Valuing the Attributes of Wetlands in Coastal Areas of South Asia: Incorporating the Economic Value into Policy Making

18

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Abstract

In recent years, understanding the economic consequences resulting from the loss of wetland goods and services because of intensifying threats, both geogenic and anthropogenic, to the coastal wetlands of South Asia has received great attention Greater need for conservation of these wetland ecosystems and preserving their natural resource bases have become apparent. Consequently, over the last two decades, economic valuation of the attributes of wetlands is being widely recognized in South Asia as the popular means of developing strategies for wetland resources management under such threats. The chapter, thus, endeavors to review comprehensively the theoretical and methodological aspects involved in the economic valuation of wetland attributes in general and presents a case study of a coastal wetland from Bangladesh for better understanding the valuation approaches in particular. The chapter also examines the challenges and issues commonly faced during the wetland valuation especially in the South Asian region. Finally, the chapter concludes that a better socially acceptable, economically viable, and environmentally sound policy action can be achieved for wetland conservation and management if all the economic values of the wetland are carefully considered.

Keywords

South Asia • Total economic value • Valuation approaches • Wetland attributes

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18.1 Introduction

Wetlands in coastal areas, whether fresh or saline, are important natural resources and are gaining increasing recognition in recent years as they play a central role in the coastal sedimentary environments where the freshwater inflow in combination with the tidal flow action develops wetland ecosystems at the continental margin. Therefore, the coastal wetlands constitute critical transition zones between continental landmasses, freshwater habitats, and the sea and are ecologically sensitive systems (Turner et al. 2000). These transition zones provide many essential ecosystem services including shoreline protection, organic decomposition, carbon sequestration, flood control, nutrient cycling, water quality improvement, habitat for migratory and resident animals, and regulation of fluxes of nutrients, water, particles, and organisms between land, rivers, and the ocean (Costanza et al. 1997; Levin et al. 2001). It is estimated that wetland ecosystems occupy approximately 6% of the global land area (Turner et al. 2004; Kirwan and Megonigal 2013). In terms of global land area coverage, it ranges from 917 to more than 1275 million ha with an estimated economic value of US$15 trillion per annum (Finlayson and Spiers 1999; Lehner and Döll 2004; MEA 2005). The estimated economic value of the wetland ecosystems highlights the value of wetlands to human population. Aside from the supply of numerous goods and services provided by wetlands to humankind resulting in a high wetland economic value, they have significant bearing on maintaining rich compositions of the biodiversity in natural ecosystems (Levin et al. 2001; Sathirathai and Barbier 2001; Turner et al. 2004). But these multiple goods and services provided by the wetlands are often overlooked resulting in indiscriminate exploitation of wetland resources (Ghosh and Mondal 2013). As a result, wetlands are one of the most threatened and vulnerable natural resources especially in coastal areas worldwide (Turner et al. 2004; Kirwan and Megonigal 2013).

The South Asian region (India, Pakistan, Bangladesh, Nepal, Bhutan, Maldives, Afghanistan, and Sri Lanka) possesses extensive coastal wetland ecosystems that provide a wide variety of goods and services for the coastal population through maintaining an inextricable relationship between livelihoods and community people in this region (WIAP-WB 2000; UNDP 2012). Of the South Asian countries, in Bangladesh the combined floodplains of the Ganges and Brahmaputra rivers largely support the country's wetlands especially in coastal areas. However, in recent years the wetlands in the South Asian region encounter ever-increasing threats from both natural and anthropogenic sources, thereby impacting their goods and services potentials. The major threats include development interventions, excessive harvesting of wetland resources, coastal water pollution, an increasing occurrence of disasters, and vulnerability to climate change (WIAP-WB 2000; MEA 2005; UNDP 2012). Moreover, over the past few decades, the wetlands in the coastal areas of the South Asian regions have increasingly experienced over-exploitation of coastal wetland resources, agricultural expansion with excessive use of fertilizers and pesticides, pollution from urban conglomerates, and oil spillage (Sharma 1996; UNDP 2012). So, the wetland ecosystem degradation in this region is mainly because the intrinsic economic values the wetlands possess are often overlooked and not duly considered by the policy makers. However, effective and efficient management of the wetland ecosystems in coastal areas of South Asia is imperative for achieving sustainable wetland resources management under different environmental vulnerabilities and/or threats in the future. The economic valuation of wetland ecosystems can give an important insight for effective and efficient management and into environmental decision-making relating to the wetlands. Therefore, the chapter endeavors to review comprehensively the theoretical and methodological aspects involved in the economic valuation of wetland attributes and presents a case study from Bangladesh for better understanding the valuation approaches and its application for wetland resources management in coastal areas.

18.2 Wetland Categorization

In order to estimate the economic value of wetlands, understanding the nature and type is very important because the nature and type of wetlands have important bearing on the multiple benefits provided by wetlands. Understanding of the wetland category is also imperative for estimating the economic value comprehensively. A wide variety of wetlands are found in the South Asian region. The seasonal rainfall and extensive floodplains in the region make up wetland habitats in this region. Although professionals have categorized wetlands in different ways, a specific categorization of wetlands is required in the South Asian region for sustainable management of the wetland resources in the region. Therefore, the classification system proposed by Gopal and Krishnamurthy (1993) for categorizing the wetlands in the South Asian region has been adopted in this chapter. As per the classification system, the wetlands in South Asia can be categorized into freshwater and saline water wetlands based on their hydrological nature (i.e., type of water body, duration of flooding during monsoon) and the characteristics of vegetation (i.e., herbaceous or woody) that the wetland supports. The wetland categories are illustrated in Table 18.1, while more details of the proposed classification and nature of the wetlands in South Asia can be found elsewhere (Gopal and Krishnamurthy 1993; Haque et al. 2011). The table depicts that the wetlands either freshwater or saline water can be associated with permanent flooding or temporary flooding and have diverse vegetation attributes. Understanding vegetative attributes of wetlands is important because the types of goods and services provided by the wetland ecosystems are dependent on their natural setting and vegetation attributes.

Of the freshwater wetlands, temporary wetlands can be flooded or retain water for 3–9 months in a year, while in the case of saline water wetlands, water retention in the depressed basin exists for 1–3 months in a year. In Bangladesh, temporary freshwater wetlands, which are locally called as *beels*, are abundantly found in coastal areas. The case study described in the last section (see Sect. 18.7) of this chapter deals with such wetland ecosystems.

Table 18.1 Wetland categorization in South Asia

Major category	Subcategory	Nature of wetland	Vegetation attributes
Freshwater wetland	Permanent freshwater wetland (flooding throughout the year)	Lotic freshwater wetland (e.g., rivers, streams)	Herbaceous (reeds, bamboos, grasses) and woody (riparian fringing forests)
		Lentic freshwater wetland (e.g., lakes, ponds, reservoirs)	Herbaceous (submerged and floating macrophytes, sedges, reeds) and woody
	Temporary freshwater wetland (3–9 months of flooding)	Lotic freshwater wetland (e.g., floodplains of streams and rivers)	Herbaceous (reeds, grasses, sedges, cattails and other herbs) and woody (floodplain forests)
		Lentic freshwater wetland (e.g., lakes, ponds, reservoirs)	Herbaceous (submerged and floating macrophytes, sedges, reeds and other tall emergent vegetations)
Saline water wetland	Permanent saline water wetland (flooding throughout the year, e.g., mangroves)		Herbaceous (coastal beds of kelp and angiosperms) and woody (mangroves)
	Temporary saline water wetland (1–3 months of flooding, e.g., inland saline habitats)		Herbaceous (halophytes) and woody (saline scrubs)

Modified from Gopal and Krishnamurthy (1993)

18.3 Attributes of Wetland Ecosystems

18.3.1 Goods and Services of Wetlands

Wetlands in coastal areas support many of the life forms including human population on Earth as it generates essential ecosystem services that are required for sustenance of life. In economic valuation literature, these ecosystem services provided by the wetland can be termed as attributes. Inextricable interactions among physical, biological, and chemical components of a wetland ecosystem enable the wetland to perform many vital functions and consequently generate wetland goods and services. Coastal wetlands also make coastal population more adaptive and resilient by providing important functions and services through storing floodwater, buffering storm surges, controlling erosion, improving water quality, etc. that are presented in Table 18.2.

The wetland ecosystem services are categorized into four major groups proposed by MEA (2005), *viz.*, provisioning, regulatory, supporting, and cultural services. The provisioning services of coastal wetlands are the benefits that people directly obtain from the wetland. These involve the resources or products of the wetlands such as food, freshwater, raw materials (wood), genetic resources (biotechnology), medicinal resources, ornamental and resources (skin, shells, flowers). The regulatory services of coastal wetlands involve the benefits that are related to the essential ecological processes and life support systems such as gas and climate regulation, erosion control, water supply and regulation, waste treatment, and pollination. For

Table 18.2 Important goods and services of coastal wetlands

Wetland services	Wetland goods	Wetland ecosystem functions
Provisioning	Food	Production of fish, invertebrates
	Freshwater	Filtering, retention, and storage of fresh water (e.g., in aquifers)
	Fiber and fuel	Production of timber, fuel wood, peat, and fodder
	Biochemical products	Extraction of materials from biota
	Genetic resources	Genetic material and evolution in wild biota
Regulating	Climate regulation	Regulation of global temperature, precipitation etc. at global or local levels
	Pollution control	Recovery of mobile nutrients and detoxification
	Water regulation	Regulation of hydrological flows
	Erosion control	Retention of soil within an ecosystem
	Natural hazards	Controlling floods and storms
	Pollination	Role of biota in movement of floral gametes
Supporting	Biodiversity	Habitat for resident and transient populations
	Nutrient regulation	Role of biota in storage and recycling of nutrients
	Soil formation	Weathering of rocks
Cultural	Recreation	Providing opportunities for recreational activities
	Aesthetic information	Appreciation of attractive landscape features
	Spiritual and historic information	Personal feelings
	Science and education	Use of natural systems for excursions and training

Compiled and modified from Costanza et al. (1997) and MEA (2005)

example, estuaries provide regulating services because they absorb the force of storms in coastal areas and regulate changes in air and water temperature. On the contrary, the supporting services of coastal wetlands are the provision of coastal wetlands to provide habitats for flora and fauna in order to maintain biological and genetic diversity such as primary production and soil formation. Finally, the cultural services are the source of inspiration to human culture, education, recreation, spiritual, and historic information. However, more details of the wetland ecosystem services can be found elsewhere (Costanza et al. 1997; MEA 2005).

18.3.2 Wetland Attributes and Human Dependency

Coastal areas constitute approximately 4% of the Earth's total land area and support more than one third of the world's population and 90% of marine fisheries catch (MEA 2005; Barbier 2013). It is also estimated that approximately 400 million people live in coastal areas of South Asia depending extensively on coastal wetland ecosystems for their livelihoods (UNDP 2012). These estimates are indicative of the human dependency on coastal wetlands and pinpoint a direct relation of human population with wetland's provisioning services because these wetlands provide numerous ecosystem goods to a large number of ever-increasing coastal populations and protect them against loss of infrastructures and lives. Coastal wetlands also provide habitats that support seasonal or perennial fisheries essential for not only migratory and resident birds but also coastal people whose livelihoods are dependent on the coastal wetlands. This type of human-wetland dependency relationship is well depicted in the form of a case study in the last section of this chapter wherein the direct relevance of the coastal freshwater wetland for sustenance of local livelihoods is evident.

People living in and around a wetland in coastal areas are directly dependent for their drinking, domestic, irrigation, fishing, washing, bathing, and several other purposes on the wetland. Beside these direct wetland benefits, coastal wetlands provide many important ecosystem services that are not usually transacted in our conventional economic markets such as nutrient cycling, waste assimilation and pollution control, breeding ground for fish species, groundwater recharge, soil erosion and flood control, and local climate regulation. These attributes are often overlooked and undervalued by the community and policy makers, resulting in indiscriminate exploitation of the natural resource bases in wetlands with development interventions including agricultural conversions. Since, the long-term sustainability of the coastal population is related to wetland ecosystem attributes, ensuring wise use of coastal wetland resources is important for sustainable wetland resources management.

18.4 Concept of Total Economic Value

Over the past few decades, economic valuation of wetlands in coastal areas has become a widely recognized means of wetland resources management (Guo et al. 2001; Kumar and Kumar 2008). Understanding of the concept of total economic value (TEV) is a prerequisite to elucidate the economic values of wetlands comprehensively. Whenever we think of a wetland, the value what comes to one's mind is the direct use values derived directly by harvesting the resources such as fish and water lily (as vegetable) for human consumption or fodder for domestic animals. However, the wetland values are widely ranging from such direct and tangible benefits to several non-tangible benefits.

The term "economic valuation of wetlands" is usually defined as the effort to assign quantitative values to the goods and services derived from the wetlands (Kumar and Kumar 2008). Generally, the TEV of a wetland (Fig. 18.1) can be categorized into two broad groups such as use attribute/value (instrumental value) and nonuse attribute/value (intrinsic or passive value).

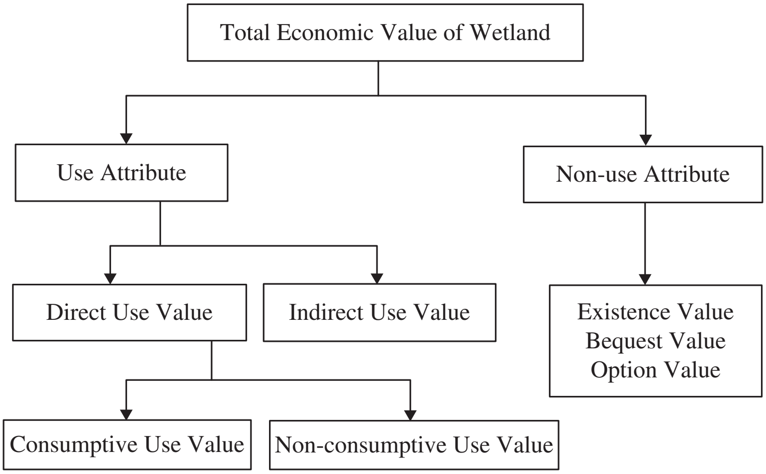

Fig. 18.1 Taxonomy of the economic value of wetlands (compiled and modified from Oglethorpe and Miliadou 2000; Alam and Marinova 2003; Samonte-Tan et al. 2007; Nijkamp et al. 2008)

The components of the use attribute are the benefits individuals derive from using wetland resources, whereas the components of the nonuse attributes reflect the values individuals attach to wetlands even if they themselves do not use it (Smith 1987; Cameron 1992; Bateman et al. 2002). The use attributes can be further subdivided into direct use values and indirect use values. Direct use values are derived from the actual use of wetlands either in a consumptive way (may be also called extractive value, e.g., timber harvesting, fishing, and fodder collection) or a nonconsumptive way (e.g., bird watching, boating, or other recreational activities). Indirect use values of wetlands reflect the environmental services derived from wetland ecosystem functions such as watershed protection, soil stabilization, and carbon sequestration.

On the contrary, nonuse attributes of wetlands are inherent characteristics of the wetlands and are measures of the satisfaction (in terms of economic welfare) we derive from the wetland ecosystem. Thus, nonuse attributes are associated with the benefits derived simply from the knowledge that wetland resources such as species or habitat are maintained. By definition, such a value is not associated with the use of the resource or the tangible benefits derived from wetland's resource use. Hence, nonuse values are intangible benefits that people derive from preservation of environmental assets or wetland resources (Thomas et al. 1991; Stevens et al. 1995). These nonuse attributes can be further divided into existence, bequest, and option values, which are presented in Fig. 18.1 (Oglethorpe and Miliadou 2000; Alam and Marinova 2003; Samonte-Tan et al. 2007; Nijkamp et al. 2008). First is the existence value, which is not associated with the use of the wetland goods but reflects a value that will continue to exist independently. In the case of existence value, an individual derives satisfaction from simply knowing that a wetland resource exists. A good example of existence value is the dolphin usually observed in the South

Asian region. Many people, who have never seen dolphin, will nevertheless be willing to contribute money or even time for dolphin protection and conservation program so that they are not hunted. Second is the bequest value that arises from the benefits derived by individuals from the awareness that future generations may benefit from the use of the wetland resources. Thus, in the case of bequest value, individuals assign monetary values to wetland resources for the benefit of future generations. Third is the option value, which is associated with an individual's knowledge that the wetland resources will be available for future use or enjoyment. Thus, the TEV of wetlands is regarded as a result of the aggregation between various uses and nonuse attributes (commonly called as values), and understanding of the TEV of wetlands is useful for informed decision-making for better wetland resources management.

18.5 Overview of Valuation Approaches

In environmental economics literature, it is well recognized that the annual net benefits generated from coastal ecosystems are the sum of all net benefits obtained from use and nonuse attributes of the wetland (Samonte-Tan et al. 2007). To understand these benefits from coastal wetland ecosystems, valuing its attributes is necessary and, thus, adopting valuation methods is compulsory to comprehensively understand the multiple benefits from wetland ecosystems. An array of valuation techniques is commonly adopted to estimate the multiple benefits provided by the wetland ecosystems. As discussed earlier that the use attribute is one of the two broad categories of the TEV, the valuation techniques adopted to estimate the value of the use attributes of wetlands are very straightforward, while in the case of the nonuse attributes, it is often more complex and problematic. Moreover, selection of a proper valuation method to estimate the value of the attributes of wetlands is also challenging and complex and often needs to be justified. However, the techniques commonly applied to estimate the economic value of wetlands are shown in Fig. 18.2.

Generally, the valuation technique can be categorized into two broad groups such as market valuation and nonmarket valuation approaches (Fig. 18.2). The market valuation method depends on quantification products and is based on the estimates of quantities produced, prices, and costs of inputs (Turpie et al. 2010). Direct consumptive and nonconsumptive use values can be estimated using market-based approaches, whereas nonmarket approaches can be classified into two groups such as revealed preference and stated preference approaches. The first one (i.e., revealed preference approach) is based on observed methods or observed economic behavior in which benefits or damages from changes in wetland services are estimated by observing wetland user's behavior in simulated markets or in markets for related private goods (Haque et al. 2011). For example, the value of a national park can be estimated in terms of consumer surplus by the costs or expenditures incurred by an individual for travelling purpose to that national park. Moreover, if you think of valuing water pollution, then the cost of water pollution can be estimated by analyzing residential property value near the polluted site. However, production function

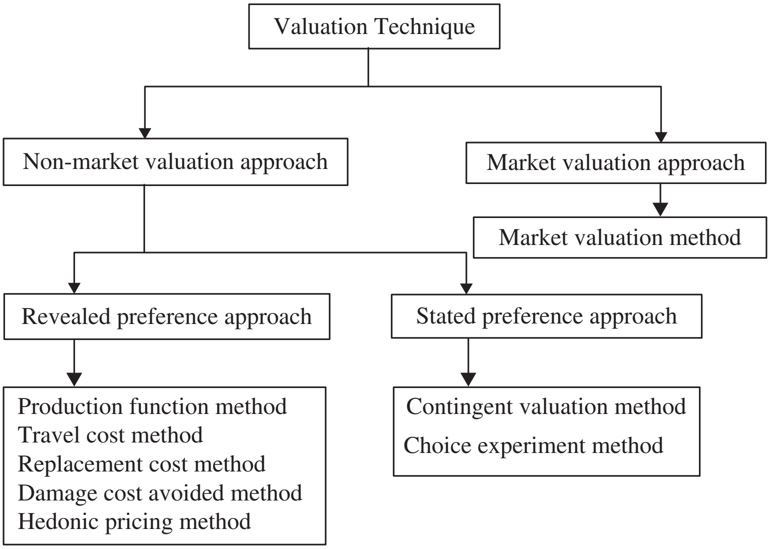

Fig. 18.2 Valuation methods for estimating economic values of the wetland ecosystems

methods are based on economic input-output production functions. In this method, the wetland resources are considered as inputs in production processes for an economic output. For example, the economic value of mangrove wetlands can be estimated by recognizing its role in fisheries production. Another example includes the estimation of the economic value of groundwater recharge function as an indirect use value of coastal wetlands, and in that case the welfare changes due to the increase in water table can also be estimated by the production function approach.

The travel cost approach is a technique popularly employed in estimating the monetary benefit obtained from the cultural ecosystem service of coastal wetlands like recreational services. The main assumption underlying the approach is that the cost an individual incurred by visiting a wetland site including his/her spending time in the site will represent his/her recreational value of such wetland site. Accordingly, it is assumed that an individual's utility obtained from visiting a coastal wetland site is a function of the attributes of such coastal wetland and the individual's socioeconomic characteristics, which results in travel cost modeling of the visitation. The travel cost approach can be categorized into two methods, *viz.*, individual travel cost method and zonal travel cost method. In the first case, the annual number of visits by an individual to the wetland site is modeled with the travel cost and an individual's socioeconomic characteristics, resulting in a trip-generating demand curve. Thereafter, the area under the demand curve is calculated by integration, and an individual's consumer surplus is obtained. For the second method, different zones are demarcated around a wetland site to where an individual travels for his/her recreation in such a way that the travel cost from each zone to the wetland site is approximately same. After that, the trip-generating function as zonal visitation rate is modeled with the zonal travel costs and individual's characteristics, resulting in zonal travel cost modeling. It is notable that in the zonal travel cost method, the demand curve is prepared using the zonal visits instead of the individual's visits adopted in the individual travel cost modeling.

Hedonic pricing methods are also largely employed in wetland valuation, and the hedonic pricing model is grouped into hedonic property value models and hedonic wage models. For the first case of the hedonic pricing model, the basic underlying assumption is that there is an intrinsic relationship between a housing unit and coastal wetland amenities. Thus, the model is developed by taking into account the influences of environmental or wetland attributes on property or house values. The model assumes that an individual's utility is a function of the individual's consumption of a Hicksian composite private good and a vector of amenities associated with the individual's occupying house, *viz.*, the structural characteristics of the house (e.g., size, number of rooms, construction type), neighborhood characteristics (e.g., location of nearby schools, parks, hospitals, markets, working places), and environmental amenities (e.g., the presence of good water quality, clean air, the absence of noise pollution). On the other hand, the hedonic wage model is based on the assumption that employers always want to work in a pleasant or good environmental condition, and the environmental conditions are associated with the environmental, cultural, and social amenities of that working environment. Therefore, wage differentials in different areas are assumed to be the differences in the levels of environmental quality, and, thus, the wage differences of individuals are modeled to derive a hedonic wage model (Freeman et al. 2014).

Replacement cost method is used to estimate regulatory services of the wetland. For example, the cost of building embankments or dams is usually considered while estimating the value of flood control service of wetlands. Even damage cost avoided method can also be used instead, and in that case the costs of the damage to infrastructures, life, etc. due to flooding are estimated (Turpie et al. 2010). Benefit transfer method is usually used while estimating nonmarket values of the wetland services, and the method involves transferring values in monetary terms from another similar situation or location to the current situation or location for the same wetland good or service. Generally, this method is applied in the cases where there is a lack of available data for the wetland of interest and limited study time. For example, the method can be applied to estimate the value of the impact of water quality improvement on recreational value and public health in an urban area. Thus, the benefit transfer method could be most suitable in the case of urban wetlands.

The second set of approach under "nonmarket valuation approach" is the stated preference approach that is a survey-based methodology wherein valuation of wetland services is made through appropriately constructed questionnaire surveys. In this, individuals are asked to state their preferences for the valuation of the wetland services. The stated preference approach can be broadly categorized into (i) contingent valuation method and (ii) choice experiment method (Fig. 18.2). In contingent valuation method, individuals are asked to place a monetary value on wetland goods or services in question in a hypothetical market and then, the wetland benefits can be estimated using appropriate econometric models through eliciting individual's responses. The practical applicability of this method is shown by a case study from

Bangladesh in the last section of this chapter. However, the choice experiment method is further classified into conjoint analysis and choice modeling. In the case of conjoint analysis, respondents or individuals are required to assess preference and, thereby, choose between alternatives based on different levels of characteristics of the attributes of wetland ecosystems. The preference by the respondent is generally done through applying one of the three techniques such as contingent ranking, rating, and paired comparison. On the other hand, in choice modeling method, respondents are at first presented with a range of wetland use alternatives in which each alternative is characterized by several attributes with different levels. The choice modeling method is commonly applied for estimating wetland benefits in the case where multiple wetland use alternatives are in question. However, in the South Asian region, the application of different valuation approaches described herein can be found elsewhere (e.g., Haque et al. 2011).

18.6 Challenges of Wetland Valuation Studies in South Asia

Although a large number of wetland valuation studies have been conducted in developed countries, few studies on wetland valuation in the South Asian region have been done over the last two decades. The beginning of the wetland valuation studies in the region started during the late 1990s, and, now, valuation studies of the wetlands are increasingly being recognized in the region because of degradation and loss of the wetland ecosystem services abruptly (Haque et al. 2011). However, a number of challenges during the wetland valuation studies are well recognized in the region. The experiences of such challenges are presented in this section through reviewing relevant literature from the South Asian region and developing world (Alam 2006; Korsgaarda and Schou 2010; Haque et al. 2011; Christie et al. 2012).

In wetland valuation studies, a wide range of information and data are required to successfully estimate the economic values of wetlands. Usually, along with primary data, secondary data are also required. In South Asian countries, obtaining secondary data and information are very problematic because, on the one hand, in few cases environmental economists usually get published data in a very limited scale, but in most cases they do not get secondary data in published forms (e.g., air/water pollution data for valuing air/water pollution abatement benefit), and, on the other hand, a complex and unfriendly official system of the government often undermines the applicability of the wetland valuation approaches in the region.

Delineating clearly the spatial and temporal scale of the wetland is vital in wetland valuation. Without considering those scales, the estimation of wetland values does not represent the true value. The spatial scale of the wetland is the geographical extent of the wetland ecosystem services being valued and includes the location of stakeholder beneficiaries, whereas the temporal scale is the changes in the values of the services of wetland ecosystems over time (Korsgaarda and Schou 2010). The temporal scale should carefully be considered while estimating the economic values of wetlands. Since the natural setting and vegetation attributes of wetlands are influenced by the seasonal variability of different environmental factors, the goods and services provided by the wetlands are also influenced thereby. Hence, examining the wetland in specified spatial and temporal scales is challenging while valuation.

It is well reported that the South Asian region is vulnerable to climate change impact, and the mountainous ecosystems of South Asia are highly vulnerable to fragmentation because of changing climate (MEA 2005; Korsgaarda and Schou 2010). Thus, coastal areas including the coastal wetlands in this region would be affected, while intensity of flooding, storm surges, and rainfall would accelerate erosion and landslide problems in the region (Korsgaarda and Schou 2010). These events will affect the ecosystem services of the wetlands, and, therefore, identification of future uncertainties during the wetland valuation in this region is urgent. This is because wetland ecosystems may show catastrophic and/or irreversible and strong resilient responses under changing climate, and, consequently, the responses influence the degree of the diversity of wetland ecosystem services (Limburg et al. 2002).

In South Asian region, ignorance of the wetland values by the policy makers especially the nonmarket values is more common, and, thus, development interventions are commonly made at the cost of wetland ecosystem services without proper consideration of its non-tangible benefits. Another important issue is the survey design used in estimating the economic values of wetlands. The survey design for valuation of wetlands in this region is more complex compared to developed countries because of relatively high cost for the survey, and lack of public awareness of environmental problems makes the survey design challenging. Moreover, in many cases, people, during eliciting their willingness to pay (WTP) in contingent surveys, often show interest to spend time instead of money, and, thus, we need to adopt various approaches to the valuation of time such as the wage rate approach. However, it would be complex in valuing time if individual's income sources are not fixed and permanent as evident in this region (Alam and Marinova 2003). Therefore, the WTP survey design should incorporate this valuation issue in order to properly estimate the economic value of wetlands in this region. The inclusion of time in WTP survey can be better realized by a case study described in the following section of this chapter, and it is evident that a considerable number of people are willing to contribute time instead of money for the wetland management program in Bangladesh.

18.7 Case Studies from Coastal Area of Bangladesh

18.7.1 Coastal Wetlands of Bangladesh

Located in the southeastern part of the Indian subcontinent, Bangladesh with a 710 km long irregular coastline is surrounded by India in the north, west, and east and in the south by the Bay of Bengal (Islam 2010). There are a large number of wetlands occupying 7–8 million ha of the geographical area in Bangladesh. The types of wetlands include permanent rivers and streams (480,000 ha), estuarine and mangrove swamps (610,000 ha), shallow lakes and marshes (120,000–290,000 ha), large reservoirs (90,000 ha), small ponds and tanks (150,000–180,000 ha), shrimp farms (90,000–115,000 ha), and seasonally flooded floodplains (5,770,000 ha, Nishat 1993). Five categories of wetlands are identified in Bangladesh, *viz.*, saltwater wetlands, freshwater wetlands, palustrine wetlands, lacustrine wetlands, and manmade wetlands. The wetlands of Bangladesh can also be broadly classified into six major groups such as the Brahmaputra-Meghna floodplain, the Haor Basin of northeast region, lower *Punarbhaba* floodplain, Gopalganj-Khulna *Beels*, Chalan *Beel*, and Surma-Kushiyara floodplain (Islam 2010). Wetlands in the coastal area of Bangladesh play a crucial role in life support systems. The wetland ecosystems of the country are rich in biodiversity and house a large number of endangered and economically important species of national and international significance (Nishat 1993; Islam 2010). Moreover, the wetlands of the country support millions of coastal population in thousands of villages in rural Bangladesh providing employments, food, fuel, fodder, transportation, irrigation, etc. (Nishat 1993). Approximately 2.1 million ha of wetlands has been lost in the Ganges-Brahmaputra-Meghna floodplain mainly because of flood control, drainage, and irrigation development (Khan et al. 1994), indicative of the large extent of anthropogenic threats (Islam 2010). Therefore, understanding of the multiple benefits of coastal wetlands including its non-tangible benefits is necessary, and this can be achieved by a comprehensive valuation of the wetlands.

18.7.2 Case Study of Human Dependency on Coastal Wetlands

The economic valuation study presented here was conducted to realize the hidden values of the nonuse attributes of a particular type of coastal freshwater wetland (i.e., the Chanda *Beel* wetland ecosystem) in Bangladesh. The *beel* is a specific type of coastal freshwater wetland located in the southwestern coastal Bangladesh (Fig. 18.3). It falls under temporary freshwater wetland category as per the classification described in the previous section (see Sect. 18.2). The Chanda *Beel* wetland is a low-lying *beel* wetland in the Madhumati river floodplain ecosystem. It is located in Gopalganj district (an administrative unit) of Bangladesh at about 120 km south of Dhaka, the capital of Bangladesh, and the area experiences tidal influences. The district has five *Upazilas* (sub-administrative unit of a district in Bangladesh), namely, Gopalganj Sadar, Muksudpur, Kotalipara, Kashiani, and Tungipara. The freshwater wetland covers a total area of 10,890 ha of which about 60% fall under Muksudpur *Upazila*, 30% fall under Kashiani *Upazila*, and the remaining 10% fall under Gopalganj *Sadar Upazila* (LGED 2007).

The Madaripur *Beel* Route Canal (MBRC) and tributaries of the Kumar River supply water to the Chanda *Beel* freshwater wetland. Both the MBRC and the Kumar River receive waters from the Ganges river system. The wetland is connected with the MBRC by eight major canals and tidal water enters the wetland from the MBRC. Usually, inundation of the wetland starts from the middle of May, and the wetland remains inundated about 4–6 m during monsoon (i.e., June through October). In the early October, water starts receding, and the wetland dries

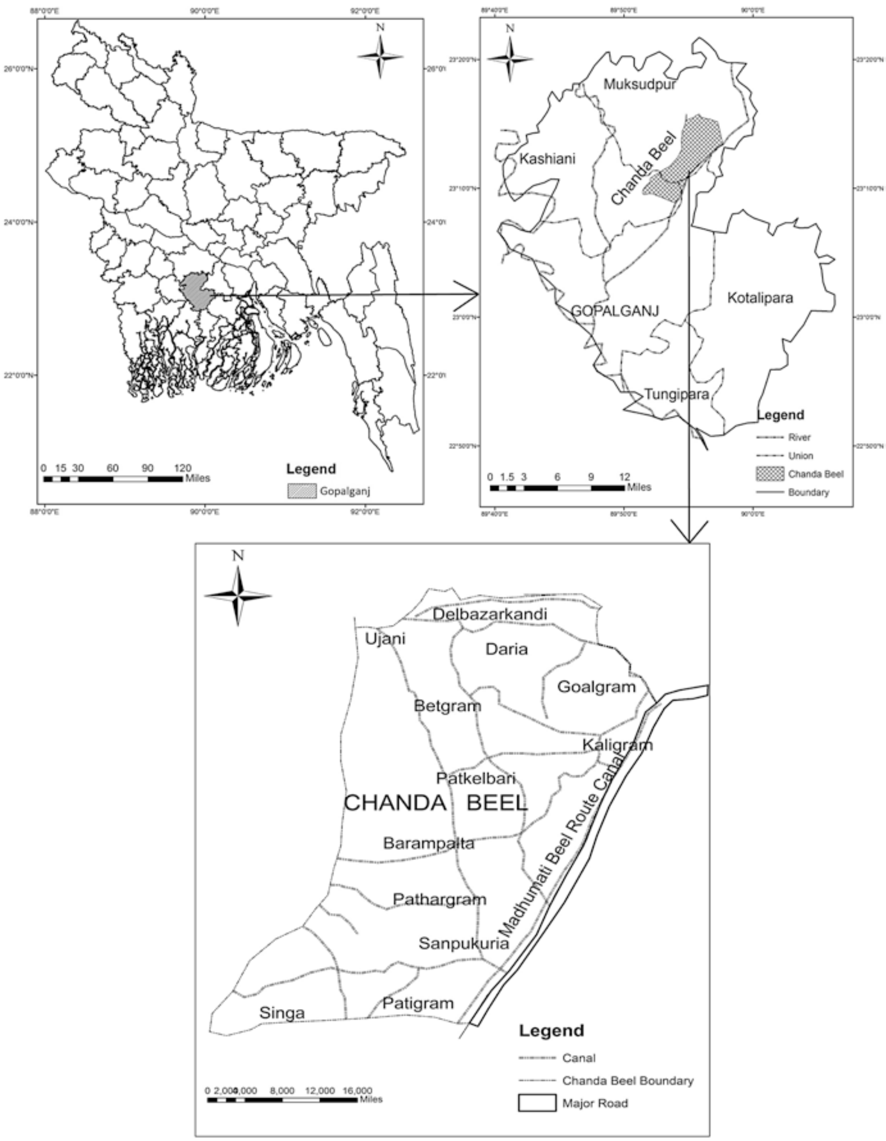

Fig. 18.3 Location of the *Chanda Beel* in southwestern coastal Bangladesh

up by December except for some natural trenches (Ghosh 2010; Ghosh and Mondal 2013). The people living in and around the Chanda *Beel* are dependent on various resources of the wetland for their livelihoods. In total, 216 naturally growing species of plants, comprising 50 species of trees, 38 species of shrubs, and 100 species of herbs, are found in the Chanda *Beel* wetland. The wetland also supports a rich diversity of faunal resources including fishes, crustaceans and shellfishes, amphibians, reptiles, and terrestrial and aquatic birds. Of the 57 fish species reported from the wetland, 16 species are rare and seven species are extinct. In the wetland, 16 prawn species, six species of crabs, and 15 species of molluscs (*viz.*, *Pila globosa*, *Bellamya bengalensis*, *Lymnaea acuminate*, etc.) are also found (BCAS-CDI 2006). Chanda *Beel* makes provision for livelihoods of the community as many people living around the wetland area are largely dependent on fishing and collection of snail, wild vegetable, fodder, and water hyacinth for subsistence. Thus, the dependency on the freshwater wetland has reached a level of over-exploitation of animal and plant resources.

18.7.3 Valuation Methods

Contingent valuation (CV) method was used to estimate the nonuse values of the *Chanda Beel*. The CV questionnaire was designed following the guidelines set by the National Oceanic and Atmospheric Administration (NOAA) Panel of the USA (Arrow et al. 1993). Stratified systematic random samples of 250 households were selected for the CV interviews. Of these, 179 were from region 1 (Gopalganj Sadar, Muksudpur, and Kashiani *Upazilas* and comprising people who were closely related to direct use of the wetland or had close contact with the wetland), 48 were from region 2 (Kotalipara *Upazila* and comprising people who were likely to have visited the wetland at least once before conducting the CV survey), and 23 were from region 3 (Tungipara *Upazila* and comprising those people who were unlikely to have visited and known the wetland). The questionnaire was divided into three parts that included respondent's eagerness to take part in the CV survey, demographic and economic information, respondent's perception, attitudes, and awareness towards the environmental condition of the wetland. A hypothetical wetland management program was explained to respondents clearly, and if the respondents supported the hypothetical wetland management program, they were asked whether they were willing to participate in the same program. If the response from a respondent was affirmative, the WTP was elicited, and respondents were asked to distribute their monetary values over the nonuse value components. More details of the CV survey and its design can be found in Ghosh and Mondal (2013).

18.7.4 Major Findings from the Case Study

The major results and conclusion presented in this section briefly are based on the wetland valuation conducted by Ghosh (2010) and Ghosh and Mondal (2013). Usable responses are vital in a contingent valuation study, and, thus, 214 usable responses to the CV questionnaire were identified in the study conducted by Ghosh and Mondal (2013). Examining protest bids in a CV survey is also very important as they reflect individuals' behavior in a hypothetical market for environmental improvements. Protest bids are found in a CV survey when an individual votes against a proposed hypothetical market for environmental improvements. In the

Table 18.3 Value of the nonuse attributes for the monetary contribution by the local people

Survey question theme	Minimum WTP (BDTk./month)	Maximum WTP (BDTk./month)	Average WTP (BDTk./month)
Continuous existence of faunal and floral resources of the Chanda *Beel* ecosystem	1.50	15.50	2.12
Enjoyment of the Chanda *Beel* ecosystem services in the future	1.50	35.50	3.47
Enjoyment of the Chanda *Beel* ecosystem services by future generations in the future	1.50	75.50	8.10
Total nonuse value (BDTk./month/household)	4.50 (0.07 US$)	126.50 (1.82 US$)	13.69 (0.20 US$)

Source: Ghosh (2010)

study, 36 protest bids were identified and examined carefully to divide the protest responses further. The respondents who answered "have not enough money but otherwise would contribute" and "don't believe that the wetland resource management program would bring the desired changes" were treated as valid zero bid. The respondents who answered that "it is the government's responsibility" and "it is the responsibility of those who degrade wetland resources should pay for it" or who rejected the contingent market were treated as protest bid in this study. The CV survey results show that 2.8% of the respondents said that they did not have enough money to pay for the program but otherwise would pay. Of the respondents, 61.1% said that they would not get benefit from the wetland resource management program, 33.3% said that it is the sole responsibility of the government to pay for the program, while 2.8% said that people who degrade wetland resources should pay. Therefore, 63.9% responses were identified as valid zero bids, whereas 36.1% responses were identified as protest bids. Moreover, the total nonuse values were divided into three categories (Table 18.3) in the case of willingness to contribute money (as shown in Bangladesh taka – BDTk – with respective US$) for the wetland management program. The results reveal that the bequest value was the largest monetary value that the respondents placed among all the nonuse value attributes, suggesting that the local people are aware of their future generations.

In the region, many people in coastal areas are reeling under poverty, yet show their interest in wetland resources management program. However, the people who have shown their interest in the program may be willing to spend their time instead of money. Therefore, the inclusion of monetary benefits from the contribution of time by the local people during the WTP estimation is necessary to elucidate the true WTP. Thus, the study incorporated the monetary benefits obtained from the contribution of time (as a resource) by the local people into estimation of the total nonuse value for the wetland improvement program following Alam and Marinova (2003). Accordingly, during the CV survey, the types of works were fixed. The types of works included physical labor, campaign and public awareness building, office works, and arrangement of meetings, and the respondents were allowed to

Table 18.4 Value of the nonuse attributes for the time contribution by the local people

Type of work	Minutes	Hours	Average rate per hour (BDTk.)	Monetary value (BDTk.)
Physical labor	547	9.12	20	182.4
Campaign and public awareness building	2966	49.44	30	1483.2
Office works	431	7.19	100	719
Arrangement of meetings	866	14.44	20	288.8
Total	4810	80.19	–	2673.4 (38.35 US$)

Source: Ghosh (2010)

Table 18.5 Total value of the nonuse attributes of the Chanda *Beel* freshwater wetland

Feature	Monetary benefit (million BDTk.)
Total number of households in Gopalganj district	247,972
Household's monthly average WTP (BDTk.)	13.69
Proportion of households willing to contribute money	81.60
Annual average monetary contribution by the households (million BDTk.)	33.24
Household's monthly average monetary value of time (BDTk.)	55.70
Proportion of households willing to contribute time	19.20
Annual average monetary value of time by the households (million BDTk.)	31.82
Total annual monetary benefits derived from the non-use attributes of the Chanda *Beel* freshwater wetland (million BDTk.)	65.06 (US$ 0.94 million)

Source: Ghosh (2010)

allocate their time to these different works. The respondent's time allocation was recorded on a time range basis, and the average time value of each time range was used in calculating the total time (Ghosh 2010) as shown in Table 18.4. The wage rate approach was used in valuing time, and the average monetary rate for each type of physical work was calculated following Alam and Marinova (2003).

All the monetary conversions used in this study from Bangladesh taka (BDTk.) to US$ are done as per September 2010 rates (1 US$ = 69.71 BDTk.). The components of the estimation of the TEV derived from the nonuse attributes of a specific type of freshwater wetland in the southwestern coastal Bangladesh are shown in Table 18.5. The annual aggregate nonuse value for the nonuse attributes of the freshwater wetland is estimated to be about BDTk. 65.06 million (US$ 0.94 million). This aggregate estimate suggests that the monetary benefits derived from the contribution of time by the local people cannot be ignored and need to be incorporated while estimating the total WTP. Since the economic valuation of the nonuse attributes of the specific type of coastal freshwater wetland is a first attempt in the southwestern coastal Bangladesh, it was not possible to compare the estimated nonuse value with other published wetland valuation studies.

18.8 Policy Implication of Wetland Valuation Studies

Estimated economic values of wetlands have significant policy implications. Ignoring such values would lead to misinformation about public preferences for wetland conservation among the policy makers and can result in misallocation of wetland resources and conflicts among different users of the resources. The estimated economic value can guide policy makers about how to allocate and manage wetland resources in an efficient and effective way. Generally, the estimated economic value reflects societal preferences for the wetland resources management in question and helps choose a management strategy ensuring sustainable uses. The economic valuation of wetlands can help policy makers prioritize sectors for environmental development. Thus, the main aim of the present exercise was to provide data and information for policy makers so that the wise use of wetland resources is achieved.

Cost-benefit analysis (CBA) is an economic tool mostly applied to public decision-making that attempts to quantify the advantages (i.e., benefits) and disadvantages (i.e., costs) associated with a particular policy, program, or action. CBA primarily determines whether society as a whole would benefit from the implementation of a policy, program, or action. Thus, CBA is a decision-making tool that is fully consistent with the use of economic value, and estimated economic values can help policy makers analyze cost-benefit for a development policy or action in the wetland area. The estimated economic value expressed in monetary terms can also provide significant incentives, and, thus, the estimated values need to be brought to the attention of policy makers and wetland resource managers in order to ensure the sustainable use of wetland resources. It is found that estimated economic values of wetlands reflect not only public attitudes towards wetland conservation but also provide a number of opportunities and advantages to wetland management. Even, the results of the economic valuation of wetlands act as significant inputs to mechanism of exploring the public demand for wetland conservation and development considering the relationship between wetland services as economically free goods and dependency of human being. Understanding the relationship between local people and wetlands along with their perception and knowledge on such public goods is vital in designing a socially acceptable, economically viable, and efficient wetland management strategy or policy. This warrants policy makers to take into account public preferences and, consequently, involve dependent community in environmental decision-making relating to the wetland. Failure to consider these may lead to degradation of wetland ecology. So, an incorporation of the values of the use and nonuse attributes of wetlands is imperative in the planning and decision-making process for wetland resources management.

18.9 Conclusion

The compilation and syntheses of coastal wetland valuation approaches and the case studies presented from Bangladesh reveal that coastal wetlands possess a considerable economic value as they are productive natural resources in coastal areas. The non-tangible economic benefits that policy makers often overlook constitute a considerable portion of the total economic value of the wetlands, necessitating careful and proper consideration of the economic values of coastal wetlands in environmental decision-making. Understanding of the ecosystem services of coastal wetlands and their valuation approaches is vital in environmental policy making for wetland resources management. Thus, if all the wetland values are not incorporated into wetland management policies or actions properly, a better socially acceptable, economically viable, and environmentally sound outcome would not result from such policies or actions.

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