

Valuing Fishing Activity of the Deepor Beel

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Abstract

The Deepor Beel is one of the large and important riverine wetlands in the Brahmaputra valley of Assam, India. The only Ramsar site of Assam, the Beel is one of the richest biodiversity grounds in the wetland eco-system of the state. The Deepor Beel is the hub of a wide range of organisms. It provides various goods and services directly or indirectly to the villages near to the beel for their livelihood. Despite its contribution to society and ecology as a whole, these goods and services of the Beel are undervalued in the policy provisions. The prime reason for this undervaluation is that most of the goods and services of the Beel are non-marketable and those goods which have direct use-values are never valued in an economic term. To fill the gap partially, this study tries to estimate the direct use values of the Deepor Beel. Among the goods the Deepor Beel provides, fishing can be considered one of the economically significant goods. Fishing provides livelihood directly to 825 households living near the Beel. Therefore, this research tries to estimate the direct use value of fishing in the Deepor Beel. A market price approach is applied to estimate the value of this wetland resource. Net Present Value (NPV) of fishing is also estimated. The total estimated value of fishing is INR 11,64,69,375 per annum. The estimated value of fishing per hectare is INR 29,015.78 per annum. The estimated Net Present Value (NPV) of fishing is INR 97,05,78,125. This valuation is important to draw the attention of the policymakers for resource investment in conserving the Beel for continued benefits.

Keywords: Direct Use Value; Economic Valuation; Market Price Approach; Net Present Value (NPV); Deepor Beel; Assam; India

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Introduction

Wetlands, on the one hand, are the most productive ecosystem providing various significant services to human and wildlife and on the other, these are the ecologically sensitive systems (Gokce, 2018). A single wetland system can provide multiple ecosystem services such as provisioning, regulating, cultural and supporting service (Sofia & Nurlianti, 2019). The ecosystem services of wetlands are mostly undervalued by society, resulting in the conversion of the wetlands. The wetlands in India are also facing the acute problem of existence. Even though many conservation and protection acts are enacted, the rate of loss of wetland is increasing at a fast pace. Studies depict that India has lost more than 38 per cent of its wetlands in the last decade. In some districts, the rate has been as high as 88 per cent (Vijayan et al., 2004). The principal causes of degradation are habitat destruction by land-filling, hydrological alterations, upstream dams and pollution by industrial and domestic sources.

Assam in the northeast part of India has also been experiencing the fast conversion or loss of wetlands since the 1990s (Deka et al., 2011). The only Ramsar site¹ of Assam, the state of the Deepor Beel² is of no difference. The Deepor Beel (Figure 1) was declared as the Ramsar site in November 2002. The Deepor Beel is one of the important natural freshwater wetlands of Assam. According to the information available in Ramsar website, the Beel is situated within the coordination of 26°08'N 091°39'E. The Beel lies on the southwestern fringe of Guwahati City (Saikia 2005). The main sources of water to the Beel are Basistha river, Kalmani river and local monsoon run-off. Through Khonajan channel, the beel drains its water into the Brahmaputra River. The Deepor Beel acts as a natural storm water reservoir for the Guwahati city during the monsoon season. It is a hub of varied wild flora

and fauna. Several endemic, endangered and threatened animals, birds and plants are found in the Deepor Beel (Saikia & Bhattacharjee, 1987; Saikia, 2005; Saikia & Saikia, 2011). Some of the flora and fauna are included in the Directory of Asian Wetlands (IUCN, 1987). The Beel is the breeding ground of many rare fish species. The Deepor Beel is under tremendous pressure due to development activities and unsustainable land-use practices. Unlawful encroachment, discharge of pollutants, air pollution created by the brick kilns set up in the Beel area, construction of road and railway lines on the Beel area are major factors responsible for the degradation of this ecosystem. Siltation, dumping of solid waste materials and toxic chemical discharge by the inlet channels to the wetland have reduced its carrying capacity significantly leading to a rapid depletion of its fish productivity. As a result, many fishermen families have lost their livelihoods. Due to these anthropogenic pressure, the area of this wetland has been diminishing over the years. A study conducted by Deka et al. (2011) on the monitoring of changes in the spatial extent of the Deepor Beel found that the total area of open water bodies has diminished 2.904 sq. Km from 1991 to 2010. Meng & Dong (2019) has also undertaken a similar study on Nansi lake in China which shows that over 30 years (1987-2017), 54.4% of the natural wetlands in Nansi Lake were replaced by constructed wetlands.

Various programs and policies were introduced by the Government of Assam to protect this inimitable wetland. The government declared it as a wildlife sanctuary in 1989 under the Wildlife Protection Act, 1972 (Forest Reports, Govt. of Assam, 1992). The wetland was included in Birdlife International lists as an Important Bird Area in 2004 (Islam & Rahmani, 2004). In 2008, 4.14 sq.km of the Beel was declared as Bird Sanctuary. In the same year, the Guwahati

¹ A Ramsar site is a wetland site chosen as a site of international importance under the Ramsar Convention. The key aim of the Ramsar Convention is to protect and conserve the world's wetland. Therefore, an intergovernmental environmental treaty was established in 1971 at Ramsar, Iran through a convention. This convention is known as the Ramsar Convention.

² Beel means lake in the Assamese language.

Water Bodies (Preservation and Conservation) Act, 2008 was introduced. The Act was meant to conserve and preserve the water bodies that come under the jurisdiction of the Guwahati Metropolitan Development Authority (GMDA). The Act prohibits certain activities in the water-bodies such as dumping of solid waste, developmental activities, encroachment which may reduce the size of the water-bodies (Saikia, 2019). Surprisingly, Guwahati Municipal Corporation (GMC) took the devastating decision of transferring the landfill area of the Guwahati city to the Deepor Beel in year the

2008 itself. No significant action in real sense is taken up till now to stop waste dumping, encroachment or other illegal activities on the Beel. The key reason for above mentioned scenario is the misunderstanding of the policymakers regarding the real value of the Deepor Beel. Like other natural resources, the ground of the undervaluation of the Deepor Beel is that most of the goods and services of the Beel are non-marketable and those goods which have direct use value are never valued in an economic term.

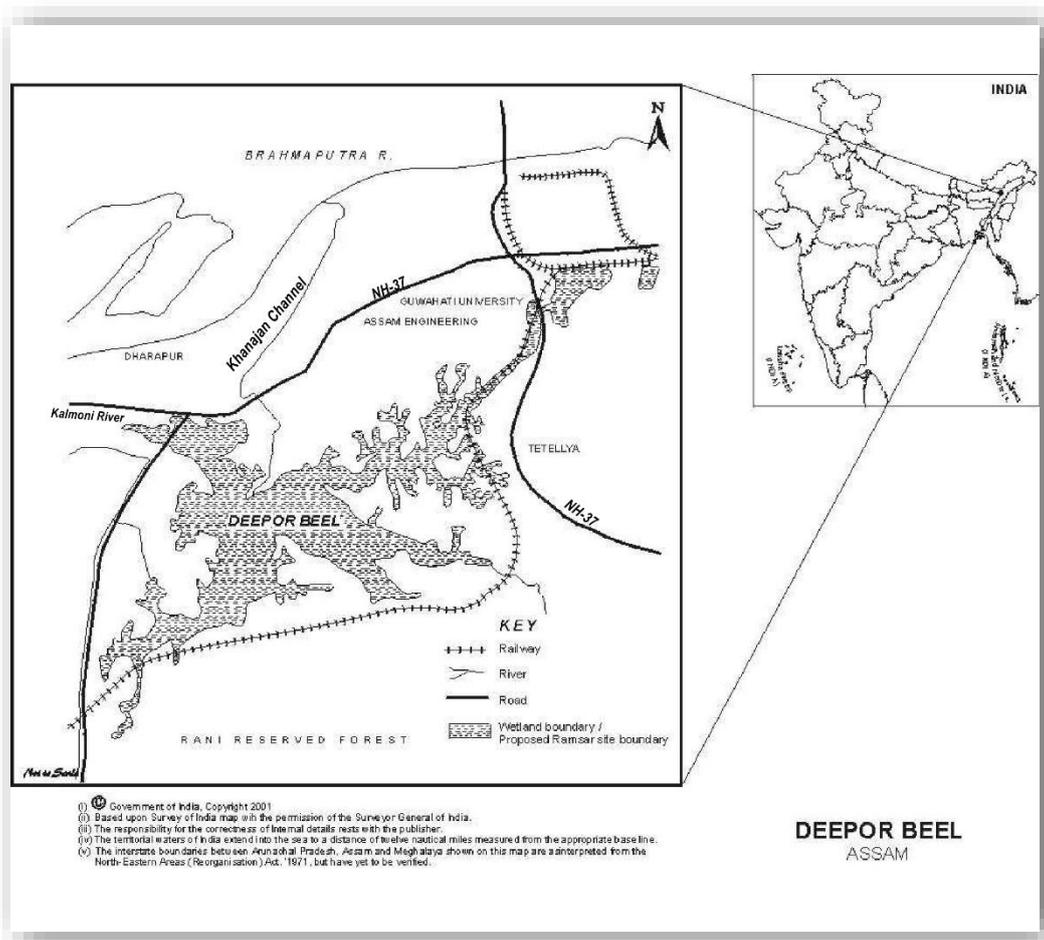


Figure 1: Map of Deepor Beel

Source: Ramsar website. Retrieved on 31 December 2019 from, <https://rsis Ramsar.org/RISapp/files/41543220/pictures/IN1207map.pdf>

Although extensive studies on hydrological, physical, chemical, ecological functions of the Deepor Beel have been conducted, no study on economic valuation of goods and services of the Beel was conducted till 2012. The attempt was taken up by the author (Dutta, 2017) to conduct an economic valuation of the Deepor Beel as her

doctoral research. As a part of her research work she presented a paper on the socio-economic value of the Deepor Beel in 2012 in an international seminar held in Nepal (Dutta and Sharma, 2012) where she carried out valuation of both use and non-use values of the Beel. This

study is based on the doctoral research work of the first author.

The values of goods and services provided by the Beel to the human and other living things come under use and non-use values. Under use-values, the Beel provides a few numbers of goods which has direct use-values. Among them, fishing can be considered as the economically significant good as most of the people, directly and indirectly depend on fishing as their source of livelihood and source of nutrients. This observation has also been reinforced by Pandit et al. (2018) who argue about the development of aqua-tourism in Deepor Beel as they found fishery is the major occupation of the fishermen residing near the Deepor Beel area. Seemingly, in a slightly different spatial context of North Hulu, Sungai Regency, South Kalimantan, Indonesia, Sofia & Nurlianti (2019) argue that traditional fishing plays an important role as a source of livelihood for most households in wetland areas. Fishing is considered both as a source of household protein as well as money.

Considering the importance of fishing, this research paper tries to estimate the direct use value of fishing in the Deepor Beel. The structure of the study is as follows: in the next section, the key methods adopted in the study has been discussed. Following this, it discusses the result of the study. The conclusion of the study has been summarised in the final section.

Research Methodology

Sources of Data

Both primary and secondary data sources are used in the study. Secondary information is collected from the reports available in Ramsar website; reports retrieved from the Ministry of Environment and Forest (MoEF), Government of India on Indian Wetlands, and MoEF sponsored reports prepared by ARSAC,³ ASTEC.⁴ Different reports and publications of individual researchers are also consulted to construct the backdrop of the study. Primary sources of data

have been collected through a household survey.

Sampling Design and Sample Size

According to the Resource Inventory of Beel Fishery, 2015, 825 households, living in the villages adjacent to the Beel, directly depend on fishing as their source of livelihood. This study deployed stratified random sampling procedure. For this, first, the villages are divided into different strata according to the residents who are involved in fishing. The random sampling procedure is then followed to select sample households to conduct the survey. From the 825 fishing households, 20 per cent of the households are taken as samples. A structured information schedule survey is conducted among 165 households. A brief description of the scope and coverage of the study and possible outcomes are explained at the beginning of the interview. To collect the required data, a door-to-door survey was carried out. Apart from the household survey, other necessary information were collected from the Village Headman. The survey was conducted from January to February 2016.

Analytical Method for Calculating the Value of Fishing

The calculation of economic value crucially depends on the selection of appropriate tools. In this study, the market price approach is used to estimate the gross and net value of fishing activity in the Beel area. The market price approach uses the prices of goods and services of an ecosystem as a tool to determine the value of an ecosystem service which is bought and sold in commercial markets (Carson & Bergstrom, 2003). As it is believed that the market provides precise information about the value of goods and services, therefore, the private and social willingness to pay for the traded ecosystem services is reflected in the market operation.

The use of the market price approach can be seen in the study conducted by Das et al. (2000) to calculate the economic value of ten wetlands

³ Assam Remote Sensing and Application Centre

⁴ Assam Science Technology and Environment Council

⁵ Resource Inventory of Beel Fishery, 2010 is prepared by the Village Headmen to submit to the respective Revenue Circle Office.

in the Gangetic flood plain in Bardhaman district of West Bengal. The value of the fisheries in operation in these wetlands varies from INR 500 to INR. 16,000 per ha per year. Verma (2001) estimated the economic value of Bhoj wetland. In the study, she estimated the annual total earnings of fishing as INR 80,00,000 with the help of the market valuation method. The same analytical tool is also used by Roy et al. (2012) to estimate the annual (average) income of fishing of Bhomra Beel in their study on socio-economic valuations of wetland based occupations of Lower Gangetic Basin. The estimated value of this study stood at INR 1200. Meng & Dong (2019) also used Market value approach (MV) to value fishing in Nansi lake, China and the result

$$NF = V_i - C_i$$

where,

NF=Net monetary annual benefits from fish catch from the wetland

V = average annual monetary value of the fish catch

C = various cost incur during fishing

(C=n+e+b+m) (average annual cost)

n = cost of net used per year

e = cost of equipment used to keep caught fish per year

b = cost of boats per year

m = cost of maintenance of boats per year

i = individual household

The total net money value of fishing is calculated by multiplying net monetary benefits per household to the total population of fishers.

To make the results more precise, the input value of food production should be considered. Fish in natural water mainly feed on plankton, therefore, the input value can be neglected (Meng & Dong, 2019). The following section estimates the current net value of fishing in the study area.

Results

Estimation of Present Net Value of Fishing

It can be considered that goods and services provided by the Deepor Beel have a substantial share in the economy of the Guwahati City. If we think of the goods & services provided by the Deepor Beel as a stream of annual 'income', then

unravelling that in the local market, the average price of fish was \$1.745 × 10³/t. The average unit area yield were 31.5 t/sq. Km in natural water and 225 t/sq. Km in aquaculture area. Seemingly, Kauffman (2018) too found that the residents of Delaware, US spent an estimated \$62 million on fishing. He tried to quantify the economic value of Delaware wetlands. The Net Present Value (NPV) of the Delaware wetlands has also been measured over 100 years.

In this study, for valuing the fishing activity, net monetary benefit from commercial fishing per household is estimated with the help of the following expression:

the Beel can be considered as part of Guwahati city's total natural capital. This observation is similar to the argument made by Bateman et al., (2011). Net Present Value (NPV) is used to convert the stream of benefits from the future flows of ecosystem services to figure out the value of this natural resource capital. Net Present Value (NPV) is an economic term representing the economic value of a natural resource item over time, discounted to present-day terms (Azar and Sterner, 1996). The Wetland benefits are often expressed as a yearly flow of money. If this yearly flow is expected to continue indefinitely, there is an easy formula for the relationship between NPV and yearly flow: NPV = yearly flow of net income/discount rate (Liu et. al., 2010). Here, NPV is calculated for fishing activity. The results of the fishing activities of the study area are outlined in the following sections.

Identification of Major Goods Provided by the Deepor Beel to the Resource Users

As stated above, an in-depth survey was conducted to identify the economic activities performed in and around the Deepor Beel area. It is found in the survey that fishing, paddy cultivation, and fodder collection are the major

activities that are carried out by the local residents dwelling in and around the Beel area. A significant number of local people who belong to the fishing community depend on the Beel. Fishing is the main source of livelihood of these people. A total of 825 families depend directly on fishing. The fish is also the main source of protein of these people.

Table 1: Information on Time Spent on Fishing Per Day in the Beel	
Information	Sample statistics(N=165)
Number of People that Go for Fishing per Day	
1	10(6.06)
2	125(75.75)
3	30(18.19)
No of days fish in a week	
6 or less	30(18.18)
7	135(81.82)

Numbers in Brackets Indicate Percentage to the Total
Source: Survey Data

Time Spent on Fishing

Results of the survey indicate that households mostly fish along the periphery of the Beel. Only on the occasion of Magh Bihu and Bohag Bihu (one of the major festivals of Assam), people fish near the core area of the wetland. Most of the households (81.82 per cent) fish for 7 days a week; only 18.18 per cent of the households fish for 6 or fewer days a week. On average, a household spends approximately three and a half hours in the morning and three and a half hours in the evening per day for fishing in the Beel. From every household, on average two members go for fishing everyday (see Table 1).

Various Tools Used During Fishing

The fishermen use different nets to catch various sizes of fishes. They also use *jakoi* or *khawoi*.

The nets are made of different small parts such as *sola*, *goli*, *bai*, etc. Generally, women are engaged in making or weaving fishing nets. Approximately, four to five hours is required to complete the weaving of a net. The detail of various nets used during fishing in the Beel are given below in Table 2. Usually, people do not collect other vertebrate and invertebrate from the Beel other than fish. In the case of plants, sometimes people collect water lily or *mokuwa* for eating. There is no storage facility for the caught fish. This is the reason that fishermen do not go for overfishing. Overfishing leads to wastage of caught fish which will lead to a reduction of fish stock in the Beel, indirectly hamper their source of livelihood in long run.

Table 2: Information on Various Nets Used During Fishing			
Type	Nets	Size	Fish size
Small	Parangi, ghoka, sana langi, kawai langi	10mm-15mm	Small
Middle	Puthi langi	25mm-35mm	Medium
Large	Langi, Kareng/ faasi, Basu jaal, polo, barasi ⁶ , jakoi	70mm-200mm	Large

Source: Survey Data

⁶ *Polo, barasi*: local name of fishing equipments which are also used for fishing other than nets.

The Monetary Value of the Fish Catch

The small-sized fishes are generally caught during the winter season. Big sized fishes are caught in summer season along with small-sized fishes. Fishing is comparatively reduced during summer due to the increase in the water level of the Beel. Fishermen generally sell fishes they catch to the fish sellers at per *Aska*.⁷ One *Aska* is equivalent to 4-5 kgs of fish. From the sample it has found that the value of each *Aska* ranges

from INR 400 to INR 500 depending on the variety of fishes they catch. Some fishermen also sell their caught fish to the local market. They sell their fish at per *bhag*.⁸ Each *bhag* cost around INR 20 to INR 30. The percentage of those people is negligible. Therefore, the bigger unit of measurement is considered for the calculation. The calculation of the money value of fishing is considered by the average income earned by a fisherman (see Table 3).

Variables	Amount
Average Income earn by each day per <i>Aska</i>	INR 450 (400 to 500)
The average income per month	INR 13,500
Average income per annum	INR 1,62,000

Source: Survey Data, INR: Indian Rupee

The Cost Incurred in Fishing

Every household poses a boat for fishing. The boats are made of wood. One boat costs around INR 25,000 to INR 35,000. One boat last for four years. The fishermen do not use boats run by the engine as they believe that the sound of the engine may hamper the environment of the Beel affecting the fish stock in the Beel. Another reason which keeps the fishermen away from using an engine in the boats is that the engine creates vibration in water due to which fishes try to run away from the route where the boats pass. This generally disturbs the fishermen to

catch fish. To use the boats for a long period, fishermen have to maintain their boats. They use coal tar⁹ in the whole body of the boats so that they cannot be damaged by the polluted water of the Beel. The cost of the maintenance of the boats is approximately INR 300 per year.

Various types of nets are used in fishing. The costs of raw materials used to make a net; the cost of equipment such as *khara* (to keep the caught fish) are included in the estimation of the cost incurred in fishing. The details of the various costs incurred in fishing are presented below (see Table 4).

⁷. *Aska* is the unit of measurement for fish used by the local fishermen of Deepor Beel. The measurement is bigger than *bagh*.

⁸ Smallest unit of measurement for fishing. 1 *bhag* contains 20-25 fishes

⁹ A thick, black, tarry liquid obtained by the distillation of bituminous coal in the manufacture of illuminating gas, used for making printer's ink, black varnish, etc.

Table 4: Information Related to The Cost of Fishing Per Household	
Variables	Amount
Parts of nets and their costs	
Sola	INR 150
Goli (1kg=INR 50) needed 5 kgs	INR 250
Jaal (average)	INR 550
Bai (1kg= INR 50) needed 4 kgs	INR 200
Cost of 1 net (jaal)	INR 1150
Nets needed in a year	
For small fish (puthi langi, kawai langi, baro and kareng net)	2+2+2+2
For medium fish (parangi langi net)	2
For large fish(langar langi net)	1(total 11 nets)
The total cost of 11 nets	INR 12650 (INR 1150 X11)
Average Cost of equipment(khara) used to keep fish after been caught	INR 125per khara
Cost of required khara(3 khara per year)	INR 375
Average Cost of boats for 4 years	INR 30,000
The average cost of boats per year	INR 7,500
Cost of maintenance of boats per year	INR 300
Total cost per year	INR 20,825
Source: Survey data, INR: Indian Rupee	

Therefore, the Net Monetary Benefits from the fishing per annum is

$$NF = V_i - C_i$$

$$= \text{INR } 1,62,000 - \text{INR } 20,825$$

$$= \text{INR } 1,41,175 \text{ per household}$$

The total value of fishing is $\text{INR } 1,41,175 \times 825 = \text{INR } 11,64,69,375$

Value of Fish in per hectare of the Deepor Beel

The per hectare yield of fish is calculated by dividing the total value of the fishing by the total area of the Beel. The total area of the Beel is 4,014 hectares. The total value of fishing is INR 11,64,69,375 per annum. Therefore, per hectare value per annum of fishing in the Deepor Beel is INR 29,015.78.

Estimation of Net Present Value (NPV) for Fishing

As stated above, to determine the NPV of fishing, the net annual value of fishing is divided by a

discount rate. In this study, the discount rate considered is 12 per cent. This discount rate is equivalent to the interest rate of the loan of the cooperatives society of that locality. The name of the cooperative society is Bandhan which has now turned into a bank. The fishermen take loans from this cooperative society for buying boat and other necessary equipment for their livelihood.

The estimated Net Present Value (NPV) of fishing for an infinite period is INR 97,05,78,125. The finding of this study bear resonance to the study of Stuij et al. (2002), who conducted a study on

socio-economics of wetlands. In this study they included case studies from developing countries that address different wetland types and values. In the case of Mirja Zerga wetland of Morocco, NPV for agriculture is estimated considering the infinite period. The estimated value of NPV for agriculture is 33 million US \$ at a 6 per cent discount rate.

Conclusion

The environment of the Deepor Beel is under continuous deterioration. Its real conservation has been neglected over the years. As mentioned earlier, the Government has allocated a good amount of money for the conservation, preservation and development of the Beel, yet, its ecological quality and spatial size have been degraded incessantly. Decision-makers consider the allocated amount of money for the Beel as a cost without getting any return in monetary terms. The result of the study should be the eye-opener for them. With this ailing state, if the Deepor Beel can generate a significant amount of money (that it only for fishing), what would be the scenario if the Beel would be restored and conserved. It could be interpreted that if the Beel was conserved by increasing its ecological quality and spatial size, then it would generate more income and become a productive asset. The present results might prove very useful for decision-makers and local stakeholders, developing a management plan for the Deepor Beel.

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