CHAPTER

19

Economic Valuation of Biodiversity-recent Approaches

R.NARAYANAKUMAR AND P.LAXMILATHA
ICAR-Central Marine Fisheries Research Institute

Introduction

Bio-diversity refers to the variability among living organisms from all sources including, inter alia terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within the species, between species and of the ecosystem. (UNEP, 1992). This bio-diversity is considered as world's fundamental stock due to their inherent potential.

Why economic valuation?

The link between economics and is vital to understand their value. But most of the natural resources that we use have value but not priced and also not traded in the market –E-g Air. The natural resources (NRS) need valuation because of missing market, alternatives and alternative uses of NRS, uncertainty in demand and supply of NRS, Policies for conservation of NRS and NRS accounting (Kadekodi, 2001)

Ecosystem values

Ecosystems have three distinct characteristics in valuation namely (i) existence value; (ii) intrinsic value and (iii) option value

Values of bio-diversity

Productive use value

Consumptive use value

Intrinsic value (Mc Neely, 1996)

Productive use value It is the value assigned to the products that can be harvested for exchange in formal market and is the only value of biological resources that appears in the national income accountExample: Fuel wood, fodder, timber, fish, medicinal plants

Consumptive use value: The value assigned to natural products that are consumed directly i.e., the goods that do not enter normal channels of trade. Example: A variety of Non Timber Forest Products (NTFP)

Intrinsic value: It is the value related primarily with the functions of the ecosystem but sometimes outweigh the consumptive/non-use values like, Maintenance of ecological balance, Prevention of soil erosion etc.

The different types of values that are associated with the economic valuation of the bio-diversity (or ecosystem) are detailed below.

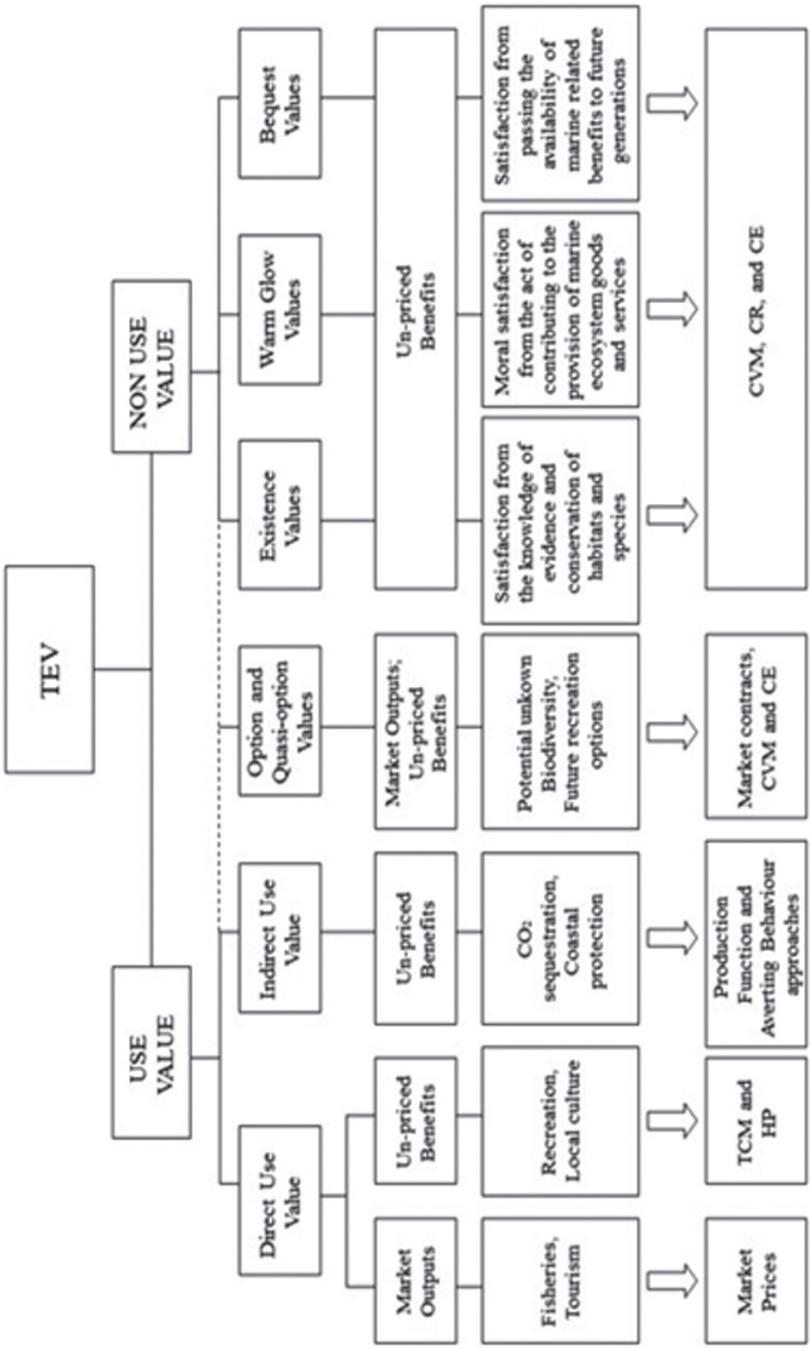

Figure 1 Total economic value (TEV)

Primary source: Cohen, Dave. "What is the Economic Value of Healthy Oceans?" Decline of the Empire. (2012)
Secondary source: Dr.Ramachandra Bhatta, 2015

The economic valuation of bio-diversity, which is also a part of the ecosystem, is estimated through **Millennium Ecosystem Assessment (MEA)** approach developed by United Nations Environment Programme **(UNEP) in 2006** as detailed below. (Figure 2 & 3)

Figure 2 Millennium Ecosystem Assessment (MEA) approach
Primary source: metrovancouver.org; Secondary source: Dr.Ramachandra Bhatta, 2015

The services provided by the ecosystem can further be grouped under four major heads namely (i) Provisioning; (ii) regulating; (iii) cultural and (iv) supporting services. The sub-components of each of these four services are also indicated based on which the economic valuation is arrived at. (Figure 3)

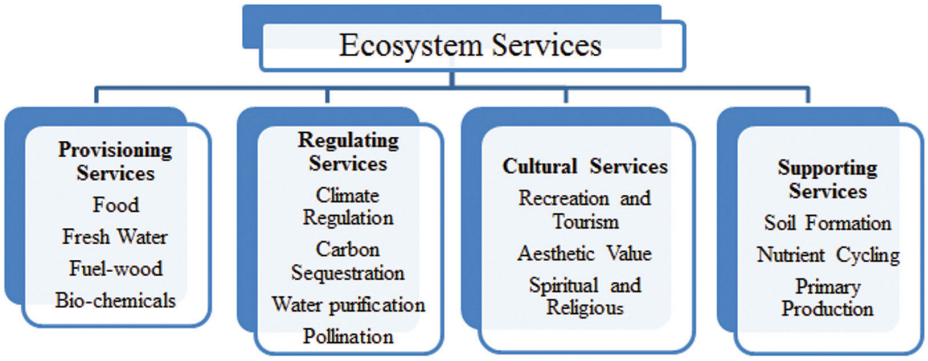

Figure 3 Classification of ecosystem services

Valuation of biodiversity

Before economic valuation of the biodiversity, the list of services provided by the various components of the biodiversity has to be enlisted as given below. (Table 1). Once the components of the biodiversity are identified such as mangroves, corals, sea weeds, sea grasses, marine mammals and others species, we can proceed to the selection of appropriate valuation methodology for these components as indicated in Table 2.

Table 1. Format for valuation of biodiversity services

Biodiversity services	**Components of biodiversity**					
	Mangroves	**Corals**	**Seaweeds**	**Marine mammals**	**Sea grass**	**Others**
	Availability (Yes or NO)	**Availability (Yes or NO)**	**Availability (Yes or NO)**	**Availability (Yes or NO)**	**Availability (Yes or NO)**	**Availability (Yes or NO)**
Provisioning services						
Food						
Fibre, timber, fuel						
Medicines, other resources						
Regulating services						
Biological regulation						
Freshwater storage & retention						
Hydrological balance						
Atmospheric & climate regulation						
Human disease control						
Waste processing						
Flood/storm protection						
Erosion control						
Supporting services						
Biochemical						
Nutrient cycling & fertility						
Cultural services						
Cultural & amenity						
Recreational						
Aesthetics						
Education & research						

Table 2. Tentative methodology for economic valuation of biodiversity

Biodiversity services	Components of biodiversity						Valuation method to be adopted
	Mangroves	Corals	Seaweeds	Marine mammals	Sea grass	Others	
Provisioning services*							
Food							Direct valuation based on market prices
Fibre, timber, fuel							Direct valuation based on market prices
Medicines, other resources							Direct valuation based on market prices
Regulating services							
Biological regulation Freshwater storage & retention Hydrological balance Atmospheric & climate regulation Human disease control Waste processing Flood/storm protection Erosion control							Values for these items can be taken from the studies already worked out for different ecosystems in the world in Costanza, 1997, 2000, 2014 paper on millennium ecosystem assessment.However, these values have to be reworked for our area (i.e extent say 15 sq.m or 30 sq.m) of study
Supporting services							
Biochemical							As mentioned above
Nutrient cycling & fertility							
Cultural services							
Cultural & amenity							
Recreational							Travel cost method
Aesthetics							Abstract concept. We have to use Contingent valuation method (CVM)and ask respondents, how much they will be willing to pay (WTP)for the services of biodiversity
Education & research							To use a **proxy method.** How much research work has been done on this biodiversity? How much spent on research? How many scholars have worked on this aspect? How much fees has been charged from them and related details can be collected and the approximate values can be added up

*Note: * **Provisioning service:** The major components of provisioning services include food, fresh water, fuel wood and bio-chemicals. Among them food is the most important provisioning service which addresses the nutritional security of the stakeholders. The provisioning services can be valued directly based on the market value available. The total output multiplied by the unit value per output will give you the value of the provisioning services –food.*

To get more precise estimation, we can define the services provided under each component as indicated below. We will take for example mangrove biodiversity. (Table 3)

Table 3. Tentative format for valuation of provisioning services of mangrove biodiversity

Service: Provisioning	Definition	Method and value
Food	Assessment of the marine species around the mangroves and estimation of its value	Direct pricing method
Fuel, timber etc	Revenue from cutting down trees; Sale of mangrove leaves and related aspects	Direct pricing
Medicinal value & other resources	How much of leaves or fruits or pods sold for medicine purpose	Indirect estimation (indirect pricing)

Similarly the regulating, supporting and cultural services provided by the biodiversity (Ecosystem) can be defined and appropriate methods can be used for valuation. Regarding the regulating and supporting services, the earlier studies conducted in that ecosystem can be used as a base and suitable modification (up dating) can be made for our study area (based on the geographical extent of the study area (may be in "cents", or "sq.m" or "acres" or" hectares")

The recreational and tourist values of the ecosystem or biodiversity are worked out based on the widely adopted standard methodologies as detailed below.

1. Travel cost method (TCM)

This method is used to estimate the recreational or tourism value of any ecosystem service. In case of marine biodiversity conservation, the marine parks (or) biosphere reserves (or) marine protected areas (MPA) are demarcated. Such protected areas have tourism or recreational value, which can be estimated using this method.

Travel cost method **estimates the economic value** associated with the ecosystem or sites that are used for recreation (which in turn serves as tourist spots also.), The TCM estimates the economic benefits due to (i) Changes in visiting fees (access charges); (ii) Closure of an existing recreational site; (iii) Addition of a new recreational site and (iv) Changes in environmental quality of a site. The principle behind TCM is that the **travel cost expenses of the people is a proxy to their willingness to pay (WTP) for conservation of a existing resource or facility**

In this method, initially a set of zones around the site are defined. The number of visitors from each zone is enlisted. Then, the visitation rates per 1000 population in each zone are estimated. Besides, the round trip travel distance and travel time for each zone is calculated. Then the variables influencing the per capita travels costs have to be identified using any regression models. Based on this information, the demand function is estimated. Finally the economic benefit (or) value of the site is computed as the consumer surplus i.e. the area under the demand curve)

The specimen Schedule (Work sheet to collect Secondary information) to work out the tourism value using the travel cost method in the study on **An assessment of eco-labeling as a tool for**

conservation and sustainable use of biodiversity in Ashtamudhi Lake, Kerala (South west coast of India) is given in **Annexure-I.**

2. Expressed Preference : Contingent valuation method (CVM)

This approach can be used to estimate the non-use value of marine biodiversity. This involves assigning monetary value to the non-use values of environment. In this method, the stakeholders (or) users are asked directly to express their willingness to pay (WTP) for any environmental service or benefit such as A park, walk way, marine protected area, biosphere reserve and related services. The other side of this concept namely, willingness to accept (WTA) is asked to get the opinion of the people the compensation that they can accept for giving up certain environmental benefits like pollution, construction of bridges or special economic zones and related aspects.

The CVM method comprises five steps namely, (i) definition of the problem,; (ii) deciding on mode of survey; (iii) finalizing survey design; (iv) implementation of survey and (v) compilation, analysis and report writing. Each step has a few sub components as detailed below.(Table 4)

Table 4. Steps in CVM

Sl.No	Steps	Components
1	**Define the valuation problem**	**a)** What services are valued?
		b) Who are the relevant population
2	Decide the mode of survey	a) Either personal interview or mailed one
		b) Sample size
		c) Time, man-power and money involved
		d) Importance of the issue
3	Finalize the actual survey design	a) Refer similar studies to draw the range of values
		b) Focussed Group Discussion
		c) Note the people knowledge on the subject under consideration
4	Actual survey implementation	a) Select the sample using appropriate sampling method
		b) Get maximum possible response from the respondents by repeated visits or contacting them at their convenient time and place
5	Compile, analyse and report results	a) Suitable statistical techniques
		b) Eliminating out layers
		c) Deal with non-response bias (zero value for no-response**)**

Case Study

Economic valuation of the Devagad island ecosystem, Karnataka

Among the marine ecosystems, island eco system is a very sensitive and fragile ecosystem, which is threatened quickly by the human activities. This emphasizes the need to know the value of

these ecosystems and before that the socio economic status of the intrinsic inhabitants or users of these eco systems to have comprehensive understanding of the situation. This will also help in formulating suitable management or policy measures for conservation of the ecosystem as well as bio-diversity. With this theme in focus, a study was undertaken to value the Devagad island ecosystem of Karnataka State using the "ecosystem approach" which takes environmental, social, and economic factors into consideration.

Devagad Island is in Uttara Kannada district of**,** Karnataka State. It is about 30 km or nautical miles off Karwar. (Baithkol landing centre). Devagad Island houses a light house and rich in terrestrial and marine biodiversity. An attempt was made to value the marine biodiversity in this island ecosystem as detailed below. (Table 5)

Table 5. Valuation of island eco system (Devagad Island): Provisional

Services of the ecosystem	Value in INR (Rs.million)	Value in US $ million	Methodology applied
1. Provisioning services	366.896	5.396	Direct pricing
2. Regulating services	375.534	5.523	Indirect estimation Costanza (1997, 2000)
3. Supporting services	38.762	3.876	As above
4. Cultural services	1.431	0.021	Travel cost method
Total	**747.738**	**10.996**	

It is seen from the table that the **provisional value** of the Devagad island ecosystem of Karnataka state is estimated at around Rs.747.74 million or US$ 10.996 million comprising Rs. 366 million (US$ 5.396 million) towards provisional services; Rs.375.534 million (US$5.523); Rs.3.876 million (US$0.057 million) for supporting services and Rs.1.316 million(US $0.021million). Thus the valuation of an ecosystem is carried out considering all the four services rendered by the biodiversity (or) eco system.

Conclusion

The ecosystem services are valued mainly to impress upon the stakeholders the importance of using the ecosystem in the most judicious way. The magnitude of the monetary tag will really make the stakeholders to think how important it is to conserve the ecosystem (Or) biodiversity or any other ecosystem services to sustain the nature.

However there is a caution that not all the ecosystem services can be economically evaluated. The process becomes complex once the ecosystem itself in the shape of a complicated net work due to the intrinsic relation among the components. To economically value the ecosystem services there is a need for a discussion between economists and ecologists for proper understanding of both economics and ecology. Brito (2005) puts rightly that poor understanding of the natural science by economists can lead to flawed results and the dissemination of inaccurate information (Primary source Beaumont, et.al, 2008). Valuing marine biodiversity has been referred as a complicated one by many researchers (Ray and Grassle, 1991, Ledoux and Turner, 2002, Patterson, 1999).

The economic valuation of any ecosystem service or biodiversity is not an end in itself. The subject is very dynamic and the valuation of one researcher need not be in conformity with the

other as certain values like bequest, aesthetic, intrinsic values differ from the perception of the researchers. However, the output of such valuation studies should be treated as a yardstick and more precisely as reference points for developing the valuation process further.

References and Suggested readings

Bhatta,Ramachandra, 2015, Linking Valuation of Ecosystem Services with policies. Presented in Interactive Training Workshop on Methods of Valuation of Ecosystem Services, 5-9 January 2015, CMFRI, Madras Research Centre.

Beaumont, N.J. M.C.AustenS.C.MangiM.Townsend, 2008. Economic valuation for the conservation of marine biodiversity. Marine Pollution Bulletin, 56 (3):, 386-396

Cohen, Dave. "What is the Economic Value of Healthy Oceans?" Decline of the Empire. (2012)

United Nations Environment Programme, 1992. Convention on biological diversity. United Nations. Pp.30

Kadekodi, Gopal, K. 2001. Valuation of natural resources: what have we learnt from Indian Experience? Indian Journal of Agricultural Economics, 56 (3), 285

Laxmilatha et.al Project completion report, 2017 Valuation of island and coral ecosystem, Central Marine Fisheries Research Institute

McNeely, Jeffrey A. W. Paul Weatherly, (1996) "Innovative funding to support biodiversity conservation", International Journal of Social Economics, 23(4/5/6): 98-124

Mohamad, K.S. et.al (2015) Assessment of eco-labelling as tool for conservation and sustainable use of biodiversity in Ashtamudi Lake, Kerala GIZ TEEB

Narayanakumar R., J.Jaisankar, Ganga, U. Shyam S.Salim and Vivekananadan, E.,(2015) Economic valuation of SFB in selected maritime States in India GIZ-TEEB

Nick Hanley, Stephen Hynes, Niels Jobstvogt and David M. Paterson, 2014. Economic valuation of marine and coastal ecosystems: Is it currently fit for purpose? Discussion Papers in Environmental Economics. Paper 2014 – 11. University of St Andrews

Vivekanandan, E and Narayanakumar, R and Najmudeen, T M and Jayasankar, J and Ramachandran, C (2010) Marine Fisheries Policy Brief-2; Seasonal Fishing Ban. CMFRI Special Publication, 103. pp.

www.millenniumassessment.org

.<http://www.teebweb.org/our-publications/all-publications>