UNESCO / MAB Project

VALUATION OF THE MANGROVE ECOSYSTEM IN CAN GIO MANGROVE BIOSPHERE RESERVE, VIETNAM

Final Report

Implemented by The Vietnam MAB National Committee

in collaboration with

Center for Natural Resources and Environmental Studies (CRES),
Hanoi University of Economics (HUE)
and Management Board of Can Gio Mangrove Biosphere Reserve

Hanoi 8-2000

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SUMMARY

Due to shortage of time and fund, the project focuses on partial analysis, including cost-benefit analysis of planting, protection, thinning and extraction options, fishing and part of benefits rising from eco-tourism, while indirect-values or function and existence values will be initiate for further studies.

All marketable data available has been collected and collated, and the solicited by the intensive surveys in December 1999 and January 2000. A set of secondary data available in Management Boards of Can Gio Forestry Park, Statistic Office of District Can Gio and Management Boards of Protected Forests is being accessed, analyzed and aggregated by computerization.

A new approach on economic valuation based on Total Economic Value (TEV) is introduced in the case study. The analysis framework of direct use values and non-use values of mangroves which is developed by using Stella 2 dealing with ecosystem services of mangroves in can Gio is tested. A detailed description of methods estimating the direct value of mangroves is described, including their limitation.

Based on Cost-Benefit Analysis, it is presented for each direct benefits/costs: planting, thinning, branching, nipa thatching, propagule supply, in-site and off-site fishing catch, aquaculture, fishing trades and travel cost analysis of eco-tourism. Some avoided costs / benefits is not estimated for shoreline protection, flood and storm mitigation and stock of water. However, the value of biodiversity conservation is evaluated by using the cost or annual investment from HCMC, as considered the existence value. It needs to be added and improved.

The results of cost benefit analysis (CBA) shows that it is of a partial nature, comparing planting, protection and thinning costs, with the direct benefits from extracted marketable products, and with the indirect benefits of the City' investment to restoration of the biosphere reserve. A benefit to cost (B/C) ratio in range of discount rates from 1 to 10 % is analyzed.

For the B/C Ratio of direct benefits, the figures illustrates that most of the costs for planting from initial stage and protection and management system is less than the direct benefits. It can be explained that the limitation of thinning areas, over exploitation of fishing catch, water pollution, oil spill and others related is contributing the low direct benefits, but still higher than cost. However, this is also not meaning that local livelihood of people can be able to sustain in terms of basing the direct benefits.

Otherwise, a new regulation of banning any thinning activities from the City Administration has been launched in September last year and enforcement from early this year. According the regulation, a triple incentive will be given to households allocating forestry lands and protecting forests. However, a detailed response from communities has not been recorded. For the B/C Ratio of total benefits, the big different of benefits to costs is showing the vital role of investments from the National Government and City Administration to restore the reserve.

Based on the estimation of total economic value of mangrove restoration and rehabilitation, management options in dicision-making processes can be laid out from current to hypothetical

scenarios in order to create a scene from unsustainable development up to sustainable one for resource use, like mangroves. Humain activities as driving forces effect to both socio-economic and natural processes. The total economic value can be used as a tool in estimating the activities, especially the mass conversion of mangroves to other purposes. It was really an exchange of three kind of benefits (local, regional and global) in sustainable to one private benefit in short time. As an economic indicator, the total economic value may reflect the effects of policies in management and development in feedback estimation.

This is initial work to contribute the analysis framework needing an investment of time and funding, especially indirect use value, option and quasi-option values and existence value or non-use value as described by Barbier (1989, 1993, 1994) and Scodari (1990). The estimation of non-market values is a big challenge of environmental economists. However, valuation methods proposed by R. Costanza et al. 1997 on ecosystem services, natural capital and GNP are being applicable for this issue. It would be so kind to ask UNESCO/MAB to invest more time and funding for the work.

VALUATION OF THE MANGROVE ECOSYSTEM IN CAN GIO MANGROVE BIOSPHERE RESERVE, VIETNAM

INTRODUCTION

The Can Gio Mangrove Biosphere Reserve has been designated for inclusion in the World Network of biosphere Reserve, by decision of the International Coordinating Council of the Program on Man and the Biosphere, in January 21, 2000.

Consisting of 77 mangrove species (35 true mangroves and 42 associates), the mangrove has contributed an economic and environmental importance in the coastal zone, as long as very vulnerable to impacts from natural and human driving forces. For almost population living in these areas, the mangrove provides not only valuable products from forests including timber, firewood, charcoal, tannin, food, medicinal but also the breeding ground for many species of marine organisms like shrimp, crab, fish, water and migratory birds as well as other economically terrestrial species of monkey, wild boars, boas etc.

It has been recognised by economists that the functions and services provided by mangroves, and wetlands in general, have positive economic value and that these are often ignored in the ongoing process of mangrove conversion (Barbier, 1993; Ruitenbeek, 1994; Turner, 1991; Swallow, 1994; Farber and Costanza, 1989). The various functions and services provided by mangrove areas have been documented and appraised (e.g. Mitsch and Gosselink, 1994; Reimold, 1994; Lugo and Snedaker, 1974). Mangrove wetlands display the features of public goods in that their use is non-exclusive, and they are converted to other uses with private economic returns because the functions and services associated with them are undervalued. Identification of the functions and services and the incorporation of these into policy and the designation of property rights are therefore necessary first steps in promoting sustainable utilisation of such resources. The valuation of functions and services has often been expressed in a framework of the total economic value.

Critical issues in promoting the adoption of such schemes, and hence their ultimate sustainability, include the timing of the costs and benefits and the sensitivity of the economic appraisal of such schemes to discount rates and the limit of the benefits of rehabilitation compared to conservation of existing wetlands (reflected in the absence of option and existence values for such habitats). In the instance under analysis here, the benefits of direct use value of timber, non-timber products including fish, shrimp, crab and thatching, and other benefit for recreation, biosphere reserve as well is an important issue

THE STUDY SITE

The Biosphere Reserve is located on Can Gio District, about 65 km south of Ho Chi Minh City with latitude: $10^0$22'14"-$10^0$40'09" and longitude: $106^0$46'12"-$107^0$00'59". It is 35 km long from North to South and 30 km from East to West. During the two Indochina wars, almost all the mangroves in Can Gio were destroyed. After many years of herbicide spraying, the degraded land here still remains shattered bushy or bare land. A great effort of local people after wars is the rehabilitation of 21,000 ha of mangroves. To date, Can Gio has become one of the most beautiful and extensive sites of rehabilitated mangroves in the world with high values of biodiversity, as seen in table 1.

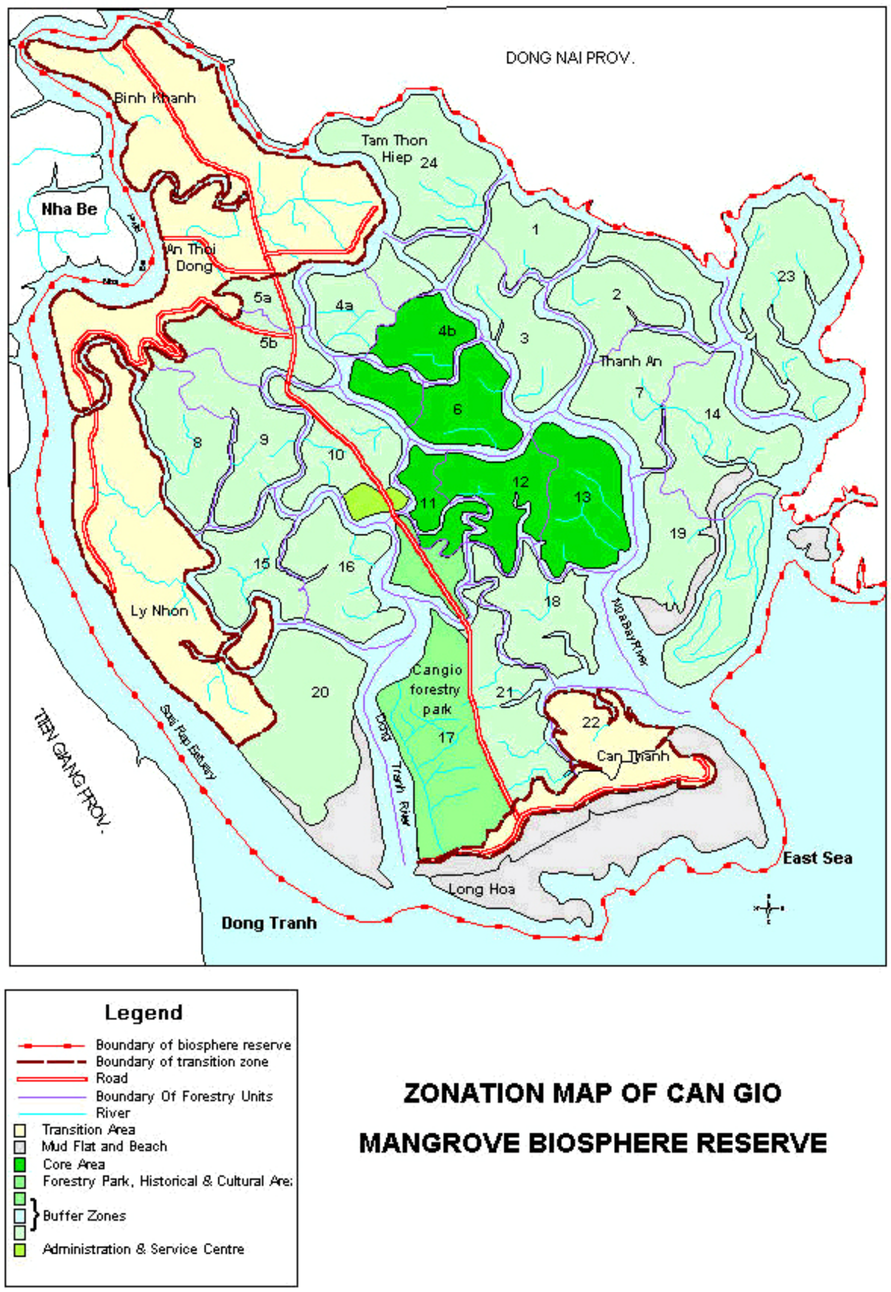

Fig. 1. The map showing the study site

Table 1: Mangrove areas and its management system up-dated in 1999

Forestry Compartments	Planted forests (ha)	Natural forests (ha)	Non-mangrove vegetation (ha)	Total (ha)
1.	644	294	292	1,229
2.	1,613	317	451	2,381
3.	550	463	154	1,166
4.	1,124	334	224	1,682
5.	719	187	228	1,134
6.	940	350	366	1,657
7.	496	231	444	1,172
8.	934	180	340	1,454
9.	859	407	180	1,446
10.	1,126	330	141	1,597
11.	657	289	422	1,367
12.	742	136	458	1,336
13.	880	201	802	1,882
14.	659	281	539	1,478
15.	866	401	674	1,941
16.	642	234	722	1,598
17.	1,164	378	691	2,233
18.	652	284	744	1,680
19.	480	295	472	1,247
20.	540	478	892	1,910
21.	641	169	794	1,604
22.	265	236	231	732
23.	2,474	74	201	2,748
24.	1,438	476	627	2,541
Total	21,104	7,026	11,087	39,217

Can Gio's topography is uneven. Its borders rise gradually to form the central hollow bottom, comprising 6 - types of land topography (Un-flooded, Multi-year cycle flooded, Annual cycle flooded, Monthly cycle flooded, Daily cycle flooded and Accretion type).

Can Gio is situated in the typical tropical monsoonal zone with 2 distinctive seasons. The dry season lasts from November to the next May, the rainy season from the end of May to the end of October. The temperature is high, stable, the monthly mean temperature is 25.5-29.0 ^{0}C. The daily average temperature amplitude is 5-70C. The insolation is 5-9 sunshine hours per day. The solar radiation is 10-14 kcal/cm2/month on an average. The radiation intensity does not vary much with different seasons.

The monsoons form different wave directions and coastal currents, directly influencing Can Gio's coast, leading to erosion and sea level rise. Compared to other areas in Ho Chi Minh City, the rainfall in Can Gio is lower and decreases gradually southwards. The rainy season begins on 20-25 May and ends around 25-31 October. The average annual rainfall is about 1,336mm. September sees the highest rainfall (300-400mm). The mean annual relative humidity is 80%. In the dry season, the air humidity during daytime is usually under 60%. The evaporation is 3.5-6mm/day and in March and April 7-8mm/day at the highest. It is 2.5-5.0 mm/day in the rainy months

Salinity: The survey data after 11 years (1977-1988) (Thanh, 1988) showed that in the dry season, highest salinity in March, April being 1.9-2.0% at Nha Be area, 2.6-3.0% near the sea. In the rainy season, the salinity is low; from August to October, the salinity in mangrove areas is only 0.4-0.8%. The average monthly salinity is 1.8%. Since 1988, the drainage of water from the reservoir of Tri An Hydroelectric Plant in the dry season has decreased the salinity in canals and rivulets of this area.

Given the prevailing circumstances in the coastal districts of Can Gio, and similar regions elsewhere, it is clear that mangrove rehabilitation can have a variety of benefits. In such situations, mangrove rehabilitation can provide income where households are often severely constrained in cash income sources, as well as bringing about environmental benefits in terms of productive assets and biodiversity resources. The following sections quantify an economic model of such an approach.

METHODOLOGY/APPROACH

The approach of total economic valuation is used in this work. Total Economic Value (TEV) is given by the sum of a number of components:

TEV = Direct-use value + Indirect-use value + Option value + Existence value

Direct use values include revenues from timber and values of other products such as thinning from Nipa palms. Indirect-use values or ‘functional’ values relate to the ecological functions performed by mangroves, such as global geochemical cycling, the protection of agricultural areas, and the provision of spawning grounds for fisheries. Option value, or more precisely, quasi-option value is the expected value of the information on the benefits of an asset, conditional on its preservation enabling an increase in the stock of knowledge relevant to the utilisation of the asset. A frequently evoked example of quasi-option value is associated with genetic resources: for example, the future value of pharmaceuticals developed from plant materials. Existence value relates to the value of environmental assets irrespective of current or optional uses. Empirical measures of existence values based on donations to conservation organisations, or on the contingent valuation method, suggest that these can be a significant element in total economic value, especially in contexts where the asset has unique characteristics or cultural significance.

Although intuitively appealing, applications of Total Economic Value to particular environmental resources are few because of the problems of double counting if the elements are simply added and of quantification of the components. For example, although direct and indirect benefits of mangrove conservation can generally be assessed, the option and existence value of mangroves are difficult to determine within an economic analysis. Much research has been undertaken in this area, and some studies suggest that non-use values (option and existence) can be at least as large in magnitude as use values (see Walsh et al., 1984; Cummings and Harrison, 1995 for example). It has however been pointed out in studies of Total Economic Value that option and existence values reflect global as well as local scarcity and that the welfare gained from resource conservation normally accrues at the regional or global level, bypassing the local users (see Adger et al., 1995, and Kumari, 1995, for example).

The crucial aspects of value for local decision-making, and for the differential impacts of global change, are the direct and indirect use benefits. It should be noted that some economic benefits of the mangrove resource will increase in value over time, while others will remain constant or decline. For example, as agricultural development intensifies, the potential economic losses from storm surges increases, so the value of the coastal protection function of the mangroves will rise accordingly. Exogenous environmental change associated with global climate change may increase the frequency and intensity of storm surges, and hence the value of this function of the mangroves will rise.

Recent attempts to value coastal wetlands have concentrated on valuing specific contribution of various wetland systems .Some economics studies have valued the benefits of temperate wetlands, but to date, little analysis of tropical wetland benefit has been undertaken (Turner et al.1991,92). The value of Florida coastal marshes for marine fishery production, relating wetland area to crab production, in this case the Florida blue crab fisheries was estimated by Lynne *et al.* (1981) and the value of Louisiana wetlands for hurricane wind damage protection was estimated by Gosselink *et al.* (1974).

E.B. Barbier (1993) gave a basic methodology for assessing and valuing the economic benefit of tropical wetlands applied in Central America in distinguishing between direct-values, indirect-values and non-use values (typology of benefits of conservation), particularly a case study of a mangrove system in Indonesia for woodchip production. The value of wetlands for residential development and the value of Virginia coastal wetlands for oyster production. The valuation of oyster production is directly related to wetland area. The same methodology can therefore be used to value for crab and shrimp fisheries, but not for offshore fisheries were estimated by Bertelson and Shabman (1979).

S. Farber and R. Costanza (1987) stated that the harvest of the shrimp and crabs from the mangroves is directly related to the area of the mangroves by relating the marginal value to the area in a regression equation. The paper derives a linear relationship between area of wetland and offshore fish catch based on a cross section of wetlands. Ruitenbeek, H.J. (1994) gave a full valuation excise, and show the trade-off between protection and logging mangrove forest for timber in indicating that harvesting is much lower when the ‘linkages’ between the reduction in mangrove area and the functions (such as off-shore fishery) are taken into account. The benefits of the mangroves remaining in existence include the shrimp fishery and biodiversity (Batie and wilson, 1978).

Natural wetlands perform many important functions for humankind- storm prevention, flood and water flow control, and wood products. When properly measured, the TEV may exceed the economic gain of converting the area to an alternative use. It is difficult to assemble estimates of values of these various contributions for the same wetlands system. Because of this difficulty, little is known about the ordes of magnitude of value for one entire wetlands system. Economic analysis of resource use can be undertaken in order to assess the magnitude of benefits to local users of the resource. Some values of the goods and services can be assessed by observation of existing markets, but some of the functions and services of mangroves are indirect, or functional, benefits (see Pearce and Turner, 1990, for example) is still difficult to estimate.

The purpose of this paper is to obtain a consistent set of estimates of the value of one wetland system, a biosphere reserve for as many independent contributions as existing methodology and data currently allow.

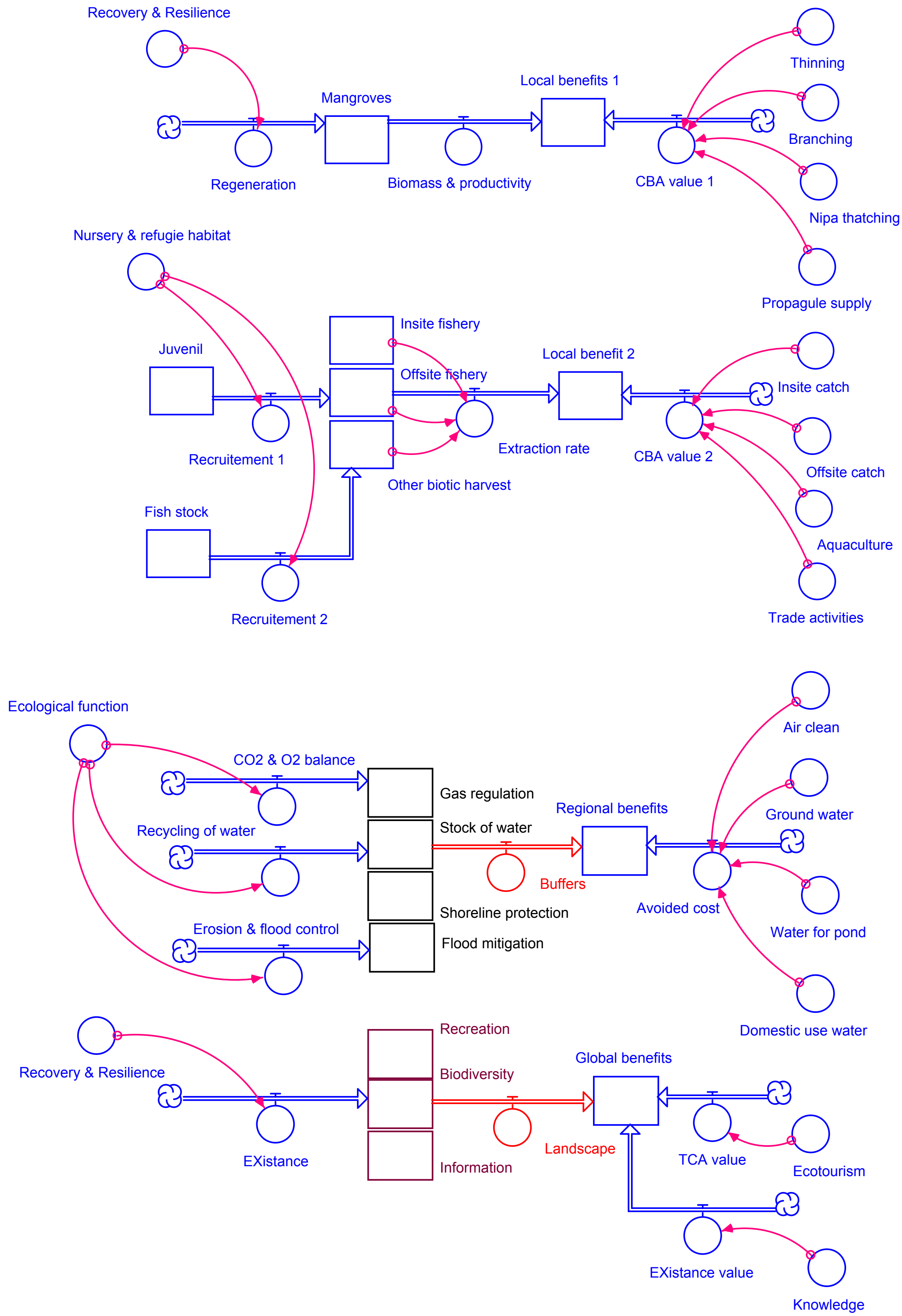

Fig. 2. Diagram showing the analytical framework for economic valuation in the study site

FRAMEWORK FOR ANALYSIS AT THE STUDY SITE

The valuation of the mangroves is divided into two components: direct use values and indirect or non-use values. For each component, potential counts of benefits as well as their linkage i.e. presented in figure 2, where the STELLA 2 is basically used for potentially linking components and estimating afterward.

For direct use values, all marketable estimations is laid out as thinning, branching, nipa thatching and propagule supply contributing to local benefit 1 though the cost benefit analysis 1. The local benefit 2 includes on site and off site catches, aquaculture at household levels and trade activities of the aquatic products. Clearly, these benefits is linked to other bio-ecological processes such as recovery and resilience of mangroves through biomass and productivity, and nursery and refuse habitats on which the fisheries depend. All linkages should be estimated by ECOPATH application.

For indirect or non use values, the regional benefit that includes air clean, ground water and domestic water supply, and shoreline protection is linked with ecological functions such as gas regulation, recycling of water and erosion and flood control. The global benefits of biodiversity or existence values includes eco-tourism and knowledge benefits. It is a part of eco-tourism may be monetary estimated but the rest and their cultural and information values should be included in the existence values.

Obviously, the plan would be useful to have a analytical framework for study and contribution to management and decision making processes, but we can not evaluate all components presented in the diagram, so a partly estimation is our expectation for doing the project. The linkage should be done for next phases.

STRATEGY FOR DATA COLLECTION AND ANALYSIS

The data is basically based on annual records from the Management Board of Protected Forests, Can Gio and data book of Can Gio District. The primary data collected during fieldwork at household levels is checking and correcting the secondary ones (Table 2). Total questionnaires is 50 deep interviews including households doing onsite and offsite fishing, brokers, thatching and aquaculture, and 220 responses from domestic tourists. The aggregation is net benefits for all components.

The economic cost benefit analysis of mangroves in this case is of the form:

$$NPV = \sum_{t=1}^{y} (B_t^d + B_t^f + B_t^{nu} - C_t) / (1+r)^t$$

where:

NPV	=	net present value (Mil. VND per year)
B_t^d	=	Direct values including local benefits 1 and 2 (Mil. VND per year)
B_t^f	=	Function values (Mil. VND per year)
B_t^{nu}	=	Non-use values (Mil. VND per year)
C_t	=	costs of planting, protection and thinning of mangroves (Mil.VND per year)
r	=	rate of discount
Y	=	time horizon (100 year rotation).

Marketable products and services derived from the mangrove ecosystem have direct value. The values of fisheries production in the mangroves and surrounding areas, and of forestry products such as wood, fuel wood and thatching, have been estimated through interviewing fishermen and by surveying local available markets. Value of crab, shrimp and thatching in mangroves is presented by equation:

Output (Q) = f (Mangrove area, input) and marginal value of mangroves (MVm) = Marginal output (MQ)*Price of output (P).

The evaluation of the role of mangroves in biodiversity is estimated from expenditure on their maintenance and protection from annual investment of the Ho Chi Minh City Administration.

Option value of the mangrove was approached by the methodology to estimate the value of pharmaceuticals from forests adopted from Pearce and Puroshothaman, the function for the value on a per ha basis is: Vp (L) = {N.P.r.a. V/n} / H yr^{-1}

Where:

- Vp (L) = The pharmaceutical value of 1 ha of forest (USD ha^{-1})
- N = The number of plant species in forests
- P = The probability of a "hit"
- r = The royalty rate
- a = The appropriation rate, or rent capture
- V/n = The average value of drugs developed (USD ha^{-1})
- H = The area of forest (ha)

Table 2: Valuation methods for goods and services of mangroves at the study site

Type of Goods/ Services	Product/ Function	Type of Values	Valuation Methods	Data Source/ Approach
Timber	Wood, charcoal	Direct	Market price	From forest harvest level, biomass and productivity, etc.
Non-timber	Fish, crab, shrimp, claim, thatching	Direct	Market price	Project inventory, 1999
Function	Gas regulation Water supply Shoreline protection	Indirect	Damage avoided cost	Used information on the cost in upgrading and rehabilitating defend system and agro-protection cost
Recreation	Recreation	Indirect	Surrogate Travel cost	Derived potential recreational value based on information from existing visitor number to the Biosphere Reserve site
Existence values	Biodiversity	Existence	Contingent valuation Opportunity cost	Actual willingness to pay by conservation organizations for Biosphere, Reserve designation

For recreation value of the site, the travel cost analysis cost was used to estimate the cost of travel or benefit from the site. The basis equation refers to individual i is:

$TC^i = (C f^i + C^i l)+(\alpha y^i/H)(hf^i+h^i l+8g^i)(m^i a+\beta m^i c)(A^i a^i+b^i+D^i d^i)$

where:

TC: total travel cost

CfCl: cost of flight, land transportation

α: Coefficient to convert value of work time into value of leisure time (assume α = 0.5)

y: annual income

H: total working hours per annum

hf, hl: hours of flight, land transport

g: number of on-side days multiplied by 8, to give the number of non-travel leisure hours, to be added to travel leisure time.

β: adjustment weight to a child's time (assume β = 0.25)

ma: number of adults

mc: number of children

A, D: % weight assigned to the percentage reported under "a", "d", in questionnaire

a,b,d: percentage reported under "a", "b" and "d", in questionnaire

Fore existence values, in principle it derives from the knowledge of a resource's continued existence, independent of any use. The investment from any sources to restore the protected areas may be considered in some cases as the global benefits from biodiversity

ESTIMATED DIRECT AND INDIRECT COSTS AND BENEFITS

Costs

Estimates of the costs of establishing the rehabilitated mangrove stands are presented in Tables 3. These costs are estimated primarily based on the cost of labour for the activities described.

Table 3: Cost analysis for planting mangroves with density of 10,000 seedlings per ha and take care in three first years in Can Gio (Nat. Fixed Price in 1994, in VND)

Investment items	Unit	Volume	Unit price	Total
Propagule collection fee	Kg/ha	300	700	210,000
Petrol for boating	Litter / ha	11	3,500	38,500
gasoline for boating	Litter / ha	0.33	9,000	2,970
Water supply	m3/ha	3.73	20,000	74,600
Planting fee	Workdays	56.5	20,576	1,162,572
Preparation of site	Workdays	43	20,576	884,789
Designing			40,000.	40,000
Take care and gaffing year 1	Workdays	45	20,576	925,942
Take care and gaffing year 2	Workdays	30	20,576	617,295
Take care and gaffing year 3	Workdays	19	20,576	390,953
Total				3,401,102

Note: 1 US$ equal 14,000 VND

The planting and handling fees for seedlings obtained from forests in the area under rehabilitation are not significant compared to costs for collecting, handling and transportation for other areas which increase depending on the distance from the seedling source site to the planting site. The seed mortality rate between time of collection and time of planting adds an additional cost factor.

For some mangrove species, such as *Sonneratia sp, Avicennia sp, Aegiceras sp* and others, planting directly onto mud flats is unsuccessful due to the exposure to strong wind and wave forces which wash away the seedlings. The cost of raising such species in a nursery and transplanting them at eight months old is relatively high, with fees for maintaining the nursery, care, protection and transportation adding to overall expenditure. The costs of establishing a stand, including planting, gapping and protection, occur mainly in the three first year. The cost of thinning occurs in years 6, 9, 12, 15, 20 and 25 and exclused when considering teh net benefits.

Value of Timber Benefits

The benefits from wood from trunk, branch prop root sources from the processes of periodic thinning and extraction are derived from data collected from the Management Board of the Protected Area (MBPA) and observations in local markets. The net benefit of the thinning is projected from data managed by the MBPA. As seen in the Fig 3, the trend shows increasing rate during the period of 1985-99 in terms of benefits, although the thinning volume is reduced in the last year. It is estimated that a areas of 10,683 ha of the mature mangroves is harvested. It is marketly estimated that 0.67 million VND per hectare per year or 482.14 million VND per year to be a benefit from the mangrove are reasonable.

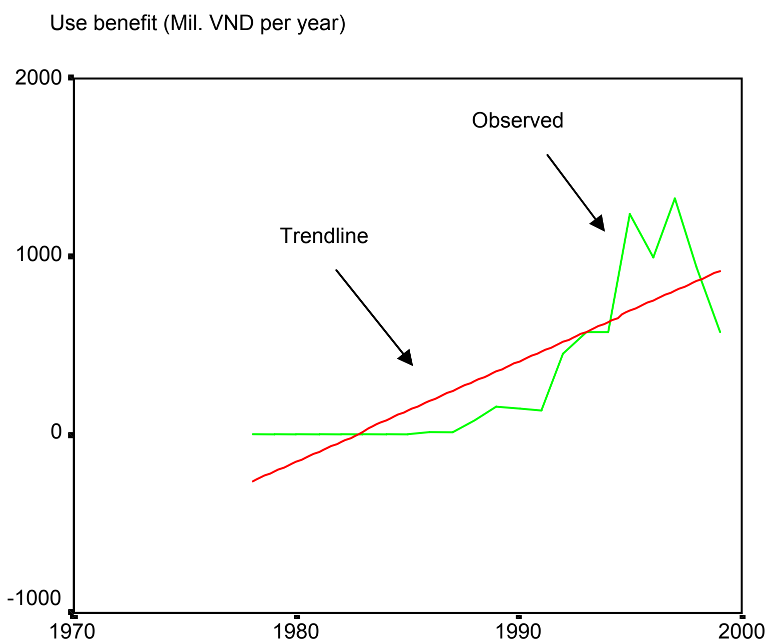

Fig. 3. Net benefit and trendline analysis from thinning activities

A long with the production from thinning, a small scale of charcoal kiln is locally maintained for enduringly use of trunk and prop root. There are only 3 charcoal kilns of 2-3 tons per one operation with 3 cycles for trunk and 6 for branch and prop root. It is estimated that total benefit of 660 million VND during 1985-99 or 44.02 million VND per year given by the mangrove is reasonably evaluated, as seen in figure 4.

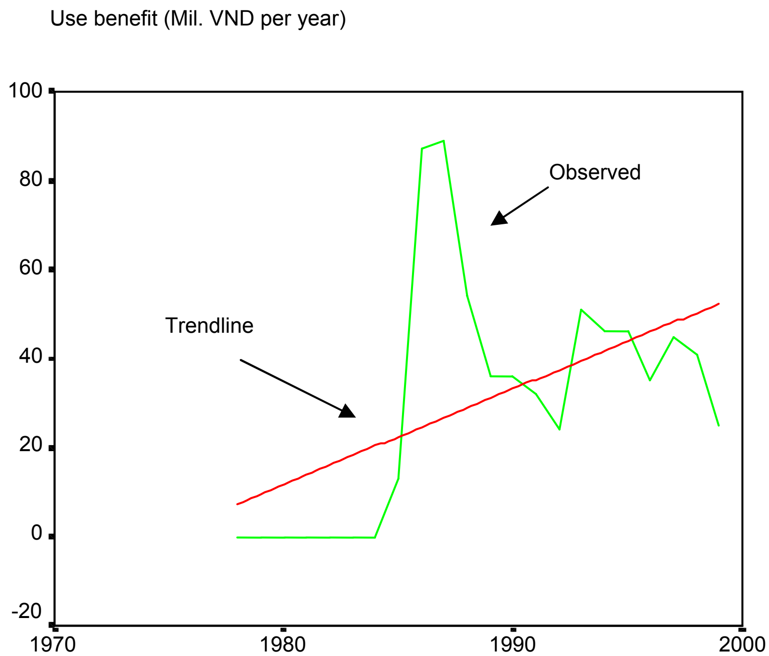

Fig. 4. Net benefit and trendline analysis from charcoal kiln activities

Value of Fishing Catches (fish, Crab, Shrimp, Claim, etc.) and shellfish culture at household level

The benefits from direct fishing sources were estimated on-site. Fishing activities in the mangrove including the shellfish culture at household level is undertaken through the use of simple fishing nets, simple tools or evens by hand. Net benefit from aquatic products is 0.035 million VND per ha/yr., including fish, crabs, indigenous shrimps and shell fish and others is evaluated by the surveys.

The collected data of catching production during 1985-99 is showing the reduction trend as presented in the Fig 4. The number of causes is explained such as overexploitation, pollution and especially oil spills in 1993-4 and 1996-7. The total benefit of 10.742 million VND during the period of 1985-99 or 716.3 million VND per year is reasonable, as seen in figure 5.

However, there is some evidence that present exploitation of mangrove aquatic products in the mangrove in general may be leading to declines in fish stocks, so the estimated yield estimates may be not be sustainable, although they are considered conservative for the district surveyed.

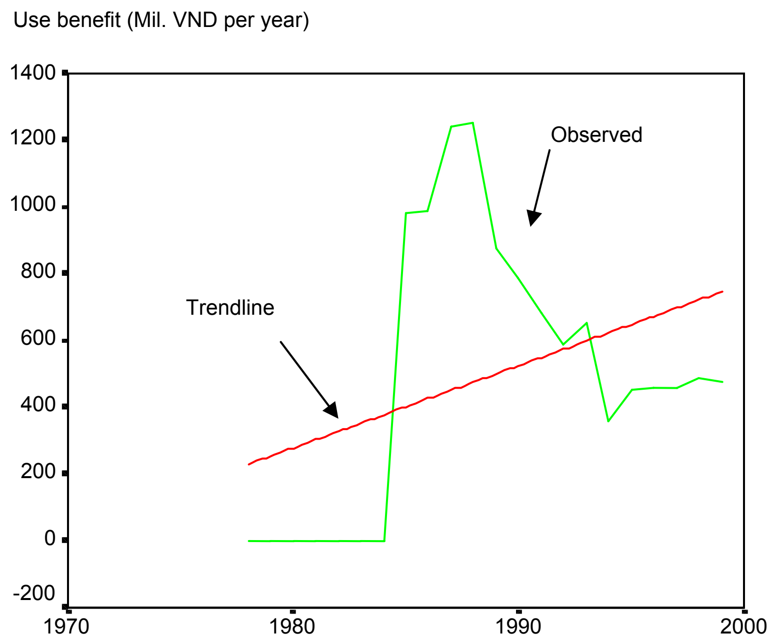

Fig. 5. Net benefit and trendline analysis from fishing activities

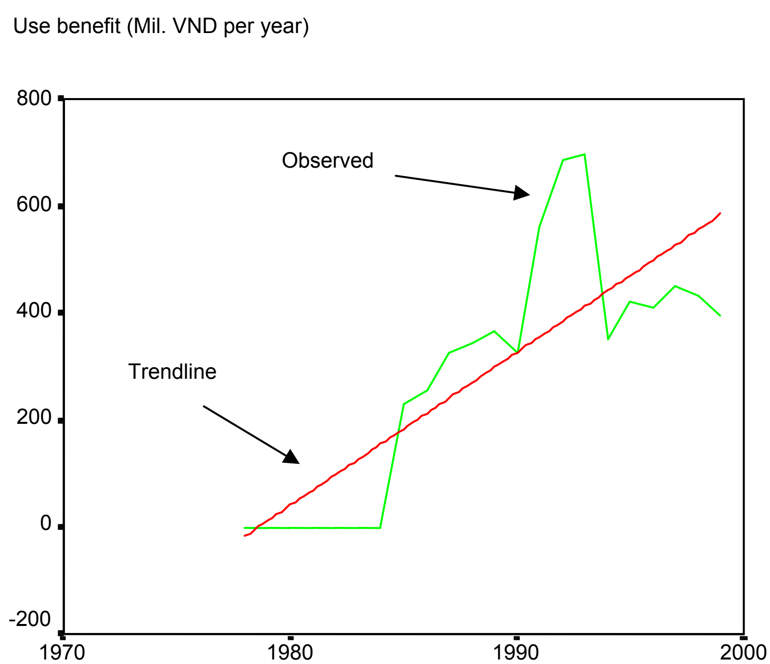

Fig. 6. Net benefit and trendline analysis from aquatic trade activities

Value of Benefits from Trading Aquatic Products

The benefit from trading aquatic products is estimated from price differences of buy and sale at the same volume at 20-30 brokers from Can Gio to HCM City. The collected data from 1985-99 shows that the trading activities obtains 6,254 million VND or 416.9 million VND per year. However, the present exploitation of mangrove aquatic products in the mangrove in general may be leading to declines in fish stocks, also the estimated yield estimates may be not be sustainable, as seen in figure 6.

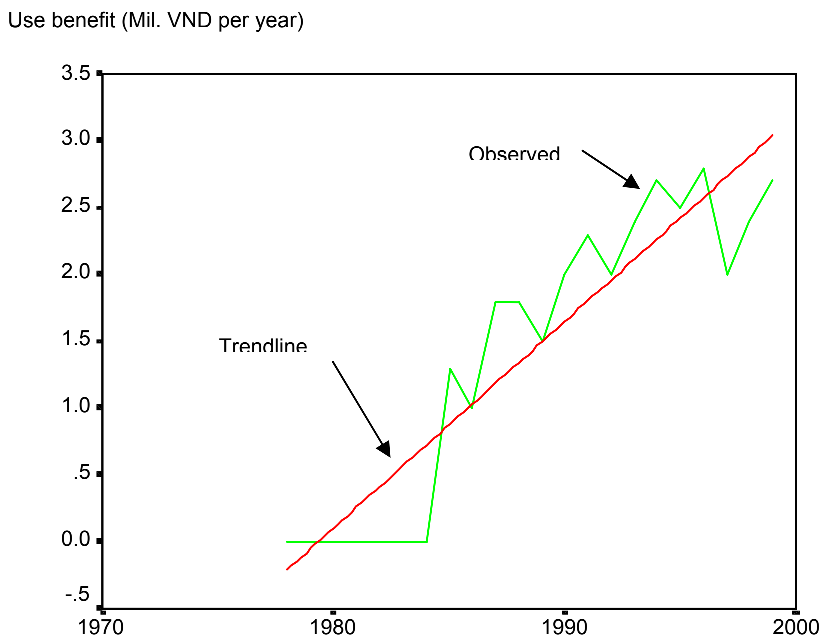

Fig. 7. Net benefit and trendline analysis from thatching nipa activities

Value of Benefits from Thatching Nipa Palm

It is estimated that there are 600 ha of *Nipa fruticans* producing leaves for thatching a harvest per year for around 50-60 households in the are. The total benefit is 31.2 million VND during 1985-99 or 2.08 million VND per year is reasonably estimated as presented in figure 7.

Value of Benefits from Tourism

The tourism has recently developed during the last 5 years, i.e. from 1996. In fact, research activities have been active from 1985 with international co-operation projects or individual contacts. The estimation is considered during 1995-99 for foreigners and 1996-99 for domestic tourists. The benefit of 324.8 million VND per year from foreigners and 3,148 million VND per year from domestic tourists is largely estimated from Travel Coast Analysis during the surveys, as presented in figure 8.

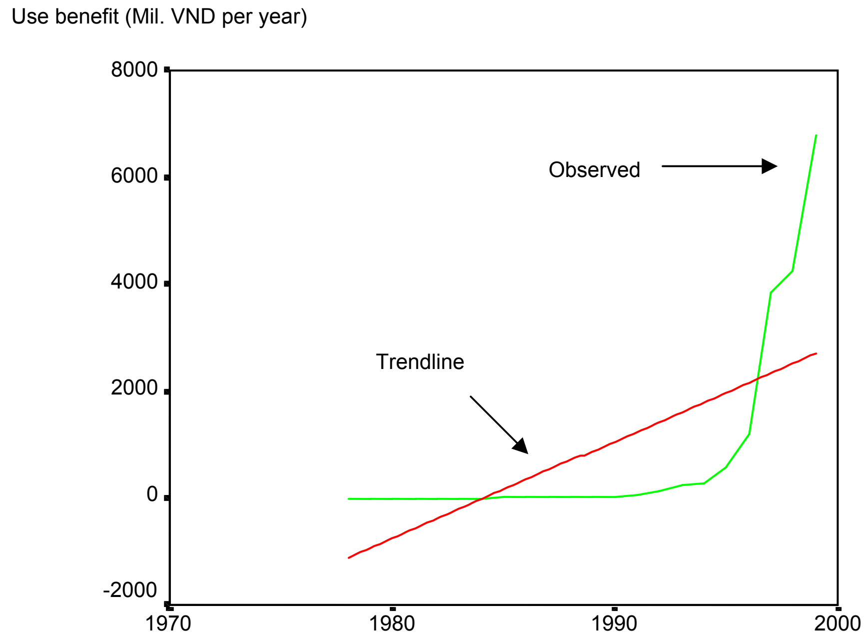

Fig. 8. Net benefit and trendline analysis from recreation activities

Benefits from Medicinal Plants of Mangroves

It was known that almost mangrove species could be used as local medicinals for tradition of long time, as presented in the table below. Although modern live brings a lot of chemically synthesis medicines or local name 'western medicine', local people is still using the mangroves for treatment of some diseases. However, it is difficult to estimate benefits in term of money from the use value. It should be considered in decision-making processes.

Table 4: Potential uses of medicials from mangrove species

Species	Medicated part	Indications
Abrus precatorius	Leaf paste	Abortifacient
Acanthus ebracteatus	Bark roots	Water extract of boiled bark and roots helps to reduce cold symptoms, cure skin allergies and diseases. Ground fresh bark when applied on abscess or chronic wounds accelerates the healing process, treats malaria (mixed with ginger) relieves back pain (mixed with grant licorice and honey)
A. ilicifolius	All plant Leaves	Analgesic relief of swelling, control leukemia rheumatic pain. Neuralgia
Acrostichum aureum	Rhizomes Tender leaves	Wound and boils Boiled in water and the liquid is given as antidote to poison victims
Avicennia alba	Heart wood	Water extract accelerates the discharge of menstrual blood
Avicennia marina	Leaves, trunk Bark	Abscess of skin Contraceptives
Avicennia officinalis	Fruits, seeds Barks and roots Seeds and roots	Astringent, cure ulcers Aphrodisiac Maturate poultice
Barringtonia racemosa	Roots, fruits Kernels	Curing cough, asthma or diarrhea patients Curing jaundice patients (used with milk)
Bruguiera sexangula	Bark	Poultice of the back is use to treat scald and burns

B. parviflora		- ditto -
Caesalpinia bonduc	Leaf paste Leaf &bark	Swollen testicles Antihelmintic
Calophyllum inophyllum	Seed oil	Rheumatism, skin diseases and leprosy
Cerbera manghas	Seeds	Toxic but use as cardiotonic
Ceriops decandra	Bark	Astringent, anti- diarrhea, anti-emetic and anti-dysenteric effect-Fine crushed bark is homeostatic treat scald and burns
Ceriops tagal	Shoots. Bark	Decoction of shoots to treat malaria (substitute for quinine) Astringent, wound cleaning
Clerodendron inerme	Leaves Dried roots	Jaundice (by the Nicabarese) fetrifugal properties leaf poultice to resolve buboes; water extract of the leaves is used for wound cleansing and as a skin parasiticode Treatment of cold; hepatomegaly, spleenomegaly and traumatic wounds
Crinum asiaticum	Bulbs, Leaves	Tonic; laxative and expedorant, used in the cases of biliousness Treat tendinitis
Cynometra ramiflora	Leaves, Roots, fruits	- Ingredient of a medicine used for skin diseases - A lotion form leaves is applied externally in leprosy scabies Purgative oil from fruits and roots for leprosy
Derris trifoliata	Trunks, roots, leaves	Laxative/expectorant and can reduce the effects of malnutrition in children
Excoecaria agallocha	Bark Latex, leaves	Curing laxative and leprosy Therapeutic use for ulcers, curing epilepsy
Hibiscus tiliaceus	Roots Leaves Fresh flowers	Febrifuge, operative, emollient, sudorific, diuretic and laxative. Used against pimples Expectorant, diuretic, deroxicate cassava food boiled with fresh milk uses to clear infection in ear canals
Heritiera littoralis	Seeds Back	A decoction of seeds is used in diarrhea and dysentery Treat haematuria
Ipomoea pes caprae	All dry plant Leaves	Astringent, stomachache, alternative, tonic, diuretic and laxative. Cure headaches; make a preparation to hasten delivery in expectant mothers
Pluchea pteropoda	Leaves	Treat scald and burn anti-dysenteric; febrifugal properties, treat scald and burn anti-dysenteric
Pluchea indica	Leaves	- ditto -
Rhizophora apiculata	Bark	Water extract of boiled bark is used as astringent, anti-diarrhea and anti-emetic, fresh wound and for scalds and burns haemotstatic and antiseptic
Rhizophora stylosa	Bark	- ditto -
Rhizophora mucronata	Bark	- ditto - Making plaster cart for fractured bones
Scavola taccada	Leaves	Febrifuge; headaches and coughs
Terminalia catappa	Leaves Bark	Treating rheumatic joints; leaf juice for curing scabies, leprosy and other cutaneous diseases Treat toothache
Thespesia populnea	Leaves Leaves and fruits Bark	Stomach troubles Curing scabies The water extract in used for cleansing chronic wounds
Xylocarpus granatum	Bark, fruits and seeds	Used as febrifuge and in dysentery Combat diarrhea and cholera ; the water extract is used for cleansing wounds
Xylocarpus moluccensis	Bark Seeds	Used as febrifuge and in dysentery, combat diarrhea and cholera The water extract is used for cleansing wounds insect biter
Wedelia biflora	Leaves	Used to cure wounds and cuts. Leaf paste is used to cure headaches

Sources: *Hong et al. (1994.)*

Value of biodiversity benefits

The value of natural system as biodiversity in the biosphere reserve as consideration of option and existence value, which is usually defined in terms of the preservation of species, groups of species or ecosystems (Randall, 1991, Bishop, 1978). The option value is made up of the elements of:

- a value akin to an insurance premium to ensure supply of an environmental asset, the availability of which would otherwise be uncertain;
- an information value for the characteristics of an asset which is unknown which may become valuable in the future with changing demand or technological progress.

Randall (1991) concludes that 'we should approach the potential loss of any species, habitats with the presumption that its expected value to humans is positive' (Randall, 1991). In this paper, an approach of the cost or capital investment from the City Administration to rehabilitate and reserve the resource as considered to be the benefits of the mangrove is used. So the City' investment is estimated 899,154 million per year as a benefit for national and global scales. This investment includes all direct and indirect aspects of mangrove rehabilitation, protection, management and others related, as seen in the figure 9.

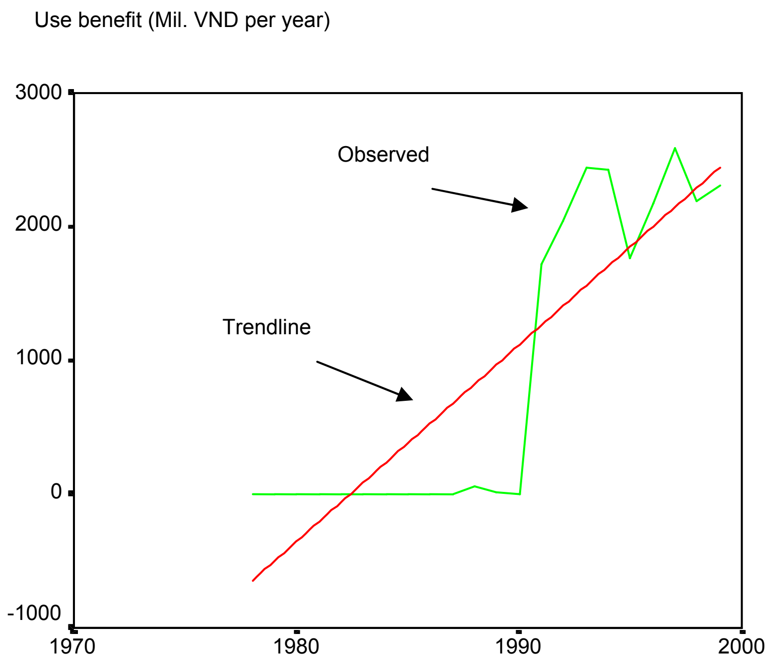

Fig. 9. Net benefit and trendline analysis from investment activities of HCMC, as indirect benefits

COST BENEFIT RESULTS AND DISCUSSIONS

The results of the results of cost benefit analysis (CBA) are presented in table 4. This CBA is of a partial nature, comparing planting, protection and thinning costs, with the direct benefits from extracted marketable products, and with the indirect benefits of the City' investment to restoration of the biosphere reserve. The results show a benefit to cost ratio in range of discount rates, as seen in the figure 10.

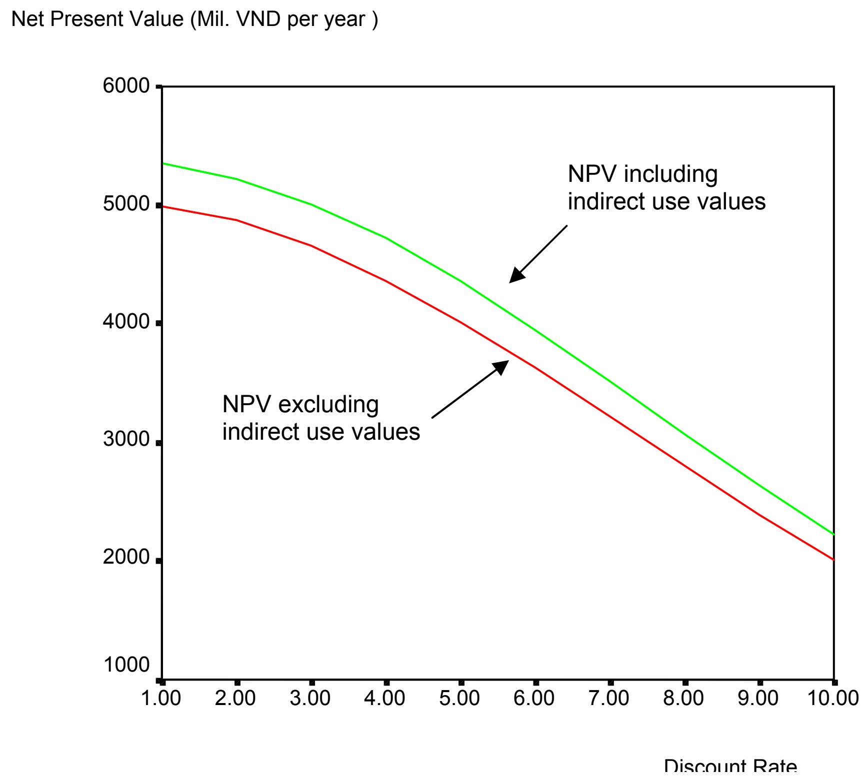

Fig 10. Net present value of mangroves in the biosphere reserve, including indirect use values

Table 5: Net benefit analysis for direct benefits from mangroves in Can Gio

Year	Thinning (in Mil. VND $yr.^{-1}$)	Charcoal (in Mil. VND $yr.^{-1}$)	Nipa thatching (in Mil. VND $yr.^{-1}$)	Fishing catch (in Mil. VND $yr.^{-1}$)	Trading benefit (in Mil. VND $yr.^{-1}$)	Recreation (in Mil. VND $yr.^{-1}$)
1985	0.256	13	1.3	985	230	12
1986	10.278	87	1	987	256	15
1987	10.109	89	1.8	1240	325	21
1988	85.86	54	1.8	1252	345	18
1989	159.052	36	1.5	875	365	12
1990	146.45	36	2	789	325	36
1991	140.302	32	2.3	685	562	75
1992	455.976	24	2	587	685	135
1993	572.095	51	2.4	650	698	234
1994	572.095	46	2.7	358	351	267
1995	1240.614	46.3	2.5	452	421	567
1996	994.564	35	2.8	458	412	1204.9
1997	1326.379	45	2	457	451	3833.8
1998	937.502	41	2.4	489	432	4265.6
1999	580.584	25	2.7	478	396	6771.1

For the B/C Ratio of direct benefits, the figures illustrates that most of the costs for planting from initial stage and protection and management system is less than the direct benefits. It can be explained that the limitation of thinning areas, over exploitation of fishing catch, water pollution, oil spill and others related is contributing the low direct benefits, but still higher than cost. This is also not meaning that local livelihood of people can be able to sustain in terms of basing the direct benefits.

Table 6: Results of Cost Benefit Model of indirect and indirect use values

Discount rate	Cost	NPV Direct	NPV Indirect	NPV Total	B/C direct	B/C total
1	1,963	4,998	349	5,347	2.55	2.72
2	1,943	4,871	357	5,228	2.51	2.69
3	1,923	4,656	358	5,014	2.42	2.61
4	1,903	4,366	352	4,718	2.29	2.48
5	1,884	4,017	338	4,355	2.13	2.31
6	1,864	3,629	318	3,947	1.95	2.12
7	1,844	3,218	293	3,511	1.74	1.90
8	1,824	2,802	265	3,067	1.54	1.68
9	1,804	2,397	235	2,632	1.33	1.46
10	1,785	2,015	205	2,220	1.13	1.24

Otherwise, a new regulation of banning any thinning activities from the City Administration has been launched in September last year and enforcement from early this year. According the regulation, a triple incentive will be given to households allocating forestry lands and protecting forests. However, a detailed response from communities has not been recorded.

For the B/C Ratio of total benefits, the big different of benefits to costs is showing the vital role of investments from the National Government and City Administration to restore the reserve.

CONCLUSION

Based on the estimation of total economic value of mangrove restoration and rehabilitation, management options in dicision-making processes can be laid out from current to hypothetical scenarios in order to create a scene from unsustainable development up to sustainable one for resource use, like mangroves. Humain activities as driving forces effect to both socio-economic and natural processes. The total economic value can be used as a tool in estimating the activities, especially the mass conversion of mangroves to other purposes. It was really a exchange of three kind of benefits (local, regional and global) in sustainable to one private benefit in short time. As a economic indicator, the total economic value may reflect the effects of policies in management and development in feedback estimation.

This is initial work to contribute the analysis framework needing an investment of time and funding, especially indirect use value, option and quasi-option values and existence value or non-use value as described by Barbier (1989, 1993, 1994) and Scodari (1990). The estimation of non-market values is a big challenge of environmental economists. However, valuation methods proposed by R. Costanza et al. 1997 on ecosystem services, natural capital and GNP are being applicable for this issue. It would be so kind to ask UNESCO/MAB to invest more time and funding for the work.

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