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*“Reversing Environmental Degradation Trends
in the South China Sea and Gulf of Thailand”*

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**TOTAL ECONOMIC VALUES OF COASTAL HABITATS AND COST-
EFFECTIVENESS OF THE HABITAT COMPONENT ACTIONS PROPOSED IN
THE STRATEGIC ACTION PROGRAMME**

Weighted Mean National and Regional Values for the Annual Production of Goods and Services by Mangroves, Coral Reefs, Seagrass and Wetlands bordering the South China Sea

Background

The Regional Task Force on Economic Valuation has been charged with determining regionally appropriate values for environmental goods and services provided by the coastal habitats bordering the South China Sea. The reason being that values used in the draft Strategic Action Programme prepared in 1998 were based on the values for ecosystem goods and services determined by Costanza *et al.* on the basis of a world-wide dataset. In reviewing this the Project Steering Committee noted that the values might not be appropriate for use in the South China Sea and requested that appropriate values be developed for use in evaluating the cost benefit of action compared to non-action in implementing the actions proposed in the revised and up-dated Strategic Action Programme.

Determination of Weighted Mean National Values

As is well known farm gate prices for environmental goods vary within countries reflecting both the local supply and the demand. Where blood cockle beds (*Anadara granosa*) for example, are located in close proximity to a centre of population the unit farm gate price is higher than when an equivalent sized resource is located farther away.

In order to address this problem of wide variation in prices within one country the Regional Task Force decided to weight the data from each location and determine a "Weighted Mean National Value" that reflected **both** the prices for the same resource at each location and the "stock" of that resource at the same location. Hence the price at location A was multiplied by the stock (or area where the stock could not be estimated) in area A, and this value was added to other values determined for locations B, C etc. The summation was then divided by the total stock for which prices were available thus providing the **Weighted Mean National Value**. This results in a national value that reflects the totality of the stock rather than being a simple arithmetic average of all values. Full details of this method are contained in the various reports of the regional task force.

Determination of Weighted Mean Regional Values

The determination of regionally weighted mean values was undertaken in a similar manner using data and information concerning the total stock (or area) in each country and the Weighted Mean National Values. Thus the weighted mean national value was multiplied by the stock for each country and the resultant values summed; then divided by the total stock (or area) of the habitat bordering the South China Sea.

The absence of values in a particular table may reflect one of two circumstances:

- First, and most commonly, no data for farm gate prices and hence no value could be found for that resource in the country concerned; and,
- Secondly that, particular resource is not used in the country concerned.

An example of the latter is the case of sipunculid worms which are highly prized in China and also eaten to a lesser extent in the Philippines but which are not consumed in the other countries of the region. Consequently there are no market values from Cambodia, Indonesia, Malaysia, Thailand and Viet Nam reflecting the fact that these worms are not eaten and do not enter the market in these countries. Sipunculid worms are however found in all mangrove areas in all countries, the contribution of the weighted mean regional value for sipunculid worms to the total economic value of mangrove production in the region is therefore much smaller than if a benefits transfer method of determining value were used to value the entire South China Sea stock of sipunculid worms.

In the case of mangrove "fruit" or propagules the value from China represents the price of *Avicennia marina* propagules which are used in soup and other dishes in southern China and are apparently not eaten elsewhere in the region. Propagules of other species are processed as sweets and eaten in Thailand but no farm gate price is available from that country.

Determination of Total Economic Value (TEV)

The task force agreed that the Total Economic Value of the habitats bordering the South China Sea should be estimated as the summation of the values of all goods and services produced by each habitat on an annual basis. The summation of the regionally weighted values therefore represents the Total Economic Value of the annual production per hectare, whilst the Total Economic Value for the entire area of each habitat is derived from the product of this value multiplied by the total area of the habitat bordering the South China Sea.

Results

In the case of mangroves the annual values of production per hectare for both goods and services varies from 450 US dollars in Viet Nam and the Philippines to in excess of 21,000 US dollars in the case of China. The latter value reflects the high value for the service of sediment retention by mangroves determined by the difference in annual cost of dredging of the Fangchenggang Port before and after removal of mangroves. Since the total area of mangrove in China is only 23 thousand hectares compared with nearly 2 million hectares along the Indonesian coast of the South China Sea, this very high value does not distort the regional value for this service which computes at a modest 66 US dollars per hectare annually.

The most comprehensive dataset is that for mangroves, whilst the least comprehensive are those for coral reefs, where only three national datasets were found for coral reef goods; and for wetlands where the bulk of the data are from Viet Nam. This results in a regional value of coral reef production of a modest 1,500 US dollars per hectare per annum and for wetlands of around 300 US dollars per hectare per annum. These should be compared with the regional value for mangrove of nearly three thousand dollars per hectare and the value of 1,118 US dollars per hectare for seagrass meadows.

Discussion

On first principles one might expect the value of mangrove goods to exceed those for coral reefs and seagrass since this will include values for mangrove timber and other direct derivatives which have few if any equivalents in coral reef and seagrass habitats. In contrast one would expect that the service values for coral reefs would be greater than those for the other three habitats given the extensive coral reef tourism in the region.

Examination of the value of total annual production of goods and services by the four habitats from areas bordering the South China Sea demonstrates unequivocally the importance of mangroves in this region. The total annual value of mangrove production exceeds 5.1 billion US dollars annually compared with around 1.2 billion for wetlands and coral reefs and a mere 86 million US dollars for seagrass habitats.

It is important to recognise that the values for goods and services both individually and collectively are extremely conservative as a consequence of the manner in which they have been calculated using weighted means. Where data are lacking for a good or service from one country the consequence will be a lowering of the weighted mean regional value. Given the absence of values for many goods and services in each habitat the values are likely to be as low as 50% or less of the real value. For comparison the values derived by Costanza *et al.* are presented along side those from the present study in the following table.

Table 5 Comparison of the Total Economic Value of coastal habitats as determined by Costanza *et al.* 1997 and during the present study.

	Area ha	US \$ per hectare per annum		Total Value present study
		Costanza	Present study	
Mangroves	1,799,136	9,990	2,872.25	5.196 billion
Coral reefs	750,307	6,076	1,542.56	1.157 billion
Seagrass	73,769	22,400	1,181.59	0.872 billion
"Wetlands"	4,201,145	14,785	295.15	1.239 billion

In all four cases the values cited by Costanza are greater than those determined in the present study and consequently would result in Total Economic Values ranging from 22 (for seagrass) to 3 (for mangroves) times as great as those determined in the present instance.

Table 1 Weighted Mean National and Regional Values for the Annual Production of Goods and Services by Mangroves Bordering the South China Sea.

Mangrove Goods	Cambodia	China	Indonesia	Malaysia	Philippines	Thailand	Viet Nam	Regional
Timber	779.95	137.07	73.55	9.59	202.67	0.00	10.91	73.45
Firewood	17.35	0.00	65.06	0.00	84.21	106.80	242.63	2.08
Poles	0.00	0.00	0.00	0.00	2.34	0.00	0.00	0.06
Charcoal	71.39	0.00	15.85	0.00	0.92	2.42	0.00	0.43
Leaves/palm fronds (Thatch, fodder)	13.66	0.00	0.00	0.00	1.93	0.00	0.00	0.27
Fruit/propagules	0.00	100.78	0.00	0.00	0.00	0.00	0.00	0.59
Bark (tanning & dyes)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Medicine	0.00	0.00	238.31	0.00	0.00	0.00	0.00	172.52
Sap (sugar, alcohol, Acetic acid)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wood tar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fish capture	0.00	186.29	281.88	0.00	160.89	206.88	200.41	230.64
Fish fry	0.00	0.00	47.07	0.00	0.00	51.11	0.00	37.43
Eels	0.00	0.00	41.39	0.00	0.00	0.00	0.00	30.21
Crab capture	0.00	200.39	266.67	0.00	12.52	22.38	0.00	199.46
Prawn capture	0.00	135.11	272.33	0.00	11.01	149.57	0.00	210.19
Shellfish collection	0.00	1,153.82	18.83	0.00	2.08	386.47	0.00	55.26
All Fisheries resources	0.00	0.00	0.00	3,632.95	0.00	0.00	0.00	513.54
Insect and larvae collection	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Worms	0.00	2,582.30	0.00	0.00	0.44	0.00	0.00	40.66
Wildlife	0.00	0.00	25.13	0.00	0.00	0.00	0.00	18.19
Zooplankton	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jellyfish	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Honey & wax	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Algae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total value of goods US\$ per Ha	882.35	4,495.76	1,346.06	3,642.54	479.02	925.63	453.95	1,584.97
Mangrove Services								
Ecotourism	0.00	0.00	59.79	0.00	0.00	0.00	0.00	43.28
Nursery Function	0.00	1,274.37	781.50	0.00	0.00	0.00	0.00	573.23
Sediment retention	0.00	11,344.56	0.00	0.00	0.00	0.00	0.00	66.43
Coastal Protection	0.00	1,044.35	421.56	0.00	0.00	2,198.48	0.00	443.85
Windbreak	0.00	1,200.32	0.00	0.00	0.00	0.00	0.00	7.03
Carbon Sequestration	0.00	326.43	115.62	0.00	0.00	60.40	0.00	89.26
Oxygen Production	0.00	434.84	0.00	0.00	0.00	0.00	0.00	2.55
Option Value	0.00	0.00	70.07	0.00	0.00	0.00	0.00	50.73
Aesthetic Value	0.00	1,866.78	0.00	0.00	0.00	0.00	0.00	10.93
Total value of services US\$ per Ha	0.00	17,491.67	1,448.53	0.00	0.00	2,258.88	0.00	1,287.28
Grand Total Goods and Services	882.35	21,987.43	2,794.59	3,642.54	479.02	3,184.51	453.95	2,872.25
Total Area of Mangrove Ha	72,350	23,446	934,000	532,100	28,014	62,618	156,608	1,809,136.00
Value of Annual Production US\$	63,838,022	515,517,394	2,610,142,421	1,938,197,499	13,419,183	199,407,799	71,091,633	5,196,296,711

Table 2 Weighted Mean National and Regional Values for the Annual Production of Goods and Services By Coral Reefs Bordering the South China Sea.

	Cambodia	Indonesia	Malaysia	Philippines	Thailand	Viet Nam	Regional
Coral Reef Goods							
Capture Fisheries (food and aquarium fish)	0.00	285.49	0.00	150.98	0.00	0.00	108.31
Shrimp	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shellfish collection	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Molluscs	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sea Cucumbers	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Echinoderms-Sea urchins	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coral - Building materials m3	0.00	482.81	0.00	0.00	0.00	0.00	25.28
Coral (curio trade)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Seaweed	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Value Goods US\$ per Ha	0.00	768.30	0.00	150.98	0.00	0.00	133.59
Coral Reef Services							
Coral Reef Tourism	0.00	0.00	0.00	270.19	7,149.70	964.17	1,024.62
Research	0.00	0.00	0.00	0.00	0.00	0.00	
Beach Protection	0.00	7,330.56	0.00	0.00	0.00	0.00	383.80
Biodiversity Option Value	0.00	10.57	0.00	0.00	0.00	0.00	0.55
Total Value Services US\$ per Ha	0.00	7,341.13	0.00	270.19	7,149.70	964.17	1,408.97
Total Value Goods and Services US\$	0.00	8,109.43	0.00	421.17	7,149.70	964.17	1,542.56
Total coral reef area in the South China Sea (ha)	2,807	39,287	44,276	464,000	90,000	110,000	750,307
Value of Annual Total US\$	0	318,595,042	0	195,422,880	643,473,000	106,058,248	1,157,393,756

Table 3 Weighted Mean National and Regional Values for the Annual Production of Goods and Services of Seagrass Meadows Bordering the South China Sea.

	Cambodia	China	Indonesia	Malaysia	Philippines	Thailand	Viet Nam	Regional
Seagrass Goods								
Capture Fisheries (food and aquarium fish)	452.15	176.33	0.00	0.00	34.84	0.00	0.00	222.92
Shrimp	96.14	158.82	0.00	0.00	0.00	0.00	0.00	48.29
Crabs	117.00	0.00	0.00	0.00	0.00	0.00	0.00	53.63
Crustaceans	0.00	0.00	0.00	0.00	0.00	0.00	117.54	14.24
Shellfish/Molluscs collection	12.04	0.00	0.00	0.00	0.00	0.00	399.30	53.91
Acorn worms	0.00	794.10	0.00	0.00	0.00	0.00	0.00	21.10
Seaweed-algae	508.67	584.69	0.00	0.00	0.00	0.00	36.40	253.11
Seagrass fertiliser	0.00	0.00	0.00	0.00	0.00	0.00	29.12	3.53
Handicrafts	0.00	559.84	0.00	0.00	0.00	0.00	0.00	14.87
Cosmetics	0.00	1,007.76	0.00	0.00	0.00	0.00	0.00	26.78
Total Value of Goods US\$ per Ha	1,186.00	3,281.53	0.00	0.00	34.84	0.00	582.36	712.38
Seagrass Services								
Seagrass Tourism	0.00	0.00	0.00	0.00	0.00	0.00	1,264.13	153.20
Research	0.00	57.83	0.00	0.00	0.00	0.00	0.00	1.54
Beach Protection	0.00	1,190.80	0.00	0.00	0.00	0.00	0.00	58.41
Nursery Function	0.00	1,966.79	0.00	0.00	0.00	0.00	414.64	102.51
Biodiversity Option Value	0.00	439.02	0.00	0.00	0.00	0.00	0.00	11.66
Turtle Nesting beaches	0.00	0.00	0.00	0.00	0.00	4,097.93	0.00	141.82
Carbon sequestration	0.00	2.26	0.00	0.00	0.00	0.00	0.00	0.06
water quality-nutrient removal	0.00	38.54	0.00	0.00	0.00	0.00	0.00	1.02
Oxygen release	0.00	3.71	0.00	0.00	0.00	0.00	0.00	0.10
Total Value of Services US\$ per Ha	0.00	3,656.70	0.00	0.00	0.00	4,097.93	1,678.77	469.21
Grand Total Goods and Services Value US\$	1,186.00	6,938.23	0.00	0.00	34.84	4,097.93	2,261.13	1,181.59
Total known areas of seagrass	33,814	1,960	3,035	222	23,245	2,553	8,940	73,769
Annual value of production in US\$	40,103,435	13,598,940	0	0	809,766	10,462,004	20,214,500	87,164,402

Table 4 Weighted Mean National and Regional Values for the Annual Production of Goods and Services of Wetlands¹ Bordering the South China Sea.

	Cambodia	China	Indonesia	Malaysia	Philippines	Thailand	Viet Nam	Regional
Wetland Goods								
Timber	0.00	92.58	0.00	0.00	0.00	0.00	147.53	14.23
Firewood	0.00	0.00	0.00	0.00	0.00	0.00	135.04	12.61
Charcoal	0.00	0.00	0.00	0.00	0.00	0.00	5.87	0.55
Leaves/palm fronds (Thatch, fodder)	0.00	0.00	0.00	0.00	0.00	21.84	0.00	1.43
Medicine	0.00	0.00	0.00	0.00	0.00	0.00	22.51	2.10
Fish capture	0.00	109.66	0.00	0.00	0.00	438.67	966.93	119.53
Crab capture	0.00	192.55	0.00	0.00	0.00	0.00	0.00	0.93
Wildlife	0.00	0.00	0.00	0.00	0.00	4.38	0.00	0.29
Honey & wax	0.00	0.00	0.00	0.00	0.00	0.00	164.18	15.34
Total Goods US\$ per Ha	0.00	394.79	0.00	0.00	0.00	464.89	1,442.05	167.00
Wetland Services								
Ecotourism	0.00	294.46	0.00	0.00	0.00	75.45	26.62	8.84
Research & Education	0.00	954.54	0.00	0.00	0.00	0.00	0.00	4.61
Migratory species	0.00	373.62	0.00	0.00	0.00	0.00	0.00	1.80
Sediment retention	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nutrient retention	0.00	0.52	0.00	0.00	0.00	0.00	0.00	0.00252
Coastal Protection	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Windbreak	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Carbon Sequestration	0.00	140.61	0.00	0.00	0.00	0.00	0.00	0.68
Oxygen Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Option Value	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.01
Aesthetic Value	0.00	0.00	0.00	0.00	0.00	0.00	1,201.32	112.21
Total Services US\$ per Ha	0.00	1,763.75	0.00	0.00	0.00	75.58	1,227.94	128.15
Grand Total Goods and Services Value US\$	0.00	2,158.54	0.00	0.00	0.00	540.47	2,670.00	295.15
Total known areas of wetlands	77,202	20,276	3,252,780	0	183,818	274,653	392,416	4,201,145
Annual value of production in US\$	0.00	43,766,563	0.00	0.00	0.00	148,440,949	1,047,749,247	1,239,956,427

¹ It should be remembered that in the context of the UNEP/GEF project the only habitats included in the coastal wetlands group are: coastal lagoons, estuaries, inter-tidal mudflats, peat and non-peat swamp forest.

Costs of Actions identified in the regional Strategic Action Programme and a Preliminary analysis of the costs and benefits of implementing the Strategic Action Programme

BACKGROUND

During the course of 2006 the various regional working groups have identified the actions required at the regional level to ensure co-ordination of national level actions and the exchange of expertise and experience in the implementation of the Strategic Action Programme. In addition the costs have been estimated based upon experiences with the implementation of the UNEP/GEF project entitled: *"Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand"*

These costs do not include the costs of actions detailed in the supporting national action plans that are designed to support the achievement of national targets that contribute towards the achievement of the regional targets defined in the Strategic Action Programme (SAP). If the targets of the SAP are in fact achieved then various economic benefits might be expected to be gained in terms of the avoidance of economic losses consequent upon the loss and degradation of coastal habitats.

Unfortunately during development decision making, all too often the economic benefits provided by environmental goods and services are at worst ignored and at best considerably under-valued. Consequently development decisions are frequently unsustainable even in the short term.

What is presented in this annex constitutes an initial attempt to prepare and analysis of the economic benefits that would accrue through successful implementation of the SAP and their associated costs.

DISCUSSION

Costs

Tables 6 to 9 present the summary of the costs of regional actions proposed by the regional working groups for inclusion in the SAP. It should be noted that in the case of the wetlands some attempt was made to cost national level actions and these have been discounted from the present analysis.

In broad terms the total costs over five years are quite modest when compared with the value of annual production from each habitat:

- Mangroves 2.99 million US dollars compared with 5.1 billion US dollars of annual production.
- Coral reefs 3.96 million US dollars compared with 1.1 billion US dollars of annual production.
- Seagrass 1.58 million US dollars compared with 87.2 million US dollars of annual production.
- Wetlands 5.99 million US dollars (14 million dollars of national costs excluded) compared with 1.2 billion dollars of annual production.

Examination of these costs in detail indicates that the basis upon which the individual working groups determined them were not consistent and consequently the Project Co-ordinating Unit will work to reconcile these and ensure that they are determined upon a common basis.

Table 6 Costs of Actions Proposed in the Mangrove Component of the Regional Strategic Action Programme.

Costs			Years					5 yr. Total
			2008	2009	2010	2011	2012	
1.Building Capacity to ensure long-term sustainable use of mangrove habitats and resources								
1.1 Mechanisms for information exchange								
1.1.1	Maintain and expand the existing regional website as a mechanism for programmed exchange of information and experience between managers, government officials, teachers, research students, and community leaders	20,000	20,000	20,000	20,000	20,000	100,000	
1.1.2	Organise programme of study visits for government officials, community leaders, and mangrove managers to demonstration sites to study on-going practices in rehabilitation, management and conservation in the region.	40,000	40,000	40,000	40,000	40,000	200,000	
1.1.3	Organize regional forum every two years to share knowledge and experiences on how to improve government services in managing mangroves in Marine Parks and MPAs		30,000		30,000		60,000	
1.1.4	Meeting to secure Regional exchange of experience on how to enforce the laws in practice	18,000	18,000	18,000	18,000	18,000	90,000	
1.1.5	Regional training programme for country trainers on effective monitoring the state of mangrove ecosystems.	35,000					35,000	
1.1.6	Regional workshop every two years for exchange of experiences of developing livelihood and other income generation activities		30,000		30,000		60,000	
1.1.7	To Establish a network of environmental journalists and educators, and provide them materials of awareness on mangroves.						0	
1.2 Materials for use at all levels in promoting knowledge and awareness of sustainable management practices								
1.2.1	Develop regional guidelines on establishment of community based micro-credit schemes	24,000					24,000	
1.2.2	To establish a regional bibliography			148,000			148,000	
1.2.3	Produce guide books for mangrove rehabilitation, management and conservation in the region	144,000					144,000	
1.2.4	To translate relevant national publications to English for regional use	140,000	140,000	140,000	140,000		560,000	
1.2.5	Development of curricular and materials for use in training programmes relating to sustainable use and management of mangroves, offered by educational institutions in the region.		97,000				97,000	
2. Enhancing mangrove management skills through development and dissemination of regionally applicable tools								
2.1 Develop guidelines and other tools as information resources, and facilitate their regional dissemination and adoption for mangrove managers								
2.1.1	To develop regionally applicable standards and criteria for defining sustainability of mangrove management system.	41,000	30,000				71,000	
2.1.2	Document models for sustainable use of mangrove ecosystem	30,000	18,000				48,000	
2.1.3	Identify and encourage the use of environmental friendly technologies for timber harvesting, fishing and shrimp farming	30,000	36,000				66,000	
2.1.4	Promote multiple-use of mangrove resources and alternative livelihood	23,000	46,000				69,000	
2.1.5	Establish criteria and guidelines for zoning of mangrove ecosystem	29,000	27,000	15,000			71,000	
2.1.6	Develop and design standardized methodology and guideline for inventory and assessment, using skilled managers and community volunteers	27,000	18,000				45,000	

Table 6 cont. Costs of Actions Proposed in the Mangrove Component of the Regional Strategic Action Programme.

Costs	Years					5 yr. Total
	2008	2009	2010	2011	2012	
2.2 Applied research, knowledge management, and monitoring of mangroves for sustainable management						
2.2.1 Establish a regional system to Periodically Monitor the state of Mangrove Ecosystem in the region	27,000	27,000	15,000			69,000
2.2.2 Study the potential impacts of sea level rise, climate change, and episode events on mangrove ecosystems bordering the South China Sea	27,000	66,600	15,000			108,600
2.2.3 Quantification of mangrove as a carbon sink	27,000	114,200	15,000			156,200
2.2.4 Develop algorithms for interpretation of remotely sense images of mangrove associations and zonation.	27,000	36,800	15,000			78,800
2.2.5 Build on the work of the RTF-E of economic value of mangrove goods and services in order to determine total economic value of mangrove ecosystems						
2.2.6 To establish a mechanism for collection and exchange of regional mangrove data and information	29,000	15,000	15,000			59,000
2.2.7 Establish a web-based regional mangrove information centre				27,000	15,000	42,000
2.2.8 Test and elaborate the criteria and indicators of sustainable mangrove management				63,500	63,500	127,000
2.2.9 Develop and test guidelines to strengthen community participation in mangrove management			63,500	63,500		127,000
2.2.10 Establish guidelines to promote participation of local communities in management of mangrove habitats	27,000	18,000				45,000
2.2.11 Develop and test specific guidelines for the conduct of environmental impact assessment in mangrove areas			63,500	63,500		127,000
3. Policy, Legal and Institutional Arrangement						
3.1 Integration of Research Programme with Management and Policy Making						
3.1.1 To maintain the network of communication between policy makers managers, and scientists as established under the UNEP/GEF/SCS Project, to ensure the inclusion of new research findings in management and policy making				72,500	72,500	145,000
3.1.2 Establish an expert group to assist participating countries in meeting their obligations under international conventions relating to biological diversity and RAMSAR conventions				25,000	25,000	50,000
3.2 International and Regional Co-operation						0
3.2.1 To maintain the network of mangrove specialists established under the UNEP/GEF/SCS Project, to advice the governments on sustainable management of mangroves				72,500	72,500	145,000
3.2.2 Organise periodic regional conference to facilitate cross-sectoral discussion of issues and problems relating to mangrove management.			25,000	25,000	25,000	75,000
3.2.3 Establishment of formal mechanism for cooperation in managing the marine environment in the south China Sea.			20,000	20,000		40,000
3.2.4 Establish an appropriate mechanism to monitor and evaluate the implementation of SAP			27,000		18,000	45,000
Total Cost	765,000	827,600	655,000	710,500	369,500	3,327,600
PVC	735,577	765,163	582,293	607,338	303,702	2,994,073

Table 7 Costs of Actions Proposed in the Coral Reef Component of the Regional Strategic Action Programme.

		Year					5 yr. Total
0	2008	2009	2010	2011	2012		
1. Enhancement of resource and habitat management							
1.1 Promotion of good environmental governance and sustainable management of coral reefs ecosystems							
1.1.1	Review and formulation of good practices in sustainable management						
	1.1.1.1 workshop	25,000		25,000			
	1.1.1.2 dissemination of results					10,000	
1.1.2	Assessment and advice						
	1.1.2.1 workshop	25,000		25,000			
	1.1.2.2 Consultancy	3,200	3,200	3,200	3,200	3,200	
	1.1.2.3 dissemination of results					10,000	
1.1.3	Review and formulation of good practices in community - based management activities at the region						
	1.1.3.1 workshop	25,000		25,000			
	1.1.3.2 Consultancy	3,200	3,200	3,200	3,200	3,200	
	1.1.3.3 dissemination of results					10,000	
1.1.4	Introduction of cost effective waste management and environment friendly systems.						
	1.1.4.1 workshop	25,000		25,000			
	1.1.4.2 Consultancy	3,200	3,200	3,200	3,200	3,200	
	1.1.4.3 dissemination of results				10,000		
1.1.5	Synthesis of successes from models developed for coral reef management.						
	1.1.5.1 workshop	25,000		25,000			
	1.1.5.2 Consultancy	3,200	3,200	3,200	3,200	3,200	
	1.1.5.3 dissemination of results					10,000	
1.1.6	Synthesis of successes on alternative livelihood programmes. (Combined with activity 5.7.1)						
1.1.7	Review of good practices of appropriate technologies in the region						
	1.1.7.1 workshop	25,000		25,000			
	1.1.7.2 Consultancy	3,200	3,200	3,200	3,200	3,200	
	1.1.7.3 dissemination of results					10,000	
1.1.8	Review of existing transboundary management practices and Identification of priorities in transboundary management zones						
	1.1.8.1 workshop		25,000		25,000		
	1.1.8.2 Consultancy	3,200	3,200	3,200	3,200	3,200	
Total Sub-Component 1.1		144,200	44,200	144,200	54,200	59,200	446,000

Table 7 cont. Costs of Actions Proposed in the Coral Reef Component of the Regional Strategic Action Programme.

		Year					5 yr. Total
		0	2008	2009	2010	2011	
1.2	Maintain a regional Management Framework to ensure sound the use of sound science in the sustainable management of coral reefs in the South China Sea						
1.2.1	Regional coral reef expert group maintained to integrate research programmes and data and information used for coral reef management						
	1.2.1.1 Working group meeting and workshop		36,000	36,000	36,000	36,000	36,000
1.2.2	Monitor achievement of SAP targets and NAP objectives every 5 year period.						
	1.2.2.1 Consultancy for external evaluation		16,000	16,000	16,000	16,000	16,000
1.2.3	Synthesis of laws that contribute effectively to sustainable coral reef management, emphasizing on rule and regulation for good management practices						
	1.2.3.1 Consultancy		10,000	10,000	10,000	10,000	10,000
	1.2.3.2 Workshop for dissemination of national level lesson learnt to the results					20,000	20,000
1.2.4	Regional coordinating mechanism to facilitate convergence of national and regional action plans.						
	1.2.4.1 Workshop of agreement of coordinating mechanism		20,000		20,000		
1.2.5	Review of existing management models involving stakeholders and synthesis factors contributing to successes.						
	1.2.5.1 Consultancy		9,600	9,600	9,600	9,600	9,600
	1.2.5.2 Workshop for dissemination of national level lesson learnt to the results					20,000	20,000
1.2.6	Information exchange for promotion of stakeholder involvement in sustaining management.						
	1.2.6.1 Material production		20,000	20,000	20,000	20,000	20,000
1.2.7	Review of existing management models regarding community empowerment and synthesis factors contributing to successes, focusing on ownership of local people.						
	1.2.7.1 Consultancy		9,600	9,600	9,600	9,600	9,600
1.2.8	Review of traditional value, knowledge and good management practices of coral reefs in the region.						
1.2.8.1	Consultancy		96,000	96,000	96,000	96,000	96,000
1.2.9	Establishment of recognition and award system for good management of coral reefs.						
	1.2.9.1 Workshop to set up criteria		20,000				
	1.2.9.2 Cost for coral reef management award		6,000	6,000	6,000	6,000	6,000
1.2.10	Review of level of compliance to various int'l obligations and conventions pertaining coral reefs						
	1.2.10.1 Consultancy		9,600	9,600	9,600	9,600	9,600
1.2.11	Exchange and sharing experience between nations on coral reef research and management.						
	1.2.11.1 workshop		8,000	8,000	8,000	8,000	8,000
Total Sub-Component 1.2			260,800	220,800	240,800	260,800	260,800
2. Public Awareness, Communication and Education							
2.1 Increase awareness of stakeholders on the ecological roles; economic values of coral reefs; and need for sustainable management							
2.1.1	Facilitation of mainstreaming of regional coral reef information and education programme						
	2.1.1.1 Material supports to the national levels		12,000	12,000	12,000	12,000	12,000
	2.1.1.2 National workshop		12,000		12,000		
2.1.2	Development and launching of regional information campaigns for sustainable use of coral reefs.						
	2.1.2.1 Strategic meeting to launch information		15,000	15,000		15,000	15,000
	2.1.2.2 Sharing training materials among the countries by dissemination through regional website.		200	200	200	200	200
Total project 2.1			39,200	27,200	24,200	27,200	27,200
							145,000

Table 7 cont. Costs of Actions Proposed in the Coral Reef Component of the Regional Strategic Action Programme.

		Year					5 yr. Total
		0	2008	2009	2010	2011	
3. Research and monitoring							
3.1 Provide relevant scientific data and information for sustainable management of coral reefs							
3.1.1	Facilitation of and support to assess baseline information and status of coral reefs.						
	3.1.1.1 National Workshop: 6 countries,		60,000		60,000		
	3.1.1.2 Regional workshop		30,000		30,000		
	3.1.1.3 printing cost		2,000	2,000	2,000	2,000	2,000
3.1.2	Facilitation of and support to regular biological and socio-economic monitoring						
	3.1.2.1 National Workshop: 6 countries,		12,000	12,000	12,000	12,000	12,000
	3.1.2.2.Financial support for target sites		24,000	24,000	24,000	24,000	24,000
3.1.3	Prepare a base map of coral reefs in SCS and overlays to reflect indicators of sustainable management						
	3.1.3.1 Consultant		6,400	6,400	6,400	6,400	6,400
3.1.4	Analysis of regional socio-economic status and culture significance of coral reefs, to provide vital information for sustainable management and use of coral reefs						
	3.1.4.1 Regional workshop		12,000	12,000	12,000	12,000	12,000
3.1.5	Management and update of coral reef GIS and other databases by SEA START RC.						
	3.1.5.1 Payment for maintenance of website and database: (to be added)		18,000	18,000	18,000	18,000	18,000
3.1.6	Financial support to SEA START RC for sustainable management of the databases.						
	3.1.6.1 Payment for maintenance of website and database: (to be added)		18,000	18,000	18,000	18,000	18,000
3.1.7	Regular analysis, synthesis and update of databases, and dissemination of information to general public, decision makers, governments, potential partners.						
	3.1.7.1 Writing workshop		12,000	12,000	12,000	12,000	12,000
	3.1.7.2 Material production and dissemination:		4,000	4,000	4,000	4,000	4,000
3.1.8	Develop mechanism for analysis of impacts of different development scenarios on coral reef environment.						
	3.1.8.1 Consultant		38,400	38,400	38,400	38,400	38,400
3.1.9	Develop mechanism for multi-countries participation in EIA in transboundary areas.						
	3.1.9.1 Bilateral workshops		20,000	20,000	20,000	20,000	20,000
Total Sub-Component 3.1			256,800	166,800	256,800	166,800	166,800
							1,014,000

Table 7 cont. Costs of Actions Proposed in the Coral Reef Component of the Regional Strategic Action Programme.

	Year						5 yr. Total
	0	2008	2009	2010	2011	2012	
4. Sustainability and capacity building							
4.1 Improving regional capacity in management of transboundary issues regarding coral reefs							
4.1.1 Exchange of experts for human resource development in coral reef management.							
4.1.1.1 Payment for experts' visits and site training cost: 5 areas, 2 times, 10,000 = 100,000 USD		20,000	20,000	20,000	20,000	20,000	
4.1.2 Conduct of training of trainers for coral reef management at regional level.							
4.1.2.1 times, 25,000 = 50,000 USD		10,000	10,000	10,000	10,000	10,000	
4.1.3 Conduct of special training requested by the national level							
4.1.3.1 countries, 2 times, 10,000 = 120,000 USD		24,000	24,000	24,000	24,000	24,000	
4.1.4 Exchange of experiences regarding skill of law enforcement.							
4.1.4.1 National workshops: 6 countries, 2 times, 10,000 = 120,000 USD		24,000	24,000	24,000	24,000	24,000	
4.1.4.2 Regional workshop: 2 workshops, 25,000 = 50,000 USD		10,000	10,000	10,000	10,000	10,000	
4.1.5 Exchange of information, compliance and effectiveness of enforcement (combined with activity 4.3.1)							
4.1.6 Review and formulation of mechanism for financial sustainability for application in the region.							
4.1.6.1 National workshops: 6 countries, 2 times, 10,000 = 120,000 USD		24,000	24,000	24,000	24,000	24,000	
4.1.6.2 Regional workshop: 2 workshops, 25,000 = 50,000 USD		10,000	10,000	10,000	10,000	10,000	
4.1.7 Strengthening network of marine research stations. Provision of directory of marine research station to the website							
4.1.8 Maintenance and enhancement of SCS facility for coordinating unit.		18,000	18,000	18,000	18,000	18,000	
4.1.9 Maintenance of demonstration site network; Forum of local government officials, project management personnel from demonstration sites:		32,000	32,000	32,000	32,000	32,000	
4.1.10 Strengthening of network of research centres and reef management agencies in the region.; Provision of directory of research centres and reef management agencies to the website; Forum of research centres and reef management agencies:		32,000	32,000	32,000	32,000	32,000	
4.1.11 Development of guideline for sustainable use of coral reefs.							
4.1.12 Consultancy and dissemination of result= 26,000 USD		5,200	5,200	5,200	5,200	5,200	
4.1.13 Provision of information on value added benefit of enhancement of sustainable use derived from transboundary management of reefs							
Workshop: = 50,000 USD - Consultancy: = 16,000 USD		13,200	13,200	13,200	13,200	13,200	
Total project 4.1		222,400	222,400	222,400	222,400	222,400	1,112,000
Total Grand Cost		923,400	681,400	888,400	731,400	736,400	3,961,000

Table 8 Costs of Actions Proposed in the Seagrass Component of the Regional Strategic Action Programme.

Activities	2007	2008	2009	2010	2011	2012	5 yr. Total
1. Building capacity and awareness at all levels to ensure long-term sustainable uses of seagrass habitats and resources							
1.1 Mechanisms for knowledge and information exchange							
1.1.1 Building partnerships through personnel exchange, specially among demonstration sites through meeting and site visit Meeting:		30,000.00		30,000.00		30,000.00	
1.1.2 Short and long terms training activities, including exchange programmes, training courses, and scholarships on subjects such as paralegal issues, stakeholder analysis, community empowerment, participatory approaches; enhancing use of scientific data in EIA; Seagrass monitoring and management; GIS & remote sensing; community based management & monitoring, control & Surveillance, etc.		60,000.00	60,000.00	60,000.00	60,000.00	60,000.00	
1.1.3 Continue feeding seagrass information to SCS Website		10,000.00	10,000.00	10,000.00	10,000.00	10,000.00	
1.1.4 Periodical publications		10,000.00	10,000.00	10,000.00	10,000.00	10,000.00	
1.1.5 Regional symposium for stakeholders, scientists and managers			45,000.00		45,000.00		
1.2 Materials for use at all levels in promoting knowledge and awareness of sustainable management practices							
1.2.1 Formulate the regional seagrass awareness syllabuses for formal and informal education		20,000.00					
1.2.2 Compilation, selection, production and dissemination of awareness materials of seagrass through media/website		69,000.00					
2. Enhancing management skills through development and dissemination of regionally applicable tools							
2.1 Develop and enhance guidelines and other tools as information resources and facilitate their regional dissemination and adoption for seagrass management							
2.1.1 Further enhance the regional seagrass map (e.g. finer resolutions, using standardized methods, technology		20,000.00	20,000.00	20,000.00	20,000.00		
2.1.2 More assessment of baseline information on seagrass from deeper waters and other unstudied areas		55,000.00					
2.1.3 Develop regional guidelines on socio-economic and cultural assessment related to seagrass			70,000.00				
2.1.4 Compilation and analysis of regional social, economic and cultural aspects (including ethnobotanical and traditional practices and management) of seagrass			82,000.00				
2.1.5 Expand and up-date the regional seagrass meta-database		10,000.00	10,000.00	10,000.00	10,000.00	10,000.00	
2.1.6 Regional synthesis of experiences and lessons learnt at UNEP/SCS demonstration sites and other sites (e.g., alternative/complimentary livelihood, seagrass rehabilitations, etc.)		30,000.00		30,000.00		30,000.00	
2.1.7 Compile, publish and disseminate environmentally friendly seagrass technologies in the region			45,000.00				
2.1.8 Development of criteria and award system for exemplary seagrass related projects			12,600.00				
2.1.9 Develop guidelines based on regional synthesis of experiences in community-based seagrass management and sustainable use of seagrass and associated species		30,000.00	30,000.00				

Table 8 cont. Costs of Actions Proposed in the Seagrass Component of the Regional Strategic Action Programme.

Activities	2007	2008	2009	2010	2011	2012	5 yr. Total
2.2 Applied research, knowledge management and monitoring of seagrass for sustainable management							
2.2.1 Countries adopt and implement a regional seagrass resource assessment and monitoring protocol (e.g. SeagrassNet and SeagrassWatch)			35,000.00				
2.2.2 Replicate successful models for conservation and management of seagrass for use in the region				15,000.00			
2.2.3 Establish seagrass habitat corridors				15,000.00			
3. Policy, legal and institutional arrangement and regional coordination							
3.1. Integration of research programme with management and policy making							
3.1.1 Develop guidelines or procedures on process to integrate research into management and policy making			31,500.00				
3.1.2 'Promotion of the' Integration of assessment research results into local management plans			70,000.00				
3.2 International and regional cooperation and coordination							
3.2.1 Maintain and enhance the existing network of regional working group for seagrass	12,600.00	12,600.00	12,600.00	12,600.00	12,600.00	12,600.00	
3.2.2 Develop and obtain data/information from countries to the Seagrass Information Network for East Asia (SINEA)		65,000.00					
3.2.3 Promote transboundary management and zoning of seagrass for conservation of marine endangered species (e.g. sea turtles and dugongs)			55,000.00				
3.2.4 Promote and support establishment of sub-regional and/or regional bodies for joint management of seagrass resources			20,000.00				
Total cost		421,600.00	618,700.00	212,600.00	167,600.00	162,600.00	

Table 9 Costs of Actions Proposed in the Wetlands Component of the Regional Strategic Action Programme.

	2008	2009	2010	2011	2012	5 yr. Total
1.1 Human Resource Development						
1.1.1 Training needs assessment (forms of training, target audiences, places of training, timeframe, existing course programme)	50,000				20,000	70,000
1.1.2 Training programme may include elements for example on basic ecology, law enforcement, monitoring. The programme may include study tours, and field visit for wetland managers, communities, students, and NGOs	227,500	227,500	227,500	227,500	227,500	1,137,500
1.1.3 Regional inter-country training.	35,000	35,000	35,000	35,000	35,000	175,000
1.1.4 Develop and produce the education and training materials and tools for three courses per year.	15,000	15,000	15,000	15,000	15,000	75,000
1.1.5 Exchange of regional expert for human resources in wetlands conservation and management	42,000	42,000	42,000	42,000	42,000	210,000
1.1.6 Organize annual meetings/workshops for wetland management professionals.	45,000	45,000	45,000	45,000	45,000	225,000
1.1.7 Establish the linkages among wetland management institutes or agencies in the region and maintain the communities (e-forum and website)	2,400	2,400	2,400	2,400	2,400	12,000
1.1.8 Strengthen bilateral cooperation between the countries bordering the South China Sea through high-level meetings that include representatives of potential donor countries (meetings/workshops)	60,000				60,000	120,000
1.2 Communication, education and public awareness						
1.2.1 Develop regional education on public awareness plan.	100,000					100,000
1.2.2 Disseminate and translate the regional education on public awareness plan to stakeholders in participating countries by CD and hardcopy	72,000	14,000	14,000	14,000	14,000	128,000
1.2.3 Develop wetlands educational center model in region by organizing workshops within participating countries	45,000	45,000	45,000	45,000	45,000	225,000
1.2.4 Develop curricula guideline (context, format, educational levels, type of wetlands)	72,000	14,000	14,000	14,000	14,000	128,000
1.2.5 Produce national newsletters to disseminate among countries in this region.	36,000	36,000	36,000	36,000	36,000	180,000
2.1 Policy, Legal and institutional framework enhancement						
2.1.1 Review the implementation of the NAPs at regional level					50,000	50,000
2.1.2 Review and update the existing framework of wetland policy and regulation in the region					20,000	20,000
2.1.3 Maintain and strengthen the Regional Working Group on Wetlands to provide policy, scientific and technical advice on coastal wetland management to the participating countries	20,000	20,000	20,000	20,000	20,000	100,000
2.1.4 Undertake a stakeholder analysis, including stakeholders' roles in wetland management and conservation.	20,000					20,000
2.1.5 Identify good practices on community empowerment and promote the replication of these good practices at the regional level	560,000					560,000
2.1.6 Compile and analyse traditional knowledge and practices and to evaluate their utility in modern context.	40,000					40,000

Table 9 cont. Costs of Actions Proposed in the Wetlands Component of the Regional Strategic Action Programme.

	2008	2009	2010	2011	2012	5 yr. Total
2.1.7 Develop incentive mechanism models (e.g. eco-labelling) to recognize outstanding accomplishment of sustainable wetland use.	80,000					80,000
2.1.8 Strengthen international and regional exchange of legal and policy information in the region.	21,000	21,000				42,000
2.2 Promotion of international cooperation						
2.2.1 Support participants from each countries to attend the COPs meeting on relevant multilateral environmental agreements (MEA)	21,000	21,000	21,000	21,000	21,000	105,000
2.2.2 Organize international conference on wetland management among countries in region and international agency.		100,000				100,000
2.2.3 Maintain the network of wetlands specialists	25,000				25,000	50,000
3.1 Develop , maintain information system and disseminate products						
3.1.1 Develop a regional handbook/manual for standardization of techniques for wetland resource assessment	108,000					108,000
3.1.2 Develop the guidelines on wetland classification and mapping for estuaries and mudflat area.	80,000					80,000
3.1.3 Conduct the regional wetland map of peat-swamps, non-peat swamp and lagoon	120,000					120,000
3.1.4 Develop the regional guideline of social and cultural assessment in wetlands	80,000					80,000
3.1.5 Conduct and update socio-economic valuation and cultural assessment of wetlands at regional level.	82,000					82,000
3.1.6 Maintain and update GIS and meta databases	45,000					45,000
3.1.7 Develop a regional monitoring scheme		138,000				138,000
3.1.8 Implement the regional monitoring scheme						0
3.1.9 Identify research needs and priorities in the region	50,000					50,000
3.1.10 Conduct joint research which may include joint surveys to support the information for policy making	50,000	50,000	50,000	50,000	50,000	250,000
3.1.11 Guideline for communities participation in wetlands conservation and management	72,000	14,000	14,000	14,000	14,000	128,000
3.2 Wetland conservation and restoration						
3.2.1 Develop or update wetland management plans of the important coastal wetland sites in the region	60,000	60,000				120,000
3.2.2 Establish criteria and guideline for zoning of wetland ecosystem for management and conservation	94,000					94,000
3.2.3 Develop manuals/handbooks for sustainable use, incl. restoration, of estuaries, coastal lagoons, inter-tidal mudflats, peat swamp forest, and non-peat swamp forest.	200,000	300,000				500,000
3.2.4 Conduct, test and elaborate criteria2 and indicators of sustainable wetlands use	110,000					110,000
3.2.5 Disseminate environmental friendly methods and good practices in the region.		140,000				140,000
3.2.6 Restore degraded coastal wetlands (1 site/country) for demonstration.		3,500,000	3,500,000	3,500,000	3,500,000	14,000,000
Total cost (USD\$) excluding costs of national demonstration sites	2,739,900	1,339,900	580,900	580,900	755,900	5,997,500

DISCUSSION

Costs and Benefits of mangrove interventions

The value of the annual production of goods and services by mangrove habitats bordering the South China Sea has been established as 2,872.25US\$ per hectare, giving a total value of 5,196,296,711 US dollars per annum.

The targets in the SAP are of four types:

1. Areas to be transferred from various categories of use of protected area status
 2. Areas to be transferred from status defined as "conversion" to sustainable use
 3. Areas in which management is to be improved
 4. Areas of deforested mangrove land to be replanted
 5. Areas of degraded mangrove to be subject to enrichment planting to increase the species biodiversity.
1. In the first case the rate of mangrove loss in the region over the preceding decade of 1.61% per annum is used to ascertain the proportion of the mangrove currently not accorded protection status that will be saved by achieving this target. It is further assumed that the proportion accorded protection status is equally spread across the first five years of the SAP implementation. The cumulative benefit is therefore the value of the annual production saved through such a change in designated status.
2. In the second case it is assumed that mangrove forest designated for conversion to alternate uses will have a change in designation to sustainable use (including sustainable timber extraction) and that such change in designation will impact areas in equal proportion over the first five years of the SAP implementation. The cumulative benefit is therefore the value of the annual production saved.
3. In the third case a modest 5% per annum improvement in annual production is projected over the first five years of the SAP implementation.
4. In the case of areas of degraded mangrove forest that are replanted, no cumulative benefits are anticipated over the first four years and the first year in which a return is likely to be seen is in year five. In this year the annual production of the area planted in the first year is assumed to reach one sixth of the Total Economic Value. This proportion was decided upon based on the harvest cycle of mangroves under sustainable forestry management, namely a thirty year rotation in the only known example of sustainable forest management of mangroves at Matang, Malaysia.
5. As in the case of the fourth target it is assumed that no benefit accrues until the final year of the first phase of SAP implementation. Benefit is calculated in a similar manner to that calculated for the fourth target.

The costs of the actions contained in the SAP were determined by the Regional Working Group for mangroves on the basis of experience in implementing the first phase of the UNEP/GEF project entitled *"Reversing Environmental Degradation trends in the South china Sea and Gulf of Thailand"* and are expressed as 2006 costs.

It is important to recognise that the actions costed in the Strategic Action Programme are only those actions undertaken at a regional level to ensure co-ordination of national actions and the sharing of experience and expertise across national boundaries. The Regional Task Force on Economic Valuation is of the opinion that national level management costs might be expected to reach between 15 and 20% and that correspondingly regional management and administrative costs might be expected to reach a maximum of 1% of the total value of the interventions. Using these figures it is possible to extrapolate that the costs of national level actions might reach as much 300 million US\$ if the targets of the regional SAP are to be met.

Table 10 presents the costs and benefits with respect to mangroves, over the first five years of SAP implementation, whilst Table 11 presents a summary of the costs and benefits. From Table 11 it can be seen that the costs represent 0.2% of the estimated net benefits amortised over the five years.

Table 10 Summary of the Regional Costs and Benefits of Achieving the Targets Defined in the Strategic Action Programme.

YEARS	Values in US\$ ha ⁻¹	2008	2009	2010	2011	2012	TOTAL
Target 1 Area of mangrove saved Benefit increased i.e. rate of loss avoided – 1.61 % per annum		185	369	554	739	924	
I. Value of Mangrove Goods	1,585	292,748	585,496	878,243	1,170,991	1,463,739	
II. Value of Mangrove Services	1,287	237,764	475,527	713,291	951,055	1,188,819	
III. Total	2,872	530,512	1,061,023	1,591,535	2,122,046	2,652,558	
Target 2 Non-conversion of mangrove, sustainable use		33,320	66,640	99,960	133,280	166,600	
I. Mangrove goods	1,585	52,811,200	105,622,401	158,433,601	211,244,802	264,056,002	
II. Mangrove services	1,287	42,892,170	85,784,339	128,676,509	171,568,678	214,460,848	
III. Total	2,872	95,703,370	191,406,740	287,110,110	382,813,480	478,516,850	
Target 3 Improved management relating to sustainable use	0	120,554	241,109	361,663	482,218	602,772	
I. Mangrove goods	1,585	9,553,755	19,107,511	28,661,266	38,215,021	47,768,777	
II. Mangrove services	1,287	7,759,363	15,518,727	23,278,090	31,037,454	38,796,817	
III. Total	2,872	17,313,119	34,626,238	51,939,356	69,252,475	86,565,594	
Target 4 Replanting of deforested mangrove land		4,200	8,400	12,600	16,800	21,000	
I. Mangrove goods	1,585	0	0	0	0	1,109,479	
II. Mangrove services	1,287	0	0	0	0	901,096	
III. Total	2,872	0	0	0	0	2,010,575	
Target 5 Enrichment planting to increase mangrove biodiversity		2,240	4,480	6,720	8,960	11,200	
I. Mangrove goods	1,585	0	0	0	0	591,722	
II. Mangrove services	1,287	0	0	0	0	480,585	
III. Total	2,872	0	0	0	0	1,072,307	
Total for goods	1,585	62,657,704	125,315,407	187,973,111	250,630,814	314,989,719	
total for services	1,287	50,889,297	101,778,593	152,667,890	203,557,187	255,828,164	
Grand total	2,872	113,547,000	227,094,001	340,641,001	454,188,001	570,817,883	1,706,287,886
SUMMARY							
COSTS at 2006 prices		765,000	827,600	655,000	710,500	369,500	
Discount factor NPV for 2006 i=4%		0.9246	0.8890	0.8548	0.8219	0.7903	
Costs 2006 value		707,286	735,733	559,897	583,979	292,021	2,878,916
Compound factor NPV for 2007 i=4%		1.0400	1.0400	1.0400	1.0400	1.0400	
Costs 2007 values		735,577	765,163	582,293	607,338	303,702	2,994,073
BENEFITS at 2005 prices		113,547,000	227,094,001	340,641,001	454,188,001	570,817,883	
Discount factor for NPV 2005 i=4%		0.8890	0.8548	0.8219	0.7903	0.7599	
Benefits 2005 values		100,942,870	194,120,903	279,982,072	358,951,375	433,774,677	
Compound factor for NPV 2007 i=4%		1.0816	1.0816	1.0816	1.0816	1.0816	
Benefits 2007 values		109,179,808	209,961,169	302,828,609	388,241,807	469,170,691	1,479,382,085
Net Benefits		108,444,231	209,196,006	302,246,317	387,634,469	468,866,989	1,476,388,012

Table 11 Summary of Benefits in Terms of Cumulative National Production over the First Five Years of SAP Implementation and Costs of Executing the Mangrove Component of the Strategic Action Programme.

Total benefit	1,479,382,085
Total cost	2,994,073
Total Net benefit	1,476,388,012
Benefit-Cost ratio	494
Costs as percentage of benefits	0.2 %

Costs and Benefits of coral reef interventions

The total area of coral reefs bordering the South China Sea is estimated at 750,307 hectares of which the present area under management at 82 identified locations is around 102,105 hectares. The total value of annual production is estimated at 1,157,393,566 US dollars.

The targets for the coral reef component of the Strategic Action Programme are of two types:

1. Placing additional identified areas under sustainable management regimes bringing the total management area to 152,057 hectares.
2. At a regional scale reducing the decadal rate of loss of live coral cover from 16 to 5%.

In the case of the first target it is assumed that the areas are brought progressively under sustainable management of the first five years and consequently the cumulative benefit is represented by a reduction in the present decadal rate of coral cover from 16 to 0 percent as the areas are brought under sustainable management.

For the second target the area under consideration is the total coral reef of the region (750,307) of which 647,195 hectares are currently unmanaged and the cumulative benefits are derived from reducing the decadal rate of decline from 16% of live coral cover to 5% by 2015. This equals a reduction in the rate of decline to 1.375% per annum

Table 12 provides details of the costs and benefits to be derived from implementing the coral reef actions outlined in the SAP as in the case of mangroves it should be noted that the costs do not include national level costs. Table 13 presents a summary with the benefits for management, i.e. the first target separated from those for the second target and for the two targets combined. It can be seen that placing a further 50,000 hectares of coral reefs under sustainable management does not justify the costs of the regional actions, whereas successful achievement of the target to reduce the regional rate of degradation does. The costs expressed as a percentage of benefits are somewhat high which is likely explained by the low valuation for coral reef goods and services determined during the present study.

Table 13 Summary of Costs and Benefits of Coral Reef Interventions.

	Management	All benefits
Present Value of benefit	184,188	396,897,137
Present Value of costs	5,389,077	5,389,077
Net Present Value	-5,204,890	391,508,060
Benefit-Cost ratio	0.03	74
Cost as percentage of benefit	2,925.86	1.36

Table 12 Summary of the Costs and Benefits of Successful Implementation of the Coral Reefs Activities in the SAP to Meet the Coral Reef Targets.

	2008	2009	2010	2011	2012	2013	2014	2015	Total
Total accumulated new area under management (ha)	6,244	12,488	18,732	24,976	31,220	37,464	43,708	49,952	
Coral reef value 1,542.56 US\$ per hectare 2005 prices adjusted 4% per annum	1,735	1,805	1,877	1,952	2,030	2,111	2,196	2,283	
4. Benefit expected from coral reef management if value increased by 16% under management	173,350	360,569	562,488	779,983	1,013,978	1,265,444	1,535,405	1,824,939	
COSTS (at 2006 prices) costs for the last three years estimated at 5% increase per annum on 2012 costs.	923,400	681,400	888,400	731,400	736,400	773,220	811,881	852,475	
Discount factor (NPV for 2006) i=4%	0.9246	0.8890	0.8548	0.8219	0.7903	0.7599	0.7307	0.7026	
Costs 2006 value	853,735	605,762	759,408	601,157	581,988	587,584	593,233	598,938	5,181,805
Compound factor (NPV for 2007) i=4%	1.0400	1.0400	1.0400	1.0400	1.0400	1.0400	1.0400	1.0400	
Costs 2007 values	887,885	629,993	789,784	625,204	605,267	611,087	616,963	622,895	5,389,077
Benefits at 2005 prices 16% of total value saved	6,787	13,031	19,275	25,519	31,763	38,007	44,251	50,495	
Discount factor for NPV 2005 (i=4%)	0.88900	0.85480	0.82193	0.79031	0.75992	0.73069	0.70259	0.67556	
Benefits 2005 values	6,033	11,139	15,842	20,168	24,137	27,771	31,090	34,112	170,292
Compound factor for NPV 2007 (i=4%)	1.0816	1.0816	1.0816	1.0816	1.0816	1.0816	1.0816	1.0816	
Benefits 2007 values	6,526	12,047	17,135	21,813	26,107	30,037	33,627	36,896	184,188
Cumulative benefits at 2005 prices of reducing the decadal rate of decline from 16% of live coral cover to 5% by 2015. Equals decline in loss of 1.375% per annum	13,727,135	27,454,271	41,181,406	54,908,542	68,635,677	82,362,812	96,089,948	109,817,083	
Discount factor for NPV 2005 (i=4%)	0.88900	0.85480	0.82193	0.79031	0.75992	0.73069	0.70259	0.67556	
Benefits 2005 values	12,203,373	23,468,026	33,848,114	43,395,018	52,157,474	60,181,700	67,511,523	74,188,486	
Compound factor for NPV 2007 (i=4%)	1.0816	1.0816	1.0816	1.0816	1.0816	1.0816	1.0816	1.0816	
Benefits 2007 values	13,199,169	25,383,017	36,610,120	46,936,051	56,413,523	65,092,527	73,020,463	80,242,267	396,897,137
Net Benefits	12,317,810	24,765,072	35,837,471	46,332,661	55,834,363	64,511,477	72,437,127	79,656,268	391,692,247

Costs and Benefits of seagrass interventions

Addressing problems regarding the loss and degradation of seagrass habitats in the South China Sea poses problems unlike those faced in the case of the other coastal habitat types. These include the absence of good data regarding the actual distribution and abundance of seagrass meadows in the region; a lack of data regarding the rates of loss and degradation and inadequate understanding of the economic significance of these habitats as nursery areas for fish and crustaceans of subsistence and commercial importance. Only 73,769 hectares of seagrass are sufficiently well documented to be included in the estimations and the value of annual production is estimated at 1,181.59 US dollars per hectare giving a total value for the region of only 87,164,402 US dollars per annum. This is significantly smaller than the estimates for coral reef and mangroves which reach 1.1 and 11.6 billion US dollars respectively.

Costs of action have been estimated by the Regional Working Group on Seagrass in 2006 at 2006 prices, and encompass actions over the first five years of implementation of the Strategic Action Programme. These costs represent the costs of regional actions and not the cost of the national actions required to achieve the national targets established within the National Action Plans and reflected in the SAP. The values used are based on the Total Economic Value of seagrass habitats derived from the values for goods and services as calculated by the Regional Task Force on Economic Valuation and are standardised to 2005 prices.

In calculating the benefits of the Strategic Action Programme an average annual loss of seagrass habitat of 3.5 percent of total area per annum has been assumed. Hence the avoided loss represents 3.5% of the habitat area placed under sustainable management over the five year period.

Net benefits and the cost benefit ratio have been calculated using net present (2007) values

Table 14 presents an analysis of the costs and benefits of the regional actions to address seagrass degradation in the South China Sea, whilst Table 15 presents a summary of these costs and benefits which suggests that the costs represent greater than 50% of the benefits over the five years of SAP Implementation. This almost certainly reflects the gross undervaluation of the seagrass habitat, particularly with respect to its nursery function for commercial and subsistence fisheries.

Table 14 Costs and Benefits of the Regional Actions to Address Seagrass Loss.

YEAR	2008	2009	2010	2011	2012	Total
Cumulative Target Areas to be Managed (ha) 2008 onwards	18,151.2	23,374.4	28,597.6	33,820.8	39,044	
Cumulative benefit in terms of area saved (ha)	182.81	365.62	548.44	731.25	914.06	
Value of Goods per hectare US\$	801.33	833.38	866.72	901.39	937.44	
Value of Services per hectare US\$	527.80	548.91	570.87	593.70	617.45	
Cumulative value of Goods saved	146,493	304,705	475,340	659,138	856,880	
Cumulative value of Services saved	96,488	200,694	313,083	434,142	564,385	
Cumulative value of Goods and Services saved 2005 prices	216,009	432,018	648,026	864,035	1,080,044	
Cumulative value of Goods and Services saved at prices of the current year	242,981	505,400	788,423	1,093,280	1,421,264	
COSTS (at 2006 prices)	421,600	618,700	212,600	167,600	162,600	
Discount factor (NPV for 2006) i=4%	0.9246	0.8890	0.8548	0.8219	0.7903	
Costs 2006 value	389,793	550,022	181,731	137,755	128,505	1,387,806
Compound factor (NPV for 2007) i=4%	1.0400	1.0400	1.0400	1.0400	1.0400	
Costs 2007 values	405,385	572,023	189,001	143,265	133,645	1,443,319
BENEFITS at 2005 prices	216,009	432,018	648,026	864,035	1,080,044	
Discount factor for NPV 2005 (i=4%)	0.8890	0.8548	0.8219	0.7903	0.7599	
Benefits 2005 values	192,031	369,291	532,631	682,860	820,745	2,597,557
Compound factor for NPV 2007 (i=4%)	1.0816	1.0816	1.0816	1.0816	1.0816	
Benefits 2007 values	207,701	398,834	575,241	737,488	886,404	2,805,668
Net Benefits	-197,684	-173,189	386,240	594,223	752,759	1,362,350

Table 15 Summary of Costs and Benefits of Seagrass Interventions.

Total benefit	2,805,668
Total cost	1,443,319
Total Net benefit	1,362,350
Benefit-Cost ratio	1.94
Cost as percentage of benefit	51.4

Costs and Benefits of wetland interventions

As in the case of seagrass some difficulties arise in the case of the information assembled by the Regional Working Group on Wetlands. Initially this group was to have focussed on coastal lagoons, estuaries and inter-tidal mudflats. Subsequently coastal peat and non-peat freshwater swamp forests were added to the range of habitats under consideration. Unfortunately the range of data available for the economic values of goods and services from these habitats was far less extensive than for the other habitats resulting in a regional value for annual production of 295.15 US dollars per hectare, which is absurdly low. This results in a total value of 1.2 billion US dollars for the estimated 4,201,145 hectares of these habitats bordering the South China Sea. Further work is need to refine and improve the estimates of value.

Table 16 provides an analysis of the costs and benefits of the actions proposed in the wetlands component of the SAP whilst Table 17 provides a summary of the costs and benefits. Examination of these data suggest that it is uneconomic to undertake actions in coastal wetland habitats bordering the South China Sea, a conclusion which is likely invalid resulting from the unreasonably low value of annual production per hectare.

Table 16 Costs and Benefits of the Wetlands Interventions in the SAP.

YEAR	2008	2009	2010	2011	2012	Total
COSTS (at 2006 prices)	2,739,900	1,339,900	580,900	580,900	755,900	
Discount factor (NPV for 2006) i=4%	0.9246	0.8890	0.8548	0.8219	0.7903	
Costs 2006 value	2,533,192	1,191,166	496,556	477,457	597,399	-5,295,770
Compound factor (NPV for 2007) i=4%	1.0400	1.0400	1.0400	1.0400	1.0400	
Costs 2007 values	2,634,519	1,238,813	516,418	496,556	621,295	5,507,601
Benefits at 2005 prices	267,347	534,694	802,041	1,069,393	1,336,740	
Discount factor for NPV 2005 (i=4%)	0.8890	0.8548	0.8219	0.7903	0.7599	
Benefits 2005 values	237,670	457,058	659,219	845,157	1,015,813	3,214,918
Compound factor for NPV 2007 (i=4%)	1.0816	1.0816	1.0816	1.0816	1.0816	
Benefits 2007 values	257,064	494,354	713,011	914,122	1,098,703	3,477,255
Net Benefits	-2,377,455	-744,458	196,593	417,566	477,408	-2,030,346

Table 17 Summary of Costs and Benefits of Wetlands Interventions.

Total benefit	3,477,255
Total cost	5,507,601
Total Net benefit	-2,030,346
Benefit-Cost ratio	0.63
Cost as percentage of benefit	158.4