

REGIONAL ECONOMIC VALUES AND COST/BENEFIT ANALYSIS OF SAP ACTIONS

ECONOMIC VALUATION

Today's society uses and is heavily dependent on the environment as a source of a range of services and resources, that is, natural capital. At the same time, society uses (or abuses) and depends heavily upon the environment as a "sink" or repository for its pollution and waste. The source and sink services are in scarce supply and are continually being degraded and limited by economic activities. This requires the adoption of more conservative patterns of use that will increase the base of environmental assets over time, which is related to sustainability of the environments capacity to provide continued goods and services.

Economic valuation is defined as the attempt to assign quantitative or monetary values to the goods and services provided by environmental resources, whether or not market prices are available to assist in the process (Barbier²³ and Aylward, 1996; Bateman²⁴ *et al.*, 2002). The National Research Council²⁵ (1995) defines economic valuation as an attempt to provide an empirical account of the value of the services and amenities or of the benefits and costs of proposed action (project or policies) that would modify the flow of services and amenities. Both definitions are in agreement regarding the quantification of goods and services that provide information about the environmental resources.

Valuation forms a key exercise in economic analysis and provides important information for the sustainable use of any habitat. The basic aim of valuation is to determine people's preferences – how much they are willing to pay for, and how much better or worse off they would consider themselves to be as a result of changes in the supply of different goods and services. Valuation provides a means of quantifying the benefits that people receive from habitats, the costs associated with their loss, and the relative profitability of land and resource uses which are compatible with habitat conservation *vis-à-vis* those economic activities that contribute to habitat degradation. Valuation helps to predict and understand the consequences of economic decisions and economic activities which impact on the integrity and status of habitats.

Valuation in the context of habitat management is generally used to indicate the overall economic efficiency of the various competing uses of habitats and resources. That is, the underlying assumption is that habitat resources should be allocated to those uses that yield an overall net gain to society, as measured through valuation in terms of the economic benefits of each use, less its' costs. However, the valuation should be based on reasonably well-founded methodology and speculative assumptions will not contribute to decision-making (Munasinghe, 1995²⁶).

"Valuing" an ecosystem is essentially valuing the characteristics of a system. Costanza²⁷ *et al.* (1997) have made a comprehensive list of ecosystem functions and services and defined ecosystem services as "flows of materials, energy and information from natural capital stocks which combine with manufactured and human capital services to produce human welfare".

The concept of Total Economic Value (TEV) provides a framework for valuing natural systems and is used to identify and estimate the monetary value of all economic benefits that a society derives from a particular ecosystem. In some countries this method has been used to improve forest policy, planning, and management decisions by accounting for all short- and long-term benefits to society from forests, including alternative options. TEV accounts for a wide variety of market and non-market functions and services provided by the habitat.

²³ Barbier, E.B. and Aylward, B. (1996). *Capturing the pharmaceutical value of biodiversity in a developing country. Environmental and Resource Economics*. (8), pp.157-181.

²⁴ Bateman, I.J., Carson, R.T., Day, B., Haneman, M., Hanley, N., Hett, T., Lee, M.J., Loomes, G., Mourato, S., Ozdemiroghu, E., Pearce, D.W., Sugden, R., and Swanson, J. (2002). *Economic valuation with stated preferences techniques - A manual*. Cheltenham, UK: Edward Elgar.

²⁵ National Research Council. (1995). *Wetlands characteristics and boundaries*. National Academy Press, Washington D.C.

²⁶ Munasinghe, M. (1995). *Applicability of techniques of cost-benefit analysis to climate change*. In *global climate change, economic and policy issues*. Edited by Mohan Munasinghe. World Bank Environment Paper Number 12. The World Bank, Washington D.C.

²⁷ Costanza, R., d'Arge, R. de Groot, R., Farber, S., Grasso, M., Hannon, B. Limburg, K., Naeem, S., O'Neill, R.B., Paruelo, J., Raskin, R.G., Sutton, P. and van den Belt, M. (1997). *The Value of the world's ecosystem services and natural capital Nature* 387 (6630) 253-260.

The Regional Task Force on Economic Valuation (RTF-E) developed a procedure and related methods to derive regional values of the goods and services from coastal habitats bordering the South China Sea. Values derived at sites in any particular year are standardised using 2005 as the base year. The Consumer Price Index (CPI) for 2005 in each country is used as the basis for conversion of the data for other years and all nominal values have been converted to real values using the CPI. This conversion is effected using the following equation:

In local currency

$$\text{STANDARD VALUE 2005 (SV}_{2005}) = \frac{(\text{RAW VALUE DATA} * \text{CPI OF 2005})}{\text{CPI YEAR OF VALUATION}}$$

For comparability all standard values are converted into US dollars as follows:

In US dollars

$$\text{STANDARD US\$ VALUE 2005 (}^{\text{US\$}}\text{SV}_{2005}) = (\text{SV}_{2005}) * (\text{US DOLLAR EXCHANGE RATE FOR 2005})$$

At the national level, where several differing values for the same resource or service are available from one country, a weighted mean national value has been derived based on the economic values related to the stock at each location, using the following equation:

$$\text{WEIGHTED MEAN NATIONAL VALUE (}^{\text{US\$}}\text{MV}_{2005}) = \frac{\sum (^{\text{US\$}}\text{SV}_{i,2005} * \text{S}_i)}{\sum (\text{S}_i)}$$

where $^{\text{US\$}}\text{SV}_{i,2005}$ = Standard US\$ Value of 2005 at Location i
 S_i = Stock at location i
 i = 1..... N
 N = Number of values (locations) from the country concerned.

The total economic value in one country is thus the product of the stocks and the weighted mean national value, i.e.,

$$\text{TEV} = \sum (\text{S}_i) * ^{\text{US\$}}\text{MV}_{2005}$$

The regional total economic value is derived in a similar manner to the weighted mean national value²⁸ and in instances where the volume (or weight) of the total stock is not available for all countries then a surrogate, namely the area of the habitat in each country, has been used to weight the mean national values in the following equation:

Weighted Mean Regional Value of Resource or Service A_1 is:

$$\text{R}_V\text{A}_1^{-\text{Kg}} = \frac{[(\text{S}_{\text{Ca}} * \text{MV}_{\text{Ca}}) + (\text{S}_{\text{Chi}} * \text{MV}_{\text{Chi}}) + (\text{S}_{\text{In}} * \text{MV}_{\text{In}}) + (\text{S}_{\text{Ma}} * \text{MV}_{\text{Ma}}) + (\text{S}_{\text{Ph}} * \text{MV}_{\text{Ph}}) + (\text{S}_{\text{Th}} * \text{MV}_{\text{Th}}) + (\text{S}_{\text{Vi}} * \text{MV}_{\text{Vi}})]}{(\text{S}_{\text{Ca}} + \text{S}_{\text{Chi}} + \text{S}_{\text{In}} + \text{S}_{\text{Ma}} + \text{S}_{\text{Ph}} + \text{S}_{\text{Th}} + \text{S}_{\text{Vi}})}$$

Where S = The Stock
 MV = Weighted Mean National Value for countries (in US\$):
 Ca = Cambodia; Chi = China; In = Indonesia; Ma = Malaysia; Ph = Philippines;
 Th = Thailand; Vi = Viet Nam.

Thus, the regional total economic value of the stock of the resource is measured by the product of the total stock with the weighted mean regional value i.e.,

$$(\text{S}_{\text{Ca}} + \text{S}_{\text{Chi}} + \text{S}_{\text{In}} + \text{S}_{\text{Ma}} + \text{S}_{\text{Ph}} + \text{S}_{\text{Th}} + \text{S}_{\text{Vi}}) * \text{R}_V\text{A}_1^{-\text{Kg}}$$

²⁸ UNEP/GEF/SCS/RTF-E.5/6 "Derivation of Regional Values of the Goods and Services from Coastal Habitats".

In deriving the regional total economic values the following items should be included in the guidelines for valuation by resource categories for each ecosystem:

1. Value of Resource i per hectare, $i = 1 \dots n$ at site j [\$/ha]
2. Total Value of Resource i for the country: $\sum [1 \times \text{acreage at site } j]$ over all sites [\\$]
3. Calculate the Weighted Value of the Resource i for the country per hectare: $[2 \div \text{total country acreage}]$ [\$/ha]
4. Total Value of Resource i for the region: $\sum [2]$ over all countries [\\$]
5. Calculate the Weighted Regional Value of the Resource i per hectare: $[4 \div \text{total regional acreage}]$ [\$/ha]
6. Calculate the Regional Total Value of all resources: $\sum [4]$ over all resources [\\$]
7. Calculate the Weighted Regional Total Value per hectare: $[6 \div \text{total acreage for the region}]$ [\$/ha]

The regional total economic values are used in the cost benefit analysis of actions versus non-action as contained in the revised SAP.

COST AND BENEFIT ANALYSIS

Financial analysis is usually the first step in assessing the monetary costs and benefits of projects or management options. A financial analysis is taken from the perspective of private investors who are typically interested in the actual money costs and returns on their projects. It therefore measures private profits accruing to households or firms based on market prices. While financial analysis can be invaluable in illustrating the motivations of the private sector, it does not ask whether market price is the "proper" price and reflects true economic value.

An economic analysis goes beyond a financial analysis to perceive a project's economic costs and benefits on the welfare of society. It examines all of a project's impacts, including its environmental consequences. An economic analysis usually requires various adjustments to financial prices to correct for market imperfections, policy distortions and distributional inequities.

The economic cost-benefit analysis is said to provide a better framework for assessing the holistic profitability of project alternatives by incorporating the environmental costs and benefits of use and non-use activities. This economic analysis approach departs from the financial analysis because the latter only accounts for direct transacted cost and benefit elements. The financial values are inadequate to capture all environmental effects and are inadequate representations of the welfare of society. Environmental effects increase or decrease welfare even though they may not be traded in the market with monetary prices. In financial analysis, environmental effects are considered only when they directly affect revenue streams or cost outlays of the project concerned.

Cost-Benefit Analysis of Action Versus Non-action in the Strategic Action Programme

The benefits derived from action as outlined in the SAP reflect in reality the anticipated change (decline) in the rate of loss or degradation of the habitat. Each regional working group provided up-to-date estimates of the rates of loss and degradation of important coastal habitats in order that the costs of non-action could be estimated. These are then compared with the costs of the actions proposed in the SAP and a measure of the cost effectiveness of acting derived. The data and information used include:

- 1) Time series data of the rates of habitat loss and degradation;
- 2) Estimated rates of loss and degradation in high-pressure (non-action scenario) and low-pressured scenarios (action scenario); and
- 3) Investments and costs needed to undertake the actions and achieve the targets included in the SAP.

Tables in the preceding chapters of the SAP present a 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 1.67 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 1.82 million US dollars compared with 1.2 billion dollars of annual production.

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 US\$2,872.25 per hectare, giving a total value of US\$5,196,296,711 per annum.

The targets in the SAP are of four types:

1. Areas to be transferred from various categories of use to 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 diversity.

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 24 presents the costs and benefits with respect to mangroves, over the first five years of SAP implementation, whilst Table 25 presents a summary of the costs and benefits. From Table 25 it can be seen that the costs represent 0.2% of the estimated net benefits amortised over the five years.

Table 24 Summary of the Regional Costs and Benefits of Achieving the Mangrove 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	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							
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 25 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 26 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 27 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 (all benefits). It can be seen that placing a further 50,000 hectares of coral reefs under sustainable management is not as cost effective as successful achievement of the target to reduce the regional rate of degradation. 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 26 Summary of the Costs and Benefits of successful implementation of the Coral Reef 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	
Benefit expected from coral reef management if value increased by 16% under management	173,333	360,653	562,559	780,050	1,014,026	1,265,384	1,535,724	1,824,647	
Costs (at 2006 prices) costs for the last three years estimated at 5% increase per annum on 2012 costs.	135,449	242,916	175,785	295,259	321,335	229,915	94,250	177,310	
Discount factor (NPV for 2006) i=4%	0.9246	0.889	0.8548	0.8219	0.7903	0.7599	0.7307	0.7026	
Costs 2006 value	125,236	215,952	150,261	242,673	253,951	174,712	68,868	124,578	1,356,233
Compound factor (NPV for 2007) i=4%	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	
Costs 2007 values	130,246	224,590	156,271	252,380	264,109	181,701	71,623	129,561	1,410,482
Benefits at 2005 prices 16% of total value saved	173,333	360,653	562,559	780,050	1,014,026	1,265,384	1,535,724	1,824,647	
Discount factor for NPV 2005 (i=4%)	0.889	0.8548	0.82193	0.79031	0.75992	0.73069	0.70259	0.67556	
Benefits 2005 values	154,093	308,287	462,384	616,482	770,578	924,603	1,078,985	1,232,658	5,548,071
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	166,667	333,443	500,115	666,787	833,458	1,000,051	1,167,030	1,333,243	6,000,793
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	15,314,711	15,777,627	16,245,834	16,727,386	17,221,510	17,727,434	18,252,696	18,779,815	
Discount factor for NPV 2005 (i=4%)	0.889	0.8548	0.82193	0.79031	0.75992	0.73069	0.70259	0.67556	
Benefits 2005 values	13,614,778	13,486,715	13,352,938	13,219,820	13,086,970	12,953,259	12,824,162	12,686,892	
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	14,725,744	14,587,231	14,442,538	14,298,558	14,154,867	14,010,245	13,870,614	13,722,142	113,811,938
Total Benefits	14,892,411	14,920,674	14,942,653	14,965,344	14,988,324	15,010,296	15,037,643	15,055,386	119,812,731
Net Benefits	14,762,165	14,696,084	14,786,382	14,712,964	14,724,215	14,828,595	14,966,020	14,925,825	118,402,249

Table 27 Summary of Costs and Benefits of Coral reef Interventions

	Management	All Benefits
Present Value of Benefits	6,000,793	119,812,731
Present Value of Costs	1,410,482	1,410,482
NPV	4,590,311	118,402,249
Benefit-Cost Ratio	4.254	84.94
Cost as percentage of Benefit	23.5	1.18

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 US\$1,181.59 per hectare giving a total value for the region of only US\$87,164,402 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 28 presents an analysis of the costs and benefits of the regional actions to address seagrass degradation in the South China Sea, whilst Table 29 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 28 Costs and Benefits of the Regional Actions to Address Seagrass Loss.

YEARS	2008	2009	2010	2011	2012	Total
Cumulative Target Areas to be Managed (ha) 2008 onwards	18,151	23,374	28,598	33,821	39,044	142,988
Cumulate benefit in terms of area saved	183	366	548	731	914	
Value of Benefits at 2005 prices	216,009	432,018	648,026	864,035	1,080,044	3,240,132
Discount factor for NPV 2005 (i=4%)	0.89	0.85	0.82	0.79	0.76	
Benefits 2005 values	192,031	369,291	532,631	682,860	820,745	2,597,557
Compound factor for NPV 2007 (i=4%)	1.08	1.08	1.08	1.08	1.08	
Benefits 2007 values	207,701	398,834	575,241	737,488	886,404	2,805,668
Costs at 2006 prices	239,650	118,920	124,670	96,600	144,650	724,490
Discount factor (NPV for 2006) i=4%	0.92	0.89	0.85	0.82	0.79	
Costs 2006 value	221,570	105,719	106,568	79,398	114,319	627,575
Compound factor (NPV for 2007) i=4%	1.04	1.04	1.04	1.04	1.04	
Costs 2007 values	230,433	109,948	110,831	82,574	118,892	652,678
Net Benefits	-22,732	288,886	464,410	654,914	767,513	2,152,990

Table 29 Summary of Costs and Benefits of Seagrass Interventions.

Total Benefit	2,805,668
Total Cost	652,678
Total Net Benefit	2,152,990
Benefit-Cost ratio	4.30
Cost as percentage of benefit	23%

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 freshwater, peat and non-peat 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 US\$295.15 per hectare, which is absurdly low. This results in a total value of US\$1.2 billion for the estimated 4,201,145 hectares of these habitats bordering the South China Sea. Further work is needed to refine and improve the estimates of value.

Table 30 provides an analysis of the costs and benefits of the actions proposed in the wetlands component of the SAP whilst Table 31 provides a summary of the costs and benefits. These tables suggest that less economic benefit is derived from investing in coastal wetlands than in coral reefs and mangroves and approximately the same benefit as in the case of seagrass.

Table 30 Costs and Benefits of the Wetlands interventions in the SAP.

Years	2008	2009	2010	2011	2012	Total
Total costs of proposed actions (USD\$)	248,000	616,000	506,000	298,000	153,000	1,821,000
Discount factor (NPV for 2006) i=4%	0.92	0.89	0.85	0.82	0.79	1
Costs 2006 value	229,290	547,622	432,531	244,934	120,918	1,575,295
Compound factor (NPV for 2007) i=4%	1.04	1.04	1.04	1.04	1.04	
Costs 2007 values	238,462	569,527	449,832	254,732	125,755	1,638,307
Total value per hectare of annual production of wetland goods and services 2005 values	295 US dollars					
Total area to be brought under sustainable management within five years	938,261 hectares					
Total benefits derived from avoiding the annual losses(USD\$) 2005 values	830,783	534,694	802,041	1,069,393	1,336,740	4,573,651
Discount Factor	0.889	0.855	0.822	0.790	0.760	
Benefits 2005 values discounted	738,563	457,059	659,219	845,157	1,015,813	3,715,810
Compound factor (NPV for 2007) i=4%	1.082	1.082	1.082	1.082	1.082	
Benefits 2007 values (Compound factor i=4%)	798,830	494,355	713,012	914,122	1,098,703	4,019,020
Benefit-Cost (USD\$)	560,368	-75,172	263,179	659,390	972,948	2,380,714
Rate of loss assumed as 30% per century = 0.3% per annum or 0.003 per annum	2,815	5,630	8,444	11,259	14,074	42,222
Costs as percentage of benefits	41%					

Table 31 Summary of Costs and Benefits of Wetland Interventions.

Total Benefits	4,019,020
Total Costs	1,638,307
Total Net Benefits	2,380,714
Benefit-Cost Ratio	2.45
Costs as percentage of Benefits	40.76