A Study on the Impact of Industrial Effluents on Local Ecosystem and Willingness to pay for its Restoration

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Abstract
Development is a multidimensional process involving qualitative changes in the socio-economic and political structures, popular attitudes, national institutions, as well as in the acceleration of economic growth, reduction of inequalities and eradication of poverty. It has both positive and negative impacts on the society. Setting up of industries is essential to accelerate the pace of economic growth, but haphazard industrialization in the name of development has affected the lives and livelihood of people and deteriorated the local ecosystem. To grasp the reality about the impact of industrial effluents on ecosystem and lives of people, a micro level study was done at selected locations near Brahmaputra Cracker and Polymer Limited (BCPL) in Dibrugarh district of Assam. Functioning of BCPL has contributed greatly to the deterioration of the local ecosystem and the livelihood of the inhabitants. This study employs the Contingent Valuation Method to determine the factors which influence the individual’s willingness to pay for restoration and conservation of Sessa river. Two factors namely bid value and water use has turned out to be the significant determinants influencing willingness to pay.

Keywords: Brahmaputra Cracker and Polymer Limited (BCPL), Willingness to Pay, Contingent Valuation Method, Development, Industrial Effluents

JEL Classification: Q51, Q52

Paper Classification: Research Paper

Introduction
Development is a multidimensional process involving qualitative changes in the socio-economic and political structures, popular attitudes, national institutions, as well as in the acceleration of economic growth, reduction of inequalities and eradication of poverty. Developmental projects such as construction of roads, highways, bridges and industries needs to be undertaken to accelerate the pace of economic growth. Such projects could either help indigenous people in improving their lives or may deteriorate their livelihood, cultural heritage depending on how they are managed. It may also lead to tremendous alienation from common property resources such as forests, land, fodder and water bodies. It may also lead to displacement which involves forced movement of people from their place of dwelling to an unknown destination where they are compelled to live in order to carry out a development
project. In this process, they have to face various adverse effects in the form of socio-economic and cultural upheaval. They have to undergo the entire process of resocialization and adjustment in an unfamiliar environment (Ganguly and Ganguly, 1989). Industries have become an essential contributor to economic progress and the waste and effluents generated poses a serious threat on the health and environment as they are disposed of without proper treatment. It has led to the depletion of natural resources and extinction of many species of flora and fauna. The degradation of environment poses a threat to the lives of the local inhabitants (Bhandari and Garg, 2015). It also leads to an increase in urban population and transforms the Agrarian Society into an industrial one causing imbalance in the relationship between man and nature. It resulted in creating many problems such as involuntary displacement of human population, degradation of traditional forms of living and ecological imbalance in a particular region. Rapid changes have been noticed in the society, with rich becoming more richer and poor becoming more poorer (Kapoor, 2014). In Assam, even though industries are starting to take effective measures for hazardous waste management, but still they are lagging behind. In order to obtain a vivid picture about the reality, an intensive micro level study was done at selected locations near Brahmaputra Cracker and Polymer Limited (BCPL) in Dibrugarh district of Assam. The Brahmaputra Cracker and Polymer Limited (BCPL) is the first ever petrochemical plant in the entire North Eastern region which came as a part of the historic Assam Accord signed on 15th August, 1985 with the motive of setting up of the plastic processing industries which shall generate both direct as well as indirect employment. It is a Joint Venture Company with 70 percent of equity participation from the Gas Authority of India Limited (GAIL) and the rest 30 percent is equally shared by Oil India Limited (OIL), Numaligarh Refinery Limited (NRL) and Government of Assam. The foundation stone of the project was laid on 9th April 2007. The Complex is spread over 3000 bighas of land at Lepetkata which is situated about 15 kms away from the Dibrugarh town. It is expected to produce 2,20,000 tons of polyethylene, 60,000 tons of polypropylene, 55,000 tons of raw pyrolysis gasoline and 12,500 tons of fuel oil per year.

**Literature Review**

In recent years with the growing pace of industrialization, intensive work has been done on impact of industries on lives and livelihood and regarding people’s perception of restoration and preservation of common property resources from industrial hazards. Few studies have been incorporated in this section.

In modern society, industrial waste constitutes a toxicological and epidemiological risk as it penetrates into the soil, air, groundwater, and surface water bodies and vegetation directly or indirectly affecting people’s health (Cherniaeva, 2013). There are both positive and negative effects of mining, refinery, aluminium smelter and industrial effluents on human and ecological health, pattern of livelihood, income, education and settlement of local population etc (Behera, 2015). Rapid industrialization severely affects the quality of river and its ecology with the discharge of untreated industrial sludge containing multi-level heavy metals, residue and byproducts. These hazardous chemicals and metal ions seep into the groundwater and affect the quality of water causing various health problems (Laxmi et al., 2015). Besides these, industrialization has created various problems such as involuntary displacement of human population, loss of traditional sustainable livelihoods and landholdings and increase in ecological imbalances in the region (Kapoor, 2014). While benefits such as employment have accrued from economic development projects but changes in land use and in people’s occupations may have adverse impact on their future livelihoods (Chandy et al., 2012). Industry also causes great devastation of both terrestrial and aquatic environments on a local and regional scale. It produces large quantities of waste,
which is deposited on land or in aquatic systems causing pollution of air, soil, river water, and groundwater (Rybicka, 1996). The consumption of toxic water polluted by industrial effluents causes various health problems such as skin allergy, respiratory infections, general allergy, gastritis and ulcers (Govindarajalu, 2003). Industrial effluents also affect soil, health and agriculture. In India, a huge amount of waste water generated from distillery and paper industries is discharged on land or into the running water which adversely affects seed germination and seedling growth of various crops (Chhonkar, 2000). Hazarika and Dutta (2017) found that Brahmaputra Cracker and Polymer Limited, an outcome of the Assam Accord was aimed at promoting socio economic development of Assam. But the project has degraded the environment and common property resources of ten villages surrounding the plant adversely affecting the health, food security, livelihoods and cultural life of villagers.

Travel Cost Method (TCM), Hedonic Pricing Methods (HPM), and Contingent Valuation Methods (CVM) were used for quantitative assessment of economic value of non-marketed resources. Each method focuses on different aspects of social benefit associated with such resources like lakes, streams, rivers, and wetlands. The TCM and HP methods depend on linkages between ecosystem indicators and markets for related private goods and services (Anderson and Bishop, 1986). These two methods are indirect valuation methods which are limited by their ability to assess use values only. In contrast to the related-market methods, the CVM estimates total value through a questionnaire, and allows considerable flexibility in the ecological scenarios which are used to value. It is used for estimating both use and non-use values. Due to its potentiality of non-use valuation, CVM has gained its importance despite its limitations. And it is currently the only method where the respondents are given an opportunity to express their non-use value for environmental goods (Williams, 1995). Graves (1991) made a comparison of different environmental studies of two or more of the techniques to assess the value of non-marketed goods. He found that in all cases the estimates obtained were close, fairly close or ballpark similar. However, in comparison between CVM and indirect methods, he found that many of the non-marketed goods value have aesthetic qualities which are expected to have high non-use value which could not be captured by indirect valuation methods.

The Contingent Valuation Method is used for exploring individuals’ Willingness to Pay (WTP) for a variety of non-market goods and services. It is a simple, flexible nonmarket valuation method which is widely used in cost-benefit analysis and assessment of environmental impact (Venkatachalam, 2004). It is a stated preference method as the respondents are asked to state their willingness to pay for some hypothetical good or service for which market does not prevails (Wright, 2012). It was first used by Davis to assess the benefits of outdoor recreation in a Maine (USA) backwoods area (Davis, 1963) and was extensively developed throughout the 1970s and 1980s. Contingent Valuation Method is used to estimate the individual’s willingness to pay for changes in the quality or quantity of goods and services as well as effect of covariates on willingness to pay (Haab and McConnell, 2002). WTP indicates the strength of one’s preference for environmental quality and it is influenced typically by several factors such as individual’s income, gender, cultural preferences and education or age (Nguyen and Vietnam, 2007). It is also influenced by other factors such as bid value, mode of payment and perception of mangrove degradation (Ekka and Pandit, 2012).

Shang et al. (2012) studied about the river networks degradation due to increasing urbanization and population growth in Shanghai, China. They examined residents’ awareness of the value of river network by using a logistic regression analysis based on Contingent Valuation Method to assess the total benefit and to determine the socio-economic factors influencing resident’s willingness to pay. They found that the residents had highly valued river network and
are willing to pay for its protection but are unsatisfied with government’s actions and current situation. Number of years spend in Shanghai, distance to the nearest river from home and the amount of bid were some of the factors influencing respondents’ WTP.

Nallathiga and Paravasthu (2010) adopted the Contingent Valuation Method for estimating the economic value of conservation of river water of Yamuna. The results depicts that there exists a willingness among the inhabitants residing in Yamuna Basin for the conservation of river water quality which is about 14.93 percent higher for restoration of water quality than for current water quality maintenance.

Markowska (1999) studied about the protection of the Baltic Sea in Poland from excessive inflow of substances such as nitrates and phosphates. He employed Contingent Valuation method and the result depicted that the Poles would be willing to pay to protect the Baltic Sea and the Baltic beaches from the negative effects of eutrophication.

Foster (2008) assessed Columbia Country residents’ willingness to pay for improvement of Ichetucknee Springs and river by employing Contingent Valuation Method. The results revealed that majority of the residents were concerned about protection of water quality of the river. The variables that influenced individuals’ willingness to pay includes bid value, political affiliation, frequency with which they visited the site and importance of maintenance of water quality of the river.

Research Gap

A study conducted in this area discussed about the impact of BCPL on health, food security, livelihoods and cultural life of villagers (Hazarika and Dutta, 2017). But it did not discuss about the importance of restoration and conservation of Sessa river from people’s perception and their willingness to pay for its preservation.

Objectives

- To analyse how the functioning of BCPL has contributed greatly to the deterioration of local ecosystem and lives of the inhabitants.
- To assess the people’s perception about importance of restoration and conservation of Sessa river.

Methodology

The study is mainly based on primary data collected from people residing near Sessa river. To grasp the reality and for an in depth study, interview schedules were designed with the purpose of collecting information on socio-economic characteristics of the respondents, impact of BCPL on environment, health and on their lives and livelihood. The Contingent Valuation Method questionnaire shall also be prepared which will be divided into two parts. In the first section, a detailed description is given of the Sessa river that is being valued and a hypothetical market has been constructed. The second section shall include questions relating to respondents’ willingness to pay which shall reveal their preference for preservation and restoration of water quality of Sessa river. They were asked to state their preference for restoration of the quality of Sessa river. Informal interactions and interviews with the inhabitants were also conducted. The
interactions were designed to elicit responses pertaining to the villager’s perceptions regarding the changes that they have seen with the setting up of BCPL. Three villages were covered namely Akhapur Notun Gaon, Dewanbari Koibarta Gaon and Lezai Gaon under Barbaruah block and 166 respondents were enquired.

This study employs the contingent valuation method which involves assessing an individual’s willingness to pay for goods by constructing a hypothetical market (Kolstad, 2000). Logistic Regression model was used following Cameron and Huppert (1989); Ekka and Pandit (2012) to attribute weightage to the factors which influence respondent willingness to pay for restoration and conservation of Sessa river. In logit model, the dependent variable is a dummy i.e, a dichotomous variable which takes the value of 0 and 1. Here it takes the value of 1 if the respondent is willing to pay and 0 if he/she shows unwillingness to pay.

The Functional Form of the Model

In order to analyse the determinants influencing the respondents’ willingness to pay for restoration and conservation of Sessa river, a Binary Logistic Regression Model is applied. To attribute weightage to these determinants in view of the discontinuation of the dependent variable, whether or not the, the following model is used

\[
\ln \left( \frac{\hat{Y}}{1-\hat{Y}} \right) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + u
\]

where \( \hat{Y} \) = The probability that the respondent shows willingness to pay for restoration of Sessa river which is coded as 1;

1- \( \hat{Y} \) = The probability that the respondent shows unwillingness to pay for restoration of Sessa river which is coded as 0;

\( u \) = disturbance term

\( \beta_1, \beta_2, \beta_3 \ldots \) stands for the coefficients of the predictor variables, \( X_1, X_2, X_3, \ldots \)

\( X_1 = \) Age;

\( X_2 = \) Annual Income of the respondent;

\( X_3 = \) Use of the Sessa river for various purposes;

\( X_4 = \) Bid Value;

\( X_5 = \) Gender of the respondent;

\( X_6 = \) Educational Status;

\( X_7 = \) Distance of the respondent’s household from the Sessa river

Table 1 details the variables included in the Binary Logistic Regression Model.
Table 1: Specification of the Binary Logistic Regression Model

<table>
<thead>
<tr>
<th>Variables along with notation</th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent variable</strong></td>
<td><strong>Willingness to Pay</strong></td>
</tr>
<tr>
<td></td>
<td>1= if the respondent shows willingness to pay</td>
</tr>
<tr>
<td></td>
<td>0= if the respondent shows unwillingness to pay</td>
</tr>
<tr>
<td><strong>Independent Variables</strong></td>
<td></td>
</tr>
<tr>
<td>Age (X1)</td>
<td>Age of the respondent (in years)</td>
</tr>
<tr>
<td>Income (X2)</td>
<td>Annual income of the respondents</td>
</tr>
<tr>
<td>Water Use (X3)</td>
<td>Use of the Sessa river for various purposes</td>
</tr>
<tr>
<td>Bid Value (X4)</td>
<td>Bid value is the amount in Rs. the respondent is willing to pay for water quality improvement of the Sessa river</td>
</tr>
<tr>
<td>Gender (X5)</td>
<td>Gender of the respondent. Binary Variable: 0=male and 1=female</td>
</tr>
<tr>
<td>Education (X6)</td>
<td>Educational Status of the Respondents. Binary Variable: 1=Literate and 0=Illiterate</td>
</tr>
<tr>
<td>Distance (X7)</td>
<td>Distance of the respondent’s household from the Sessa river</td>
</tr>
</tbody>
</table>

Data Analysis and Results Discussion

Socio-Economic Profile

In this section, the socio-economic characteristics of the respondents are examined which shall comprise the assessment of their social composition and their sources of income. Table 2 depicts that with respect to age, majority of the respondents belong to the age-group 40-60 years. Educational indicator depicting educational attainment reveals that 64.46 percent were literate and 35.54 percent were illiterate. Employment ensures economic security, enhances human capabilities, provides a sense of dignity and enables to live a better life. The primary occupation of majority of the respondents is fishing (45.18 per cent). Besides catching fish, they are also involved in fish processing, fish trading (12.04 percent), transportation of fish and supply of fishing gear and other inputs. About 24.69 percent respondents were engaged in various occupations such as in construction works as casual workers, in tea gardens as permanent or temporary labour, were newly engaged in BCPL as casual workers, few were teachers and only a negligible number were engaged in government service. About 18.08 percent respondents were engaged in agriculture and allied activities. As majority of the workers were casually employed their income was highly irregular and uncertain. So most of them fall in the income group of Rs.10,000-50,000 (61.45 percent).
Table 2: Demographic and Socio-economic Profile of Respondents

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Sub-Indicators</th>
<th>Number of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age-group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-40</td>
<td></td>
<td>104 (62.65)</td>
</tr>
<tr>
<td>40-60</td>
<td></td>
<td>69 (41.26)</td>
</tr>
<tr>
<td>60+</td>
<td></td>
<td>17 (10.24)</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Literate</td>
<td></td>
<td>107 (64.46)</td>
</tr>
<tr>
<td>Illiterate</td>
<td></td>
<td>59 (35.54)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td>112 (67.5)</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td>54 (32.5)</td>
</tr>
<tr>
<td>Occupation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td></td>
<td>30 (18.08)</td>
</tr>
<tr>
<td>Fisherman</td>
<td></td>
<td>75 (45.18)</td>
</tr>
<tr>
<td>Traders</td>
<td></td>
<td>20 (12.04)</td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td>41 (24.69)</td>
</tr>
<tr>
<td>Income</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10,000-50,000</td>
<td></td>
<td>102 (61.45)</td>
</tr>
<tr>
<td>50,000-1,00,000</td>
<td></td>
<td>47 (28.31)</td>
</tr>
<tr>
<td>Above 1,00,000</td>
<td></td>
<td>17 (10.24)</td>
</tr>
</tbody>
</table>

Note: Figures in the parenthesis indicates percentage

Deterioration of local ecosystem, lives and the livelihood

Functioning of BCPL has contributed greatly to the deterioration of environment because of the disposal of industrial effluents in the Sessa river. It has destroyed the local ecosystem and the livelihood of the inhabitants. As a result of human driven changes, the river has lost its emblematic value and the cultural ecosystem services such as drinking water, fishing, bathing, washing etc due to degradation and so it is not feasible any longer. It has also posed a threat to the health of the people.

Ecosystem Disruption

Industrial Pollutants have an adverse effect on vegetation. According to the inhabitants, the biodiversity is at stake after the establishment of BCPL. They stated that the trees and the plants are dying because of the pollution. Before they were able to consume vegetables grown in their own gardens but now they complained that the plants have withered yielding no fruits. The adverse effects of vegetation ruined the source of earnings of many vegetable growers. Earlier they could find some edible wild plants like fiddlehead fern (dhekia), Colocasia leaves (kosu), mint (podina), water spinach (Kolmou), Patchouli (Shuklati), heart leaf (Mosondori) etc everywhere but now such plants have turned brownish black in colour. So they could be hardly eaten, and nor are they saleable. It has adversely affected germination of seeds and growth of seedlings of various crops. Atmospheric and water pollution also affected the plants and trees. As plants are major source of food for animals so when they are affected, animals had to struggle to acquire food for their survival. People also stated that industrial effluents affected their livestock which in turn affected their source of earning as many of them were indulged in livestock rearing.

Loss of Cultural Ecosystem Services of Sessa River

River water is undeniably one of the most important sources for survival of people residing near Sessa river. There are various functional uses of river water. Most of them were engaged in fishing which was their source of livelihood (50 per cent). The old tradition practice of fishing
passed from one generation to the other. The condition of these fisherman were good prior to the setting up of BCPL as they received a good price for their sale. River water was also used for drinking (21.08 percent), bathing (12.04 percent) and washing clothes (15.06 percent). Only a negligible number i.e. 1.8 percent of the respondents responded that river water was not used by them for any purpose.

But after the functioning of BCPL, there had been changes in the quality of the river water with its progressive deterioration as industrial waste has been dumped in the river. Earlier the river water was very clear but now some greasy sticky foams can be seen floating. The water in the river had turned a strange brown-black hue and there is suffocation in the odour. The plants emerging from water have turned out brownish-black in colour and the smell of kerosene made it impossible for them to use for consumption purposes (Hazarika and Dutta, 2017). People had stopped using river water for washing clothes as it turned white clothes dirty and shady. Sessa river’s fishes were once considered to be very tasty and there was a great demand for the Sessa fish. The various fish species found were Giant river cat fish (Arii), Indian butter cat fish (pabhoh), Magur, Freshwater shark (Barali), chital fish, Rohu (Rau), Day’s mystus (Singarah) etc. Fish that used to fetch them thousands of rupees was now sold at hundreds. The livelihood of the people engaged in fishing activities is at stake as people refused to purchase fish due to foul smell. Many customers turned violent towards them and forced them to repay their money back. Some were even beaten up by their customers as if they were responsible for the foul smell. So few left fishing in Sessa and now go to the Brahmaputra river for fishing.

As their occupations were at stake, they were forced to shift from their age old practice of fishing and seek work in town as daily labourers. People choose to diversify their source of income in diverse portfolio of activities in order to survive, to improve their standard of living, stabilize their income and food consumption over time (Ellis, 1998; Reardon et al., 1992; Block and Webb, 2001). Diversification towards non-farm livelihood strategies from subsistence farming enable households to have better incomes, enhance food security, increase agricultural production by smoothing capital constraints and also helps in coping with various environmental stresses (Barrett et al., 2001; Liu et al., 2008; Babatunde and Qaim, 2009; Bezu et al., 2012; Hoang et al., 2014). They involved themselves in various casual works such as construction of roads, houses and engaged themselves as casual labourers in various construction activities of BCPL. Some of them were also engaged in various petty trading and business. Due to absorption in various casual works, they experience various problems such as low wages, low job security, low productivity due to limited skills and low household income, but as they have diversed towards casual jobs due to shortage of jobs in formal sector, they have to face various financial uncertainties.

![Fig. 1: Frequencies of functional uses of Sessa River (before the functioning of BCPL)](image-url)
Fig. 2 : Frequencies of functional uses of Sessa River (after the functioning of BCPL)

Threat to health

Skin diseases like scabies and lesions are affecting the people living in its vicinity. The symptoms of these diseases are intense irritation at night, increasing nervous tension, fatigue, lack of concentration, impairment of efficiency and eventually loss of working time. They also suffer from prolonged loss of sleep due to intolerable noise and foul smell from the plant. They have also been suffering from stomach ailments, headaches and respiratory problems.

Individual’s Willingness to pay for the restoration of Sessa River

Willingness to pay is the maximum amount an individual is willing to sacrifice for water quality improvement of the Sessa river. Both river users and non-users expressed their willingness to pay for river protection. The individual’s willingness to pay is given in Table 3. It depicts that about 66.3 percent of the respondents agreed to pay for preservation and restoration of the Sessa river at different bid levels. The maximum value which the respondent were willing to pay was Rs.20 (22.3 percent) followed by Rs10 (15.1 percent) and Rs 30 (12 percent).

With the increase in bid value, the willingness to pay decreases. The respondents valued the conservation of river but their low income forbids them from paying more. About 33.7 percent of the respondents expressed their unwillingness to pay as they felt that it is the responsibility of BCPL authority and government to take effective measures to restore the quality of Sessa river.

Table 3: Individual’s Willingness to pay Bid Value (in Rs.) for the restoration of Sessa River

<table>
<thead>
<tr>
<th>WTP Bid value (in Rs.)</th>
<th>Number of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>56 (33.7)</td>
</tr>
<tr>
<td>10</td>
<td>25 (15.1)</td>
</tr>
<tr>
<td>20</td>
<td>37 (22.3)</td>
</tr>
<tr>
<td>30</td>
<td>20 (12)</td>
</tr>
<tr>
<td>40</td>
<td>13 (7.8)</td>
</tr>
<tr>
<td>50</td>
<td>7 (4.2)</td>
</tr>
<tr>
<td>60</td>
<td>5 (3.01)</td>
</tr>
<tr>
<td>80</td>
<td>3 (1.8)</td>
</tr>
</tbody>
</table>
A special focus has been also been made to assess the people’s perception about importance of restoration and conservation of Sessa river using Binary Logistic Regression Model. The results of the Binary Logistic Regression Model is reported in the following Table 4.

Table 4: Determinants influencing willingness to pay for restoration and conservation of Sessa River: Results of the Binary Logistic Regression

<table>
<thead>
<tr>
<th>Regressor</th>
<th>$\hat{Y}$</th>
<th>Wald</th>
<th>Exp ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (X1)</td>
<td>0.010</td>
<td>0.093</td>
<td>1.010</td>
</tr>
<tr>
<td>Income (X2)</td>
<td>-0.296</td>
<td>0.155</td>
<td>0.744</td>
</tr>
<tr>
<td>Water Use (X3)</td>
<td>1.891**</td>
<td>6.357</td>
<td>0.151</td>
</tr>
<tr>
<td>Bid Value (X4)</td>
<td>-0.328***</td>
<td>28.45</td>
<td>1.388</td>
</tr>
<tr>
<td>Gender (X5)</td>
<td>1.031</td>
<td>1.709</td>
<td>2.805</td>
</tr>
<tr>
<td>Education (X6)</td>
<td>-0.150</td>
<td>0.045</td>
<td>0.861</td>
</tr>
<tr>
<td>Distance (X7)</td>
<td>-0.324</td>
<td>1.274</td>
<td>0.723</td>
</tr>
<tr>
<td>Constant</td>
<td>1.434</td>
<td>0.029</td>
<td>4.195</td>
</tr>
</tbody>
</table>

*** 1 % level of significance  
** 5% level of significance  
N= 166  
Cox and Snell R2 = .61  
Nagelkerke R2 = .84  
Hosmer and Lemeshow goodness of fit test statistic  
Chi-square = 2165.819, df=8

The binary logistic regression analysis estimates that only 2 variables namely bid value and water use have turned out to be the significant determinants influencing willingness to pay for restoration and conservation of Sessa river. Other variables like age, income, gender, education and distance were not significant predictors of willingness to pay for restoration of Sessa river. Bid value has a significant negative impact on respondent’s decision for willingness to pay. One rupee increase in bid value reduces the odds of WTP by about 1.388 times. With the increase in the bid value respondent’s willingness to pay decreases. Water use is found to have positive significant impact on respondent’s decision for willingness to pay. The exponential of the coefficient for water use indicates that for increase in the use of Sessa river for more than one purpose, the odds in favour of respondent’s willingness to pay increases by 84.9 percent.

Initiatives taken by BCPL authority

The inhabitants constantly protested against the BCPL and accused that it discharges the industrial waste directly into the Sessa river. So to combat pollution, BCPL initiated some measures. In conformity with the Pollution Control Board of Assam, a modern water treatment plant was set up to treat all effluents. Moreover to enhance safety and reduce atmospheric emissions, safety valve outlets were connected to an integrated flare system, a gas detection system to ensure quick detection of gas leak (Hazarika and Dutta, 2017).

Management of Common Property Resources: A Way Forward

Local management of Common Property Resources are very much essential for effective, productive and efficient utilisation of resources. Joint ownership provides checks and balances
to prevent over harvesting by illegal means such as stealing. It also provides incentives and motivates people to protect their CPRs (Gurung, 2005). Two Beels namely Horu Sorai Beel and Bor Sorai Beel located in Dewanbari Koibarta Gaon were locally maintained by a group of 40 members on lease. They had been rearing fingerlings and fish seeds along with fish. They sell their products both in the local market as well as outside the district. Production of these two Beels has also been increasing with the introduction of new mixed carp culture practice. Bundhs were constructed all around the Beel for protection of fish from going out and for preventing water from coming out. So, they were least affected in comparison to other fishermen who directly depended upon Sessa river for their livelihood. All the members were engaged in cleaning the weeds and renovation of the Beel. If any member failed to come, he had to pay a daily wage to any member who shall do his work on his behalf. They received government funds under schemes implemented by Assam Fisheries Development Corporation Limited. Various traders visit their place to buy fish. Fish is sorted, weighed by species and then auction takes place. Fishes were sold to those traders who offer the highest bid. They annually received a profit of more than Rs 15 lakhs which is shared among the members.

Conclusion

The basic aim of setting up an industry is to bring socio-economic development, but it should not be at the cost of harming the nature. BCPL in the guise of bringing socio-economic development was somewhere responsible for degradation of the natural environment. The inhabitants highly value the Sessa river due to its various functional uses and expressed their willingness to pay for its preservation and restoration. But they were unsatisfied with the initiatives taken by the BCPL authority to combat pollution. Contingent Valuation Method was used to assess the factors influencing resident’s willingness to pay. Bid value and water use were the significant factors influencing the respondents’ Willingness to Pay. The inhabitants residing there were mostly related to primary sector so when the natural environment deteriorated there was direct impact on their lives and livelihood.

Various employment avenues should be generated by setting up Ancillary Industries as soon as possible. Moreover, relaxation in the recruitment norms should be made to facilitate maximum appointment of local people. As experience is needed to perform various operations of the plant, so the authority should take proper initiatives to train the local youths as per their qualification and capabilities. Industrial Training Institute should be set up which shall help in formation of productive workforce with necessary skills.

Moreover, BCPL used the Sessa river as dumping ground of their industrial effluents which polluted the water and deteriorated the conditions of aquatic plants and animals disrupting the entire ecosystem. The inhabitants mostly were fishermen, so when the river was polluted the direct effect was on them, they lost their very means of survival. BCPL should realize their very aim of socio-economic development by maintaining a balance between society, development and nature. The plants should be well ventilated, well planned, properly structured and equipped so that the chances of accidents are minimal. A sufficiently tall chimney should be constructed so that the dispersion of pollutants has least impact on the nearby surroundings.

Limitations

The study did not incorporate the changing occupational structure of the inhabitants and its effects on their living standard.
Scope for further Research

One can analyse the economic impacts of ecological disruption, changing occupational structure and its effects on standard of living. One could also study about what are the initiatives taken by BCPL and the local people to combat pollution and to restore the quality of water of Sessa river and what are its positive effects on the society.

References


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