# ECONOMIC VALUATION OF THE WATER RESOURCES OF SELECT AREAS OF RANGAMATI'S PABLAKHALI PROTECTED REGION: A COMPREHENSIVE APPROACH

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**Abstract -** The remote area of Pablakhali is situated in the northeast corner of the Chittagong Hill Tracts and consists of many ponds, lakes, waterfalls and springs. It is not only home to three types of forests and over thousands of animal and plant species, but also several hundred human families (mostly fishermen and farmers). Protected Areas (PAs), like Pablakhali, have been monitored and managed by the country's Forest Department (FD). However, in reality, these areas are not protected in their original sense, mainly due to poor focus on public involvement and ethical issues. Hence, this project aims to evaluate a valuation of this area's selected parts with the aims to establish a detailed inventory, as well as an understanding of the dimension of water use by different stakeholders in the hilly areas; address the threats, perform capacity building, bringing financial sustainability; establish a better governing body to maintain standards and effectively manage the area; and to divert much-needed funds to perform research, acquire conservation projects and better manage Pablakhali Protected Area by involving its residents by presenting the real value (not a vague one) to the donors and government offices. The valuation will be a comprehensive one using survey tools like, structured questionnaire done in two stages (pilot and final); the first of which is complete and has proved instrumental in identifying flaws and developing/expanding the methodology and scope, and focused group discussions to identify the selected water bodies' and its resources' value from the human residents' perspectives in four categories: economic benefits, consumption value, cultural importance and dependence value of select flora and fauna. Additionally, nature's valuation will be incorporated by adding the water availability benefits for soil quality and carbon sequestration by trees. The findings will be disseminated to help the locals better manage their surroundings and propose important policy implications and changes that are required for the better management (and allocation) of the water resources for sustainable practices. Also, this research project will be a forerunner of its kind as such comprehensive valuation papers are rare and will be highly useful in the future as biodiversity and ecosystem conservation/management are soon to become even bigger issues than they are now.

**Keywords** - Pablakhali, Economic Valuation, Ecosystem Services, Chittagong Hill Tracts, Rangamati, Protected Areas

## I. INTRODUCTION

The valuation of ecosystems and related services is not an easy task. Most of these services are intrinsic, have no market value and hence, putting a monetary perspective on them is usually a challenge of several dimensions (Ghosh and Bandyopadhyay, 2009). The task becomes even harder when valuation techniques such as stated and revealed preferences are used together, not only because different people value different services variably, but also because most of the respondents are grossly unaware of the real value of a service.

However, the economic valuation of environmental assets is crucial if we want to take proper decisions regarding that place's true worth at present and the future. Additionally, such valuation researches are great in the sense that they bring to the surface views of locals whose livelihood depends and/or have become better/worse due to their natural surroundings. Unfortunately, previous valuation projects have always performed partial (Bashar, 2016), and often underestimated, valuation of such ecologically and economically important areas (except the recent Kibria et al paper of 2017); furthermore, developing countries like Bangladesh have not witnessed many environmental valuation researches (let alone comprehensive ones).

Pablakhali Protected Area is one such place and the recent projects implemented there for watershed management through the initiatives of North South University (under the research named "Biodiversity Conservation through the Protection and Restoration of Water Sources of Pablakhai Protected Area under Rangamati District"), Centre for Natural Resource Studies, Department of Environment, Forest Department and a few other environmental/developmental organizations have greatly improved the lifestyles of several hundred households. Consequently, this is the right time to firstly, evaluate the additional economic value that has resulted from these water resource related improvements in that area and secondly, to assess how economically important the water and its resources are for the area's residents, as well as the flora and fauna dependent on them. This project attempts to do just that in two stages: pilot (completed) and final (ongoing).

Unfortunately, the problem is that this is a difficult and comprehensive task and thus, will need the implementation of proper surveys prepared through the in-depth analysis of expert papers, literature review and most importantly, understanding of valuation techniques, frequent visits to Pablakhali's heart and obviously funds. The good news, though, is that due to past and on-going projects in that area, the

access to information for this project will be less of a problem and more like a follow-up to find out the value added to the lives of the locals and the area due to the aforementioned projects, while also measuring its overall monetary importance to be presented to policy makers who can, finally, take better decisions regarding Pablakhali (which should have already happened).

## II. PROBLEM STATEMENT AND GOALS

Cost-benefit analysis is one of the major steps in determining whether a project is to be undertaken, but determining the 'correct' monetary value of both cost and benefit is still a matter of great concern. This is especially true when projects are implemented at places that have evident and potential ecosystem services. Another problem of not having a monetary value for protected areas like Sundarbans, Lawachara and, more importantly in our case, Pablakhali in Baghai Chari of Rangamati is that the policy makers and even the locals themselves are unaware of the importance of their actions to conserve and manage their surroundings.

This research project is thus an attempt to identify the water resources and produce the economic value of those resources at the Pablakhali Protected Area taking into account the opinions of the locals who use, sell/buy and sometimes even protect it and certain aspects of nature, namely carbon sequestration by the water-dependent trees and monetary loss/gain due to poor/richer soil quality due to higher levels of moisture. A couple of projects done in that area have brought to the surface the immense lacking in proper management of Pablakhali's water resources, as well as the water bodies of that area. They have also helped identify some unique (often native) plant and animal species in that area's water bodies that are endangered, but are not under any conservation programs to be saved; this again shows the lack of much-needed valuation of water species that must be performed to efficiently manage the area.

It is not that the locals do not value their surroundings, because in reality, unlike the city-dwellers whose livelihoods are not entirely dependent on their surroundings, theirs is. It is just that they are themselves less aware about how their actions can and cannot cause harm to the surrounding water resource(s) that for many is the major/only source of income. Furthermore, they are unaware of the concepts of sustainable yield, free-riding, internalization of externalities, tragedy of the commons and other such environmental economic issues that ultimately will lead to the irreversible degradation of the protected area. However, their knowledge of the nearby water resources is incomparable to anyone from elsewhere and hence, involving them to put the right value on the water resources is crucial and will ensure their continued support if and when we decide to implement awareness campaigns, trainings and ecosystem/livelihood-enhancing projects in the area.

Additionally, the water resources should be valued to showcase the immense importance of this area (in terms of both use and non-use values) for the future of the country, to the policy makers. This will enable them to take better decisions while assigning funds and resources in ensuring the conservation of Pablakhali, without conflicts with the locals. Furthermore, by identifying the ecosystem services and other uses that the water resources endow us with or may in the future, more projects can be initiated that would enhance the lives of the locals without harming the ecosystem and may even improve the area to make it a major tourist attraction for national and international visitors. Lastly, but very importantly, this research will also help us to produce the additional economic value that the watershed management projects were able to bring to the area's forests, residents, animals, etc. Examples of such improvements include lower stress levels (as women of the household no longer need to travel long distances to acquire fresh water), better attendance in educational institutions of children (as they now have access to better hygiene and sanitation and fall sick less often), better forest cover and habitat (as water has become available for more flora and fauna) and so on.

## III. OVERVIEW OF THE AREA

Situated in the northeast corner of the Chittagong Hill Tracts, the Pablakhali Protected Area, also called Pablakhali Wildlife Sanctuary, of 42,087 hectares of beautiful hilly terrain ranging from 100-300meters and several water bodies/systems, is home to several hundred human families, land and water animals like Asian elephants, Rhesus Macaque, Capped Langur, Hoolock Gibbon, Dhole, small cats, Otters, Wild Boars, Sambars, Waterfowl, Little Grebe, Herons, Egrets, Common Moorhen, Common Coot, Asian Openbill Stork, White-winged Wood Duck, Indian Python, numerous birds and consists of three forest types – tropical wet evergreen forest, tropical semi-evergreen and tropical moist deciduous forest (Offroad Bangladesh, 2016). It was established in 1983and this tiny sanctuary is positively teaming with life. Although it's quite remote many nature lovers still visit it and find there is much diversity there, owing to the region's great topographical diversity (Jakariya, 2016).Pablakhali consists of many ponds, lakes, waterfalls and springs and its aquatic flora and fauna are unique and diverse.

## IV. BACKGROUND INFORMATION

The hilly areas in the South-eastern part of the country, where Rangamati is situated, have a large number of waterfalls and springs. These springs are one of the main sources of water for the entire forest

communities for their drinking, cooking, bathing, agriculture, etc. Mostly, all the springs and some waterfalls provide fresh water which is essential for the sustainability of the biodiversity and ecosystem. Also, residing in and dependent on these waters are numerous flora and fauna like fishes, land mammals, aquatic plants, etc. However, despite of its many benefits, these significant components have always remained out of sight from any development or protection initiatives because of its seasonal characteristics and remoteness. Considering the immense importance of the spring water for the hilly communities, it is very important to have a detailed inventory, as well as an understanding of the dimension of water use by different stakeholders in the hilly areas. More importantly, a value should be assigned to better present the case of the area to the Ministry of Environment and Forests (MoEF) to divert much-needed funds to perform research, acquire conservation projects and better manage Pablakhali Protected Area by involving its residents.

The Protected Areas (PAs) have been monitored and managed by the country's Forest Department (FD), but although PAs have been established for all of Bangladesh's forest types, in reality these areas are not protected in their original sense, mainly due to poor focus on public involvement. Hence, before implementing projects to address the threats, performing capacity building, bringing financial sustainability (e.g. through tourism), establishing a good governing body to maintain standards and effective management and usingmodern science and technology (GIS, remote sensing, satellite image, etc.) with community acceptance and participation, valuation must be done as that is the only way in which we can appeal to the right people to focus on areas like Pablakhali and involve all stakeholders to run conservation projects smoothly.

## V. SIGNIFICANCE AND IMPACTS

Performing valuation on a particular resource at an area that is remote, has innumerable ecosystem services and a rich biodiversity is one of the toughest job there is. Most of the services have never been assigned a market value and is said to be important only for its local use and mainly aesthetic appeal. However, the government of a nation will only think funding projects and that conservation programs are necessary at an area when proof of its importance in terms of money and other economic values associated with its present or future use can be presented as justification.

Hence, if the attempt to correctly value Pablakhali's water resources using a number of traditional and new revealed and stated preference valuation techniques is successful with the least amounts of exaggeration, we can then push the research results to make policy makers and official decisions makers focus on better management for the mandatory (from an environmental economist's point of view) conservation of Pablakhali's water bodies and related resources. Moreover, the identification of the endangered and economically important water resources will ensure better standard of living for the locals and pave the way for better future local participation and maybe even mainstream tourism.

## VI. METHEDOLOGY

To summarize, the research is attempting to place a value on the water resources of the area in question in terms of market value (from the selling of water resources in the local markets), consumptive value, cultural value and dependence value of flora and fauna (both economically and non-economically important ones). The individual values are then to be added up to present a comprehensive value of the area selected.

### 6.1 Area Selection

The first step was to become educated about the area's characteristics, including its people, the projects done/being done there, the literature available on the valuation techniques that are likely to be used and areas similar to Pablakhali where such researches have been conducted and identify the gaps if any. Next, two 'paras' (small communities of 30 – 120 households separated by a lake or miles of land area) were selected after rigorous discussions with a few locals and researchers from Pablakhali that were in tune with the research at hand, namely Noboperachara and Talukdar para. Noboperachara was chosen, because it was the site of a watershed management project funded partially by North South University and hence, access was easier there; Talukdar para was chosen, because it had no watershed project and hence, the researcher though that it would be a great opportunity to find out the difference in valuation that had resulted from the presence of the watershed management project at one of the paras and its absence in the other.

A further step was to select the most popular water body in each of the paras (as all of the water bodies' valuation will be beyond the financial and time scope of this research) and the five most popular water resources/flora/fauna (as per the value to be generated) in each para (as all of their valuation will be beyond the financial and time scope of this research; a further problem would be the identification of linkages among them as the concept of environmental unity i.e. everything affects everything else, is persistent).Moreover, addressing the lack of proper maps of these two paras (the whole of Pabalakhali to be exact) will also prove necessary as without that the area coverage of flora/fauna/water resource/residents under the research scope is impossible. Geographic Information System (GIS) will hence, play a crucial role in generating map of the regions actually being valued; this will also help

to avoid underestimation/overestimation as only the area being valued will be marked on the map(s).

**6.2 Scope Identification**

Through intensive research and using existent expertise of the researcher the values and corresponding valuation methods to be employed-were decided upon as follows –

1. **Value of the water resources based on the economic benefit that the people of Pablakhali receive (Birol et al, 2006):**

- Done through a survey that does not directly declare to the respondents that the income they receive from the selling/exchange of the water resources like fishes (similar to revealed preference methods) is the response desired, to avoid biasedness. It is important to note that sometimes the income generated may not be from a resource that comes directly from the water body, but depends on it; for example, their cattle that consumes the water from the water bodies.

2. **Value of water as a consumptive good (Birol et al, 2006; Kibria et al, 2017):**

- Performed by looking at the amount of consumption of water (irrigation, drinking, cooking, bathing, cleaning, sanitary purposes, etc.) per household (household's woman's response preferred) from the random households selected, get an average and then multiply that with the number of households present in the area. Then, the average volume is multiplied with the amount of money (both fixed cost and maintenance cost) that would have been needed if it was to be assumed that Pablakhali had no other water sources and (i) the watershed is the only source (Noboperachara) or (ii) the government had to provide water to this place (Talukdar para).

3. **Value of the water bodies depending on one of its non-use value (cultural importance)**

- This again will be done through surveys, but this time the residents will directly be asked how much they would pay to preserve the water body or to stay close to it for spiritual purposes (stated preference) in the pilot study. If this fails, then the amount of water used for cultural activities will be found out in the final survey and the same method as stated in (B) will be used to generate a value.

4. Value generated by carbon sequestration performed by trees in the research area (Kibria et al, 2017)

- This valuation is another reason why generating the actual map of the areas being valued is key. The tree/plant species will be identified and then the total amount of sequestration done by them will be calculated. Then the sequestrated amount will be multiplied by the international carbon tax to generate a value, assuming that if the nearby water body was absent, there would be no sequestration as there would be no trees in the first place to do so.

5. **Value generated by better soil quality**

Soil samples will be collected from two places in the paras, one with rich soil (which generates crops) and other with poor soil (which cannot generate crops). The difference in moisture will be evaluated in the lab as justification to show the difference in crop value ($X in the local market from region with rich soil minus $0 in the local market from region with poor soil) from the two regions. Only 50% of this difference in value will be attributed to the presence/absence of a nearby water body (as crop production depends on other factors like internal and external nutrient content, local weather, etc.).

When all the above values will be generated separately after both the pilot and final survey, they will then be shared with locals and officials of the governmental and non-governmental organizations for criticisms and feedback via short meetings and workshops. At the end, the values generated from (A) to (E) will be added up to produce the comprehensive value of the areas under the scope of the research. To avoid overlapping (and any overestimation) appropriate analytical tools will be employed, which will become apparent as the research progresses.

## VII. PILOT STUDY AND SOME RESULTS

Before performing a final survey, to gain a better understanding of the study area, fine-tune the final questionnaire and test out the scope of the research, a pilot survey was conducted. The pilot survey enabled the researcher to do the following:

1. Identify the water source from each survey area to be included in the research
2. Identify the five most popular fauna, flora and water resource from residents' perspectives (as all the plants and animals cannot be valued)
3. Generate an idea of the total valuation of the 70 and 48 households surveyed in the two paras
4. Identify some flaws associated with the scope and area selection, as well as no. 3

A pilot questionnaire (semi-structured) was prepared (in both English and Bangla) and local surveyors were trained in Dhaka to successfully extract the complicated numbers from the respondents.The survey was conducted over a period of 20 days. It took more time than planned because of the natural disasters at the remote area and the lower literacy rates of the para's residents.Keeping in mind the 60% (or higher) rule for random sampling, from Noboperachara, 70 households were randomly chosen (from a total of 110 households) and surveys were done with the involvement of almost all the members

of the households; 48 were chosen from Talukdar para (out of a total of 70 households).

The filled-in questionnaires were sent to Dhaka by courier and is now at the stage of being analyzed to produce an easier and simpler version of the questionnaire for the actual data collection and later, analysis. An updated literature review and background is also being prepared and a visit to Pablakhali is also to be undertaken in the first week of March 2018. The pilot study revealed several lacking in the questionnaire that needed to be resolved before making the new questionnaire like, the problem of language, lack of understanding of water and its relationship with culture, absence of awareness about linkages to livelihoods of some animals from the locals' perspectives and so on. The major flaws identified from pilot study and some corresponding decisions are summarized as follows:

- A very meticulous, structured questionnaire needs to be prepared, because one household's answer differs widely from the other and incorporation of so much data might make the valuation complicated and hence, flawed
- Survey must be done for a month, not a year, as every month the valuation of both natural and man-made parameters differs
- Many-a-times, in a month even, unusual occasions such as weddings or certain religious events take place that increase the valuation of water (this is an anomaly)
- Each and every household's consumptive use is very different and so, all of the households must come under the scope of the sample i.e. population of the area = sample of the project
- GIS analysis will be needed to plot the two areas chosen for the project as there are no previous maps that accurately located them in Pablakhali and to understand forest cover
- Economic value should be determined in terms of how much is sold in the market each month, instead of asking the respondents, as their answers differ
- The final result must be presented in the way of "…comprehensive value much higher than 'USD Z' per month that has been obtained by the research as many of the flora/fauna/water resource and even area have not been included in the scope of the research

## VIII. WAY FORWARD

The research is now at the stage of analysis from data collected during the pilot survey. Next, a structured questionnaire is to be prepared incorporating the flaws and lessons, to perform the final survey. A site visit is scheduled for the beginning of March, 2018 for training the local surveyors, acquiring coordinates for mapping using the ArcGIS 10 software, getting market price for the items to be valued, collecting soil samples, collecting flora and fauna information, collecting data for carbon sequestration amount generation, performing a few focused group discussions with the residents, doing a couple of key informant interviews with the local forestry officials and finally, instigating the survey with the Pablakhali residents.

After the final survey, the data collected will be processed in the five methodological categories stated previously to generate the comprehensive value of the two paras of Pablakhali. Later, dissemination of the results to the locals (to improve stakeholder improvement in conservation efforts) and policy-makers/officials (to attract more watershed and conservation projects) will be done. Lastly, the author has the wish to publish in an open-access, international, peer-reviewed journal to receive feedback on this new and unique type of research methodology and improve her results.

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