	185	200
coral reef		31	62	93	124	155	185	215	245	275	305	335	364
seagrass		349	682	998	1,299	1,585	1,857	2,114	2,359	2,590	2,809	3,016	3,212
Economic													
mangrove		3	5	8	11	13	16	18	20	23	25	27	30
coral reef		36	72	108	143	178	214	249	283	318	352	387	421
seagrass		63	122	179	233	284	332	378	422	463	503	540	575
Total Value													
mangrove		21	42	62	82	102	121	140	159	177	195	212	229
coral reef		67	134	201	267	333	399	464	529	593	658	722	785
seagrass		412	804	1,177	1,532	1,869	2,189	2,493	2,781	3,053	3,312	3,556	3,786
Total Value		**500**	**980**	**1,440**	**1,881**	**2,304**	**2,709**	**3,097**	**3,468**	**3,824**	**4,164**	**4,489**	**4,801**

Low Pressure Scenario

Table 4.5 Net Present Value (NPV) Year 1999-2010

	Discount rate		
	10.00%	**25.00%**	**50.00%**
mangrove	732	309	118
coral reef	2,430	1,018	385
seagrass	12,966	5,581	2,183
Total Value	**16,128**	**6,908**	**2,686**

Action	year 0	1	2	3	4	5	6	7	8	9	10	11	12
Fishery Management		1,904	1,904	1,904	1,904	1,904	1,904	1,904	1,904	1,904	1,904	1,904	1,904
NPV	12,973	7,093	3,779										
Pollution - aquaculture		2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304
NPV	15,699	8,583	4,572										

	Discount rate		
Total Action Programme	10.00%	25.00%	50.00%
Habitat Conservation	16128	6908	2686
Fishery management	12973	7093	3779
Pollution Prevention	15699	8583	4572
Total Action Programme	44800	22583	11037

Table 4.6 Calculation of The Rate of Loss *(sources: national reports)*

Country	Original estimated cover (ha)	Present area (ha)	% Area lost	Years of data	Lost rate Per yr %	Weigh	Lost rate with weight Per year %
Cambodia	170,000	85,100	50	20	2.5	0.04	1.00
China	42,001	14,749	65	40	1.6	0.01	0.16
Indonesia	4,254,312	733,000	83	14	5.9	0.38	22.40
Malaysia	505,000	446,000	14	15	0.9	0.23	2.10
Philippines	400,000	160,000	80	70	1.2	0.08	0.96
Thailand	550,000	247,000	55	21	2.6	0.13	3.40
Viet Nam	400,000	252,500	37	39	0.9	0.13	1.20
Average					2.2	1 (total)	4.5

The second scenario weights the average loss per year by the area of mangrove remaining in that country. The calculation is shown in the Table 4.6. The average loss per year is calculated on the loss per year for the time that records were kept in each country, e.g. the Philippines had an area of mangrove 70 years ago of 400,000 ha it is now 160,000 ha so the rate of loss is 0.86% per yr, but it has 9.6% of the total remaining mangrove area. These percentages are used to give a weighted percentage of loss for the Region of 4.5% (Table 4.6). For the high pressure scenario the annual values saved by the actions suggested are tabulated in Table 4.7. After 12 years, in 2010, the saving would be the net present value, $3.25 billion at 50% discount rate (Table 4.9). This is a conservative estimate of the benefit from mangrove habitat conservation.

Table 4.7 Calculation of Areas Saved by Action Programme: High Pressure Scenario
(in thousand ha)

Area without action programme		1	2	3	4	5	6	7	8	9	10	11	12
mangrove	1,754	1,677	1,603	1,532	1,465	1,401	1,339	1,280	1,224	1,170	1,118	1,069	1,022
coral reef	2,219	2,167	2,115	2,065	2,016	1,968	1,922	1,876	1,832	1,788	1,746	1,704	1,664
seagrass	1,652	1,495	1,352	1,224	1,107	1,002	907	820	742	672	608	550	498
Area with action programme													
mangrove	1,754	1,739	1,723	1,708	1,693	1,679	1,664	1,649	1,635	1,621	1,606	1,592	1,579
coral reef	2,219	2,219	2,219	2,219	2,219	2,219	2,219	2,219	2,219	2,219	2,219	2,219	2,219
seagrass	1,652	1,621	1,592	1,562	1,534	1,505	1,478	1,450	1,424	1,397	1,372	1,346	1,322
Area saved by action programme													
mangrove		62	120	176	228	278	325	369	411	451	488	523	556
coral reef		53	104	154	203	251	298	343	388	431	474	515	555
seagrass		127	239	339	426	503	571	630	681	726	764	796	824

Table 4.8 Calculation of Values Saved by Action Programme: High Pressure Scenario

Action	year 0	1	2	3	4	5	6	7	8	9	10	11	12
Habitat conservation													
mangrove area saved		62	120	176	228	278	325	369	411	451	488	523	556
coral reef area saved		53	104	154	203	251	298	343	388	431	474	515	555
seagrass area saved		127	239	339	426	503	571	630	681	726	764	796	824
Value of habitat saved (*million USD)													
Ecological													
mangrove		538	1,048	1,531	1,988	2,420	2,829	3,215	3,580	3,924	4,249	4,555	4,843
coral reef		148	293	435	573	708	839	968	1,093	1,216	1,335	1,452	1,566
seagrass		2,409	4,544	6,432	8,098	9,563	10,848	11,970	12,945	13,789	14,514	15,133	15,656
Economic													
mangrove		80	155	226	294	358	418	475	529	580	628	673	716
coral reef		171	339	502	661	817	969	1,118	1,262	1,404	1,542	1,677	1,808
seagrass		431	813	1,151	1,449	1,711	1,941	2,142	2,317	2,467	2,597	2,708	2,802
Total Value													
mangrove		618	1,203	1,757	2,282	2,778	3,247	3,690	4,109	4,504	4,877	5,228	5,559
coral reef		320	632	937	1,234	1,525	1,809	2,085	2,356	2,620	2,877	3,129	3,375
seagrass		2,840	5,357	7,583	9,547	11,274	12,789	14,112	15,262	16,256	17,111	17,841	18,457
Total Value		**3,777**	**7,192**	**10,277**	**13,063**	**15,577**	**17,844**	**19,887**	**21,726**	**23,380**	**24,865**	**26,198**	**27,391**

Table 4. 9 Net Present Value (NPV) Year 1999-2010: High Pressure Scenario

	Discount rate		
	10.00%	25.00%	50.00%
mangrove	19,196	8,282	3,250
coral reef	10,889	4,613	1,769
seagrass	73,432	32,879	13,503
Total Value	**103,517**	**45,775**	**18,523**

Action	year 0	1	2	3	4	5	6	7	8	9	10	11	12
Fishery Management		1,904	1,904	1,904	1,904	1,904	1,904	1,904	1,904	1,904	1,904	1,904	1,904
NPV	12,973	7,093	3,779										
Pollution – aquaculture		2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304
NPV	15,699	8,583	4,572										

	Discount rate		
Total Action Programme	**10.00%**	**25.00%**	**50.00%**
Habitat Conservation	103,517	45,775	18,523
Fishery management	16,210	7,528	3,807
Pollution Prevention	19,615	9,110	4,607
Total Action Programme	**139,342**	**62,413**	**26,936**

4.2.2 Coral reefs

The target set for coral reefs is to maintain the existing reefs in good condition (those having more than 50% live coverage) by the year 2010. Based on the data reported in the TDA, the existing area is estimated to be 2.3 million ha in 1990.

The actions required to maintain coral reefs are to protect them from human interference. Management zones, mapping and inventory taking with the data on a Regional database will assist the conservation of coral reefs. Management methods include restricting access to the area by administrative means, designating the area as a protected area, and then enforcing restriction through patrolling and licensing systems. Controlling the use of the area to minimize impact, such as providing buoys for mooring of tourist boats and limiting the number of tourists through a system of licensed tour boats, can be set and enforced.

The control of fishing activities on coral reefs may be to license fishermen and place various restrictions on fishing gear and methods. A suitable system of sanction and charges may implement the control. The design of such a system has to fit in with local conditions. Nevertheless, such interventions are necessary to maintain coral reefs for the future.

The low pressure case scenario (Table 4.2) assumes that the loss of good coral reefs (area with 50% or more live cover) will be at the rate of 0.5% per annum. Achieving the target will mean that an area of 226,000 ha of coral reef will be kept intact. This area has value as a fishery and for tourism in the future. The value of the area saved on an incremental basis is shown for twelve years in Table 4.4. Based on the Costanza values, the amount of avoided loss discounted at 50% will be $385 million US (at 1994 prices) (Table 4.5).

Another possible scenario is that, based on the 0.5% loss in the past 30 years and assuming that that rate increases to such an extent that 48% will be lost in the next 20 years (Chou, L.M. 1998. Status of Southeast Asian coral reefs. In: Status of Coral Reefs of the World: 1998. Ed. Wilkinson, C. 79-87), there will be a 2.4% annual loss (Table 4.7). The value of the area saved, at intense pressure of degradation on an incremental basis, is shown for twelve years in Table 4.7. This loss is worth $1.7 billion at a 50% discounted rate (Table 4.8).

4.2.3 Seagrass

The target for seagrass is to maintain at least 80% of the existing area by the year 2010. The estimated area of seagrass in the TDA should be taken with caution. Nevertheless, it is presented here to indicate the order of magnitude, and to derive an estimate of the costs involved. The base case scenario assumes that the area of seagrass will decline at the rate of 3% annually, this is higher than the first scenarios for mangrove and coral reefs, due to the greater sensitivity of seagrass to environmental damage and threats from human activities such as trawling and sedimentation from land-based development. With the assistance of the programme, the area of loss avoided is estimated at over 169,000 ha (Table 4.3) at low pressure of human impact and 824,000 ha at high pressure (Table 4.7).

These targets require that seagrass beds are protected from threats which are mainly human activities—namely trawling fishing boats close to the shoreline, and deterioration in water quality with solid wastes and land-based pollutants which affect the health of the seagrass beds. The actions can take the form of community management to patrol the area to keep out fishing boats and management of land-based sources of pollution so that they are not discharged to the sea. In turn, this requires planning for waste disposal on land.

Assessment of the Regional importance of the seagrass resource and hence its Regional value is a first step for its management. Next steps are preparing and implementing management plans for the identified areas, resulting in achieving the target. The main value in preventing loss of seagrass habitat will be in the maintenance of fishery yields, prevention of erosion and, to a small extent, tourism revenue.

Estimating the value of the benefit is subject to the uncertainty concerning the area of seagrass. Based on the Costanza values, all of the value from seagrass beds is related to ecosystem functions, in particular that of nutrient cycling, the services value of seagrass is negligible. Obviously, in the South China Sea the services value is of some significance considering the fisheries based in seagrass, therefore the ecosystem value needs to be determined on a Regional basis and not on a global average. We have added to Constanza *et al.* (1997) figures an estimate of value of food gained from seagrass beds using estimates of Virnstein and Morris (1996).

The incremented values of the areas saved under the two different scenarios are given in Tables 4.4 and 4.8. Using the discounted values of results from action, the total annual value of seagrass saved is estimated at more than $2.1 billion and $13.5 billion US at 50% discount for low and high pressure scenarios, respectively (Tables 4.5 and 4. 9).

4.2.4 Wetlands

Wetlands will be treated differently in this SAP from the previously described ecosystems. National Wetlands Committees will be approached and if necessary established to handle the issues in the South China Sea. The following values and cost benefit analyses will be suggested to the National Wetlands Committees.

The target for wetlands is to have management plans for all the important wetland areas, thus maintaining their value. The area of wetlands and estuaries were estimated at 2.1 million ha and the base case scenario assumes that the area will decline by 2% annually.

The proposed action will result in the preparation of management plans for wetlands areas which will control the use of the wetlands so as to maintain their ecosystem functions, during development.

Benefits are the avoided loss in value of wetlands services. The main values are the preservation of biodiversity, with reference to migratory birds, but the use values of fishery and aquaculture are also significant. Using the Costanza value estimates, the total value of wetland area loss avoided is $822 million US.

4.2.5 Total habitat values

For the ecosystem loss component as a whole, the benefit of the programme is estimated at $2.686 billion US at 1994 prices at 50% discount rates, assuming that there is a low human pressure on them (Table 4.5). At high human pressure there would be a discounted saving of $18.5 billion (Table 4.9). Around 20% of this being services, while the remaining amount is ecosystem functions. This is the value of the loss avoided, corresponding to the population's Willingness to Accept (WTA) in compensation for the degradation that would result from the "do nothing" scenario. The annual savings for both high and low scenarios are for 12 years, of which the GEF Programme will be for five. It is expected that the impetus of the programme will continue after GEF, and the results are shown in Tables 4.4 and 4.8 as the last seven years of the tables.

4.2.6 Overexploitation of fishery resources

The proposed targets are closely related to the sustainable economic and environmental resource use. The management of fishing fleets will require complex measures involving many agencies and be outside the scope of the programme. However, to support the goal of responsible fisheries, a key element is to know the environmentally sustainable yield that can be obtained from the fishing ground and to protect areas that are important breeding grounds for fish. The proposed actions are focused on assessing resources at the regional level to provide the basis for further action in the formation of a concerted regional fishery action plan.

The problem that the dependence of the majority of the coastal population is on near-shore fishery resources is addressed by the action to provide information on the need for sustainable fishing and the methods to practice it. Action is aimed at the small scale artisanal fishing community. It should help to maintain the productivity of fishing grounds and the loss of fishery income or food can be offset against the benefit of the action.

Based on a study of overfishing in the Philippines, (Israel and Banzon, 1998), by the early 1990s, the production of marine capture fisheries had exceeded the maximum sustainable yield. While the production value reached then was $2.8 million US at the Open Access point, the maximum economic yield was estimated to be only $1.4 million US. The value of the economic rent (revenue from production minus cost) under the maximum economic yield case is as high as $760,000 US in contrast to zero under the Open Access regime (Table 4. 10).

Table 4.10 Key Indicators Using the Gordon-Schaefer Model Results in the Philippines Marine Fisheries 1994

Indicator	Volume of Catch (*metric tons*)	Total Revenue (*million dollars*)	Amount of Effort (*horse power*)	Total Costs (*million dollars*)	Maximum economic rent (*million dollars*)
Maximum Sustainable point	1,803,727	3,349	5,505,882	3,155	191
Maximum Economic Point	1,403,728	2,606	2,913,072	1,669	937
Open Access Point	1,797,624	3,338	5,826,143	3,338	0

Source: Table 12, in Danilo C. Israel and Cesar P. Banzon, 1998 Overfishing in the Philippine Marine Fisheries Sector, Economy and Environment Program for Southeast Asia(EEPSEA)

Table 4.11 South China Sea Fishery Yield (in thousand tons)

Countries	1972	1980	1991	1992
Brunei	2	4	4	4
Cambodia	21	7	36	34
Hong Kong	132	187	220	220
Indonesia	836	1,395	2,380	2,692
Malaysia	325	734	904	1,024
Philippines	928	1,251	1,673	1,660
Singapore	15	16	11	9
Chinese Taipei	611	759	308	326
Thailand	1,538	1,648	2,479	2,736
Vietnam	811	398	610	810
Total (excluding china)	**5,219**	**6,399**	**8,625**	**9,515**

Source: Sudara,S. 1997.

Another study of the marine fishing industry in Indonesia came to a similar conclusion (R. Dahuri. 1997. In: Asia-Pacific Fishery Commission, Table 13, p. 113). It estimated that, based on maximum sustained yield and a fixed income for the fishing household, the optimal number of fishing households that could be supported by the fishery was 428,000 but there are now 677,000 households, 36% higher than can be indefinitely supported by the fishery. If the criteria of maximum economic yield were used instead of the maximum sustainable yield, the number of fishing households would be even lower.

Assuming that the Philippines case is representative of the other fisheries in the SCS countries, the fish catch should fall by about 50% from the present level, while the benefit from the reduction in fishing effort would be around 28% of the total value of the present catch.

It is reported (Sudara, S, Marine Fisheries and Environment in the Asian Region, Environmental Aspects of Responsible Fisheries, 1997. In Asia-Pacific Fishery Commission, p. 184) that the value of the catch in the South China Sea Region (excluding China) in the early 1990s was US$ 6,800 million, while the quantity of the catch was 9.5 million tonnes (Table 4. 11). If this is the catch weight under Open Access, it would need to be reduced to around 4.75 million tonnes, while the economic rent would increase from zero, to around $1,904 million US annually. The saving is not incremental like the ecosystem conservation but the same each year. The net present value at 50% discount is $3.8 billion.

4.2.7 Pollution

The target for the pollution problem is to set and maintain region-wide water quality standards and water quality objectives to help to maintain the health of the coastal ecosystems.

The actions are designed to develop a system of standards and objectives that will help to maintain the productivity of the seas in the region. Achieving such a Region-wide system will support the continuation of fisheries and tourism in coastal areas. Maintaining water quality standards will also help to conserve marine habitats.

While the effect of pollutants may be slight for the SCS as a whole, and the effect on the marine biota may be sporadic – fish kills and red tides, for example, the "hot spots" of high pollution risks – particularly areas with large urban settlements and heavy concentration of industry—can suffer directly from the effects of pollution.

Treated sewage dumping into the sea raises nutrients which enhance algal blooms and the growth of opportunistic algae on seagrass leaves and coral reefs. The effect of the current coral bleaching in the SCS may be worsened by an increase in nutrients. Instead of the bleached coral being able to recover quickly, algal growth quickened by increased nutrients may prevent recovery. The costs of losing coral reefs and seagrass beds were covered in the previous sections on these habitats. Additional problems can occur when seafood grown in waters containing toxic algae are consumed but these are irregular and are usually dealt with effectively by the public health authorities when they occur.

Untreated sewage has the added risk of high organic matter and coliform bacteria counts. The organic matter lowers the oxygen content in the water and results in the death of fish other animals and plants. High coliform counts may cause illness to swimmers and consumers of shellfish.

A clear case of damage from pollution is estuarine and marine aquaculture. This activity is highly sensitive to water quality changes. Water quality deterioration can wipe out the whole industry. Tourism is another activity that is adversely affected by pollution caused decline in water quality.

For the purpose of analysis, it is assumed that only aquaculture is affected by pollution in the base case scenario. Tourism sites can be developed in other areas in the same country, or they can move to another country in the region. The TDA estimates the quantity of cultured fish at 2.9 million tons. Assuming a price of \$4,000 US ton^{-1} (for cultured shrimp), the value of aquaculture production may be put at \$11,600 million US. Then, assuming that pollution would lower the yield by 20%, there will be a loss of \$2,304 million US. The programme target of setting water quality standards and maintaining them in the region would help to maintain the level and values of aquaculture activity. The net present value of the intervention action, assuming there is low pressure on aquaculture is \$4.6 billion at 50% discount (Table 4.5).

4.2.8 Regional Cooperation

There is no formal legal agreement between governments in the region to reduce pollution, use fisheries in a sustainable way or protect marine habitats. The costs of enhancing Regional cooperation in the form of a legal framework consist mainly of the costs of meetings, consultancies and travels. The benefits are evident in the success of the previous described actions to improve habitats, obtain sustainable fisheries and reduce pollution.

4.4 Assessing the Benefits from the Programme

Taking the SAP as a whole, the focus is to maintain the existing level of resources for the future, through proper planning and management and to address key problems in "hot spot" areas by curative measures. The benefits of the SAP for each ecosystem are summarized in Table 4.5 and 4.9 for the scenarios of low and high pressure on them. The ecological and economic values are estimated separately for the twelve years (Tables 4.4 and 4.8). For each habitat the value is calculated on a year by year basis. The saving is accumulative. The values commence from the latest period for which data are available - 1998, and run to 2010.

For the fisheries management and the effect of pollution control on aquaculture, the benefit each year is not cumulative and remains the same for as long as the remediative actions are carried out. For pollution, the only figure given is a saving of 20% of the value of shellfish aquaculture accomplished by preventing red tides and pollution from damaging the shellfish industry. This is an arbitrarily chosen figure to represent what may be saved by improving water quality. Such an estimate can only be made for an individual site and depends on the extent of pollution, flushing rates, density of aquaculture and other factors.

Net Present Value of these savings is given in Tables 4.5 and 4.9 at a discount rate of 10%, 25% and 50% to compare different incentives to achieve the targets.

4.5 Estimated Cost of the Strategic Action Programme

The costs of meeting the identified targets by implementation of the project activities consist of three parts: the GEF funding, the national contribution to the project activities and the contribution obtained from co-financing. As the project will enhance the institutional and legal frameworks in the South China Sea Region, the benefits will continue after the GEF project in terms of protection of marine habitats, sustainable fisheries and reduction of land based sources of pollution into the sea. An analysis will be provided to show the benefits.

To achieve the targets the actions must be taken sequentially to address the root causes of the various problems identified in the TDA. Since these problems have various causes ranging from institutional, social, and economic to technological issues, the approach must be to develop an integrated management plan to deal with each of the problems. In this section, the issue of how the proposed actions will lead to the achievement of the agreed targets will be elaborated for each of the problem areas.

In broad terms, the actions may be classified as preventive, curative, outreach, monitoring and evaluation, and integrated management planning. The terms are self-explanatory, but how they respond to the problems and the targets set for each problem area will be discussed.

The actions proposed for the SAP consist of four main types of activities:

(1) Development of criteria for assessing the importance of a habitat or standards of environmental quality to identify sites for concrete actions.

(2) Development of regional and national action plans to establish an institutional framework for planning and coordinating activities.
(3) Development of a database for inventory and monitoring of environmental status to support planning.
(4) Establishment of pilot projects where improved management practices are demonstrated.
(5) Development of justifiable ecological and services cost for each ecosystem.

The activities (1)-(3) may be implemented by holding meetings of senior officials and experts, convened at the regional level by a regional coordinating body such as the EAS/RCU. The estimated basic cost of each meeting is $30,000 US (assuming an international meeting in Bangkok).

The cost of demonstration projects was estimated based on the costs of a World Bank funded study on the improvement of the management of marine parks in Thailand (1995). The dollar values were used, to avoid the recalculation of costs in local currencies.

The estimated total cost of the programme is shown in Table 4.12 The costs for each component of the programme are given in Tables 4.13 - Table 4. 19.

The cost of the Strategic Action Programme can only be prepared when it is fully developed and finalized. As decided by the Thirteenth Meeting of COBSEA, the Strategic Action Programme will be further improved as an initial action of the project.

The main actions will include preventive and curative measures, outreach activities and the cost of inaction. The detailed analysis on the cost of the Strategic Action Programme will be provided when the project takes off.

The costs detailed in this SAP are those readily identified to progress the actions. However, cost boron by other agencies, government departments and collaborators are not well detailed yet. They will be added as the SAP progresses.

Table 4.12 Summary of Programme Cost (Unit = 1,000 US$)

Item/Issue	Total Cost	National	Regional
Mangrove	3,183.5	653	2,530.5
Coral Reef	3,275.5	**696**	**2,579.5**
Seagrass	3,299.5	**700**	**2,599.5**
Wetlands	3,275.5	**696**	**2,579.5**
Habitat total	*13,034*	*2,745*	*10,289*
Fishery	1,123.5	**385**	**738.5**
Pollution	2,981.5	525	2,456.5
Regional Cooperation	1,380.9	**350**	**1,030.9**
Sub-total	*18,519.9*	*4,005*	*14,514.9*
Programme steering Committee			150
Technical Advisory Group			80
Programme Operation			150
Duty Travel			300
Reporting/publication			70
Evaluation mission			60
Other cost			90
Sub-total			***900***
Total	***19,419.9***	***4,005***	***15,414.9***

Table 4.13 Cost of Action: Mangroves
(in thousand US dollars)

Component Sub-component Activities	Governments	GEF	Co-Financing	Total
1. Habitat Conversion & Loss **1.1 Mangroves**				
1.1.1 Establishment or re-vitalisation of National				
Mangrove Committees (N) - Cash, 2,000/country/year for 5 yrs	70	140	5	
Annual meetings for leaders of national committees		150		
1.1.2 National Data base				
Review national data; development of compatible, inter-linked national systems for data management (N)	70	28		
Convene meeting on data policy		30		
Conduct training on data exchange		35		
Operation of database	70			
1.1.3 Restoration				
Review of current restoration activities and techniques (N)	35	200		
Prepare and publish guidelines	14	35		
1.1.4 Develop national action plans (including legislation) to maintain nationally important mangrove areas (N)				
Prepare guideline to develop national action plans/legislation	21	35		
Prepare and publicsh national action plans/legislation	35	28		
Conduct a regional workshop		30		

1.1.5 Public Awareness				
Convene national public meetings for presentation and review of the national reports and findings of the national and regional task teams (N)	21	10		
1.1.6 National management Plan				
Convene a Regional workshop on preparation of national management plans		30		
Prepare and Adopt the national management plans	14	-		
Implement the national management plan	70	21		
Conduct Regional training on survey/mapping of mangrove area		30		
Coordinate the preparation of national maps of mangrove areas	28	14		
1.1.7 Regional Criteria				
Identify experts to form a regional task team	-	-	5	
Convene two regional expert meetings;	40	60		
Draft and finalise the management criteria (R)	21	50		
Apply the criteria to identify and prioritise areas for future management, protection restoration and selection of 3 pilot sites for demonstration activities (R)	21	-		
1.1.8 Regional Action Plan				
Develop regional action plans to maintain regionally important mangrove areas (N & R)	42	50		
Convene one high-level regional meeting for presentation and review of the national and regional reports and recommendations of the national and regional task teams (R)	21	-	100 -COBSEA	
1.1.9 Demonstration activities				
Identy 3 demonstration sites				

Implement activities in the 3 demonstration sites	60	1,500		
1.1.10 Personnel cost (based in Bangkok,1999)				
1/6 P5		23.6		
1/6 P3		16.6		
2/6 GS 5		14.3		
TOTAL	**653**	**2,530.5**		

Table 4.14 Cost Of Action: Coral Reefs
(in thousand US dollars)

Component **Sub-component** **Activities**	**Governments**	**GEF**	**Co-Financing**	**Total**
1. Habitat Conversion & Loss **1. 2 Coral Reefs**				
1.2.1 Establish national coral reef working groups & convene regular meetings(N)				
Establish national working groups	70	140	5	
Convene regular meetings		150		
1.2.2 National management plan 1.2.2				
Draft & publish the criteria; guidelines for the national management plans and for economic evaluation (R)	35	70		
Coordinate the preparation of a GIS/map based national inventory of coral reefs & review national data (N).	70	70[1]		
Prepare national legislation and management plans for the protection and sustainable management of nationally important coral reefs (N).	70	140		
Adopt the national management plans (N).		35		
Convene national public meetings for presentation and review of the national reports and management plans and reports of the		30		

national and regional task teams (N).				
1.2.3 Regional Network				
Identify experts to form a regional task team (R).	70			
Convene regional expert meetings (R).		120		
Develop the regional framework for inter-linking national data management systems		35[1]		
Coordinate Regional mapping of coral reefs	70	10		
Apply the criteria to identify and prioritise areas for future management, protection and selection of 3 sites for demonstration management projects (R).	14	35		
Develop regional priority actions for inclusion in the Strategic Action Programme to maintain regionally significant coral reef areas (N & R).	10	35		
1.2.4 Capacity building and public awareness				
Convene and assist with training on coral reef conservation	35	70		
Prepare and facilitate public education	70	35		
1.2.5 Demonstration Projects				
Convene intergovernmental meetings to: adopt the criteria for prioritisation of areas for management intervention; for presentation, review, and adoption of the regional priority actions for final adoption of the SAP (R).	42	50		
Implement 3 demonstration projects for integrated management in regionally significant coral reef areas (N & R).	140	1,500		
1.2.6 Personnel Cost				
1/6 P5		23.6		
1/6 P3		16.6		
2/6 GS 5		14.3		
TOTAL	**696**	**2,579.5**		

Table 4.15 Cost of Action: Seagrass
(in thousand US dollars)

Component Sub-component Activities	Governments	GEF	Co-Financing	Total
1. Habitat Conversion & Loss **1. 3 Seagrass**				
1.3.1 Establish national seagrass working groups & convene regular meetings(N)				
Establish national seagrass working groups	70	140	5	
Convene regular meetings		150		
1.3.2 National management plan				
Draft & publish criteria; guidelines for the national management plans and for economic evaluation (R)	35	70		
Coordinate a GIS/map based national inventories of seagrass & review national data (N).	70	70[1]		
Prepare national legislation and management plans for the protection and sustainable management of nationally important seagrass (N).	70	140		
Adoption of national management plans (N).		35		
Convene national public meetings for presentation and review of the national reports and management plans of the national and regional task teams (N).		30		
1.2.3 Regional Network				
Identify experts to form a regional task team (R).	70			
Convene regional expert meetings (R).		120		
Develop a regional framework for inter-linking national data management systems		35[1]		

Coordinate Regional mapping of seagrass	30	30		
Apply criteria to identify and prioritise areas for future management and protection. Select 3 sites for demonstration management projects (R).	60	35		
Develop regional priority actions for inclusion in the Strategic Action Programme to maintain regionally significant seagrass areas (N & R).	10	35		
1.2.4 Capacity building and public awareness				
Training on seagrass conservation	35	70		
Public education	70	35		
1.2.5 Demostration Projects				
Convene intergovernmental meetings to: adopt the criteria for priroitisation of areas for management intervention; present, review, and adopt the regional priority actions; finally adopt the SAP (R).	42	50		
Implementation of 3 demonstration projects for integrated management in regionally significant seagrass areas (N & R).	140	1,500		
1.2.6 Personnel Cost				
1/6 P5		23.6		
1/6 P3		16.6		
2/6 GS 5		14.3		
TOTAL	**700**	**2,599.5**		

Table 4.16 Cost of Action: Wetland
(in thousand US dollars)

Component Sub-component Activities	Governments	GEF	Co-Financing	Total
1. Habitat Conversion & Loss **1. 3 Wetland**				
1.3.1 Establish national wetlands working groups & convene regular meetings(N)				
Establish national wetlands working groups	70	140	5	
Convene regular meetings		150		
1.3.2 National management plan				
Draft & publish criteria; guidelines for the national management plans and for economic evaluation (R)	35	70		
Coordinate the preparation of a GIS/map based national inventory wetlands & review of national data (N).	70	70[1]		
Prepare national legislation and management plans for the protection and sustainable management of nationally important seaagrass (N).	70	140		
Adopt the national management plans (N).		35		
Convene national public meetings for presentation and review of the national reports and management plans of the national and regional task teams (N).		30		
1.2.3 Regional Network				
Identify experts to form a regional task team (R).	70			
Convene regional expert meetings (R).		120		
Develop the regional framework for inter-linking national data management systems		35[1]		

Coordinate the Regional mapping of wetlands	70	10		
Apply the criteria to identify and prioritise areas for future management, protection and selection of 3 sites for demonstration management projects (R).	14	35		
Develop regional priority actions for inclusion in the Strategic Action Programme to maintain regionally significant wetlands areas (N & R).	10	35		
1.2.4 Capacity building and public awareness				
Conduct and implement training on wetlands conservation	35	70		
Prepare educational publications	70	35		
1.2.5 Demostration Projects				
Convene intergovernmental meetings to: adopt the criteria for priroitisation of areas for management intervention; for presentation, review, and adoption of the regional priority actions; for finally adopting the SAP (R).	42	50		
Implement 3 demonstration projects for integrated management in regionally significant wetlands areas (N & R).	140	1,500		
1.2.6 Personnel Cost				
1/6 P5		23.6		
1/6 P3		16.6		
2/6 GS 5		14.3		
TOTAL	**696**	**2,579.5**		

Table 4.17 Cost of Action Exploitation of Fisheries
(in thousand US dollars)

Component Sub-component Activities	Governments	GEF	Co-Financing	Total
2 Over Exploitation of fisheries **2.1 Regional coordination & determination of priorities for action**				
Identify National Focal Points & experts, and establish a regional Task Force (R)	70	140		
Prepare a regional over-view of the state of fisheries including stocks, identification of significant spawning and nursery areas, optimal catch and effort, impacts of destructive fishing activities, fisheries management systems, and national compliance with international fisheries conventions	35	58		
Develop criteria for determining the national, regional and transboundary significance of individual stocks, spawning and nursery areas	35	70		
Adopt the recommended criteria and priorities for action by an appropriate regional intergovernmental forum for subsequent inclusion in the SAP		30		
2.2 Develop regional and national management plans				
Develop regional and national management plans for priority areas of regional and transboundary significance to establish a regional system of refugia to maintain regionally important fish stocks	70	140		
2.3 Trial a blast fishing detection system				
Trial a blast fishing detection system		170	University Malaysia Sabah	

2.4 Information and public awareness				
Develop and implement programmes to provide information on fish stock conservation and sustainable fishery practices among small and artisanal fishing communities in the priority areas;		51		
Develop educational and public awareness materials on sustainable fishery practices;		35		
Translate into local languages and disseminate public awareness materials	35			
Conduct national and regional workshops to promote the Code of Conduct for Responsible Fisheries	140	30		
Personnel Cost				
1/6 P5		23.6		
1/6 P3		16.6		
2/6 GS 5		14.3		
TOTAL	**385**	**738.5**		

Table 4.18 Cost of Action: Land-Based Pollution
(in thousand US dollars)

Component Sub-component Activities	Governments	GEF	Co-Financing	Total
3. Land-based Pollution				
3.1 Regional Water Quality standards (2005)				
Identify National and Regional experts and form regional and national expert working groups : guidelines/action programmes for implementation of the GPA;	70	14		
and prepare draft regional water quality objectives and water quality and effluent standards review and assess existing knowledge of regional water quality, determine information gaps,	35	140	GPA, HOTO	
evaluate carrying/assimilation capacity of sub-regions within the South China Sea, transboundary movements of contaminants	140	210		
adopt water quality objectives, prepare guidelines for the development of national management plans, including capacity building legislation, and other appropriate components to achieve the agreed water quality objectives; review national capacity to test, monitor, control and enforce water quality and effluent standards	70	140	GIPME	
develop and finalise national and regional management plans to reach these objectives within specified time frames; to be incorporated into the Strategic Action programme for the South China Sea		28		
Initiate capacity building activities that lead to improvement in water quality testing and monitoring and conduct an evaluation of the	35	60		

sensitivity of key ecosystems to specific pollutants or regional and transboundary significance				
3.2 Determination of Regional Priority "hot spots" (2005				
Discuss and agree on criteria for evaluating the regional importance of nationally identified pollution ""hot spots"" in the Transboundary Diagnostic Analysis (severity of pollution, feasibility/ease of mitigation, transboundary effect	70	210		
Assess and evaluate data relating to national "hot spots" and prepare and agree on a regional priority listing for investment	70	35		
Conduct a preliminary evaluation of the costs and benefits of alternative mitigation measures for selected priority "hot spots"; pre-feasibility studies for three selected priority pollution "hot spots"		1500		
Develop and agree on a South China Sea strategic approach to mitigating priority regional "hot spots" (including priority investment portfolio, cofinancing arrangements, national and regional actions)	35	65		
3.3 Personnel Cost				
1/6 P5		23.6		
1/6 P3		16.6		
2/6 GS 5		14.3		
TOTAL	**525**	**2,456.5**		

Table 4.19 Cost of Action: Regional Co-Operation
(in thousand US dollars)

Component Sub-component Activities	Governments	GEF	Co-Financing	Total
4. Regional Co-operation				
4.1 Regional Co-ordination of the finalisation of the Strategic Action Programme				
Appoint regional co-ordinatiing staff and consultants for management and execution of the project				
Convene of a meeting of COBSEA national Focal Points and partner organisations and institutions to prepare the framework master plan for project management and execution and determine and agree on the membership of the Regional Co-ordinating Committee for the project		70	64	
Appoint National Focal Points to Chair the National Inter-ministry Steering Committees and initial country visits by the regional co-ordinating staff to meet with the national Steering Committees and prepare national workplans and budgets		70	70	
Convene, in close association with the meetings of the Co-ordinating Body for the Seas of East Asia, regional conferences of experts to present the results & recommendations of the national and regional working groups & establish & re-inforce the linkages between the sectoral working groups		35	210	
4.2 Regional Collaboration on the development of a legal framework for action				
Identify national legal experts, create national inter-ministry working groups to review: existing national legislation relating to the environment of the South China Sea, current obligations of countries under Global Conventions including *inter alia* the UNFCC, the CBD, the UNCLOS, and MARPOL and to		70	140	

participate actively in the work of the regional task force				
Establish a regional task force to review the similarities and differences between national legislation and consider ways in which such legislation might be harmonised to achieve the common objectives of the countries as expressed in the Strategic Action Programme. Prepare recommendations concerning the optimum mode of countries meeting their obligations under the global conventions and to protecting the environment of the South China Sea		35	140	
Prepare, for consideration by a high level intergovernmental meeting, recommendations and a draft legal framework for regional co-operation in the protection and sustainable management of the marine and coastal environment of the South China Sea.		70	140	
Personnel Cost				
1/6 P5		23.6		
1/6 P3		16.6		
2/6 GS5		14.3		
TOTAL		**350**	**1,030.9**	

5 INCREMENTAL PARTNERSHIPS

5.1 Justification for Forming Partnerships

This section considers existing and planned investments by the countries, donors and non government organisations of the South China Sea as a baseline for assessing the incremental cost of the Strategic Action Programme. Before the regional economic crisis, there were several projects underway in the South China Sea region that would have been enhanced by this programme. It is this synergistic increment to these projects that this SAP is aimed. Projects underway at that time were: ASEAN-Australian Living Resources programme, UNESCO-UNDP mangrove project, ASEAN-USAID coastal management programme, and ADB/ESCAP/UNEP coastal area management programme, etc.

With the regional economic crisis, national budgets are under severe constraints and existing spending plans may not be fulfilled. Some of the existing national level actions will complement the proposed actions in the SAP drawn largely from the national TDA reports. Where existing or planned actions by the nations of the SCS coincide with the planned actions of the SAP, the "in kind" and financial backing of the country concerned is assumed.

5.2 Partnerships Available for Achieving Maximum Environmental Benefits

Assuming that there will be funds from national budgets allocated for the actions proposed in the SAP, the costing of the SAP includes both GEF and national contributions. National actions are specified in Section 3 and 4 and were agreed upon at meetings held to discuss regional issues. Many NGO's, aid organisations and donor countries are expected to contribute to the costs of the proposed actions. A list of organisations that agreed in principle to contribute to taking part in the suggested actions appears as Table 5.1.

Table 5.1 Organisations Willing to Collaborate in Programme

ORGANISATION	ACTION	TYPE OF ORGANISATION
FAO	Over fishing	UN
MAB/UNESCO	Habitats	UN
IOC/GOT	All	UN
GPA (Red River) World Bank	Pollution	UN
UNEP Clean Factories	Pollution	UN
UNEP (NETTLAP)	All	UN
UNEP EA	All habitats	UN
AIMS Pollution Indicators	Pollution	RESEARCH
SEAPOL (LAW)	Legal Framework	NGO
World Wildlife Fund	Coral	NGO
ICRI	Coral	NGO

LOICZ	Pollution	NGO
SIDA	All	DONOR
DANIDA/IOC/HAB/Viet Nam	Mangrove	DONOR
SEAFDEC	Fisheries	INTERGOVT
National Mangrove Commission	Mangrove	INTERGOVT
USAID or State Dept.	Coral	GOVT.

5.3 Examples of Potential for Existing and Planned Investments

The costs of actions to address the causes of environmental degradation and threats to the marine environment of the South China Sea were shown in Section 4 above. The organisations in Table 5.1 are willing to collaborate in projects that have common aims or that achieve mutually agreeable objectives. Costs that will be borne by these organisations and "in kind" assistance have yet to be determined. This section will deal with examples based on discussions that were carried out to determine possible partners in this programme of action.

5.3.1 Regional

The International Coral Reef Initiative and Global Coral Reef Monitoring Network are examples of organisations that have projects and a network throughout the Region. In this case coral reefs are monitored by community groups, commercial diving agencies and interested scientists. The results go on to a database held in Hongkong for dissemination to countries that wish to know about the status of their reefs. Coral bleaching is recorded and the level of health of monitored reefs. These data will be used in the programme to assist with management and legislation decisions. The database held by IOC/GOT is also of use to this programme.

5.3.2 National

The National Mangrove Committee of the National Research Council of Thailand in cooperation with UNDP and UNESCO have a research station at Ranong in Thailand. Although this is not in the South China Sea the mangroves and research are similar. This research station together with a number of mangrove restoration sites in the Gulf of Thailand, will be used in the programme as part of the mangrove management work.

5.3.3 Donor Countries

Denmark, through the IOC-Danida, is supporting a Viet Nam project on toxic algal blooms and their effect on shellfish. This project has funding of $2.4 million. Our programme has a component based around preventing algal blooms caused by high nutrients and their effect on the shellfish aquaculture trade.

There is an IOC-Westpac Cooperative Oceanographic Study in the Gulf of Thailand supported by numerous organisations and donor countries. The project funding is $1.9 million over five years and this is the second year of the study. The governments of Cambodia, Malaysia, Thailand and Viet Nam are taking part. The

objectives of this project are to strengthen the scientific capabilities of scientific institutes and government agencies related to the management of the Gulf of Thailand.

A further project which could well be linked to this programme is one undertaken by the Hong Kong University of Science and Technology in collaboration with research institutes and government agencies on the Chinese Mainland and with academic institutions in France and Hong Kong. The project will develop a real-time database of the status of specific pollutants, sediments, pesticides, heavy metals, harmful algal blooms and nutrient levels in the Pearl River Estuary. The funding is an $18 million grant.

5.3.4 Non Government Organisations

The South China Sea Informal Working Group at the University of British Columbia was instrumental in developing the proposal for a legal framework for this programme. Its work is currently in the Gulf of Thailand on legal matters in association with SEAPOL and START whose work is directly related to this programme. Their objectives include developing large-scale cooperative research and ocean science policy, solving the problems of overfishing in the Gulf, and resolving flooding problems and sealevel concerns.

5.3.5 United Nations Organisations

It is the objective of this Programme to support, facilitate and promote the capacity to apply, develop and manage access to cleaner production technologies as well as best available techniques and best environmental practice. The UNEP Regional Office of Asia and the Pacific will collaborate to support this objective and its detailed projects will be used to achieve requirements in this Programme. The environmental impact of industrial waste discharged into marine environments must be understood to justify the expense and effort of reducing these loads.

The actions required to build capacity to understand and act upon the issues developed in this SAP are wide-ranging. Education of the community from politicians to school children, illiterate fishers and research scientists takes many forms. The means by which the actions, from electronic websites to hand held pictures demonstrating correct practices, are conveyed depends on the level of sophistication of the target audience. At most levels these educational aids and capacity builders, e.g. workshops, training groups, should be in local languages.

A demonstration village site should be targeted. The villagers, through appropriate educational means, should be taught about caring for their environment. After using the relevant educational tools, the result should be monitored to determine if the exploited ecosystem improved. This type of capacity building can be incorporated into a UNEP NETTLAP project.

A UNDP/IMO GEF funded project on the East Asian Seas has two demonstration sites in the South China Sea which can be used to develop the criteria for management plans.

6 PRIORITY REGIONAL AND NATIONAL ACTIONS TO ADDRESS THE CAUSES OF ENVIRONMENTAL DEGRADATION AND THREATS TO THE ENVIRONMENT OF THE SOUTH CHINA SEA

In this section the priorities of the Strategic Action Plan are presented with justification for their importance. The Programme cannot progress if these priorities are not given the full support of governments, non-government organisations and the GEF.

6.1 Priorities

The following activities are listed, not necessarily in priority order, to demonstrate the workbase and actions required to progress the Programme:

- Endorse a legal framework upon which to facilitate and commit governments to the Strategic Action Programme, and relevant regional co-operation.
- Prepare maps and inventories of the marine resources in the South China Sea and strategically coordinate monitoring of ecosystems and water pertinent to deciding on action plans to achieve Programme goals.
- Develop a network of databases throughout the Region so that transboundary data can be used to facilitate the Programme goals.
- Develop criteria for management plans for ecosystems and fisheries in the Region. These management plans will be the framework around which the actions to achieve Programme goals are based.
- Enhance capacity building in the form of education for all levels of the population, by helping provide technology to the various activities, by assisting in changing philosophies about environmental issues and assisting local people to achieve the aims of this Programme past its completion date.

6.2 Examples of Actions that will fulfil some of the Objectives of the Strategic Action Programme

6.2.1 Support a regional programme in cleaner production technologies and best environmental practices

Industrial and urban waste should be managed in a way that it has the least possible effect on the marine environment. The industrial sectors of the SCS countries are still largely at a low level of development and therefore need further support to enable them to be environmentally sound while being able to develop in the competitive environment of the global market economy. Industrial technologies need to adapt to suit local conditions. The scope for technology transfer in relation to cleaner production technologies and best environmental practices is important for the pollution reduction component of the SAP.

It is the objective of this Programme to support, facilitate and promote the capacity to apply, develop and manage access to cleaner production technologies as well as best available techniques and best environmental practice. The UNEP Regional Office of Asia and the Pacific will collaborate to support this objective and its detailed projects will be used to achieve requirements in this Programme. The environmental impact of industrial and urban waste discharged into marine environments must be understood to justify the expense and effort of reducing these loads.

Urban waste, especially sewage, is a problem throughout the region. The extent of the problem and its impact on marine ecosystems is not well known. This section should coordinate and where, necessary initiate efforts to show the effect of sewage on the marine environment. There are many projects underway which have identified the need to treat or use sewage. The most efficient and environmentally sound treatment comes by reusing the water and nutrients contained in sewage. The reuse requires in some case large areas of land and comes with a human health consideration which must be addressed. Recharging groundwater, growing crops or forests with treated sewage and single household treatment plants are all ways of dealing with sewage and should be considered. It would be useful to set up demonstration sites to determine the economic, ecological and cultural feasibility of such proposals.

6.2.2 Monitoring of demonstration conservation sites

Capacity building, increasing public awareness, legislating for marine parks, and managing the marine environment in a more organised and consistent way must show some direct results. To determine if these management tools are, in fact, improving the marine environment some form of monitoring or quality control must exist. Monitoring a conservation site should be carried out to compare it with a non-conservation site and a marine protected area. Conservation sites are those where local people have become involved with conserving marine ecosystems. This comparison will show whether the capacity building of local people has achieved one of its purposes.

6.2.3 Review national EIA regulations to promote greater public participation

Experience has shown that resource conservation actions can be successful only when the local communities are actively involved. Participation of the local communities needs to be a part of the planning and management processes at all stages. It is necessary, therefore, to identify the stakeholders for each coastal zone resource, including the local communities, non-governmental organizations working at the local level, private sector concerns and local and national governments. All the stakeholders should be a part of the implementation of Integrated Coastal Zone Management programmes to be established under the SAP.

The objective of this section is to increase public awareness and participation. First, the problem should be identified to the participants. By public debate and careful deliberation among all parties, the alternative solutions to the problem should be reviewed. At this time there should be open access to information on environmental impact assessment of activities affecting the local environment, and open hearings in environmental impact studies. This project should be carried out at a demonstration site, and the results of the decisions made monitored to determine if these measures had an effect on the marine environment, similar to 6.2.2 above. Public awareness is about disseminating the results of established sites to other selected sites.

It is recommended that countries review their Environmental Impact Assessment (EIA) requirements and processes to incorporate, as far as possible, rules and procedures to promote participation by the public and especially the stakeholders involved. EIA's should also be taken seriously and reviewed and appraised by all stakeholders, especially scientists who would review the rigor of the EIA.

6.2.4 Demonstration site for local community conservation activity

The actions required to build capacity to understand and act upon the issues developed in this SAP are wide-ranging. Education of the community from politicians to school children, illiterate fishers and research scientists takes many forms. The means by which the actions, from electronic websites to hand held pictures demonstrating correct practices, are conveyed depends on the level of sophistication of the target audience. At most levels these educational aids and capacity builders, e.g. workshops, training groups, should be in local languages.

A demonstration village site should be targeted. The villagers, through appropriate educational means, should be taught about caring for their environment. After using the relevant educational tools, the result should be monitored to determine if the exploited ecosystem improved. This type of capacity building can be incorporated into a UNEP NETTLAP project.

Also at the village level, over fishing and the use of inappropriate fishing gear is also a problem. A demonstration site, where the use of push nets is prohibited and the prohibition enforced, to show local fishermen that, even over two or three years this method is unproductive, should be set up. Education in the way of local language flip charts and TV programs could be used to help make the enforcement more palatable.

6.2.5 Develop guidelines on preparation of national plans for protection of marine and coastal environments

The SAP provides a framework for planning actions to promote the sustainable use of the SCS resources. However, the necessary actions will be taken at a national level so countries need to integrate the proposals of the SAP in their planning and policies. At the regional level, a set of guidelines for the preparation of national plans should be developed and provided to the national planning agencies to implement. It is expected that successful projects will be continued by the collaborators after GEF funding is finished whether they be national agencies or other organizations interested in an improved marine environment

6.2.6 A regional GIS database and a mathematical model on pollution and its impact on ecosystems

The need for a database and analytical models of the relevant ecosystems and their pollutants should be ascertained by a scoping exercise in the region. Once the need is verified a network of existing databases should be prepared with the aim of finding a set that would implement and use modelling techniques to solve pollution problems.

From the TDA, it was obvious that there was a lack of data required for adequate management of resources in the SCS. It is therefore of high priority that improved and more relevant data be obtained and stored on a network of existing GIS-type databases for resource inventory, monitoring and modelling. Such a network should conform to a regional standard, be accessible to all qualified users, and be linked to a process of decision-making in each country so that it has a clear role in supporting the decision-making process.

It is difficult to manage and monitor ecosystems without knowing their extent and floral and faunal community composition. Current mapping of underwater marine ecosystems is not, generally, adequate in the Region. Mapping of underwater ecosystems can be demonstrated at a site in one of the countries and the necessary processing for the mapping and GIS-type products carried out at one of the existing GIS centres.

An overall framework for monitoring and analysis of pollution loads and their impacts on water quality in the SCS, and their effects on the ecology of marine living organisms is a priority to control pollution. It is recommended that an immediate effort be initiated to develop an analytical tool, such as a mathematical model based on a GIS database, which will help to establish the scientific framework for obtaining a resource inventory, monitoring and analysis of pollution and its impact for the SCS as a whole. Databases throughout the region should be linked such that the metadata and data are easily available and there is some quality statement about the data. The National University of Singapore and the UNEP Environmental Assessment Programme are willing to begin to form a network of databases in the Region.

6.2.7 Collect information on trade in "minor" and endangered marine products

For those animals known to be under pressure such as turtles and dugongs and for other less well known ones, like seahorses and stingrays there should be some management plans. The main constraint on preparing actions to manage these resources is the lack of information on the volume of trade and the ecological impact of the trade on population size and habitat changes. More information is urgently required on these species, in order to provide a basis of analysis and to prepare appropriate actions during the period of the implementation of the SAP.

The trade of endangered species, the amount of uncontrolled industries based on little known animals and generally data on smaller fisheries should be collected to determine the impact that these collections have. The effect of loss of habitat on these organisms should be determined as part of this section.

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Rajdamnern Avenue
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THAILAND

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