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REPORT

Economic valuation of DEMONSTRATION WETLAND SITES IN VIETNAM

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Foreword

Wetlands include marshes, rivers, streams, lagoons, plains, estuaries, reservoirs, flows, etc. In Vietnam, distributed all over the country, wetlands range from inland streams, lakes and rivers to estuary wetlands, tidalflats, lagoons and coral reefs along the shoreline.

Today, most planning and development decisions are made on economic grounds and, more and more, on the basis of the forces at play in the free-market system. While this new paradigm has its own limitations and dangers, it would be unrealistic to ignore it and to base our quest for the conservation and wise use of wetlands on a completely different set of values (Edward B Barbier, Mike Acreman và Duncan Knowler, 1997). The trend towards wetland conservation is exemplified by the many countries that have adopted the policy that there should be no further wetland loss or degradation, that wetlands must be used in a sustainable way and research should be undertaken on quantifying wetland values. International mechanisms and institutions, such as the Ramsar Convention on Wetlands, the Convention on Biological Diversity, the UN Commission on Sustainable Development, OECD, IUCN-The World Conservation Union, Wetlands International and WWF are promoting research, analysis and dissemination of information on economic valuation of natural systems, including wetlands. At the conference in Brisbane, Australia, in March 1996, the Conference of the Parties to the Convention on Wetlands approved a Strategic Plan that recognises the importance and urgency of carrying forward the work in the area of economic valuation of wetlands. According to the content of the Strategic Plan, the Ramsar Convention will promote the economic valuation of wetland benefits and functions through dissemination of valuation methods.

In Vietnam, wetlands play a very important role in human lives, especially for those who live within or near coastal wetlands. They provide free of charge many valuable functions (e.g., flood alleviation, groundwater recharge, retention of pollutants), products (e.g., fish, fuelwood, timber, rich sediments used for agriculture in the floodplains, tourist attractions), and attributes (biodiversity, aesthetic beauty, cultural heritage and archaeology). Their significant values need to be economically evaluated so as wetlands are sustainably planned and developed.

Despite their critical ecological, environmental and socio-economic values, there still exist a lot of shortcomings in the management, utilization, conservation and protection of Vietnam's wetlands. This situation originates from various causes, one of which is the fact that their values have not accurately been economically evaluated. Therefore, rises the urgent need of doing research in the economic evaluation of wetlands' socio-economic values.

Within the framework of the project "Formulation of National Management and Conservation Program", Vietnam National University Hanoi has done a research into economic evaluation of some important wetlands in Vietnam. Main contents of the research work are as follows:

- Identifying values of wetlands in need of economic valuation.
- Investigating and proposing an economic valuation method in conformity with Vietnam's real situations.
- Performing economic evaluation of important wetlands.

The major methodology used in this project includes:

- The cross-sectoral and multi-sectoral approach.
- Synthesizing, analysing by inheritance from previous research work and secondary documents.
- Consulting experts.

The report consists of two chapters, the first chapter deals with economic value types of wetlands (Consumptive Use Value, Non-Consumptive Use Value, Recreational Use Value, Option Value, Total Economic Value (TEV)...) and focuses on intergrating and inheriting international economic valuation methods. The second chapter focuses on the economic evaluation of coastal wetlands.

Due to the limit of time and scattered data, the project only concentrates on analysing the available data inherited from previous researches so as to bring out an overall evaluation of Vietnam's wetlands. More than 25 science and information publications on wetlands and other wetland-related projects have been analyzed and assessed. A wide range of experts in various science disciplines, such as socio-economy, natural conditions, ecology and biodiversity, have been invited to take part in compiling this report.

We, the group of researchers, would like to express out deep gratitude to the leaders and officers of the Vietnam National Agency of Environmental Protection, Vietnam National University Hanoi as well as wetland specialists for their useful assistance and suggestions during the completion of this project.

Constructive ideas and suggestions from colleagues are always welcome.

Chapter I Introduction of Wetlands Economic Valuations

1.1. Type of economic values of wetlands

- There are 8 types of economic values as follows (Morrison, 2002):

- *Consumptive Use Value*

Use values result from the *in-situ* use of a good. Consumptive use value results from agriculture, aquaculture, fishing, mining, hunting etc.,. Consumption of wetland resources also should be involved. Values indicated by producer and consumer surplus. Wetlands are rich ecosystems, capable of providing a range of goods and services of use to human populations. The value of these goods and services represent *use values*. In his discussion of the total economic value (TEV) of tropical wetlands such as wetland ecosystems, Barbier (1994) distinguishes between direct and indirect use values, the former relating to "the values derived from direct use or interaction with a wetland's resources and services". Examples of such direct use values are plentiful and include, among others, wood from wetland mangroves used as fuel wood and for building purposes, fish and crabs caught in the waterways running through mangroves, nipa leaves for construction (roofing and walling), other products derived from nipa palms such as alcohol and vinegar, and traditional medicines derived from plants and other species found in wetland ecosystems.

- *Non-Consumptive Use Value*

The value results from provision of drinking water, recharge of aquifers, floodwater retention, water purification, and coastal storm damage control but does not require consumption of wetland resources. Values indicated by the cost of alternative provision of these services. Indirect use values stem from "the indirect support and protection provided to economic activity and property by the wetland's natural functions, or regulatory 'environmental' services". The classic example of an indirect use value of wetland ecosystems is the support provided to off-site fisheries through their nursery function. Another is the protection provided against weather-related damage to productive activities located in or just behind wetland ecosystems (aquaculture, agriculture) and to assets such as housing and infrastructure located inland.

Non-use values, on the other hand, are derived "neither from current direct or indirect use of the wetland". Non-use values may arise, for example, from the satisfaction an individual derives from knowing that mangroves continue to exist, but is not necessarily planning to use them (sometimes referred to as *existence value*). Another possible motive of non-use value is the desire to preserve wetland ecosystems for future generations (*bequest value*). Intuitively, it is very unlikely that non-use values for the Ha Long Bay wetland site will be very important. Although the total area of wetland cover is rapidly declining worldwide, the contribution of the Ha Long Bay mangrove to the continued existence of wetland ecosystems is limited. It is therefore unlikely that people will be willing to pay a substantial amount for its preservation, unless it was one of the last remaining wetland sites. On the other hand, some unique characteristics of the area may mean that non-use values might be high. It also serves as a crucial stepping stone in bird migration paths through Vietnam and their loss could be expected to cause increased stress and thereby mortality in these populations. Thus, if there is a non-use value attached to these populations, the Ha Long Bay mangrove forest has a non-use value.

- *Recreational Use Value*

It may or may not involve consumptive use of wetland resources. This is a *non-market value*, and indicates the value of recreation at a wetland.

- *Option Value*

Option value reflects the value that individuals place on uncertainty. People may be willing to pay an amount in addition to their expected consumer surplus if it means that any uncertainty attached to the provision of the good is removed. There may be people who will never actually visit a national park who may nonetheless be willing to pay something to ensure that it remains open: this is the option value. In practice, option value is difficult to estimate separately, so analysts typically attempt to estimate option price, which is the sum of consumer surplus and option value. In theory the sign of option value can be positive or negative. If uncertainty results not just from uncertainty about the provision of the good but uncertainty about *whether somebody actually wants the good* then the sign of option value is indeterminate.

Option value (OV) refers to an individual's Willingness To Pay (WTP) to preserve the *option* of using a good in the future. It is *not* equal to the total *ex ante* WTP for preserving the option of future use. This *ex ante* WTP is known as the option price (OP). OV is only a part of this WTP, and perhaps only a small part. To clarify this, consider the following example. Suppose an individual is interested in the WTP for preservation of a certain wetland ecosystem, and the only benefit of preservation would be the use for tourism. Consider now the WTP of some (potential) tourist for preserving the area. Suppose his WTP for a visit to the area would be \$100, while the cost of visiting would be \$50. His *expected consumer surplus*, E (CS), would be $\$100 - \$50 = \$50$. Thus, his maximum WTP for preserving the area for tourism would be \$50. However, it might be that an individual is unsure about whether he will actually want to visit the area, or how often. If so, and the individual is risk averse, it is possible that he is willing to pay something just for preserving the option of using the area if he wants to. This WTP, say \$10, is known as the OV of preserving the area. Thus, the total *ex ante* WTP for preservation, or OP, is \$60 and consists of the E (CS) of preservation (\$50) and the OV of preservation (\$10).

Although it seems intuitively clear that OV would be positive for risk adverse individuals, closer analysis has shown that this is not necessarily the case. OV can be either negative, zero or positive, depending on the particular combination of risk aversion and the source of uncertainty (uncertainty about future preferences, about future income, or about future availability of the good). See Pearce and Turner (1990) for a summary of the results of option value under different combinations of risk aversion and sources of uncertainty. It seems unlikely that the option value for the Ha Long Bay wetland ecosystem will be substantial.

Remember that the source of option value is uncertainty - either a (potential) wetland user's uncertainty about future preferences or income, or uncertainty regarding the future availability of a good or service. Whether current users are uncertain with regards to their future preferences regarding wetland products cannot, of course, be said beforehand, but does not seem very likely.

Income uncertainty might play a role. In the absence of an elaborate social welfare system or other possibilities to compensate for a loss of income from, for example, unemployment, people might value the possibility to fall back on the wetland ecosystem for the fulfilment of certain needs. At the same time, with the increased market integration of communities dependent on wetland ecosystems, the dependence on the direct access to wetland ecosystems is likely to decrease (Ruitenbeek, 1992), making any option values unlikely.

Potential users, such as tourists, might be uncertain whether they want to visit the area in the future.

However, sufficient alternatives exist for tourists who want to visit wetland ecosystems, so it seems unlikely that they would be willing to pay just for keeping open the option of visiting this particular area, unless it has unique characteristics. The uncertainty regarding the effect of development on the nursery function could be interpreted as a case of uncertainty regarding the availability of a service. Thus, there might be an option value for the fishermen for conservation. If so, the option value would be positive because in such cases of uncertainty about future availability the option value is always positive.

As already mentioned, most authors agree that OV is not a separate category of value and they question the possibility and usefulness of estimating it separately (Freeman 1993; Randall 1991). OV rather reflects the difference between an *ex ante* and an *ex post* valuation. It can be shown that from an individual point of view, OP is the appropriate measure of the value of preservation, *ex ante*. However, it is less apparent which measure is preferred in the aggregate (see, for example, Johansson, 1987).

- Quasi-Option Value

Quasi-option value reflects the value that people place on obtaining further information about a good. Quasi-option value is not so much a value that can be estimated as a warning. The true value of preserving a wetland might only become clearer later; hence early development of a resource may be sub-optimal. As with option value, quasi-option value is not a separate component of the total economic value. Quasi-option value (Arrow and Fisher, 1974) relates to those planning decisions where the benefits of preservation are unknown, while at the same time development is irreversible, that is, the potential benefits of preservation will be lost forever. However, with the passage of time more information on the benefits of preservation may become available. Hence, there is some value in deferring the decision whether or not to develop the resource until such time as the uncertainty about the benefits of preservation is resolved. The expected value of the increase in total benefits that can be obtained by deferring the development decision to the period when the uncertainty will be resolved is the so-called quasi-option value. It is also known as the expected value of perfect information (Conrad, 1979).

Quasi-option value may be a useful concept in wetland management. Given the state of current knowledge about the nursery function, it is still extremely uncertain how these will be affected by alternative management regimes. At the same time, many think that the value (damage) of any impairment of this function might be very high. By delaying a decision, more scientific information of the effects of a loss of this function might become available, and therefore may result in better understanding for more informed decision making. Given some prior expectation of the outcome of the delay (for example, there is a 50% probability that more information will show that there will be no damage if the function is impaired, and a 50% probability that damage will be some amount x) the expected value of the increase in total benefits that can be obtained by waiting until the information is available can be calculated. If this expected value of information is higher than the benefits forgone by not developing now, then it is optimal to wait for the decision until that moment.

A problem here is that some development might be necessary in order to be able to resolve the uncertainty. In the literature on option value this is known as dependent learning, in contrast to the case of so-called independent learning where information will become available independently of any development. Incorporating learning in models of quasi-option value is possible, but makes the analysis considerably more difficult. Despite the potential benefits, the application of the concept of quasi-option value is extremely difficult and, to our knowledge, has never been tried for wetland ecosystem management.

- Existence Value

Existence value reflects individuals' willingness to pay to preserve a resource apart from any *in-situ* use. Existence values typically result from bequest, altruistic, stewardship and self-seeking motives. Existence value is generally conceived of being independent of either option or quasi-option value. Existence values are sometimes described of as *non-use* or *passive use* values.

- Intrinsic Value

Intrinsic value occurs when individuals are willing to pay to preserve a resource because of a belief that the resource has value within itself, and should be preserved even if they receive no individual benefit from its preservation. Intrinsic values are typically motivated by commitment,

religious reasons or belief in the rights of the environment. This is a controversial value in the economics profession; many mainstream economists don't believe it exists.

- **Total Economic Value (TEV)**

Total economic value is the overall value that an individual has for a good. It includes all of the values listed above, apart from quasi-option value. This concept is the most relevant measure of value in most economic analyses.

$$\text{TEV} = \text{use value} + \text{option value} + \text{existence value (+ intrinsic value)}$$

In environmental economics, the Total Economic Value (TEV) of a natural resource such as a mangrove ecosystem is considered to comprise two main sources of value: use value and non-use value (sometimes referred to as passive use value). Often, option value is added as a third component. However, option value is best regarded not as a separate component of the TEV, but rather as reflecting the difference in valuation from an *ex ante* or an *ex post* valuation. Below we will discuss the components of the TEV as they relate to wetland ecosystems.

- Another classification of wetland values has been suggested by Gren *et al* (1994).

In their approach, the total production output of a wetland is divided between three different uses: (i) for its own development and maintenance; (ii) for export to other ecosystems; and/or (iii) for export to human society. The first type of output refers to the build-up and organising capacity of a wetland ecosystem, and is called the *primary value*; the second and third type of outputs refer to the exported life-support values, and is called the *secondary value*. Since the secondary value is dependent on the well functioning of the wetland ecosystem, the primary value is a prerequisite for the existence of secondary values (Gren *et al*, 1994).

Although it cannot be denied that the good functioning of a wetland ecosystem such as a wetland ecosystem, is a prerequisite for it being able to provide the goods and services it does, we do not feel that the concept of primary and secondary values is, in principle, more complete than that of the TEV, and that both primary and secondary values are included in the TEV. Indeed, as the authors state themselves: "If human preferences and their valuation were consistent with perfect information on the functional properties of ecosystems as a basis for generating ecological services, both directly as exports to human society and indirectly through their exports to other ecosystems, then the measurement of value according to either of the two classification schemes ... would coincide" (Gren *et al*, 1994; 59).

Hence, it is the lack of information on the properties of ecosystems which may lead to their under valuation, but the same is of course true when an ecosystem is valued according to the classification of primary and secondary values. Further, the division between primary and secondary

Values may give rise to double counting.¹ In as much as the primary value of an ecosystem consists of it being a necessary prerequisite for generating secondary values, any change in the primary value is reflected in a change in these secondary values: if the well-functioning of a wetland is obstructed, that is, a loss of primary value, this will lead to a decrease in secondary value, that is, a decrease in goods and services provided to human society (and other ecosystems). Unless we value the well functioning of the wetland in itself, the loss in primary value is simply the resulting loss in secondary value. But this is exactly what is meant by indirect use values. And if the well functioning of the wetland ecosystem is valued in itself, this is included in the non-use value. So, although the concept of primary and secondary values may be more explicit about the importance of the well functioning of an ecosystem the idea of primary value is, in our view, implicit in the concept of indirect use value.

- **Economic valuation of mangrove sites**

Several studies have been conducted to estimate the economic value of wetland ecosystems, all of which differ in a number of ways. First, the range of wetland related products and functions which

are analysed varies; secondly, the types of mangrove management alternatives considered, such as clear cutting for fishponds, differ for each study; finally, the underlying assumptions regarding ecological linkages between wetland and other ecosystems, are inconsistent. In this section several studies will be described. In order to understand the impact of a particular methodological approach on the outcome, several of these studies are evaluated in detail, as follows:

- *Mangrove Resources and their Management Utilisation for Forestry, Fishery and Agriculture near Khung, Chanthaburi Province, Thailand: A Case Study*. Christensen (1982). The main objective of this study is to describe quantitatively the various uses of mangrove resources in the area and thus provide comparative data for land-use planning.
- *Logging versus tourism in Palawan: an Environmental and Economic Analysis*. Hodgeson & Dixon (1988). This more recent study demonstrates that, for the Philippines, benefits from tourism coupled with fishery production substantially outweigh the short-term benefits which may accrue from increased logging in Palawan.
- *Conservation or Conversion of Mangroves in Fiji*. Lal (1990). This mangrove valuation study compares the net benefits of converting mangrove lands to rice and sugar cultivation by estimating the benefits of mangrove-related products that would be lost after conversion.
- *Mangrove Management: An Economic Analysis of Management Options with a Focus on Bintuni Bay, Irian Jaya*. Ruitenbeek (1992). This includes an extended C/B analysis with varying ecological linkages for different forestry (woodchip) scenarios.
- *The Value of a Mangrove Area in Sarawak*. Bennet and Reynolds (1993). This valuation study estimates the benefits to fisheries and tourism of mangroves in Malaysia.
- *Estimating the Total Economic Value of a Mangrove Ecosystem in El Salvador*. S. Gammage (1994). This explores the different commercial and community uses of mangrove ecosystems.

The tables 1.1&1.2 illustrate the trend in mangrove valuations for both the *type of products* and *functions* taken into account, and the *type of prices* used. Typically, recent valuation studies include more intangible values: whereas Christensen limits the range of valued products and functions to absolute direct use values, Ruitenbeek includes non-use values such as biodiversity.

Table 1.3 summarises the estimates made of the different types of value incorporated in the different studies. Negative prices indicate the opportunity costs of mangrove preservation. The study by Gammage is not included because no average net benefits were provided. Generally, more products and functions are mentioned in the studies than are actually incorporated in the C/B analyses. For example, Lal mentions an annual water purification value of mangroves at US\$ 5,820 per hectare but does not apply this value to the analysis. If this value would be incorporated, it would clearly dominate the total economic value of mangrove ecosystems. Another tendency is the type of prices used in the analysis. While Christensen generally uses local market prices, Ruitenbeek converts most of the market prices into shadow prices.

Table 1.1: Range of values included in the studies

Study	Direct use values	Indirect use values & non-use values
Christensen (1982)	<ul style="list-style-type: none"> ◆ local uses : fruits, cigarette wrappers and nipa thatch for roofing. US\$230/ha/year. ◆ on-site fisheries : commercial harvest by small, medium and large scale fishermen of fish, trash fish, prawns and shrimp, based on a weighted market price of US\$.0.35/kg. US\$30/ha/year. ◆ forestry: charcoal production is 1 /ha/year (potential of 12 /ha/year). US\$30/ha/year. ◆ aquaculture: the current yield from shrimp farming is 184 kg/ha/year at a price US\$.1.1/kg (US\$206/ha/year). The potential yield is 541 kg/ha/year of better species (US\$3.9/kg) leading to a yield of US\$.2,106/ha/year. ◆ agriculture: annual rice yield of 1,700 kg but fails every fourth year. US\$165/ha/year. 	<ul style="list-style-type: none"> ◆ off-site fisheries : Mangrove related shrimp (80kg/ha), and fish species such as mullet, snapper, whiting. US\$100/ha/year.
Lal (1990)	<ul style="list-style-type: none"> ◆ on-site fisheries : total production of commercial (147 kg) and subsistence (184 kg) harvest in mangrove-ecosystem is 331 kg/hectare/year based on a weighted average market price by species of US\$2.61/kg; US\$60-US\$240/ha/year with average of US\$100/ha/year. ◆ forestry: net benefits are retrieved for commercial forestry from market prices and for subsistence consumption from next best alternative approach (buying from saw mill plus transport). US\$6/ha/year. ◆ agriculture & aquaculture: opportunity costs development into sugarcane production and aquaculture were estimated to be negative. US\$52/ha/year. 	<ul style="list-style-type: none"> ◆ off-site fisheries : these values are Included in the category onsite fisheries. ◆ nutrient (waste) filtering service: derived from conventional treatment plant (alternative cost approach). US\$5,820/ha/year.
Bennet & Reynolds (1993)	<ul style="list-style-type: none"> ◆ on-site fisheries : commercial harvest of prawns and fish based on 95% of total catch in Sarawak. ◆ forestry: commercial harvest of building poles, charcoal, semi-charcoal and cordwood of the whole West of Sarawak. 	<ul style="list-style-type: none"> ◆ tourist industry: the revenues in and around the Mangrove Forest Reserve is assumed to disappear. ◆ off-site fisheries: deep-sea and coral reef fishing is incidental.
Ruitenbeek (1992)	<ul style="list-style-type: none"> ◆ local uses : traditional household production from hunting, fishing, gathering, and manufacturing are based on "shadow" prices. This conversion into shadow prices is based on transportation cost of Rp500/kg. 	<ul style="list-style-type: none"> ◆ erosion control: based on agricultural output from local production. US\$3/ha/year. ◆ off-site fisheries : imputed (potential) value of

	<p>US\$33/ha/year.</p> <ul style="list-style-type: none"> ◆ on-site fisheries : sustainable shrimp harvest based on real average export prices US\$6.25/kg. Costs are based on investment and operation costs. Taxes, royalties and compensation payments are excluded. US\$94/ha/year. ◆ forestry: cutting for export of woodchips based on real average export prices US\$40 per cubic metre. Sago production is valued at constant local market prices Rp300/kg. Costs are based on investment and operation costs. US\$67/ha/year. 	<p>Rp300/kg for bycatch which is 90% by weight of total shrimp catch (assumption of future commercial use). Costs are based on investment and operation costs. US\$23/ha/year.</p> <ul style="list-style-type: none"> ◆ biodiversity: ascribed as the "capturable biodiversity benefit". Maximum for ecosystems (rainforest) reaches US\$3,000/km². For Bintuni Bay US\$1,500/km². US\$15/ha/year.
Gammage (1994)	<ul style="list-style-type: none"> ◆ local uses : The seeds of mangrove trees are used as fodder for the local cattle, yet this was not included. Also honey and fruits were used but not valued. ◆ on-site fisheries : the annual sustainable shrimp harvest based on local market prices are approximately 5.5 kg/ha priced at US\$14/kg. Related costs were not mentioned. ◆ forestry: local fuelwood consumption is valued through shadow wage and input cost methodology at approximately US\$100 per m². Local timber consumption is valued at local market prices. Total annual sustainable wood consumption is determined at approximately 6 m² per hectare. 	<ul style="list-style-type: none"> ◆ off-site fisheries: a pseudo production function including mangrove coverage and effort was used to estimate artesanal and commercial fishery. Subsistence fishing is negligible.

Table 1.2. Valuation techniques and key assumptions for the mangrove studies

Study	Valuation techniques	Key-assumptions
Christensen (1982)	<ul style="list-style-type: none"> ◆ market price: both commercial and subsistence forest, fisheries and agricultural products are valued at market prices (costs are practically ignored). 	<ul style="list-style-type: none"> ◆ discount rate & time horizon: future developments are ignored. ◆ environmental linkage: removal of mangroves results in total disappearance of mangrove-dependent fish species.
Lal (1990)	<ul style="list-style-type: none"> ◆ market price: the value of commercial forest and fisheries products is based on market prices corrected for actual costs incurred. ◆ shadow price: for subsistence fisheries products a shadow price is derived from the average price paid by commercial fishermen when they buy surplus fish from villagers. ◆ surrogate or substitute price: the alternative of subsistence forest products was valued to take the offcut timber from 	<ul style="list-style-type: none"> ◆ discount rate: 5 % which is the average real interest rate for 1983 to 1986. ◆ time horizon: 50 years (no rationalisation). ◆ environmental linkages: linkage scenarios varying from 20% to 100% decline in fish harvest if mangroves are destroyed. In main valuation it is assumed that 1 hectare of mangrove produces 331 kg of fish per annum. ◆ economic assumptions: marginal values of labour and

	<p>inland sawmills at on-site cost less costs of transportation. The value of the mangrove soils' filtering capacity is based on the costs of the treatment of comparable sewerage volume costs by a conventional treatment plant.</p>	<p>capital in fishing and forestry industries are zero. ♦ other assumptions: 40 year forestry rotation cycle.</p>
Bennet and Reynolds (1993)	<p>♦ market price: commercial forestry and fisheries are valued at market prices (costs ignored).</p>	<p>♦ discount rate & time horizon: future developments mentioned but ignored in the actual valuation exercise. ♦ environmental linkage: removal of mangroves results in total disappearance of mangrove-dependent fish species which is 95% of total catch.</p>
Ruitenbeek (1992)	<p>♦ market price: local farming products are not corrected for transportation costs because these are not traded outside the region. ♦ shadow price: livestock, fish and fuelwood are corrected for transportation costs at US\$ 0.25 per kg. ♦ other prices: biodiversity benefit of mangrove ecosystems is based on International transfers for rainforests (50% of US\$.3000 per kilometre); erosion is valued through valuing the benefits of local agricultural production.</p>	<p>♦ discount rate: 7.5% reflects opportunity cost of risk-free investment. ♦ time horizon: costs and benefits are extended over a 90 year period to allow three full rotations in forestry evaluations, and to accommodate potential delays in environmental linkage effects. ♦ environmental linkages: scenarios depend upon impact intensity and impact delay parameters. Various ecosystems (ie. mangrove and fisheries) are linked. ♦ other assumptions: 30 year forestry rotation cycle.</p>
Gammage (1994)	<p>♦ market price: timber is valued at local market prices net of input costs and extraction costs; the same is applied for salt, shrimp and fish. Fuelwood is valued at market prices for the traded wood, and at gathering costs of the non-traded wood. Opportunity costs of allocating labour time for fuelwood collection are zero. ♦ other prices: for comparison “the least alternative cost” of substitutes were reported but not applied to the actual C/B analysis.</p>	<p>♦ discount rate: various rates were applied. 19.08% which is the foregone return on other investment projects, 8% which the costs of external borrowing, and 4.64% reflecting the social rate of time preference. ♦ time horizon: 56 years going till 2050. ♦ environmental linkages: a Maximum Sustainable Yield (MSY) of shrimp was based on a non-linear relationship between shrimp yield and intertidal vegetation. A linear relationship between mangrove area and artesanal fish production was estimated implying a decrease of 14 kg in annual fisheries yield for each hectare of mangrove cut. ♦ economic assumptions: fishery benefits are gross of costs.</p>

Table 1.3. Benefits and opportunity costs of mangrove preservation

	Christensen	Bennet & Reynolds	Lal	Ruitenbeek
Forestry	30	14	6	- 67
Fisheries	130	2418	100	117
Agriculture	- 165	-	-52	-
Aquaculture	- 2106	-	-	-
Erosion	-	-	-	3
Biodiversity	-	-	-	15
Local uses	230	-	-	33
Tourism	-	424	-	-
Purification	-	-	5820	

Values are converted into US\$

Another difference is the inclusion of the *discount rate* in economic valuation studies so that future effects of mangrove management can be taken into account. Lal, Ruitenbeek and Gammage base their recommendations on net present values (NPV); implying that future benefits and costs are included along with present returns. The studies by Christensen and Bennet *et al.* are limited to gross annual income per hectare which do not adequately account for dynamic effects. To conduct a sound comparison of NPVs, it is important to do this under identical assumptions. Ideally, both the time horizon and the discount rate should be equal across studies, although often this is not the case. For example, Ruitenbeek (1992) uses a time horizon of 90 years while Lal includes a 50 year period.

Another relevant issue in the review of mangrove valuation studies is the type of *management alternative* with which sustainable mangrove management is compared: Ruitenbeek considers the conversion of mangroves for woodchipping while Lal studies the potential for sugar cane or rice production. Obviously, the type of conversion will have an impact on the change in total economic value of the mangrove area. Both Lal and Ruitenbeek find that the management alternative, which is, respectively, agriculture and wood chipping, are less economically feasible than mangrove preservation. Yet, in the Thailand study by Christensen, aquaculture is clearly more economically beneficial. It may therefore be concluded that the management alternative being considered is integral to the question of mangrove preservation or conversion.

Finally, the underlying assumptions across the studies vary considerably with regard to the *response relations*. Lal assumes that half of the fish stock are mangrove dependent. Thus, the mangrove area is linearly related with fishery benefits. Counteraction of the fishery sector to the decreasing fishstock through an increase in the catching effort is ignored. Gammage applies a “pseudo” production function which facilitates the substitution between catching effort in terms of labour and capital, and mangrove area. Ruitenbeek improves on the environmental linkages assumption by introducing an impact delay factor and the possibility of varying the linkage rate between mangroves and fisheries.

All these changes indicate that in the last decade valuation studies have become more comprehensive. Nevertheless it may be concluded that, given the large variations in applied ecological interdependency between mangrove area and fisheries, clear scientific evidence on this relationship is still imperfect (Gilbert and Janssen 1996).

1.2. Methods of economic valuation of wetlands

There are some methods economic valuation of wetlands (Edward B Barbier, Mike Acreman and Duncan Knowler, 1997) such as appraisal methods (Environmental appraisal or environmental impact assessment; Cost-benefit analysis (CBA), Cost-effectiveness analysis (CEA), Multi criteria analysis (MCA), Risk-benefit analysis (RBA)...).

They have some advantages and disadvantages (table 1.4 and 1.5)

Table 1.4. Comparison of economic appraisal methods

Appraisal framework	Description/purpose	Advantages	Disadvantages
Land suitability/classification.	Distinguish and map areas in terms of characteristics which determine suitability for different uses.	Distils a mass of physical, biological and (sometimes) economic information into a single index of relative suitability for various land uses.	Economic comparisons are rarely made explicit and the relative importance of different factors in calculating the final index may be arbitrary.
Environmental appraisal or environmental impact assessment.	Detailed documentation of environmental impacts, adverse effects and mitigation alternatives.	Explicitly requires consideration of environmental effects; ability to monetise does not pre-empt enumeration of all benefits and costs of an action.	Difficult to integrate descriptive analyses of intangible effects with monetary benefits and costs; not designed to assess trade-offs among options.
Cost-benefit analysis (CBA)	Evaluate projects, land use options and policies based on monetization of net benefits (benefits minus costs).	Considers the value (in terms of willingness to pay) and costs of actions; translates outcomes into commensurate terms; consistent with judging by efficiency implications.	No direct consideration of distribution of benefits and costs; significant informational requirements; tends to omit outputs whose effects cannot be quantified; tends to lead to maintenance of status quo; contingent on existing distribution of income and wealth.
Cost-effectiveness analysis (CEA)	Selects land use option that will minimise costs of realising a defined non-monetary objective.	No need to value benefits; focus on cost information more readily available; provides implicit values of objectives (e.g., marginal cost of increasing by one unit).	No consideration given to relative importance of outputs; degree to which all costs are considered will be important to judgements as to "best" approach.

Multi criteria analysis (MCA)	Uses mathematical programming techniques to select options based on objective functions including weighted goals of decision-makers with explicit considerations of constraints and costs.	Offers consistent basis for making decisions; fully reflects all goals and constraints incorporated in model; allows for quantification of the implicit cost of constraints; permits prioritising of projects.	Results only as good as inputs to mode; unrealistic characterisation of decision process; must supply the weight to be assigned to goals; large information needs for quantification.
Risk-benefit analysis (RBA)	Evaluate benefits associated with a land use option in comparison with risks.	Framework is left vague for flexibility; intended to permit consideration of all risks, benefits and costs; not an automatic decision rule.	Too vague; factors considered to be commensurate often are not.
Decision analysis (DA)	Step-by-step analysis of the consequences of choices under uncertainty.	Allows various objectives to be used; makes choices explicit; explicit recognition of uncertainty.	Objectives not always clear; no clear mechanism for assigning weights.
Macro-economic behaviour models. and	Econometric programming models used to simulate intersectoral linkages and producer behaviour.	Dynamic and price-endogenous models allow explicit simulation of feedback effects and price movements; best for large-scale projects and land use allocation.	Tend to be data and analysis intensive; expensive to build and run and often difficult to interpret.

Source: IIED (1980) adapted from Pearce and Markandya (1989)

Table 1.5. Advantages and disadvantages of valuation techniques used in the economic appraisal of wetlands

Valuation technique	Advantages	Disadvantages
Market prices method. Use prevailing prices for goods and services traded in domestic or international markets.	Market prices reflect the private willingness to pay for wetland costs and benefits that are traded (e.g., fish, timber, fuel wood, recreation). They may be used to construct financial accounts to compare alternative wetland uses from the perspective of the individual or company	Market imperfections and/or policy failures may distort market prices which will therefore fail to reflect the economic value of goods or services to society as a whole. Seasonal variations and other effects on prices need to be considered when market prices are used in economic analysis.

	concerned with private profit and losses. Price data are relatively easy to obtain.	
Efficiency (shadow) prices method. Use of market prices but adjusted for transfer payments, market imperfections and policy distortions. May also incorporate distribution weights, where equality concerns are made explicit. Shadow prices may also be calculated for non-marketed goods.	Efficiency prices reflect the true economic value or opportunity cost, to society as a whole, of goods and services that are traded in domestic or international markets (e.g., fish, fuel wood, peat).	Derivation of efficiency prices is complex and may require substantial data. Apparently 'artificial' prices may not be accepted by decision-makers.
Hedonic pricing method. The value of an environmental amenity (such as a view) is obtained from property or labour markets. The basic assumption is that the observed property value (or wage) reflects a stream of benefits (or working conditions) and that it is possible to isolate the value of the relevant environmental amenity or attribute.	Hedonic pricing has potential for valuing certain wetland functions (e.g., storm protection, groundwater recharge) in terms of their impact on land values, assuming that the wetland functions are fully reflected in land prices.	Application of hedonic pricing to the environmental functions of wetlands requires that these values are reflected in surrogate markets. The approach may be limited where markets are distorted, choices are constrained by income, information about environmental conditions is not widespread and data are scarce.
Travel cost approach. The travel cost approach derives willingness to pay for environmental benefits at a specific location by using information on the amount of money and time that people spend to visit the location.	Widely used to estimate the value of recreational sites including public parks and wildlife reserves in developed countries. It could be used to estimate willingness to pay for ecotourism to tropical wetlands in some developing countries.	Data intensive; restrictive assumptions about consumer behaviour (e.g., multifunctional trips); results highly sensitive to statistical methods used to specify the demand relationship.
Production function approach. Estimates the value of a non-marketed resource or ecological function in terms of changes in economic activity by modelling the physical contribution of the resource or function to economic output.	Widely used to estimate the impact of wetlands and reef destruction, deforestation and water pollution, etc., on productive activities such as fishing, hunting and farming.	Requires explicit modelling of the 'dose-response' relationship between the resource or function being valued and some economic output. Application of the approach is most straightforward in the case of single use systems but becomes more complicated with multiple use systems. Problems may arise from multi specification of the ecological-economic

		relationship or double counting.
<p>Related good method. Uses information about the relationship between a non-marketed good or service and a marketed product to infer value. The <i>barter exchange approach</i> relies on actual exchange of non-marketed goods. The <i>direct substitute approach</i> simply assumes that a marketed good can be substituted for a non-marketed good. The <i>indirect substitute approach</i> also relies on a substitute good, but if the latter is not exchanged in the market its value is inferred in terms of a change in economic output (i.e., the direct substitute approach combined with the production function approach).</p>	<p>These approaches may provide a rough indicator of economic value, subject to data constraints and the degree of similarity or substitutability between related goods.</p>	<p>The barter exchange approach requires information on the rate of exchange between two goods. The direct substitute approach requires information on the degree of substitution between two goods. The indirect substitute approach requires information on the degree of substitution and on the contribution of the substitute good to economic output.</p>
<p>Constructed market techniques. Measure of willingness to pay by directly eliciting consumer preferences.</p>	<p>Directly estimates Hicksian welfare measure - provides best theoretical measure of willingness to pay.</p>	<p>Practical limitations of constructed market techniques may detract from theoretical advantages, leading to poor estimates of true willingness to pay.</p>
<p><i>Simulated market</i> (SM) constructs an experimental market in which money actually changes hands.</p>	<p>SM: controlled experimental setting permits close study of factors determining preferences.</p>	<p>SM: sophisticated design and implementation may limit application in developing countries.</p>
<p><i>Contingent valuation method</i> (CVM) constructs a hypothetical market to elicit respondents' willingness to pay.</p>	<p>CVM: only method that can measure option and existence values and provide a true measure of total economic value.</p>	<p>CVM: results sensitive to numerous sources of bias in survey design and implementation.</p>
<p><i>Contingent ranking</i> (CR) ranks and scores relative preferences for amenities in qualitative rather than monetary terms.</p>	<p>CR: generates value estimate for a range of products and services without having to elicit willingness to pay for each.</p>	<p>CR: does not elicit willingness to pay directly, hence lacks theoretical advantages of other approaches.</p>
<p>Cost-based valuation. Based on assumption that the cost of maintaining an environmental benefit is a reasonable</p>	<p>It is easier to measure the costs of producing benefits than the benefits themselves, when goods, services and benefits are non-marketed.</p>	<p>These second-best approaches assume that expenditure provides positive benefits and net benefits generated by expenditure match the</p>

estimate of its value. To estimate willingness to pay:	Approaches are less data- and resource-intensive.	original level of benefits. Even when these conditions are met, costs are usually not an accurate measure of benefits.
<i>Indirect opportunity cost (IOC)</i> method uses wages foregone by labour in production of non-marketed goods.	IOC: useful in evaluating subsistence benefits where harvesting and collecting time is a major input.	IOC: may underestimate benefits significantly if there is substantial producer or consumer surplus.
<i>Restoration cost (RSC)</i> method uses costs of restoring ecosystem goods or services.	RSC: potentially useful in valuing particular environmental functions.	RSC: diminishing returns and difficulty of restoring previous ecosystem conditions make application of RSC questionable.
<i>Replacement cost (RPC)</i> method uses cost of artificial substitutes for environmental goods or services.	RPC: useful in estimating indirect use benefits when ecological data are not available for estimating damage functions with first-best methods.	RPC: difficult to ensure that net benefits of the replacement do not exceed those of the original function. May overstate willingness to pay if only physical indicators of benefits are available.
<i>Relocation cost (RLC)</i> method uses costs of relocating threatened communities.	RLC: only useful in valuing environmental amenities in the face of mass dislocation such as a dam project and establishment of protected areas.	RLC: in practice, benefits provided by the new location are unlikely to match those of the original location.
<i>Preventive expenditure (PE)</i> approach uses the costs of preventing damage or degradation of environmental benefits.	PE: useful in estimating indirect use benefits with prevention technologies.	PE: mismatching the benefits of investment in prevention to the original level of benefits may lead to spurious estimates of willingness to pay.
<i>Damage costs avoided (DC)</i> approach relies on the assumption that damage estimates are a measure of value. It is not a cost-based approach as it relies on the use of valuation methods described above.	DC: first-best methods to estimate damage costs are useful for comparison with cost-based approaches, which implicitly assume damage is worth avoiding.	DC: data or resource limitations may rule out first-best valuation methods.

Source IIED (1994)

The practicalities of planning and conducting a valuation study could be carried out by some steps. When planning a valuation study, it is necessary to balance the benefits of using the best scientific techniques with the financial, data, time and skills limitations to be faced. This part provides practical advice on choosing the appropriate methodology and conducting a valuation study. The need for a multidisciplinary team is stressed, as well as the importance of the availability of ecological and hydrological data on the wetland and a quantitative understanding of its functioning. Guidance on qualitative valuation of rare species is also provided. A step-by-step guide to undertaking a valuation study is as follows. The three-stage appraisal framework can be further broken down into seven practical steps which must be followed to undertake an economic valuation of a wetland. These are presented in Box 1.1 and described below.

Step 1: Choosing the appropriate assessment approach

There are three approaches: impact analysis; partial valuation; and total valuation. If the problem is a specific external impact, such as effluent polluting a wetland, *impact analysis* will be appropriate. If the problem is the necessity of making one choice between wetland use options, including conversion of the wetland to residential land or diversion of water upstream of the wetland to intensive irrigation, then a *partial valuation* would be the correct approach. Sometimes the problem is more general. For example, developing a national conservation strategy may require assessment of the total net benefits of the wetland system. In this case, a *total valuation* should be undertaken.

Step 2: Defining the wetland area

The boundary of the wetland may already have been defined for political purposes, such as gazettment as a National Park or Ramsar site. No definitive methodology exists to delineate the boundary scientifically. This will be the first task for the multi-disciplinary team based on maps of flood extent, soils, agricultural use and vegetation.

Step 3: Identifying and prioritising components, functions and attributes

The third step involves using various data sources, including scientific studies, consultancy reports and national resource inventories, to produce a more definitive list of components, functions and attributes present in the wetland, and then to place them in order of importance. This may be in rank order, say 1 to 10, or expressed as being of high, medium or low importance. A list of the major components, functions and attributes is given in Appendix 1. Clearly, no single wetland will exhibit all of these, and it is important for the multidisciplinary team to work together to identify the key components, functions and attributes of the wetland being studied and to use all available ecological, hydrological and economic information to score these various characteristics.

Step 4: Relating components, functions and attributes to use value

The fourth step is to determine whether each of the components, functions and attributes is associated with a direct use, indirect use or non-use. Interviews with local communities, census data and consultancy reports are usually good sources of information on direct use. More detailed scientific investigation is usually required to uncover the indirect use values, concentrating on the physical links between wetland system functioning and the economic activities affected. Some of the more intangible values – option and existence values – may be more difficult to determine, and it will often be up to the multidisciplinary team to use its best judgement, keeping in mind the difficulties of quantifying these values.

Box 1.1 Seven steps to conducting a valuation study

Stage 1

1. Choose the appropriate assessment approach (impact analysis, partial valuation, total valuation);

Stage 2

2. Define the wetland area and specify the system boundary between this area and the surrounding region;
3. Identify the components, functions and attributes of the wetland ecosystem and rank them in terms of importance (e.g., high, medium, low);
4. Relate the components, functions and attributes to the type of use value (e.g., direct use, indirect use and non-use);
5. Identify the information required to assess each form of use (or non-use) which is to be valued and how to obtain the data;

Stage 3

6. Use available information to quantify economic values, where possible;
7. Implement the appropriate appraisal method, e.g., cost-benefit analysis (CBA).

Step 5: Identifying and obtaining information required for assessment

The fifth step involves identifying and obtaining information required for the valuation. Different physical, chemical and biological data will be required depending on the values that are to be assessed, and the methodology for collecting and analysing the data must be specified. The range of data to be collected can be extremely diverse. For example, it may include fish population status, numbers of rare species, rates of groundwater recharge, amounts of flood storage, degree of nutrient retention or coastal protection and so forth.

Information on the extent and rate of various human uses of the wetland must also be collected. The types of data may again be diverse, including agricultural yields, fish catches, tourist use or reduction in annual damage from storms or floods. A variety of collection methods and sources may be required. Obtaining agricultural and fisheries yields, for example, may involve interviews with fishermen and farmers, collection of statistics from government offices and visits to markets. Travel agents or tour companies could provide data on tourism in general, whilst parks and protected areas will know visitor numbers. Insurance agencies may have information on flood and storm damage in the area, whilst environmental authorities may collect water quality data.

Information is required on all inputs and outputs for all economic activities that are either directly or indirectly supported or protected by wetland ecological functions. This will include the economic costs of the inputs (e.g., labour-time, materials, physical assets) and the prices of the outputs (products). On the inputs, a distinction needs to be made between purchased inputs (e.g., tools, licenses, hired labour) and non-cash inputs (e.g., use of their own or family labour and borrowed tools). Similarly, distinction must be made between outputs which are marketed (e.g., rice sold at the local market) and those which are non-marketed (e.g., fish eaten at home). Information is required on the producer prices, the final market prices and the transportation and other intermediary costs of marketed products. For non-marketed products, it is necessary to know their rates of consumption, and it may be helpful to obtain information on the market price of any substitute or alternative product.

The information required to assess non-use or preservation values is extremely difficult to collect for developing countries and may require specific studies to estimate willingness to pay. If such analysis is beyond the scope of the study, assessment of such values may warrant a qualitative rather than quantitative approach. This can be approached through interviews with local people and those outside the area who have a connection with it.

More general social and economic data should also be collected on communities living within the wetlands or where they benefit from, or are affected by, wetland functions. For example, this may include population growth rates, income levels, credit facilities and rates of interest, inflation and exchange rates.

Data collection should begin with a *literature survey* of available statistics, existing studies, and their analysis for the region, which may yield some of the required information. Next, any site surveys of specific economic activities should be undertaken. In the first instance, a *rapid rural appraisal* based on brief farmer or producer interviews and group participation may be relevant to collecting basic information on human uses and economic data. More detailed *baseline surveys* may be required for in-depth data collection for actual valuation purposes. In all cases, it is important to be clear in advance about the information required so as to avoid collecting ‘data for data’s sake’.

Step 6: Quantifying economic values

In this step the appropriate valuation techniques should be selected and implemented. As noted above, there are many sophisticated techniques, such as contingent valuation and hedonic pricing, which are being applied to value temperate wetland functions, products and attributes, and such methods are increasingly being implemented in tropical regions as well. However, these techniques may not always be appropriate in developing countries. Although alternative approaches are available, some of these may yield extremely inaccurate valuation estimates. Care must therefore be exercised in choosing a technique which is theoretically sound but which is also appropriate to the circumstances where it will be applied.

Step 7: Implementing the appropriate appraisal method

In the final step, the economic analysis of the wetlands should be placed in the appropriate framework as selected during the planning for the study. An example is *cost-benefit analysis* (CBA), which normally involves calculating on an annual basis the benefits and costs of conserving the natural wetland functions, products and attributes over a selected time period (see Box 3.2). The three most common methods for comparing costs and benefits are *net present value*, *internal rate of return* and *benefit-cost ratio*. Any valuation should be subject to a sensitivity analysis, which defines the variation in results arising from different assumptions or benchmark values used in the study, such as discount rates.

However, CBA is not the only possible appraisal method available, and other frameworks, such as environmental impact assessment, multi-criteria analysis and risk assessment may also require economic valuation as part of the assessment procedure. Initial planning of the study should determine which framework for assessing costs and benefits is desirable, as the choice of framework may affect all seven steps of the analysis.

Resources required for a valuation study

The cost of undertaking a valuation study will vary enormously from country to country and from wetland to wetland. Consequently it is not possible to quantify the investment required. It is possible, however, to highlight the factors which determine the costs.

Data availability will determine to a large extent the appropriate level of effort. Clearly, if sufficient economic and environmental data are readily available, a valuation study may be rapid and inexpensive, requiring only, say, a few person-months of effort. Step 5 (in Box 1.1) will involve collating data held by various authorities or published in journals. In other cases primary data collection may be necessary, which can involve (if time and the budget are sufficient) many person-years of effort, plus, in the case of hydrological and biological data, expensive field equipment.

A good valuation study is based on good quality data. Bacon (1992), for example, when approaching the valuation of Caribbean coastal wetlands, stressed that data should not be restricted to lists of species. Forest structure and mensuration, plant growth rates and stock densities, animal population sizes and dynamics, including seasonality, are all essential. In addition, detailed knowledge of the hydrological functioning of the wetland is required, including tidal cycles, sedimentation, groundwater recharge and pollutant retention. To quantify these accurately, long-term hydrological records are needed, particularly in regions with highly variable climatic regimes. Such records are very rare and costly to collect.

Some economic data, such as the price of fuel wood or livestock over many years, may be available from local government offices, and collection and analysis may take a few tens of man-days. In contrast, the recreational value of a wetland may not be known and several contingent valuation surveys may be required, involving several hundred man-days of work, including training of survey staff, interviews and analysis (see Boxes 1.2 and 1.3). As with the environmental data, long time series may be required, if, for example, the value of the wetland resources varies widely from year to year (in wet years or times of drought).

Box 1.2 Costs of undertaking a contingent valuation study in UK

Contingent valuation (see Box 3.8) is normally undertaken by face-to-face interviews (mail-based surveys cost considerably less, but the response rate is often lower). The following example gives details of a contingent valuation study undertaken in UK involving three steps: focus groups (to pilot questionnaire), the pilot questionnaire and then full questionnaire*. It involves training 12 interviewers, 8 of whom are sent out at any one time (4 to one town and 4 to another), travelling about 40 km by car from the research centre. The survey is based on a pilot of 160 people and a main survey of 1200, 600 at each site. Each interviewer is paid US\$ 8** per hour, and it is assumed that 10 questionnaires are completed in a session (the interview is quite long and detailed).

two preliminary	focus groups (piloting	questionnaire -	US\$	690
interviewer	training/practice	-	US\$	750
interviewer	wages (piloting)	-	US\$	1000
interviewer	travel (piloting)	-	US\$	100
interviewer	wages (survey)	-	US\$	7500
interviewer	travel (survey)	-	US\$	770
debriefing	half-day	-	US\$	380
printing/photocopying,	show cards and information sheets	-	US\$	2780
Total - US\$ 13970				

There then follows a data analysis and report writing phase, the cost of which depends on the scale and complexity of the study and on whether it is a public or private sector-based study. For a university-based study this would include the researcher's salary (\$30,000 per year plus consumables). For a six month study the total costs would be:

researcher's salary (6 months)	-	US\$	15600	***
consumables	-	US\$		1550
survey	-	US\$		13970
Grand Total - US\$ 31120				

Notes:

* For more complex problems focus groups may be set up to define the context, scope and information requirements, psychological/cultural factors: it is assumed here that 6-8 people attend each focus group and are paid US\$30 for attending a 90 minute session plus travelling

expenses, room hire, etc.

** An exchange rate of US\$1 = £ 0.64

*** This does not include any overheads of the University.

Source: Centre for Social and Economic Research on the Global Environment, University of East Anglia, UK.

Box 1.3 Costs of undertaking a valuation study in Nigeria

This example relates to a study of the value of the groundwater, much of which is recharged from a nearby wetland. Face-to-face interviews were held to determine the value of water extracted from village wells. Separate studies were undertaken to determine the hydrological processes in the wetlands and the rates of groundwater recharge, the costs of which are not included here. The costs below are for survey work, training, travel within the study area, and printing survey sheets.

The survey involved 4 months of fieldwork and was conducted over two seasons and in two parts of the wetland. A total of 150 households were interviewed.

10 interviewers (5 weeks for first survey) - US\$ 900*

6 interviewers (5 weeks for second survey) - US\$ 550

This includes 1 week training and 1 week practising questionnaires.

3 well dippers (for 6 months) - US\$ 164

to collect records of groundwater levels

travel costs (10 weeks) - US\$ 284

printing/photocopying - US\$ 340

Total - US\$ 2238

Expenses for expatriate expert:

salary (6 months) - US\$ 15600**

air fare - US\$ 1875

living expenses - US\$ 470

report production - US\$ 782

Grand total - US\$ 20965

Notes:

* At an exchange rate of US\$1 = 88 Naira

** This does not include any institutional overheads.

Source: Department of Environmental Economics and Environmental Management, University of York, UK.

economic surveys. In many cases, a fixed budget will be available, and this will determine the number of staff that can be employed and the data collection methods. If few data exist and time or Time may be short if results are needed before a fixed date when a decision will be made. In this case there may not be time to install hydrometric equipment or undertake ecological or socio-money preclude their collection, an application of benefits transfer may be all that can be achieved.

A further issue is that the required skills may not be readily available in or near the wetland to be studied. In this case experts from other areas or other countries may need to be brought in to advise on, or undertake, the study. Rates of pay may be higher and accommodation will need to be provided and transport costs considered.

- **The valuation study team and sample Terms of Reference**

Normally the policy maker or his or her staff will plan the study but specialists will be needed for technical aspects of the work. The focal point of the study will clearly be the economist, whose task will be to quantify the direct, indirect and non-use values of the wetland goods and services and to incorporate this analysis in the calculation of costs and benefits of actions. However, it is evident that economic valuation is a multidisciplinary exercise. For example, Step 3 (in Box 1.1) shows that a major task is to identify the components, functions and attributes of the wetland ecosystem and rank them in terms of importance (e.g., high, medium, low). This normally requires the input of an ecologist, or natural resource specialist, and a hydrologist, or water resources specialist. Thus, an interdisciplinary approach is needed.

An essential step in the management of a valuation study is the production of Terms of Reference for experts. Since each study will be very different, it is not possible to produce generic Terms of Reference, although the list of steps given in Box 1.1 provides a framework. Consequently, we use the following fictitious example to serve as an illustration.

The hypothetical River Zed in Africa has a large floodplain along its middle course. It has many components, including fisheries and forests, which perform functions such as groundwater recharge and possess attributes such as biodiversity. A dam has been built in the headwaters to supply water to an intensive irrigation scheme. Since the construction of the dam, the area of the floodplain that becomes inundated has been reduced, fish stocks and wildlife have declined, floodplain trees have started to die and water levels in the wells within and beyond the wetlands have fallen. The dam contains sluice gates which can allow water to be released during the wet season to augment the natural flood.

The River Basin Development Authority has decided to commission an economic valuation of the wetlands to assess whether the economy of the region would be best served by using the water from the river for intensive irrigation or by conserving the components, functions and attributes of the wetlands. A scoping study has shown that fisheries and groundwater recharge are the most important characteristics of the floodplain. A multidisciplinary team has been assembled led by three consultants: a hydrologist, a fish ecologist and an environmental economist. A survey team is established to interview users.

The Terms of Reference for the three consultants are given in Box 1.4, 1.5 and 1.6.

Box 1.4 Terms of Reference for the hydrologist

1. Determine the relationship between inflows to the floodplain and the area inundated;
2. Determine the rate of groundwater recharge and its relationship with the area of the floodplain inundated.
3. Organise, support and supervise the collection of data by a field team on water use from wells and boreholes.
4. Determine the water use of the intensive irrigation scheme.
5. Analyse the data and produce summary statistics suitable for economic analysis.

Box 1.5 Terms of Reference for the fish ecologist

1. Determine the relationship between fish populations and area of the floodplain inundated;
2. Organise, support and supervise the collection of data by a field team on fish catches from the floodplain.
3. Analyse the data and produce summary statistics suitable for economic analysis.

Box 1.6 Terms of Reference for the economist

1. Organise, support and supervise the collection by a survey team of economic data related to fisheries within the floodplain and water use from wells in the surrounding areas which are recharged from the floodplain.
2. Analyse the survey data to determine the economic value of fisheries and groundwater recharge within the wetland (giving the results as US\$ per unit volume of water)
3. Assess the economic performance of the intensive irrigation scheme (in terms of US\$ per unit volume of water).
4. Compare the results of the value of water use in the floodplain with that in the intensive irrigation scheme.

- **Non-economic factors**

It is also important to consider the other political, social, historical or ecological issues which may be weighed alongside the economic valuation results when a decision is being made. Political considerations may include the obligations of a state under international conventions such as the Biodiversity and Ramsar Conventions. Consequently, species may therefore be protected without the need to show that this might have an economic benefit. Some states have agreements to ensure that certain quantities of water flow downstream to their neighbours along international rivers. Decisions on wetland management may also be affected by national policies, such as the desire to make a country self-sufficient in rice, which could be used as an argument for intensive irrigation of former wetlands, even where the traditional extensive farming methods may make more efficient use of water. Social considerations may include the decision to maintain traditional ways of life which depend on wetland resources, such as fishing, flood recession agriculture and herding, and which govern the social fabric of a local society, thus effectively giving them a high value. Preservation of archaeological wetland sites, for historical reasons, may be important. Other issues which may need to be considered along with the conventional economic cost-benefit analysis are moral attitudes – for example, wetlands may be retained to conserve an endangered species. Information on the above issues will need to be collected to demonstrate the economic implications of such policies and decisions.

Economic valuation studies

Decisions affecting wetlands are frequently made on economic and financial grounds. If wetland conservation is to compete on these terms with alternative land uses, a quantitative value for wetland components, functions and attributes needs to be calculated. This can be achieved by defining the direct and indirect uses and non-use of wetlands and people's willingness to pay for these services. Economic valuation can be useful at a number of levels including impact of specific developments, making choices between options and setting regional or national policy.

Economic valuation studies of wetlands should be undertaken to make sound decisions on development options and to set regional and national policy.

Interdisciplinary collaboration

Although pure valuation itself is part of economics, and therefore a subject for economists, valuation of wetlands also requires an understanding of the functions of the wetland and therefore requires an interdisciplinary approach. For example, there is currently a study in northern Nigeria to value the groundwater recharge function of Hadejia-Nguru wetlands. The users of the groundwater are people who live downstream and beyond the wetlands. The study involves analysing the use of the water, whether for washing, cooking, crop irrigation or livestock watering. But not all the groundwater comes from recharge in the wetlands – some derives directly from rainfall or through the bed of the river. Calculating the contribution that the wetlands play in recharging the aquifer is a subject for the hydrologist. Data collection involves measuring the quantity of water drawn from village wells and then dividing this amongst the various uses. If this division is not known explicitly, it can be inferred from knowledge of the water requirements of livestock and of the crops irrigated in the village. This requires the skills of an agronomist. This example demonstrates the interdisciplinary nature of wetland valuation studies and the need for multidisciplinary teams.

Economists, ecologists, hydrologists, agronomists, engineers and other experts should work together as a multidisciplinary team to tackle wetland valuation.

Training and institutional capacity building

To ensure that economic valuation is correctly applied and that the results are used effectively in decision-making, training and institutional capacity building are essential. Planners and decision-makers should be exposed at a general level to wetland valuation techniques but, more specifically, they should be trained in planning and managing valuation studies and in how to make the best use of the results to underpin sound policy development and decision-making. Economists with 'traditional' backgrounds may need detailed training on environmental valuation methods used in wetland valuation techniques and on how to manage teams of support staff to collect the required information. Economists will also require training on wetland functioning.

Economists, planners and decision-makers should be trained in wetland valuation techniques as part of broad-based environmental management courses.

Research

There is an urgent need for more research to improve wetland valuation techniques. This is especially the case for non-use values and for application in developing countries where markets are distorted or countries cannot appropriate the true value. Contingent valuation has been criticised as a technique, but many of the problems are due to difficulties in applying the technique rather than the concept itself. Funds should be found to undertake a wide range of case studies throughout the world in different wetlands, different economic situations and using different techniques to ascertain which methods are applicable under which circumstances and where fundamental research effort is most badly needed.

A wide range of case studies should be undertaken throughout the world in different wetlands, different economic situations and using different techniques to ascertain which methods are applicable under which circumstances and to focus fundamental research where it is most needed.

Networking

Results of research and experience from application of valuation techniques are rarely disseminated adequately. Networks of experts can be a useful medium for exchange of ideas and information. Two types are required: first, a network by which researchers can exchange results and discuss basic principles; and second, a network by which practitioners can swap experiences of applying methods in different wetland types, focusing on the practicalities of finding information, undertaking surveys and assessing the response to questionnaires.

Two networks should be established. Firstly, a network of researchers to exchange results and to discuss basic principles. Second, a network of practitioners to exchange experience of applying methods in different wetland types, focusing on the practicalities of finding information, undertaking surveys and assessing the response to questionnaires.

1.3. Case study

1.3.1. Valuation and mangrove conservation in Indonesia

The economic analysis of the mangrove wetlands of Bintuni Bay, Irian Jaya, Indonesia, illustrates the use of the total valuation approach, and in particular the importance that environmental linkages play in the economics of tropical wetland systems (Ruitenbeek 1992, 1994).

Mangroves in Indonesia are under threat from intensive use of their resources. Excessive exploitation of mangrove systems for charcoal, wood, fish ponds or similar resource uses is usually based on very narrow evaluation of only one of many possible 'productive' uses of these systems, often ignoring many important linkages among all the direct and indirect uses of the mangrove wetlands. In the 300,000 hectares of mangrove wetlands of Bintuni Bay, pressures from a woodchip export industry pose a direct threat to the mangrove ecosystem, also endangering its ability to support commercial shrimp fisheries, commercial sago production and traditional household production from hunting, fishing, gathering and manufacturing. The mangrove system also has important indirect use value through its environmental function of controlling erosion and sedimentation, which protects agricultural production in the region. In addition, the wetlands have been identified as an ecologically important and 'diverse' ecosystem, which would suggest a high biodiversity value if it were kept mainly 'intact'.

The total value of household income from marketed and non-marketed sources was estimated to be around Rp 9 million per year per household, of which about Rp 6.5 million can be attributed to traditional uses of the mangroves for hunting, fishing, gathering and manufacturing (Rp 2000 = US\$ 1). Commercial shrimp production yields approximately Rp 70 billion per year, and if the by-catch fish production is ever commercially marketed, the imputed value of this catch is projected to exceed Rp 30 billion per year. Sago production could reach a sustainable level by the year 2000 and earn Rp 68 billion annually. In comparison, selective mangrove cutting schemes have a maximum value of about Rp 40 billion per year.

In the study, values were imputed to the benefits of erosion control and biodiversity. The imputed benefit of erosion control was based on its indirect use value in support of local agricultural production. This was estimated to be around Rp 1.9 million per household. Biodiversity values are expected to be 'capturable' through additional aid flows and other international transfers for conservation projects, which have an imputed value of Rp 30,000 per hectare.

The economic analysis compared different forest management options as to their effects on the total economic value of the mangrove wetlands. The forestry options ranged from complete clear cutting of the mangrove forest for woodchip production to selective cutting regimes of various intensities to a cutting ban. An important feature of the analysis was that it explicitly incorporated the linkages between mangrove conversion, offshore fishery productivity, traditional uses and the imputed benefits of erosion control and biodiversity maintenance. To the extent that these linkages exist, some of these direct and indirect uses become mutually exclusive with more intensive mangrove exploitation through forestry options. The 'optimal' forest management option will therefore depend on the strength of the environmental linkages.

The results are summarized in Figure 1.1. The 'very strong' linkage scenario suggests immediate linear linkage between changes in the forest area and other productive uses. 'Weaker' linkage scenarios involved non-linear impacts with five- or ten-year delays. The analysis indicates that the clear cutting option is optimal only if no environmental linkages exist – a highly unrealistic assumption. At the other extreme, a cutting ban is only optimal if the linkages are very strong, i.e., mangrove alteration and conversion would lead to immediate and linear impacts throughout the ecosystem. Under a scenario of linear but delayed linkages of five years, selective cutting of the mangroves has a present value of Rp 70 billion greater than the clear cutting option, and only Rp 3 billion greater than the cutting ban option. Even if weak interactions exist, an 80% selective cutting policy with replanting is preferable to clear cutting. Given that there is still considerable uncertainty over the dynamics of the mangrove ecosystem, and that alteration and conversion may be irreversible and exhibit high economic costs, the analysis suggests that there is little economic advantage to cutting significant amounts (e.g., more than 25%) of the mangrove area in the Bintuni Bay wetlands.

In sum, the Bintuni Bay mangrove analysis demonstrates the importance of economic valuation of environmental linkages in wetland development decisions. The failure to take into account such linkages may lead to critical errors in these decisions, leading to a narrow focus on a single major productive use. The analysis also demonstrates the importance of valuing traditional uses of tropical wetlands, their environmental functions and their potential to generate future use and non-use values.

1.3.2. Valuing prairie wetlands in North America: application of a bioeconomic model

The rolling prairies of western North America contain millions of small potholes which are crucial for the rearing and staging of migratory waterfowl. Although this region contains only 10% of the total continental breeding area for waterfowl, it has historically accounted for about 55% of duck 'production'. Waterfowl are valued not only by non-consumptive recreationists (e.g., birdwatchers) but by hunters, and may provide additional ecological values as well. For example, Canadian government estimates from the early 1980s placed the net value of waterfowl to Canadians at C\$ 118 million (US\$ 100 million) per year (Environment Canada, 1982). Prairie wetlands support these recreational activities and other waterfowl values by providing habitat for their breeding and other life cycle activities.

At the same time, most potholes are located on privately-held farmland. Faced with pressure to drain and convert these lands to agricultural production, the question arises of allocating these wetland resources to their best use. Hammack and Brown (1974) attempted to value prairie potholes in their alternative uses, or what amounts to a partial analysis of a wetland problem, and then to estimate the optimal numbers of potholes to conserve. Their approach has come to be known as a *bioeconomic model* because it combines both economic and biological/ecological relationships in a single optimisation model.

Hammack and Brown began by valuing waterfowl as an input to satisfying recreational hunting demand. To accomplish this they undertook a contingent valuation survey of recreational hunters in seven western states, using a mailed questionnaire. Their intent was to show that hunter's value additional waterfowl 'kills' beyond their current harvest, indicating that any policy action which increases the number of waterfowl in the fall (autumn) flight would generate hunting benefits. They further wanted to demonstrate that such increases could be related to changes in the availability of breeding habitat (e.g., prairie potholes). By approaching the problem in this way, Hammack and Brown would then be able to derive the underlying value of the wetlands as duck 'factories'. That they should have difficulty obtaining a value for prairie wetlands in their natural state simply reflects the non-market nature of many wetland-related recreation benefits and the indirect way in which these benefits are generated. Complicating things further, the harvesting of waterfowl occurs at a distance from the breeding sites, so that the link between decisions made by the farmers who own the pothole land and waterfowl hunters are not at first obvious. By extension, such a situation has ramifications for the distribution of the costs and benefits of preserving prairie wetlands which must also be addressed, including the transactional nature of the problem.

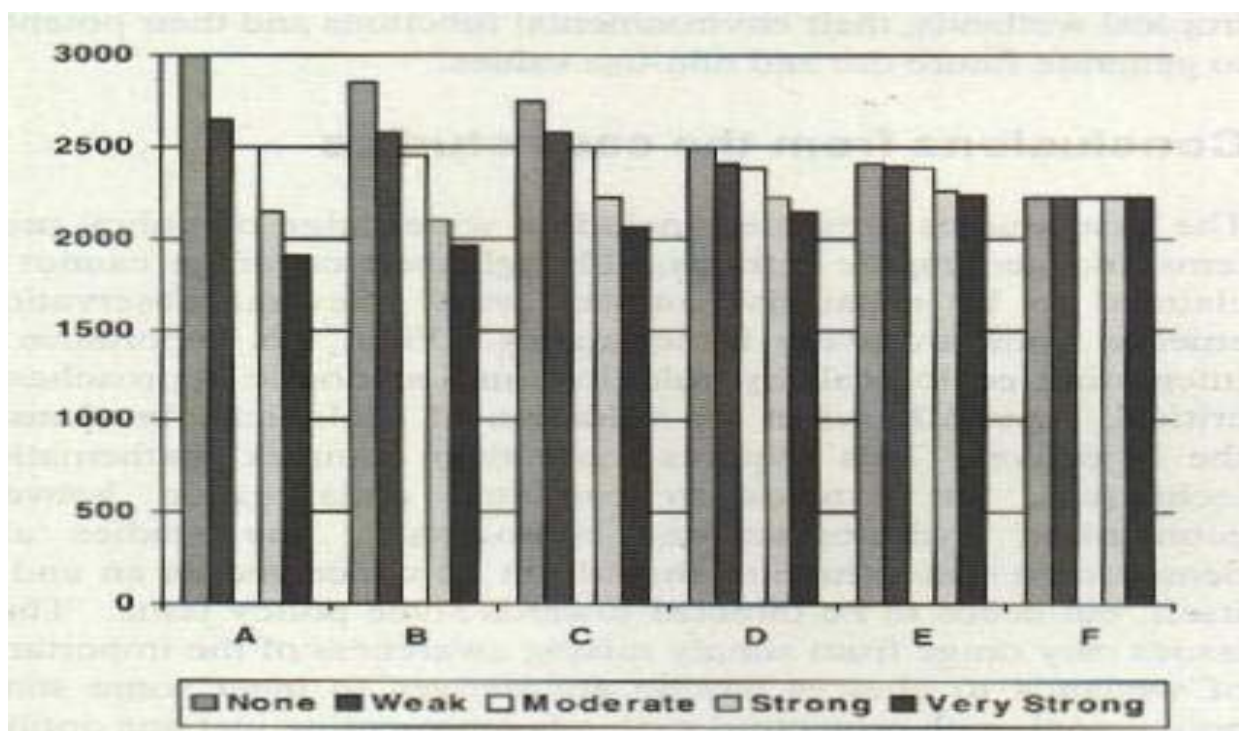


Figure 1.1 Indonesia total economic value of a mangrove system under varying environmental linkages

Economic value of mangrove system, Bintuni Bay, Indonesia (Net present value in billions of 1991 Rp: 7.5% discount rate) (2000 Rp = US\$ 1)

Environmental Linkages - None to Very Strong

A	=	20	Year	Clear	Cut	of	Mangrove	Forest
B	=	30	Year	Clear	Cut	of	Mangrove	Forest
C	=	80%		Selective	Cut	of	Mangrove	Forest
D	=	40%		Selective	Cut	of	Mangrove	Forest
E	=	25%		Selective	Cut	of	Mangrove	Forest
F	=	Ban on Cutting of Mangrove Forest						

Source: Ruitenbeek (1992).

Total Net Benefits include: a) woodchip production from mangrove forest cutting, b) commercial shrimp and by-catch fish production, c) commercial sago production, d) traditional production from hunting, fishing, gathering and manufacturing, e) imputed benefit of erosion control, and f) capturable biodiversity.

The results of their contingent valuation study suggested that hunters do indeed value the bagging of extra waterfowl, with estimated values ranging from just over US\$ 2 to just over US\$ 5 per additional bird (1968/69 prices). This information was later used to link hunter values with the physical productivity of prairie wetlands as waterfowl breeding habitat. First, the production dynamics of migratory waterfowl required investigation. Quantifying the physical production relationship requires tying the supply of breeding habitat with production of waterfowl offspring. Equations estimating historic population data as a function of annual numbers of potholes provided the necessary relationships, and, in fact, a surprisingly strong link was established, considering the multitude of additional factors which might be expected to play a role in determining annual production of young. These results were then combined with information about waterfowl mortality to provide a model which described changes in wetland area in terms of their impact on numbers of birds in the fall flight, which is the variable of direct interest to hunters.

As noted above, maintaining prairie wetlands in their natural or semi-natural state involves a cost, as they have an alternative use as cultivated land. Even though these wetlands are marginal as agricultural land, once drainage costs are considered, farmers may still find an incentive to convert them, particularly if they cannot 'capture' duck production and hunting benefits unless hunters actually pay to use their land for the latter purpose. Hammack and Brown considered two approaches to valuing prairie wetlands as agricultural land: a review of payments to farmers to set such land aside in its natural state and an assessment of the potential net returns from pothole land once drained. They found a range of \$US 1 to 17 per pothole but, to be conservative, settled on the latter value and considered a slightly lower value of \$US 12 per pothole as an alternative case.

Once one has obtained quantified values for additional waterfowl, the productivity of potholes in terms of duck production, and the opportunity costs of setting pothole land aside in its natural state, these figures can be combined within the bioeconomic model framework. The need to use a more complex optimisation framework arises because the problem at hand is continental in scope and not one of a simple either/or decision, as might characterize a conversion proposal for a single site.

Table 1.6. Bioeconomic model results for prairie wetlands and Mallard ducks *

(Units are millions unless otherwise indicated)

	Historical Values 1961-68	Model Results Ponds at US\$ 12 *	Model Results Ponds at US\$ 17 **
Number of Breeders	7.8	12.1 - 17.2	9.5 - 11.4
Number of Ponds	1.3	2.9 - 7.5	2.0 - 4.2
Value of Additional Waterfowl (US\$ per waterfowl 1968/69 prices)	.	2.40 - 4.00	3.40 - 4.65
Total Waterfowl Bagged	3.7	8.1 - 19.2	6.2 - 10.6
Waterfowl Bagged per Hunter (waterfowl/hunter) ***	3.5	4.7 - 11.2	3.6 - 6.2

Source: Hammack and Brown (1974)

Notes:

** Results are for mallards only, which represented about 30% of waterfowl bagged, and Pacific Flyway data, but extrapolated to the continental population.*

*** Ranges shown reflect the three different biological production models used; 8% discount rate used.*

**** Figures are for the Pacific Flyway only; historical figure is for 1965-69.*

The objective of the bioeconomic model is therefore to determine the optimal number of pothole sites to preserve under 'steady state' conditions (i.e., assuming the dynamic model used settles down to such a 'steady state'). Arriving at a solution to the problem requires balancing the net benefits of preserving potholes, indicated by the additional numbers of birds present in the fall flight and incremental hunting values associated with 'bagging' a share of these, against the net benefits of converting these potholes to marginal agricultural land, taking due account of the costs of drainage. Ideally, the saved costs from no longer having to work around the potholes when cultivating should also be considered, but this was not included in the analysis. Optimal results for the annual number of breeders, number of ponds, marginal value of a waterfowl and total 'kill' under differing modelling assumptions are shown below.

The results (Table 1.6) suggest that the historical numbers of prairie ponds, breeding waterfowl and waterfowl bagged have been well below the optimal number. This finding accords with the notion that important wetland benefits have not been taken into account when choosing to convert these wetlands to an alternative use, and therefore too many potholes have been drained. If wetlands of the prairie pothole type were irreversibly lost once converted, and could not be replaced, then the analysis would suggest stopping all drainage now to avoid further losses, but achieving any sort of optimum would be foregone since increasing the supply of wetlands would not be possible.

However, prairie wetlands can to some extent be restored, or new areas can be developed at alternative sites to 'replace' those lost elsewhere, suggesting that policies to encourage creation of wetlands should pay handsomely. Recognising these potential benefits, conservation groups such as Ducks Unlimited have engaged in just this sort of activity, supported primarily by American hunters and using the funds collected to assist farmers with maintaining their wetlands. This privately-initiated conservation activity has helped bridge the gap between farmers faced with the opportunity cost of preserving prairie wetlands and the hunters benefiting from this activity.

One result missing from the Hammack and Brown study is that the hunting-related value attributable to the wetlands is not isolated (except for a rough calculation not related to the authors' model). Instead, the focus is directed towards valuing waterfowl, which can be described as an 'output' of the wetlands, but an 'input' providing satisfaction to hunters. Valuing the wetlands themselves would require backtracking a step further to derive the value of wetlands as input into producing waterfowl. Solution of the model implies that ponds should be preserved as long as the number of additional ducks produced, multiplied by their value to hunters, at least equals their alternative value as agricultural land. Thus, the productivity of the wetlands preserved in the optimal solutions indicated above would at least equal US\$ 12 to 17, depending on the pond cost scenario considered. Additional reinterpretation of the results would be necessary to estimate a proper 'welfare measure' of wetlands value.

The Hammack and Brown study demonstrates the usefulness of combining economic and biological information within a common modelling framework and applying this to a wetlands conversion problem. Despite the limitations of the data, and the need to fill gaps with assumptions or extrapolate from regional information, the analysis provides clear evidence of the undervaluing of an important continental wetland resource. Subsequent work by other economists has shown the role of governments in fostering wetland conservation through 'set aside' programmes (van Kooten and Schmitz, 1992, Heimlich, 1994, Parks and Kramer, 1995), as well as the contradictory

incentives created by governments which provide incentives to drain wetlands to encourage agricultural output expansion. In some cases, both incentives have existed side-by-side.

1.3.3. Conclusions from case studies carried out worldwide

The case studies presented include a wide range of policy problems and geographic settings, although their coverage cannot be claimed to be exhaustive in any way. Several observations emerge from reviewing these studies. First, the importance of integrating ecological, hydrological and economic approaches is critical, especially when the valuation of ecological functions is the objective. This requires more than complex mathematical techniques, but extends to continual collaboration between economists, hydrologists and ecologists. The studies also demonstrate that valuation should not be conceived as an end in itself, but needs to be directed towards some policy issue. These issues may range from simply raising awareness of the importance of wetlands to choices among alternatives to meet some stated policy goal, with protecting wetlands representing just one option.

A variety of valuation techniques is also shown in the case studies, and some clear patterns emerge. Most temperate wetlands studies recognize recreation as an important wetland use and most often use contingent valuation to obtain a measure for its value. In contrast, tropical studies are more concerned with the production values or direct uses associated with wetlands, and the predominant valuation technique is likely to be the measurement of the changes in the value of productivity. The indirect uses or ecological services provided by wetlands are important in both zones and a more complex valuation technique, as was used to value nitrogen abatement in Sweden, will often be required. Unfortunately, such techniques are data-hungry and expensive to implement, and for these reasons there are still relatively few instances where indirect use values have been successfully quantified.

Chapter II. Economic valuation for Demonstration coastal wetland sites in Vietnam

Based on the research results from various sources and literature in the past years, this research attempted to evaluate the values of the wetland sites in Vietnam by the above mentioned methods. The results of valuation are discussed as follows.

2.1 Bach Dang Estuary

2.1.1. Economic, Social and Cultural values

(e.g., fisheries production, forestry, religious importance, archaeological site etc.)

	Direct value	Low value		High value	
		Estimated value (VND)	in USD*	Estimated value (VND)	in USD*
1	Timber	65,840	4.30	74,500	4.87
2	Fuel wood	28,000	1.83	32,500	2.12
	Indirect value				
1	Aquaculture	5,625,000	367.65	6,432,000	420.39
2	Marine product collection**	850,000	55.56	1,150,000	75.16
3	Medicinal plants	n/a	n/a	n/a	n/a
4	Tourism	12,400	0.81	15,600	1.02
	Environmental value				
1	Stabilising micro-climate, improving air quality, water quality, preventing the site from water surge, etc.	n/a	n/a	n/a	n/a
	Total Economic Value (+) (per ha)	6,581,240	430.15	7,704,600	503.57

Source: National Environment Agency (2001)

Note * unorganised fishing and marine product collection, conducted by household member occasionally or seasonally

** Currency exchange rate: September 2002, US\$1 = VND15,300

(+) TEV is estimated on the basis of total area of the identified wetland site

n/a: not available

2.1.2. Land tenure/ownership

- (a) Site
- (b) Surrounding area

The site is located in Hai Phong city and directly under control of Hai Phong City People's Committee. There is the biggest port in the north of Vietnam located in the area, Hai Phong Port. The site plays an important role to not only the local community but also Hai Phong city and the North of Vietnam in terms of economic development.

2.1.3. Current land use

(a) site (b) surroundings/catchments

The site has been used for agricultural production. In the last 15-20 years, since the economic renovation introduced to the area, aquacultural activities, especially shrimp farming, have been flourishing rapidly in the site. Shrimp farming is mostly conducted on the mudflat while the rice production area remains in the inland of the buffer zone of the site.

2.1.4. Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land use and development projects

(a) at the site (b) around the site.

According to Cu. N.D *et al.* (1998), there are 14 different threats affecting the site, they are:

Agricultural reclamation	Construction of aquacultural ponds	Destruction of wetland
Overexploitation of marine products	Accumulation of alluvia in tidal creeks	Construction of dams on rivers
Environmental pollution from industrial activities in the city	Fishing using explosives, electric nets and toxic chemicals	Site levelling
Construction of dams on river	Exploitation of mudflat	Duct raising
Waterfowl hunting	Building of salt field	

These threats have been going on in the site rapidly and the most serious activities are aquacultural development by which wetland mangrove has been cut and environmental pollution caused by industrial activities in the city.

2.1.5. Conservation measures

(national category and legal status of protected areas-including any boundary changes which have been made: management practices; whether an officially approved management plan exists and whether it has been implemented)

There are national and local projects to conserve the site as it is one of the most important wetland sites in the North of Vietnam. Different international organizations have also studied on wetland features and wetland ecosystems in this area. However, there has not been any effective conservation measure taken to protect the site from degradation.

2.1.6. Current conservation education

(e.g visitors centre, hides, information booklet, facilities for school visits, etc.)

Training and education courses on the important significance of the site to socio-economic development of not only the city but also the North of Vietnam as well as rich biodiversity of the wetland have been organized to disseminate information and knowledge to the local communities. However, lack of financial funding, appropriate action plan and the increasing need of economic development, these programmes have not influenced to the decision making in conserving the site.

2.1.7. Current recreation and tourism

(state if wetland is used for recreation/tourism; indicate type and frequency/intensity)

The site has not been used for any recreation and tourism activity though a potential is emerged.

2.1.8. Jurisdiction

(territorial e.g., state/region and functional e.g., Dept of Agriculture/Dept. of Environment, etc.)

Hai Phong City people's committee

2.1.19. Management authority

(name and address of local body directly responsible for managing the wetland)

Hai Phong City people's committee

2.2. Van Uc Estuary

2.2.1. Economic, Social and cultural values

(e.g., fisheries production, forestry, religious importance, archaeological site etc.)

	Direct value	Low value		High value	
		Estimated value (VND)	in USD*	Estimated value (VND)	in USD*
1	Timber	85,250	5.57	92,450	6.04
2	Fuelwood	46,500	3.04	52,400	3.42
	Indirect value				
1	Aquaculture	8,530,000	557.52	9,520,000	622.22
2	Marine product collection**	1,564,000	102.22	1,645,000	107.52
3	Medicinal plants	14,200	0.93	15,600	1.02
4	Tourism	9,800	0.64	11,200	0.73
	Environmental value				
1	Stabilising micro-climate, improving air quality, water quality, preventing the site from water surge, etc.	n/a	n/a	n/a	n/a
	Total Economic Value (+) (per ha)	10,249,750	669.92	11,336,650	740.96
	Estimated TEV				

Source: National Environment Agency (2001), Birdlife International (1996)

Note * unorganised fishing and marine product collection, conducted by household member occasionally or seasonally

** Currency exchange rate: September 2002, US\$1 = VND15,300

(+) TEV is estimated on the basis of total area of the identified wetland site

n/a: not available

2.2.2. Land tenure/ownership

(c) Site

(d) Surrounding area

The site is located in Tien Lang district, Hai Phong city with total area of 1500 ha of which 100 ha of old-growth mangrove. The site is directly managed by the Tien Lang district people's committee. The inland area of the district is also agricultural land and this is one of the important rice production areas in the Red River Delta. The agricultural land of the district is managed by administrative communes of Tien Lang district.

2.2.3. Current land use

(a) site (b) surroundings/catchments

The site has been used for extensive shrimp, fish and crab farming is also developed but products are mostly fish.

2.2.4. Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land use and development projects

(a) at the site (b) around the site.

Similar to the other sites, the site has a number of impacts affecting the ecological characters:

- Extensive aquacultural farming caused mangrove logging and ecological degradation of the site
- Overexploitation of the natural resources by local communities such as product collection on the mudflat during reproduction season
- Illegal bird hunting such as use of popgun has been recorded

2.2.5. Conservation measures

(national category and legal status of protected areas-including any boundary changes which have been made: management practices; whether an officially approved management plan exists and whether it has been implemented)

There were appearance of some species of spoonbills and other rare bird species in the area. This has also been an important site to reserve migration waterfowls. Authorities from national to local levels have been implementing some conservation measures but these activities are not stimulating effectively due to conflicts between economic development, poverty alleviation of the site and conservation purposes. Though the scientific community has conducted some studies in the site, as it is not as important as the adjacent site such as Giao Thuy district, Nam Dinh province or Tien Hai district, Thai Binh province, the site has not been taken care of properly.

2.2.7. Current conservation education

(e.g., visitors centre, hides, information booklet, facilities for school visits, etc.)

Provincial and district authorities have had some training and education courses for local residents and authorities but due to lack of financial funding, these programmes have not been implemented effectively.

2.2.9. Current recreation and tourism

(state if wetland is used for recreation/tourism; indicate type and frequency/intensity)

The site is near Cat Ba and Cat Hai islands, two of the attractions in Hai Phong city. This is an advantage for the site to develop ecotourism in combination with these islands. However, this activity has not been planned.

2.2.10. Jurisdiction

(territorial e.g., state/region and functional e.g., Dept of Agriculture/Dept. of Environment, etc.)

Tien Lang district people's committee

2.2.11. Management authority

(name and address of local body directly responsible for managing the wetland)

Tien Lang district people's committee

2.3. Ba Lat Estuary (Nam Dinh Province)

2.3.1. Economic, Social and cultural values

(e.g., fisheries production, forestry, religious importance, archaeological site etc.)

	Direct value	Low value		High value	
		Estimated value (VND)	in USD*	Estimated value (VND)	in USD*
1	Timber	103,620	6.77	108,200	7.07
2	Fuelwood	82,500	5.39	86,400	5.65
Indirect value					
1	Aquaculture	13,500,000	882.35	15,000,000	980.39
2	Marine product collection**	2,640,000	172.55	2,860,000	186.93
3	Honey	112,000	7.32	132,000	8.63
4	Medicinal plants	15,600	1.02	18,500	1.21
5	Tourism	12,000	0.78	15,000	0.98
Environmental value					
1	Stabilising micro-climate, improving air quality, water quality, preventing the site from water surge, etc.	15,100,000	986.93	16,400,000	1,071.90
Total Economic Value (+) (per ha)		31,565,720	2,063.12	34,620,100	2,262.75
Estimated TEV		254,475,574,524	16,632,390.49	279,099,283,577	18,241,783.24

Source: Adapted from Birdlife International (1996), Adger & Tri (1998) and Giao Thuy's People Committee (2000).

Note * unorganised fishing and marine product collection, conducted by household member occasionally or seasonally

** Currency exchange rate: September 2002, US\$1 = VND15,300

(+) TEV is estimated on the basis of total area of the identified wetland site

2.3.2. Land tenure/ownership

(e) Site

(f) Surrounding area

The site is at the moment under management of the Ramsar management board located at the Giao Thuy district. There are communes in the buffer zone of the zone who are also partially responsible

in managing the protected area. The communes are Giao Lam, Bach Long, Giao Phong, Giao Long, Giao Hai, Giao Xuan, Giao Lac, Giao An and Giao Thien. However, the shrimp farm area in the economic zone of the Ramsar site is mostly possessed by local resident from Giao An and Giao Thien communes which are most adjacent to the Ramsar site.

2.3.3. Current land use

(a) site (b) surroundings/catchments

According to the Giao Thuy district People's Committee (2002), there are 4 blocks allocated in the buffer zone next to the protected site of Ramsar reserve. These blocks are being used for shrimp farming with 183 shrimp ponds with total area of 1779 ha. The adjacent open sea area of the Ramsar site is also used for clam farming with more than 200 farms with total area of 373 ha.

2.3.4. Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land use and development projects

(a) at the site (b) around the site.

There are a number of reasons affecting the site's ecological functions

1. Mangrove logging for shrimp farming and fuelwood
2. Wastewater containing pesticide from the rice production area inland
3. Wastewater from upstream containing industrial waste
4. Changes in coastal processes, though not being an urgent issues but for a long-term, this is a consideration to prevent the site from degradation.

2.3.5. Conservation measures

(national category and legal status of protected areas-including any boundary changes which have been made: management practices; whether an officially approved management plan exists and whether it has been implemented)

As the site is currently the only Ramsar site in Vietnam, there are many projects implemented and going-on in the area. The site is directly under control of the Nam Ha province Ranger Agency and Ministry of Agriculture and Rural Development but there are many different national and international institutions working on conservation, environmental protection and socio-economic development for the site towards sustainable development such as IUCN, Birdlife International, etc.

2.3.6. Conservation measures proposed but not yet implemented

(e.g., management plan in preparation, officially proposed as a protected area, etc.)

As the conflicts between conservation and economic development is increasing rapidly, the local government, with support from national level and numerous organizations, has been developing an master plan for socio-economic development in which aquaculture is the major sector. The master plan will focus on developing shrimp and clam farming while reserving the wetland system and the ecosystem of the whole wetland site.

2.3.7. Current scientific research and facilities

(e.g., details of current projects; existence of field station, etc.)

There have been many research projects undertaken in the site. Some typical studies conducted by National Environment Agency (1992-2002), NGOs such as CERED, MERC, CRES, etc., IUCN, WWF, Birdlife International, WOTRO, etc. The Ramsar management site has been cooperating

with these institutions in research. These studies have contributed to the policy making of the local authorities in managing the human-environmental interaction in this area.

2.3.8. Current conservation education

(e.g., visitors centre, hides, information booklet, facilities for school visits, etc.)

A number of education training workshops and courses were organized in both the local area and national area for conserving the area. The local authority is also running several courses and knowledge dissemination programmes for the local residents to appreciate the importance of the site to the local development and natural conservation purposes.

2.3.9. Current recreation and tourism

(state if wetland is used for recreation/tourism; indicate type and frequency/intensity)

The site has been used for recreational purpose since it was established back in 1989. However, this activity is not very popular due to lack of facility for the tourists and string management. However, the southern part of the site lays a recently-developed beach which attracts domestic tourism. This would be a good chance for the site to develop tourism in the area but also a threat if not managed properly.

2.3.10. Jurisdiction

(territorial e.g., state/region and functional e.g., Dept of Agriculture/Dept. of Environment, etc.)

The site is directly under control of Nam Dinh province Ranger Agency and Ministry of Agriculture and Rural Development. Ministry of Environment and Resources (formerly known as Ministry of Science, Technology and Environment) is also taking responsibility in research and consultation for conservation purpose of the site.

2.3.11. Management authority

(name and address of local body directly responsible for managing the wetland)

The site has a management board, normally known as Ramsar Management Board. Local authority, in particular the Giao Thuy District People's committee and people's committees of the communes adjacent to the site are also responsible for managing the site.

2.3.12. Transboundary significance

Thought the site is located in the Nam Dinh province only but the site has an international significance in biodiversity and natural conservation. This is a valuable resource for scientific research and tourism.

2.3.13. Regional or global significance

The site is an internationally important wetland site in Vietnam and has a very significant important to global and regional biodiversity and environmental resources.

2.3.14. National significance/ government priority

The site has been given by the government in conservation since it was established. This is one of the most important reserves in Vietnam.

2.4. Kim Son Tidal flat

2.4.1. Economic, Social and cultural values

(e.g., fisheries production, forestry, religious importance, archaeological site etc.)

	Direct value	Low value		High value	
		Estimated value (VND)	in USD*	Estimated value (VND)	in USD*
1	Timber	105,200	6.88	112,400	7.35
2	Fuelwood	74,500	4.87	80,420	5.26
	Indirect value				
1	Aquaculture	10,560,000	690.20	11,260,000	735.95
2	Marine product collection**	1,256,000	82.09	1,450,000	94.77
3	Medicinal plants	12,500	0.82	13,500	0.88
4	Tourism	14,500	0.95	16,400	1.07
	Environmental value				
1	Stabilising micro-climate, improving air quality, water quality, preventing the site from water surge, etc.	n/a	n/a	n/a	n/a
	Total Economic Value (+) (per ha)	12,022,700	785.80	12,932,720	845.28

Source: Nguyen Ngoc Quynh (2000).

Note * unorganised fishing and marine product collection, conducted by household member occasionally or seasonally

** Currency exchange rate: September 2002, US\$1 = VND15,300

(+) TEV is estimated on the basis of total area of the identified wetland area

n/a: not available

2.4.2. Land tenure/ownership

(g) Site

(h) Surrounding area

The site is directly under control of district's people committee. The shrimp farming area, which data on the area is not available, is expected to expand to the whole 1,283 ha of the mudflat area.

2.4.3. Current land use

(a) site (b) surroundings/catchments

The district has an area of 12,592 ha of which 1,283 ha of forestland. Most of the rest is agricultural land; a small part of it is used for residential area and public works. The wetland site in the area is directly under the management of the district's people committee and used for shrimp farming in

the last 2 years. There was no data on the development of aquaculture in the district but it is expected that the shrimp farming area is expanding to the whole area of the mudflat ecosystem.

2.4.4. Factors (past, present or potential) adversely affecting the site’s ecological character, including changes in land use and development projects

(a) at the site (b) around the site.

There are some threats directly jeopardising the ecological features of the site. Similar to many other coastal areas of the North of Vietnam, mangrove is being cut down for aquacultural purposes. Overexploitation of the natural resources is also being popular with a large number of marine product collectors from the inland area. Besides, water pollution is also a potential threat from the intensive agricultural land in the district. Industrial activities have not been developed in the district but this trend is increasing. It is anticipated that industrial waste would have negative impacts on the site in the coming years.

2.4.5. Conservation measures

(National category and legal status of protected areas-including any boundary changes which have been made: management practices; whether an officially approved management plan exists and whether it has been implemented)

There is only administrative management of the district people’s committee under effect on the site. Though the threat on the ecological features of the site have been warned to the local authority, lack of knowledge and financial support, there is hardly any conservation measure under implementation.

2.4.6. Jurisdiction

(territorial e.g., state/region and functional e.g., Dept of Agriculture/Dept. of Environment, etc.)

Kim Son District People’s Committee

2.4.7. Management authority

(name and address of local body directly responsible for managing the wetland)

Kim Son District People’s Committee

2.5. Tam Giang - Cau Hai lagoon

2.5.1. Economic, Social and cultural values

(e.g., fisheries production, forestry, religious importance, archaeological site etc.)

	Direct value	Low value		High value	
		Estimated value (VND)	in USD*	Estimated value (VND)	in USD*
1	Timber	n/a	n/a	n/a	n/a
2	Fuelwood	n/a	n/a	n/a	n/a
	Indirect value				
1	Aquaculture	16,850,000	1,101.31	18,450,000	1,205.88

2	Fishing	14,260,000	932.03	16,740,000	1,094.12
3	Marine product collection**	n/a	n/a	n/a	n/a
4	Tourism	15,200	0.99	18,500	1.21
	Environmental value				
1	Stabilising micro-climate, improving air quality, water quality, preventing the site from water surge, etc.	n/a	n/a	n/a	n/a
	Total Economic Value (+) (per ha)	31,125,200	2,034.33	35,208,500	2,301.21
	Estimated TEV		0.00		0.00

Source: Thanh, T.D et al., 1999, National Environmental Agency (NEA), 2001

Note: * unorganised fishing and marine product collection, conducted by household member occasionally or seasonally

** Currency exchange rate: September 2002, US\$1= VND15,300

(+) TEV is estimated on the basis of total area of the identified wetland site

n/a: not available

2.5.2. Land tenure/ownership

(i) Site

(j) Surrounding area

Tam Giang/Cau Hai wetland site is located in an area of 5 districts: Phu Loc, Phu Vang, Phong Dien, Quang Dien, and Huong Tra, Thua Thien Hue province. Land management and property right is of the management of local people's committee of the communes and districts.

2.5.3. Current land use

(a) site (b) surroundings/catchments

The site has a rich history of rice monoculture and gardening. Local residents also use the area between the lagoon and coastline for different crops with high effectiveness and economic value. Aquaculture is also a significant economic activity in the area. There are five communes famous of their gardening and aquaculture activities: Vinh Hung, Vinh My, Vinh Giang, Vinh Hai, Vinh Hien.

The adjacent area of the lagoon is a broad agricultural production area with total of 37700 ha of rice fields out of more than 54000 ha of cultivated area. Though having a broad area of rice production, rice productivity in the area is not high, about 1.5 tonne/ha/year (Thanh D.T. et al., 1999).

2.5.4. Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land use and development projects

(a) at the site (b) around the site.

There are a number of threats affecting the site's ecological character:

- **Over-exploitation and habitat degradation**

Fishing productivity of the area is decreasing rapidly during the last 25 years, from 4515 tonnes in 1973 to 2700 tonnes in 1997 (Thanh, D.T. *et al.*, 1999). Overexploitation is caused by population growth and increasing need of economic development. The number of fishing boats has been increasing, e.g. from 3110 to 4675 during 7 years from 1990-1997. Number of labourers in fishing is also increasing, e.g. from 5500 people in 1982 to 9000 people in 1997. There are also other patterns of fishing affecting seriously the habitat of the site such as electronic fishing, some dynamite use has been recorded. Use of small mesh net is also popular recently.

Habitat of the area has been affected by several activities. Operation of boats, ships, different patterns of fishing and product collection, shrimp pond building, etc have all been affecting seriously on natural habitat of the site.

- **Environmental pollution**

Thanh D.T. *et al.* (1999) pointed out that the water quality of the lagoon has been contaminated seriously by the operation of the fishing boats. Most of the water quality parameters have been over the limit. Besides, wastewater from the rice fields containing pesticide traces is also contaminating the water in the lagoon. Hoi, N.C. *et al.* (1996) conducted a research and pointed out that pesticide pollution in the lagoon has been over the limit.

2.5.5. Conservation measures

(national category and legal status of protected areas-including any boundary changes which have been made: management practices; whether an officially approved management plan exists and whether it has been implemented)

There is currently no conservation activity implemented

2.5.6. Current scientific research and facilities

(e.g., details of current projects; existence of field station, etc.)

There are only some national and local studies in order to initially assess the economic potential and value of the area.

2.5.7. Current conservation education

(e.g., visitors centre, hides, information booklet, facilities for school visits, etc.)

nil

2.5.8. Current recreation and tourism

(state if wetland is used for recreation/tourism; indicate type and frequency/intensity)

The area has a potential to establish eco-tourism to the site. Due to lack of facility and investment, this activity has not been stimulated.

2.5.9. Jurisdiction

(territorial e.g., state/region and functional e.g., Dept of Agriculture/Dept. of Environment, etc.)

The management authority of the site is the Phu Loc district People's Committee.

2.5.10. Management authority

(name and address of local body directly responsible for managing the wetland)

Phu Loc district People's Committee

2.6. Thi Nai lagoon

2.6.1. Economic, Social and cultural values

(e.g., fisheries production, forestry, religious importance, archaeological site etc.)

	Direct value	Low value		High value	
		Estimated value (VND)	in USD*	Estimated value (VND)	in USD*
1	Timber	n/a	n/a	n/a	n/a
2	Fuelwood	n/a	n/a	n/a	n/a
	Indirect value				
1	Aquaculture	8,452,000	552.42	10,520,000	687.58
2	Organised Fishing	5,200,000	339.87	6,345,000	414.71
3	Marine product collection**	n/a	n/a	n/a	n/a
4	Tourism	16,450	1.08	17,500	1.14
	Environmental value				
1	Stabilising micro-climate, improving air quality, water quality, preventing the site from water surge, etc.	n/a	n/a	n/a	n/a
	Total Economic Value (+) (per ha)	13,668,450	893.36	16,882,500	1,103.43
	Estimated TEV				

Source: National Environmental Agency (NEA), 2001

Note: * unorganised fishing and marine product collection, conducted by household member occasionally or seasonally

** Currency exchange rate: September 2002, US\$1 = VND15,300

(+) TEV is estimated on the basis of total area of the identified wetland site

n/a: not available

2.6.2. Land tenure/ownership

(a) Site

(b) Surrounding area

The area is under direct management of the Quy Nhon provincial people's committee. The site is bordered by Tuy Phuoc and Phu Cat districts in the north, Quy Phuoc and district in the west and Quy Nhon city in the south and the east.

2.6.3. Current land use

(a) site (b) surroundings/catchments

The area is currently in use of aquaculture and agriculture. There is no study on the scale of these activities in this site. With total area of more than 5000 ha, the site has a rich potential of aquacultural activities in the region.

2.6.4. Factors (past, present or potential) adversely affecting the site’s ecological character, including changes in land use and development projects

(a) at the site (b) around the site.

There is no study on the impacts of external stresses on the site.

2.6.5. Conservation measures

(national category and legal status of protected areas-including any boundary changes which have been made: management practices; whether an officially approved management plan exists and whether it has been implemented)

No conservation activity stimulated in the site

2.6.6. Current scientific research and facilities 8

(e.g., details of current projects; existence of field station, etc.)

There were few studies of the local authority on socio-economic development of the site only. However, these studies focused on the potential of aquaculture and agriculture within the locale region. No study on scientific significance was conducted.

2.6.7. Current recreation and tourism

(state if wetland is used for recreation/tourism; indicate type and frequency/intensity)

As the site is located near Quy Nhon city with easy access, this would be a good area for ecotourism. In fact, there are some tourists coming to the site annually but the site has not been popular for its biodiversity and ecotourism facilities.

2.6.8. Jurisdiction

(territorial e.g., state/region and functional e.g., Dept of Agriculture/Dept. of Environment, etc.)

Quy Nhon provincial people’s committee

2.6.9. Management authority

(name and address of local body directly responsible for managing the wetland)

Quy Nhon provincial people’s committee

2.7. Tien Estuary

2.7.1. Economic, Social and cultural values

(e.g., fisheries production, forestry, religious importance, archaeological site etc.)

	Direct value	Low value		High value	
		Estimated value (VND)	in USD*	Estimated value (VND)	in USD*
1	Timber	145,600	9.52	158,200	10.34

2	Fuelwood	86,500	5.65	92,000	6.01
3	Coal	n/a	n/a	n/a	n/a
	Indirect value			0	
1	Aquaculture	21,450,000	1,401.96	22,480,000	1,469.28
2	Organised fishing	16,500,000	1,078.43	18,200,000	1,189.54
3	Marine product collection**	4,850,000	316.99	6,270,000	409.80
4	Tourism	160,000	10.46	220,000	14.38
	Environmental value			0	
1	Stabilising micro-climate, improving air quality, water quality, preventing the site from water surge, etc.	n/a	n/a	n/a	n/a
	Total Economic Value (+) (per ha basis)	43,192,100	2,823.01	47,420,200	3,099.36

Source: Adapted from *A Directory of Asian Wetland (2001)*

Note: * unorganised fishing and marine product collection, conducted by household member occasionally or seasonally

** Currency exchange rate: September 2002, US\$1 = VND15,300

(+) TEV is estimated on the basis of total area of the identified wetland site

n/a: not available

2.7.2. Land tenure/ownership

(c) Site

(d) Surrounding area

The site is directly under management and control of Ben Tre province peoples' committee.

2.7.3. Current land use

(a) site (b) surroundings/catchments

Fishing, aquaculture and outdoor recreation. Aquaculture is very intensive, in 1980 there was 1,800 ha of shrimp and fish ponds. Recently, this area has increased to around 3,500 ha. The adjacent inland area is mostly used for rice cultivation, some small areas are used for sugar cane and coconut growing.

2.7.4. Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land use and development projects

(a) at the site (b) around the site.

The major threat of the clearance of mangrove forest on the purpose of aquacultural development, especially shrimp farming that is being intensively developed. The loss of mangrove forest has had a serious effects on migrating waterfowl population, the natural estuarine and inshore fishery.

2.7.5. Current scientific research and facilities

(e.g., details of current projects; existence of field station, etc.)

There were only some studies on flora and fauna and fishery resources in the site.

2.7.6. Current recreation and tourism

(state if wetland is used for recreation/tourism; indicate type and frequency/intensity)

The site is a popular recreational area of people in Ben Tre province. However, lack of financial support has caused the local authority difficulties to develop ecotourism in the site.

2.7.7. Jurisdiction

(territorial e.g., state/region and functional e.g., Dept of Agriculture/Dept. of Environment, etc.)

Ben Tre Province's People Committee

2.7.8. Management authority

(name and address of local body directly responsible for managing the wetland)

Ben Tre Province's People Committee

2.8.Ca Mau southwest tidal flat

2.8.1. Economic, Social and cultural values

(e.g., fisheries production, forestry, religious importance, archaeological site etc.)

	Direct value	Low value		High value	
		Estimated value (VND)	<i>in USD*</i>	Estimated value (VND)	<i>in USD*</i>
1	Timber	123,500	8.07	138,800	9.07
2	Fuelwood	124,300	8.12	145,000	9.48
3	Coal	56,200	3.67	75,000	4.90
	Indirect value			0	
1	Aquaculture	19,394,000	1,267.58	22,459,000	1,467.91
2	Organised fishing	28,485,000	1,861.76	32,031,000	2,093.53
3	Marine product collection**	9,495,000	620.59	12,677,000	828.56
4	Tourism	2,456,000	160.52	2,761,000	180.46
	Environmental value				
1	Stabilising micro-climate, improving air quality, water quality, preventing the site from water surge, etc.	n/a	n/a	n/a	n/a

Total Economic Value (+) (per ha basis)	60,134,000	3,930.33	70,286,800	4,593.91
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Source: Adapted from Dang Trung Tan (2001)

Note: * unorganised fishing and marine product collection conducted by household members occasionally or seasonally

** Currency exchange rate: September 2002, US\$1 = VND15,300

(+) TEV is estimated on the basis of total area of the identified wetland site

n/a: not available

2.8.2. Land tenure/ownership

(e) Site

(f) Surrounding area

The southwest mudflat of Ca Mau province is located in Ngoc Hien district, adjacent to Gulf of Thailand. There are 3 communes which are of administrative management of the site, Dat Mui, Vien An and Dat Moi. These communes and Ngoc Hien district are directly responsible for managing the site. The reserve is under control by Ranger Agency of the province in terms of conservation.

2.8.3. Current land use

(a) site (b) surroundings/catchments

There are more than 6000 ha of natural mangrove forest and 44,291 ha of reforestation area within Ngoc Hien district (Tan, D.T., 2001). This area has been used for extensive aquaculture, charcoal production and fishing. Inland area in the district is used for agriculture and some industrial crops cultivated by local residents of the district.

2.8.4. Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land use and development projects

(a) at the site (b) around the site.

The site, as many other coastal zone in Vietnam, is jeopardising by the development of aquaculture, extensive fishing and over exploitation of the natural resources. Population growth and economic development need and illegal settlement have changed the site ecological features in the recent years.

The site is also contaminated by wastewater of a broad agricultural area inland of Ngoc Hien district and some adjacent districts. With the modernization and industrialization in the province, the potential to be polluted by industrial waste has also posed the area an urgent issue.

Illegal exploitation of the natural resources such as use of dynamites, fishing using small mesh net is increasingly popular in the area recently. Bird hunting is also recorded in the reserve. Though efforts have been put into the conservation site but due to lack of personnel and facility to prevent the site from these activities, conservation activities are still limited.

2.8.5. Conservation measures

(national category and legal status of protected areas-including any boundary changes which have been made: management practices; whether an officially approved management plan exists and whether it has been implemented)

The reserve was established since 1985 by the government for the site's biodiversity, potentials for scientific research and experiment. According to NEA (2001), the site has been divided into 3 different blocks: protection zones (1717 ha), research and experiment zone (1123 ha) and ecological restoration zone (1621 ha).

2.8.6. Conservation measures proposed but not yet implemented

(e.g., management plan in preparation, officially proposed as a protected area, etc.)

There are different projects for both natural conservation and economic development for the site proposed by local authority and research institutes but due to lack of financial funding. These projects are not under implementation.

2.8.7. Current scientific research and facilities

(e.g., details of current projects; existence of field station, etc.)

As stated above, the site has been divided into 3 different blocks of which the last one, research and experiment zone is used for developing a model of aquaculture and forestry farming. The zone provides timber and fuelwood for domestic use and other botanical products from the natural resources for research and experiment.

2.8.8. Current conservation education

(e.g., visitors centre, hides, information booklet, facilities for school visits, etc.)

National and local projects in environmental awareness dissemination have been implemented since the site was established back to 1985. There were frequently training and educational courses organized at the provincial and district levels but not very effectiveness as there are still conflicts between economic development of the site, which is still under the poverty line, and conservation purposes.

2.8.9. Current recreation and tourism

(state if wetland is used for recreation/tourism; indicate type and frequency/intensity)

With the establishment of the reserve, recreational and tourism opportunities have been open to the local authorities and communities. The provincial authority has had a plan to develop an ecotourism site for this area with an infrastructure development plan. Bird watching will be one of the activities of the site. Two watching towers will be built. Access roads will be developed within the site and channel tours are operating recently.

2.8.10. Jurisdiction

(territorial e.g., state/region and functional e.g., Dept of Agriculture/Dept. of Environment, etc.)

Ngoc Hien district people's committee is directly responsible in managing the site in cooperation with Ranger Agency of Ca Mau province.

2.8.11. Management authority

(name and address of local body directly responsible for managing the wetland)

Ngoc Hien district people's committee

Ranger Agency of Ca Mau province

2.8.12. Regional or global significance

The site is a stopover site for migration waterfowl and many different rare species. This is an important biodiversity site for not only Vietnam but also the region and international community.

Chapter III. Economic valuation for demonstration mangrove sites in Vietnam

Based on the research results from various sources and literature in the past years, this research attempted to evaluate the values of the wetland sites in Vietnam by the above mentioned methods. The mangrove sites along the coastline of Vietnam which are representatives of the different biophysical, hydrological, climatic and socio-economic conditions have been proposed for economic evaluation. The results of valuation are discussed as follows.

Northeast	Southeast
1. Dong Rui (Tien Yen)	6. Can Gio (Ho Chi Minh City)
Red River Delta	Mekong Delta
2. Van Uc Estuary (Hai Phong)	7. Ben Tre (Tien river estuary)
3. Ba Lat estuary (Tien Hai)	8. Tra Vinh (or Soc Trang, Hau river estuary)
4. Kim Son mudflat (Ninh Binh)	9. Ca Mau province (East Ca Mau mudflat, Cua Lon estuary area and West Ca Mau mudflat in Gulf of Thailand)
North Central	
5. Nghe An province	

3.1 Dong Rui commune (Tien Yen district)

	Direct value	Low value		High value	
		Estimated value (VND)	in USD**	Estimated value (VND)	in USD**
1	Timber	64,850	4.24	74,500	4.87
2	Fuelwood	32,500	2.12	32,500	2.12
	Indirect value				
1	Aquaculture	48,550,000	3,173.20	62,450,000	4,081.70
2	Marine product collection*	1,250,000	81.70	1,400,000	91.50
3	Medicinal plants	n/a	n/a	n/a	n/a
4	Tourism	n/a	n/a	n/a	n/a
	Environmental value				
1	Stablising micro-climate, improving air quality, water quality, preventing the site from water surge, etc.	n/a	n/a	n/a	n/a
	Total Economic Value (+) (per ha)	49,897,350	3,261.26	63,957,000	4,180.20
	Required investment	50,000,000	3267.97	60,000,000	3921.57

Source: Adapted from National Environment Agency (2001), Birdlife International (1996)

Note * unorganised fishing and marine product collection, conducted by household member occasionally or seasonally

** Currency exchange rate: September 2002, US\$1= VND15,300

(+) TEV is estimated on the basis of total area of the identified mangrove site

n/a: not available

3.2 Van Uc Estuary

Direct value	Low value		High value	
	Estimated value (VND)	in USD**	Estimated value (VND)	in USD**
1 Timber	85,250	5.57	92,450	6.04
2 Fuelwood	46,500	3.04	52,400	3.42
Indirect value				
1 Aquaculture	8,530,000	557.52	9,520,000	622.22
2 Marine product collection*	1,564,000	102.22	1,645,000	107.52
3 Medicinal plants	14,200	0.93	15,600	1.02
4 Tourism	9,800	0.64	11,200	0.73
Environmental value				
1 Stablising micro-climate, improving air quality, water quality, preventing the site from water surge, etc.	n/a	n/a	n/a	n/a
Total Economic Value (per ha)	10,249,750	669.92	11,336,650	740.96
Required investment	12,000,000	784.31	15,000,000	980.39

Source: Adapted from National Environment Agency (2001), Birdlife International (1996)

Note:

* unorganised fishing and marine product collection, conducted by household member occasionally or seasonally

** Currency exchange rate: September 2002, US\$1 = VND15,300

n/a: not available

3.3 Ba Lat Estuary (Nam Dinh Province)

	Direct value	Low value		High value	
		Estimated value (VND)	in USD**	Estimated value (VND)	in USD**
1	Timber	103,620	6.77	108,200	7.07
2	Fuelwood	82,500	5.39	86,400	5.65
Indirect value					
1	Aquaculture	13,500,000	882.35	15,000,000	980.39
2	Marine product collection*	2,640,000	172.55	2,860,000	186.93
3	Honey	112,000	7.32	132,000	8.63
4	Medicinal plants	15,600	1.02	18,500	1.21
5	Tourism	12,000	0.78	15,000	0.98
Environmental value					
1	Stablising micro-climate, improving air quality, water quality, preventing the site from water surge,	15,100,000	986.93	16,400,000	1,071.90

	etc.				
	Total Economic Value (+) (per ha)	31,565,720	2,063.12	34,620,100	2,262.75
	Required investment	32,000,000	2091.50	40,000,000	2614.38

Source: Adapted from Birdlife International (1996), Adger & Tri (1998) and Giao Thuy's People Committee (2000).

Note:

* unorganised fishing and marine product collection, conducted by household member occasionally or seasonally

** Currency exchange rate: September 2002, US\$1 = VND15,300

3.4 Kim Son Mudflat

	Direct value	Low value		High value	
		Estimated value (VND)	in USD**	Estimated value (VND)	in USD**
1	Timber	105,200	6.88	112,400	7.35
2	Fuelwood	74,500	4.87	80,420	5.26
	Indirect value				
1	Aquaculture	10,560,000	690.20	11,260,000	735.95
2	Marine product collection*	1,256,000	82.09	1,450,000	94.77
3	Medicinal plants	12,500	0.82	13,500	0.88
4	Tourism	14,500	0.95	16,400	1.07
	Environmental value				
1	Stabilising micro-climate, improving air quality, water quality, preventing the site from water surge, etc.	n/a	n/a	n/a	n/a
	Total Economic Value (+) (per ha)	12,022,700	785.80	12,932,720	845.28
	Required investment	15,000,000	980.39	20,000,000	1307.19

Source: Adapted from Nguyen Ngoc Quynh (2000).

Note:

* unorganised fishing and marine product collection, conducted by household member occasionally or seasonally

** Currency exchange rate: September 2002, US\$1 = VND15,300

n/a: not available

3.5 Nghe An Province

	Direct value	Low value		High value	
		Estimated value (VND)	in USD**	Estimated value (VND)	in USD**
1	Timber	62,000	4.05	75,000	4.90
2	Fuelwood	18,500	1.21	20,000	1.31
	Indirect value				
1	Aquaculture	8,500,000	555.56	12,500,000	816.99
2	Marine product	1,540,000	100.65	1,850,000	120.92

	collection*				
3	Tourism	n/a	n/a	n/a	n/a
	Environmental value				
1	Stablising micro-climate, improving air quality, water quality, preventing the site from water surge, etc.	n/a	n/a	n/a	n/a
	Total Economic Value (+) (per ha)	10,120,500	661	14,445,000	944
	Required investment	25,000,000	1633.99	35,000,000	2287.58

Source: Adapted from Dung, H.S. et al. (2000)

Note:

* unorganised fishing and marine product collection conducted by household members occasionally or seasonally

** Currency exchange rate: September 2002, US\$1= VND15,300

n/a: not available

3.6 Can Gio district, Ho Chi Minh city

	Direct value	Low value		High value	
		Estimated value (VND)	in USD**	Estimated value (VND)	in USD**
1	Timber	n/a	n/a	n/a	n/a
2	Fuelwood	n/a	n/a	n/a	n/a
	Indirect value				
1	Aquaculture	45,800,000	2,993.46	62,500,000	4,084.97
2	Marine product collection*	n/a	n/a	n/a	n/a
3	Tourism	1,150,000	75.16	1,550,000	101.31
	Environmental value				
1	Stablising micro-climate, improving air quality, water quality, preventing the site from water surge, etc.	n/a	n/a	n/a	n/a
	Total Economic Value (+) (per ha basis)	46,950,000	3,068.63	64,050,000	4,186.27
	Required investment	25,000,000	1633.99	30,000,000	1960.78

Source: Adapted from Dao, P.T.A., 2000, Lai, B., 2000, Nam, V.N. and Quy, N.D., 2000, Sinh, L.V., 2000, Ten, N.V., 2000, Thao, H.M. and Tri, N.T., 2000, Tuan, L.D. and Qui, N.D., 2000, and Tung, T.T., 2000.

Note:

* unorganised fishing and marine product collection conducted by household members occasionally or seasonally

** Currency exchange rate: September 2002, US\$1= VND15,300

n/a: not available

3.7 Ben Tre (Tien River Estuary)

		Low value	High value
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	Direct value	Estimated value (VND)	in USD*	Estimated value (VND)	in USD*
1	Timber	145,600	9.52	158,200	10.34
2	Fuelwood	86,500	5.65	92,000	6.01
3	Coal	n/a	n/a	n/a	n/a
	Indirect value				
1	Aquaculture	21,450,000	1,401.96	22,480,000	1,469.28
2	Organised fishing	16,500,000	1,078.43	18,200,000	1,189.54
3	Marine product collection**	4,850,000	316.99	6,270,000	409.80
4	Tourism	160,000	10.46	220,000	14.38
	Environmental value				
1	Stablising micro-climate, improving air quality, water quality, preventing the site from water surge, etc.	n/a	n/a	n/a	n/a
	Total Economic Value (+) (per ha basis)	43,192,100	2,823.01	47,420,200	3,099.36
	Required investment	35,000,000	2287.58	40,000,000	2614.38

Source: Adapted from *A Directory of Asian Wetland (2001)*

Note:

* unorganised fishing and marine product collection conducted by household members occasionally or seasonally

** Currency exchange rate: September 2002, US\$1 = VND15,300

n/a: not available

3.8 Tra Vinh province (or Soc Trang province)

	Direct value	Low value		High value	
		Estimated value (VND)	in USD**	Estimated value (VND)	in USD**
1	Timber	152,000	9.93	160,500	10.49
2	Fuelwood	75,000	4.90	82,500	5.39
	Indirect value				
1	Aquaculture	18,540,000	1,211.76	20,500,000	1,339.87
2	Marine product collection*	14,500,000	947.71	16,500,000	1,078.43
3	Tourism	2,540,000	166.01	2,850,000	186.27
	Environmental value				
1	Stablising micro-climate, improving air quality, water quality, preventing the site from water surge, etc.	n/a	n/a	n/a	n/a
	Total Economic Value (+) (per ha)	35,807,000	2,340	40,093,000	2,620
	Required investment	30,000,000	1960.78	35,000,000	2287.58

Source: Adapted from Quynh, N.B., 2000 and Khuong, L.H., 2000.

Note:

* unorganised fishing and marine product collection conducted by household members occasionally or seasonally

** Currency exchange rate: September 2002, US\$1= VND15,300

n/a: not available

3.9 Ca Mau province

Note: Estimates on average for three sites: East camau mudflat, West Camau mudflat (Cua Lon estuary area) and West Camau mudflat (Gulf of Thailand area).

	Direct value	Low value		High value	
		Estimated value (VND)	in USD**	Estimated value (VND)	in USD**
1	Timber	123,500	8.07	138,800	9.07
2	Fuelwood	124,300	8.12	145,000	9.48
3	Coal	56,200	3.67	75,000	4.90
	Indirect value				
1	Aquaculture	19,394,000	1,267.58	22,459,000	1,467.91
2	Organised fishing	28,485,000	1,861.76	32,031,000	2,093.53
3	Marine product collection*	9,495,000	620.59	12,677,000	828.56
4	Tourism	2,456,000	160.52	2,761,000	180.46
	Environmental value				
1	Stablising micro-climate, improving air quality, water quality, preventing the site from water surge, etc.	n/a	n/a	n/a	n/a
	Total Economic Value (+) (per ha basis)	60,134,000	3,930.33	70,286,800	4,593.91
	Required investment	42,000,000	2745.10	50,000,000	3267.97

Source: Adapted from Dang Trung Tan (2001)

Note: * unorganised fishing and marine product collection conducted by household members occasionally or seasonally

** Currency exchange rate: September 2002, US\$1= VND15,300

n/a: not available

Some comments could be proposed from the above mentioned in chapter II and III. The average highest economic value (EV) is attributed to wetland services, closely followed by the EV of aquaculture. However, aquaculture does not necessarily contribute to deep poverty alleviation, whereas general wetland services and collection of wetland products like, fuelwood, and marine products have a higher likelihood to reduce poverty. EV estimates for the 12 sites showed a range between an annual EV per ha between US\$ 430 and US\$ 4,600 (table 3.1). From other parts of the world figures similar figures are emerging, ranging from less than US\$ 100, to over US\$ 10,000 per ha per year. Three studies in different countries in eastern and southern Africa all suggest for multiple use wetlands an economic value of wetlands of around US\$ 350-500 ha/year. Although the range is wide, even on the basis of the lower figures and with a total wetland surface area of about 8 million ha, this would amount to an economic value of wetlands in VietNam of 3 billion US\$ per annum.

Amongst the products that are harvested from wetlands the most terms of significant in economic value is rice. In 2002 the rice production of Viet Nam reached around 34.06 million

Table 3.1. Average economic value of major benefits in 12 coastal wetlands in US\$/ha/year (after Pham Binh Quyen et al, 2002)

Item	Low value	High value	Poverty relevance
Fuel wood	5	5	High
Marine product collection	118	156	High
Medicinal plants	80	103	Medium
Timber	7	8	Medium
Coal	4	5	Medium
Organised fishing	225	284	Medium
Tourism	22	25	Medium
Aquaculture	853	949	Low
Climate moderation and hydrological services	987	1,072	High

metric tons which constitutes a street value of 6.5 billion US\$. The tremendous increase in rice cultivation over the last decade also leads to some losses for environment: rice cultivation modifies wetlands, increased pesticide use and pollution of water and soil and sediment environment. Moreover, rice cultivation is in some cases in conflict with other major wetland functions, like the fisheries industry, water retention and flood control, and biodiversity conservation.

The second largest natural resources based industry in Viet Nam is fisheries. Total fisheries production in 2000 was 2 million tons, of which 1.28 million tons was derived from marine fishing, and the rest comprises aquaculture and inland fishery products. In 2000, the sector created more than 3.4 million permanent jobs in the fields of fishing, aquaculture and seafood processing. Income of about another 10 million people in part came from forward and backward linkages to the sector. Fisheries export value occupied over 10% of total national export value.

The total value of extracted water from wetlands is extremely difficult to estimate, but probably surpasses the value of all other products combined and runs into billions of US\$ per year.

The main indirect service from wetlands in Viet Nam constitutes its hydrological functions, such as maintenance of water quality, flow and storage, flood control and storm protection, nutrient retention and micro-climate stabilisation, and the production and consumption activities they support. The storm protection function of coastal wetlands is in the Vietnamese context an extremely valuable function, and is under threat due to replacement of mangrove forests with aquaculture. The mangroves along the coast used to protect the lower inland from the wind and floods during the typhoon season. Loss of mangroves and degradation of the coastal wetlands now results in extensive damage during storm surges. A case in point is the damage done by the cyclone Linda in 1999. U Minh Thuong National Park in Kien Giang Province protects one of the last peat swamps in the Mekong River delta, and supplies water to the rice fields during the dry season. U Minh Thuong has been degraded and in March 2002 a fire destroyed the peat swamp and 3400 ha of the forest. This had an impact on the surrounding rice cultivation areas due to changes in local hydrology.

Valuing of option benefits is an arbitrarily process, as it requires an assessment of the risk loosing something valuable but unknown. For example, a 1996 fish survey by Vinh University in the Phong Nha Nature Reserve yielded 72 species of fish out of which six were not yet known to science. Halong Bay was inscribed as a natural World Heritage Area under the UNESCO Convention for the Protection of the World Cultural and Natural Heritage in 1994. The main reason is the global significance of the geological history and scenic beauty of the limestone pillars and caves. The number of tourists and the average amount they spend to travel to and through the bay is one way of attaching some economic value to Halong Bay.

The difficulties in valuing all the economic benefits of ecosystems results in a predominance in the valuation process of products or the value of alternative land-uses, which are more easy to valuate. The more hidden values in the form of natural products collected by the poor are overlooked, and the resulting change in land-use, supported by poor economic value data, may not reduce overall economic value but also shift wetland income from poorer to richer users. For example, research result from Xuan Thuy Ramsar site (Red river estuary area) shows that rich households are able to invest in shrimp production and trading, thus improving their life even more, while the poor are dependent on wild fisheries and other means of unskilled labour

The overall picture from the emerging economic data is that wetlands constitute a tremendous economic value. Changes in wetland use often do not increase the overall economic values but shifts the more measurable benefits to particular, often richer, factions in society. In other cases, while the *in situ* economic values increase by a change in land-use, the overall economic value reduces because of downstream and other outside activities impacts

Conclusion

1. In environmental economics and current condition of Vietnam, the TEV is consider as objects to value wetland sites. TEV includes of 3 significant types of economic values as follows:

- Use Value includes Direct Use Value (timber, fuel, fishery, wood, water way, material...) and Indirect Use Value (medical plant, marine products, micro climate stability..).
- Option Value (Future use ability for economy, science...).
- Existence value (+ intrinsic value)

$$\text{TEV} = \text{Use value} + \text{Option value} + \text{Existence value (+ intrinsic value)}$$

2. The practicalities of planning and conducting a valuation study could be carried out by some following steps.

- Step 1: Choosing the appropriate assessment approach
- Step 2: Defining the wetland area
- Step 3: Identifying and prioritising components, functions and attributes
- Step 4: Relating components, functions and attributes to use value
- Step 5: Identifying and obtaining information required for assessment
- Step 6: Quantifying economic values
- Step 7: Implementing the appropriate appraisal methods such as Environmental appraisal or environmental impact assessment, Cost-benefit analysis (CBA), Cost-effectiveness analysis (CEA), Multi criteria analysis (MCA), Risk-benefit analysis (RBA).

3. Based on the research results from various sources this research attempted to evaluate the total economic values of the wetland sites in Vietnam by the above mentioned methods. TEV (unit: VND/ha) for each demonstration coastal wetland sites in Vietnam as follows:

Demonstration site	Low value	High Value
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i) Mangrove sites:		
- Dong Rui commune (Tien Yen district)	49.897.350	63.957.000
- Van Uc Estuary	10.249.750	11.336.650
- Ba Lat Estuary (Nam Dinh province)	31.565.720	34.620.100
- Kim Son Mudflat	12.022.700	12.932.720
- Nghe An province	10.120.500	14.445.000
- Can Gio district, Ho Chi Minh city	46.950.000	64.050.000
- Ben Tre	43.192.100	47.420.000
- Tra Vinh province	35.807.000	40.093.000
- Ca Mau province (East Ca Mau mudflat, Cua Lon estuary area and West Ca Mau mudflat in Gulf of Thailand)	60.134.000	70.286.800
ii) Other wetland:		
- Bach Dang estuary	6.581.240	7.704.600
- Van Uc estuary	10.249.750	11.336.650
- Ba Lat estuary	31.565.720	34.620.100
- Kim Son tidal flat	12.022.700	12.932.720
- Tam Giang – Cau Hai lagoon	31.125.200	35.208.500
- Thi Nai lagoon	13.688.450	16.882.500
- Tien estuary	43.192.100	47.420.200
- Ca Mau southwest tidal flat	60.134.000	70.286.800

4. The economic valuation of wetland sites requires related comprehensive and detail information which are not available in Vietnam at present time. So it is urgent to carry out researches to conduct necessary information for accurate economic valuation of wetland sites in Vietnam.

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