# The Option Value Of Lake Bosumtwi In Ghana: Economics Analysis

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*Abstract: This paper examined the application of Contingent Valuation Method (CVM) for estimating the Option Value (OV) of Lake Bosumtwi (LB) based on the willingness-to-pay (WTP). It argues that there is maximum willingness to pay for the OV of LB and therefore it should be preserved for future personal recreation site. This could be done through ecotourism either by privatization or public ownership. Otherwise, posterity would be denied of its future value because it is getting deteriorated. In addition, the flora and the fauna eco-species as well as the fishes associated with the lake are also getting extinct as a result of human encroachment and this poses a serious challenge to biodiversity and aquatic life among others. The data were collected from a sample of 360 respondents in March-May 2016 using systematic sampling through the dichotomous method of elicitation .The extracted WTP values were tested against a hypothesis through Probit Model estimation of the factors influencing the WTP variant. According to the Probit regression results of the estimated model, income, age, educational attainment, attitude towards the present state of the Lake and family size were statistically significant throughout the analysis as they explained the variations in the dependent variable WTP option price. In the light of this finding, Private or public ownership policies as well as an alternative source of livelihood policy for the people are recommended so as to reduce the huge dependence on the Lake as a source of livelihood for the communities that surround it. The paper concluded that OV is still an important component of Total Economic Value of the lake and as such it should be inculcated into the computation of benefit cost analysis in order to determine the profitability of the lake.*

*Keywords: Contingent Valuation, Willingness-to-pay, Option Value, Livelihood, Ecotourism.*

## I. INTRODUCTION

Lake Bosuntwi (LB) is the only natural lake in Ghana. It is getting deteriorated as a result of human encroachment such as construction and farming activities, excessive and inappropriate methods of fishing, among others and may dry up in the future if care is not taken to preserve it. The lake and its resources should become the subject of considerable attention. Therefore, proper management of the lake and its resources requires economic analysis, which can be used as a basis for investment decisions. Environmental and natural resource systems such as lakes, rivers, streams, estuaries, forests, and parks provide goods in terms of resources (e.g., flora, fauna, and minerals) and services (e.g., waste sink assimilation), a source of amenity services, use for

recreational purposes, and life-support functions. Knowledge of the values of these services may be important for a variety of reasons. Access to such resources for recreation is typically not allocated through markets. Rather, access is typically open to all visitors at a zero price or a nominal entrance fee that bears no relationship to the cost of providing access. And there is no or little variation in these access prices over time or across sites to provide data for econometric estimation of demand functions (Freeman, 1993, Nillesen, 2002). Ever since the second half of the twentieth century, concern about current and future use of our natural resources and environment has emerged at an increasing rate. This growing concern is accompanied by an increasing interest in so-called nature-based ecotourism. Presently, both benefits and threats have been observed resulting from the growing importance of

ecotourism in environmentally sensitive areas (Nillesen, 2002). Ecotourism plays an important role in increasing natural resource conservation and economic growth. It may also lead to management and policy challenges. It is in the light of these and other natural bodies' conservation that the Government of Ghana established the Environmental Protection Agency, Act 490 in 1994. However, this law is not being implemented (Banuako, et al., 1995). A common argument for preserving LB is that it may provide benefits in the future. Because of the great uncertainty that surrounds these values, the lake and its resources are valuable by virtue of their potential future use. Figure i depicts, LB, the only natural lake in Ghana.
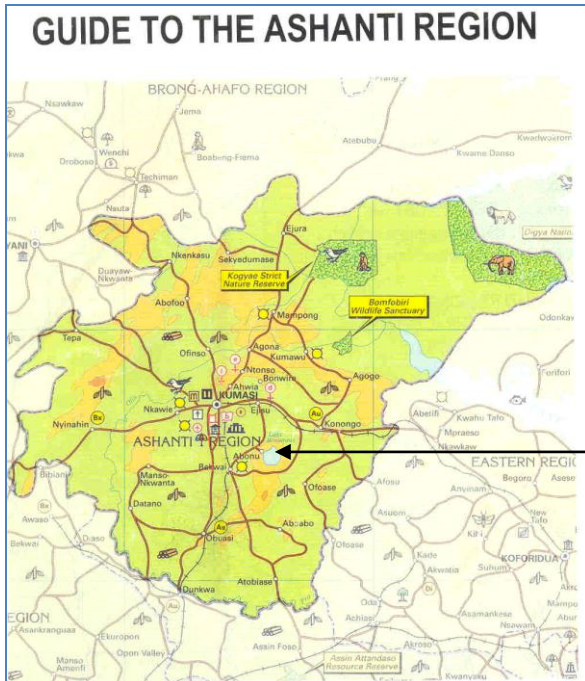


*Figure (i): Map of LB (Bosumtwi Atwima Kwawoma District Assembly, 2015)*

LB is a unique structure with immense educational and investment potential, It has rich socio – cultural values and also, a major source of fish production to most residents in the Amansie area and beyond. The fishes found in the lake are mostly the tilapia type and they have a unique natural and palatable taste when used for local Ghanaian dishes. There are scientific, Biological, Socio-cultural, emotional, wildlife conservation and job related benefits that the lake can provide and as a result, human existence, sustainability, and development are directly and indirectly dependent upon the preservation of biodiversity and such values of the Lake. Figure i shows, the total economic value of the lake.
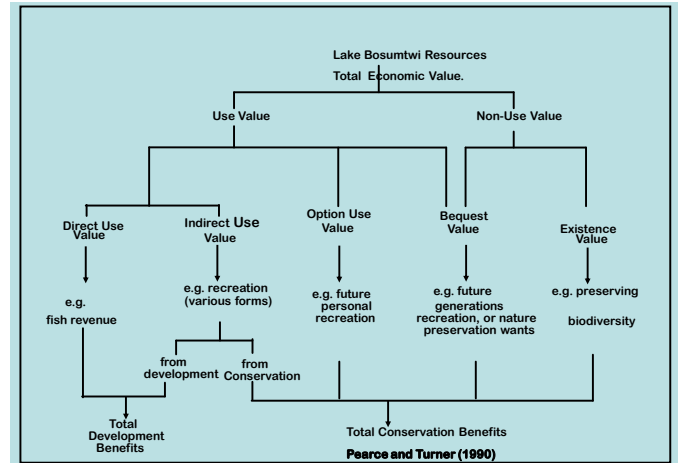


*Figure (ii). Total Economic Value of LB (Pearce and Turner (1990), adapted*

In recent times, the lake and its variety of fish species are facing serious threat and danger. This is as a result of many factors prominent among them is excessive fishing resulting in the fish stocks becoming under intense and sustained pressure. Studies by Dassah and Agbo (2003) have shown that pressure from over 1,000 fishermen in the 24 communities surrounding the lake had led to a drastic reduction of fish stocks. Also, the sizes of fish being caught presently are becoming increasingly smaller (Konadu, 2004). Moreover, there are increasing bush burning activities and other pre-mature methods of farming in the catchments area of the Lake. Again, due to rapid population growth in the area, various unregulated developmental activities in the form of building structures and construction are springing up every now and then. These activities indicate the possibility of the Lake drying up in the near future. In an interview with Nana Okogyeasuo Nkrumah II, the chief of Asaman near Kokofu in the Amansie East District of Ashanti Region, Nana said "if forests can be protected, then something must be done to protect our water bodies, especially Lake Bosumtwi, because it is getting used – up after years of fishing and other human activities". Most often, Ghanaians do not recognize non-use and option values for environmental resources. This implies that only the use values especially the direct use values are recognized. Has this attitude been examined scientifically? Are the fish species in the Lake bound to doom? Are people only-interested in the consumption of fish? Does the level of one's formal education influence him or her positively towards the Lake? Are non-use value and option value the preserve of the rich only? Is the attitude of the public towards the present use of the lake really negative? Do people from all parts of the world want to visit the lake? Can people be 'altruistic' enough and pay for just the Lake's future recreational use or pay for it to be inherited by posterity? It appears as if the only assets premiums for which people value the lake emanates from the direct use value. It is quite evident that no one probably places the future option value on the lake. This constitutes the problem for this study. In view of these, the objective of this paper is to determine the OV of LB by estimating the WTP through the Contingent Valuation Method. This will help in designing policy instruments for our natural resources in Ghana particularly for LB.

The rest of the paper is organized as follows: Section 2

presents the socio-economic challenges of the lake and section 3 gives the conceptual framework and related literature. Section 4deals with data collection and methods whiles section 5 develops and analyzes the theoretical model for estimating the Option Value of the Lake. Section 6 discusses appropriate policy instruments necessary to preserve the Lake and final section 7, deals with summary and conclusion.

## II. SOCIO-ECONOMIC CHALLENGES OF LB AND ITS COMMUNITIES

In spite of the significant socio-economic and environmental benefits of the Lake (in terms of eco-balance), the Lake is being depleted with many fish species now extinct (Painstil, 2004). Currently, animals found around the Lake have disappeared because their kingdom had been destroyed by the hunters through poaching and other factors like bush burning as well as premature methods of farming in the catchment's area (Danuor, et al., 2004). Farming on the slopes of the hills has had an adverse effect on the vegetation. Again, due to rapid population growth in the area, various unregulated developmental activities in the form of building structures and construction are springing up every now and then. These activities indicate the possibility of the Lake drying up in the near future. Out migration is also high in the community. Some migrate in search of jobs, for marriage and others migrate to further their education. There are 24 villages located around the lake with a total population of about 22,921 people (Bosumtwi-Atwima-Kwanwoma District Assembly, 2015). The major economic activity is fishing. Women engage in petty trading in foodstuff, fishery, businesses such as basket weaving, tailoring and distillation of local gin are developing. Average household income per month is approximately GH¢24. Using the World Bank classification of poverty, two poverty levels are identified in the district. "Poverty line" described as those earning below 2/3 of the average household income. With this definition, the poverty level for the district is estimated at 32%, the poverty line as GH¢20 and the hard core poverty line as GH¢8 (Danuor,2004).There are 9 Nursery Schools, 9 Primary Schools and 6 Junior Secondary Schools in 9 communities. In settlements with no schools, pupils walk to the nearest community to attend school. 12% of the population has attained formal education up to primary level 28% up to secondary level, 3% up to tertiary level, 53% have no formal education. Illiteracy rate in the communities is 60%. There are 3 clinics (not fully equipped) and a dressing station. The 24 communities have 3 KVIPS and 19 pit latrines (place of convenience). Majority defecate indiscriminately. Sanitation in the area is poor leading to a high prevalence of dysentery, diarrhea, cholera, and malaria. Leprosy is endemic to the area. There are also 7 boreholes and 5 hand-dug wells. Majority depends on rainwater, water from the Lake and its streams. Most of the roads in the communities are bad and non-motor able especially during the raining season. The pollution of nutrients such as nitrogen and phosphorus into the Lake caused by land runoff and atmospheric deposition is expected to increase with negative consequences for the water quality of the Lake. Besides, clearing and slashing-and burn practices have direct influence on the atmospheric deposition of nutrients. Ecotourism development in the LB basin undoubtedly depends to a large extent on the state of the lake. Pollution of the Lake water will hinder ecotourism development. For one thing it will affect the aesthetic beauty of the Lake due to the dirty water and dead aquatic life and for another; it would reduce the recreational and tourism value of the lake. Also, present accommodation facilities do not live up to ecotourism standards and development in the lake basin is also not organized. There were no information centers. Records on the visitor profile were inadequate. It was therefore difficult to assess trends in the tourist visiting the area, their country of origin, expenditure at the area and also their motivation for the visit. Some areas of cultural and natural interest identified include the spillover point, the primary forest within the Bosumtwi Forest Reserve and the holy rock (Ebo Kofi). These areas consist of semi deciduous tropical rainforest which provides a typical natural quietness that could please nature lovers. The biodiversity nature of the reserve also provides opportunities for researchers and students to study in the area. Thus, there is a great potential for ecotourism development in the lake basin.

The main issue is that the communities depend solely on fishing in the Lake as the main source of livelihood (Bosumtwi-Atwima-Kwanwoma District Assembly, 2015). However, an alternative livelihood source for the communities around the lake could be made possible. The following Section presents the Conceptual framework and literature.

## III. CONCEPTUAL FRAMEWORK AND RELATED LITERATURE

OV arises from that fact that individuals may be willing to pay a certain sum today for the future use of an environmental commodity. But, in the presence of uncertainty, that willingness to pay will differ from the value attached to that environmental commodity, the reason for the difference arising from the uncertainty itself.

According to Convery, F. and Tutu, K.A., (1991), the determination of the role of conservation in economic development is currently one of the global challenges facing Ghana. While it is generally anticipated that conserving natural environmental resources of developing countries will be an investment, it is often suggested by others that such investment primarily served only aesthetic values (Samples, et al., 1985). In addition, the dependence on natural environmental resources for a long –term economic well-being is not broadly recognized (Samples, et al., 1985). From this premise, the "use it or lose it" philosophy has become the very simple and compelling conservation counter (Addae, 2002). The majority of the world's remaining natural bodies are in the developing world. However, economic value of these resources has been frequently overlooked in analysis of public polices, and investment strategies

According to Addae, (2002), there is an argument for conservation of natural bodies and the protection of biodiversity as important for Sustainable development especially in developing countries. Support and protection of economic activities by ecological services and the existence of cultural values of natural environmental resources and habitats

as well as the direct subsistence use of these resources are some of the many benefits that may be derived from natural environmental resource in developing economy (Smith, et al., 1986; Cummings et al., 1995). The preservation of such areas depends on the efforts of either the Government or the private sector. Relevant decisions as to how best to allocate scarce resources for a sustainable development in a developing economy could be attained only through a careful and an appropriate valuation of these and other economic benefits of natural environmental resources (Bateman, et al., 1999). Since economic opportunities are determined by wealth, i.e. by the value of capital stock available, we can meet our obligations to the future by leaving them an inheritance of wealth no less than what the present generation inherited (Cummings, et al., 1995). What is most needed however, for a developing country such as Ghana is an economic research of natural environmental resources so as to place them in the appropriate context of economic development.

Weisbrod (1964) was the first to argue that consumer surplus might not accurately measure benefits in the face of uncertainty. According to Weisbrod (1964), the term 'consumer surplus' is synonymous with compensating surplus. They were concerned with the decision of whether to shut down a facility such as a natural park. Thus, OV is essentially expressions of preference (WP) for the conservation of environmental systems on components of systems against some probability that the individual will make use of them at a later date. Provided the uncertainty concerning future use is an uncertainty relating to 'supply' of the environment, economic theory indicates that this option value is likely to be positive (Weisbrod, 1964; Krutilla, 1975; Kristrom 1990). Arrow and Fisher (1974) demonstrated that relative to a situation in which the decision maker ignores the opportunities for learning; an extra value is attached to preservation when it is realized that one may learn the true benefits of preservation. This extra value, they called Quasi-Option –Value (QOV). Option Price on the other hand, is the maximum amount a consumer is willing to pay now to enjoy an environmental commodity in the future. Thus it is the maximum constant amount a consumer is willing to pay across states of the world for the price change. Because one cannot depend on option value to be small, or even to be of predictable sign, for important environmental valuation problems, the research focus has in more recent years turned towards estimating option price directly in situations where uncertainty plays an important role (Quartey, 1999).

Stock and Watson (2007) undertook a study in the USA by estimating the effect of race on the probability of denial holding constant other applicant characteristics that a loan officer might legally consider when deciding on a mort-gage application. They used the probit model regression estimated by maximum likelihood and the standard errors are given in parentheses under the coefficients as shown below:

Probit (deny) = -2.90 + 2.62B -0.50P + 0.22M + 0.34C + 0.16S +2.59 H    ---- (eqn. i)

(0.39)(0.61) (0.70 (0.08) (0.11) (0.10) (0.30)

F- Statistic = 5.22, p-values testing = 0.001 Difference in predicted probability of denial, White vs. Black (percentage points) = 6.3%.

The results proved that five (5) out of the eight (8) coefficients are individually, statistically significantly different from zero at 5% level, and the coefficient on Black (0.363) is statistically significant at 1% level. The change in predicted probability was computed for a hypothetical applicant whose values of the regression, other than race, equal the sample mean and it was 6.3%. Their conclusion was that a Black applicant is nearly twice as likely to be denied a loan mortgage as the White applicant.

However, they were criticized on internal validity such possible errors in the data, additional interactions, alternative nonlinear functional forms, and so on and so forth.

Quartey (1999) also carried out a research in the northern part of Ghana by estimating the monetary value of clean water in northern Ghana. The purpose of his study was to provide a means of assessing the viability or otherwise of private sector participation and later privatization of the clean water industry in Ghana. The methods he used were the contingent valuation method (CVM. The results obtained proved that the cost of fetching 30 liters of water by the communities without access to clean water was ¢108.7m and this cost measure was the TCM which also referred to the value that was attached to 30 liters of water, in other words, willingness – to – pay value for 30 liters of water. The total willingness – to – pay value obtained from his CVM measure was also ¢54.4m. It was clear from the TCM value that the observed cost of fetching for 30 liters of water was far higher than the expressed cost measured through the CVM. The two methods however met the acceptable overlap criterion for convergent validity of Cummings et al. (1986), which recommends a ± 50% overlap. A possible reason for the overlap might be the lack of cash problem which might have limited the extent of monetary bids, making CVM measure relatively smaller than the TCM measure. His conclusion revealed that the estimated models showed that all the signs of the independent variables were in accordance with a priori expectations and all the explanatory variables were together significant at reasonable significant levels (Mitchell and Carson,1989). In general, the downward slope of the demand for water curve, the signs and significance of the independent variables indicated that the empirical findings of the survey were consistent with economic theory. Thus it can be concluded that the contingent valuation method as applied in his study could measure values that are theoretically consistent and sufficiently reliable, and which can be, valid for use in benefit – cost analysis.

Addai (2002) also carried a research on the estimation of the option and the existence value of Wildlife Resources of Kumasi Zoological Gardens using CVM. The purpose of his study was to estimate households' willingness to pay for option value (option price) of wildlife resources of the Kumasi Zoological Gardens. This would serve as a guide for profitability determination by private enterprises that may want to operate in the tourism sector as well as for the government in the framing of policies concerning the wildlife resources in the zoos. An attempt was made to modify the Contingent Valuation Method (CVM) to suit the study given the local environment. Several elicitation methods were examined but the iterative bidding technique was adopted because of its proven advantages over the other elicitation methods. The results revealed that the total consumers' surplus when the officials of the zoo charged nothing as gate fee was

¢139,400,000. But when the zoo charges ¢1,000 per visit, the total consumers' surplus enjoyed by the household per visit was ¢126,200,000. The results further indicated that respondent's willingness to pay for the option use and existence values are directly related to their income level. Therefore, the empirical finding of the research is consistent with the underlying economic theory. He concluded that contingent valuation survey can actually measure non-use values that are theoretically consistent and sufficiently reliable and which can be valid for use in Cost-Benefit Analysis (CBA).

Gyampo, et.al (2004), carried out a study in to the lake under the topic "Potential for Ecotourism Development in the Lake Bosumtwi Basin". The reason for the research was to identify the potentials for ecotourism of the lake for sustainable livelihood by providing baseline information for livelihood in Ankaase, make an inventory of possible threats to the water quality, identify the opportunities and potentials of the sits of natural and cultural interest around the lake, assess the existing facilities for tourism and suggest improvement for future development. The methods used were Participatory Rural Appraisal (PRA) method, sustainable livelihood Analysis (SLA).The result proved that the people of Ankaase completely depend on subsistence farming and fishing for living which had effect on their income. It is now widely realized that many people will patronize the lake and that its sustainability and possible extending services depends on mobilizing the total WTP. The mandate of this paper therefore seeks to mobilize the total WTP for the OV based on an appropriate modeling. Next is the data collection methods.

A. DATA COLLECTION AND METHOD

The population was defined in terms of the element, sampling unit, extent and time. The population element used was individuals who are heads and income earners of households. These people were chosen as respondents because as family heads, culturally and economically, they are responsible for their families' welfare. Also, because real issues are concerned, the concept of effective demand comes into play hence income earners are very important. Therefore, each individual household head was required to qualify for interview (Grandstaff and Dixon, 1986).

A list of all the communities surrounding the lake were obtained and were given random numbers and fourteen (14) of them were randomly selected through simple random sampling. The total Population for the fourteen communities was 12,960 people. (Ghana Statistical Survey (G.S.S) 2010, Atwima Kwanwoma District Assembly, 2015). So with an average family size of six (6), the total number of households became 2,160, and the Sample Size was also 360. Therefore, the Systematic Sampling Method which involves the selection of household heads at regular intervals from a list of the entire households was used. In order to select the household heads to be interviewed, the total number of households (N) was divided by the Sample Size (n) to obtain the Sampling interval (K). Thus N/n = K which implies 2160/360 = 6. Hence, the household head of every 6th household was elected for interview. To be assured against any possible human biases when using this method, we began by selecting a random

number *b/ni* and 6 inclusive. After this, 6 is added to the first number to obtain a second and 6 to a second to obtain a third and so on till the end of the list (i.e. the random sampling *b/ni* - 6 gives 4, so 6 is added successively, thus 4, 10, 16, 22, 28 etc. (Mitchell and Carson, 1989).

This study assumed gate fee as option price and is used as a measure for OV. Respondents were presented with reasons for them to express their WTP. Respondents were told that the survey was to determine their WTP for future use of the lake. That is, the lake, due to its excessive use, would be destroyed at the expense of posterity. Thus, the lake would have to be preserved for the future and for this to be achieved "property rights" would have to be assigned to it by private investor. They were also told that the Government due to the high cost of providing social services to the populace such as building of Schools, Hospitals, cannot afford to maintain the Lake. Therefore, it has become necessary to ask some private organizations to participate in the maintenance of the Lake with their own money and resources. This would necessitate some payments for the Lake.

In this study, respondents were faced with a personal face-to-face interview in which a detailed history of the lake was made available and respondents' socio-economic data (income, age attitude, family size, education) were also sought. This study utilized the contingent valuation method (CVM) based on the Mitchell and Carson technique (Mitchell and Carson, 1989).There are several elicitation methods which include the open ended (or single bid) question method, the costless choice method, the payment card method, trade off games method, the iterative bidding game method. However, the dichotomous choice method (closed-ended referendum method) or take-it-or leave-it method was chosen for this study in such a way as to eliminate most threats to reliability and validity

The close-ended referendum method of elicitation is the system in which a single amount of money is suggested by the interviewer. Respondents are given the option to agree or disagree by replying 'Yes' or 'No'. A binary response technique is usually used to determine a mean value for WTP when the responses of respondents are put together. With this method, techniques such as the logit and probit models are used for analysis. Here a single discrete response is obtained from a take-it-or-leave-it type of question. The maximum WTP amount of ¢3.50 was arrived at for existence value after the research questionnaire was first tested in a pilot survey of 50 respondents in the study area. Therefore, the question asked for the close-ended referendum method for estimating the option value of the lake is" If the lake is allowed to be used excessively as it is now; then its resources would become endangered and destroyed. If management is able to generate enough revenues by means of gate fees proceeds they would be able to preserve the lake and its fish species for posterity. Suppose you are willing to visit the lake in the future, would you be willing to pay ¢3.50 (this was arrived at through the pilot survey conducted earlier) as gate fee per visit, yes or no? If a household's answer is 'yes' to the bid, the score is 1 and that represents maximum WTP gate fee per visit. But all other bids below ¢3.50 were 'no' responses and the score is zero (O).

This Method was criticized for loss of efficiency through

the use of a discrete choice estimator. However, an advantage which this method has, is that, it closely simulates an actual market since respondents are offered a future option visits to the lake at a given price and they have the option of whether to pay for the future use or not and it is the most suitable for this study due to the use of the Probit Model estimation. The next session presents the calculations on OV.

## B. CALCULATION OF TOTAL OV FOR THE LAKE

There are 24 villages located around the lake with a total population of about 22,921 people and a family size of 6 was considered as house hold (Bosumtwi-Atwima-Kwanwoma District Assembly, 2015) . Data collection took place from January to May 2016 and a Systematic Sampling Method was employed.

Table (i) shows the Population characteristics and distribution of WTP responses as gate fee.

|  | Number of Communities | Average Number of Households | Total population (N) |
|---|---|---|---|
| Sample (n) | 14 | 2160 | 12,960 |
| Population (N) | 24 | 3820 | 22,921 |

Source: (Atwima Kwanwoma District Assembly, 2015)
*Table (i): Population Characteristics of the Study Area*

Out of the total number of 360 respondents, 92% (331) were willing to pay a maximum amount of ¢3.0 for Option Value, whiles 8% (29) were not willing to pay for the same amount. The willingness to pay amount in cedis for each of the values measured here represent average values expressed for the Lake during the pretest of the questionnaire.

| Willingness to pay Amount in cedis (¢) (1) | Percentage of Households (2) | Number of Households (Sample) (3) | Total Number of Households (4) |
|---|---|---|---|
| 3.0 | 92 | 331 | 3514 |
| below 3.0 | 8 | 29 | 306 |
| TOTAL | 100 | 360 | 3820 |

Source: (Author's Questionnaire, 2016)
*Table (ii): Distribution of WTP Responses for OV*

These values were obtained through the use of the Dichotomous Method of elicitation which allows only a single discrete response to be obtained from a take-it-or-leave-it type of questioning where respondents were given the option to either agree or disagree by replying yes' or 'no' to a given maximum amount set for by the interviewer. Therefore, from table (ii) , it was possible that those who were not willing to pay the maximum willingness to pay amount set for by the interviewer could also express some form of willingness to pay for the Lake. However, this could not be captured here because of the choice of the use of the Dichotomous Method of elicitation for this study which does not allow the total willingness to pay expressions to be captured and this is the weakness of this method. Nonetheless, the maximum willingness to pay values obtained for this study should be taken as real average values expressed for the Lake irrespective of the weaknesses of the Dichotomous Method.

The distribution of the willingness to pay responses in

table (ii) is used to calculate the total OV. As indicated in table (iii) the total OV is calculated by multiplying the maximum willingness to pay amount of ¢3.0 in column 3 by the total number of households in column 2. Therefore, the total OV per Month is ¢10,542 as shown in table (iii)

| PERCENTAGE OF RESPONDENTS (1) | TOTAL NUMBER OF HOUSEHOLDS (2) | WTP AMOUNT ¢ (3) | TOTAL OPTION VALUE FOR THE LAKE ¢ (4) |
|---|---|---|---|
| 92 | 3514 | 3.0 | 10,542 |
| 8 | 306 | 0 | 0 |
| TOTAL | 3,820 | 3.0 | 10,542 |

Source: (Author's Questionnaire 2016). The next section now presents the appropriate model for this study
*Table (iii): Calculation of Total OV*

## IV. THE MODEL

This section presents the model and analytical results of the paper. Let Y be the households' WTP as a levy per month for Option Value measured in Cedis. The theoretical validity of the Contingent Valuation Method is examined through the estimation of the WTP function (Stock and Watson, 2007).The proposed econometric model used to analyze the WTP function was the probit model (Pr). Expectations are that the WTP for Option Value of the lake in its present state will be negatively related to respondents' (household head) Age (A), households' perception in terms of their Attitude towards the present state of the lake (At), and positively related to Formal Educational attainment (E), Monthly Income in Cedis (I), and Family Size (FZ). The probit model specification of the WTP function is stated below:

$$Pr(Y=1/ E, I, FZ, A, At) = \Phi(\beta_0 + \beta_1 E + \beta_2 I + \beta_3 F_Z + \beta_4 A + \beta_5 At + U) \quad (ii)$$

$$\frac{\partial WTP}{\partial Y} > 0, \quad \frac{\partial WTP}{\partial E} > 0, \quad \frac{\partial WTP}{\partial I} > 0, \quad \frac{\partial WTP}{\partial FZ} > 0, \quad \frac{\partial WTP}{\partial A} < 0 \quad \frac{\partial WTP}{\partial At} < 0$$

Owing to the fact that data elements within the communities were not statistically different, the mean of each of the variables of the 14 communities were used to run the probit model regression. This approach yields better results than applying each individual sample element. (Mitchell and Carson, 1989, Gertler and Glewee, 1992; Grand staff and Dixon, 1980; Stock and Watson, 2007).The summary of the explanatory variables are defined below: A = Age of a household head in years. E = Formal educational attainment of a household head. Where No Education = 0 Primary / J.S.S/Middle = 9 years Secondary/Commercial/vocational/ Technical = 12 years Tertiary education = 16 year, At. = The respondents' attitude towards the lake in its present state as a dummy variable, where Dummy Variable 0 = if present state of the lake is Good. 1 = if present state of the lake is Bad. I = respondents' monthly income in Cedis. FZ = household family size. *U* = Error term. The results of the Probit regression analysis relating the non-linear dependent variable WTP (Y) to the explanatory variables is given in table (iv) below:

| REGRESSOR | CO-EFFICIENT ESTIMATES | STANDARD ERRORS | VALUE OF t-Statistic |
|---|---|---|---|
| CONSTANT | 0.060 | 0.021 | 2.86 |
| A | -0.22 | 0.08 | -2.75 |
| E | 0.35 | 0.11 | 3.18 |
| At | -0.61 | 0.23 | -2.65 |
| I | 0.70 | 0.12 | 5.83 |
| FZ | 0.371 | 0.099 | 3.75 |
| Pseudo R-square | 0.569 | | |
| LR Chi-Squared (5) | 23.84 | | |
| Prob > Chi-Squared | 0.002 | | |

*Table (iv): Probit Regression Results Summary: (Autors questionnaire 2016)*

The relationship set out by each of the explanatory variables has the expected sign. From the model, the values of the t-statistic show that all the explanatory variables are individually statistically significant at 5% and 1% level. The coefficient of the age variable is -0.22 which shows that if the age of a household head goes up, the probability that his WTP will fall, is by 22%, and there is 35% probability that the WTP will go up when the educational level of a household head also goes up because the coefficient is 0.35. The coefficient of Attitude towards the Lake is -0.61. This implies that household heads perceived the Lake's environment as bad, and therefore the probability that they will pay more is 61%, whiles an increase in the income of a household head is also associated with a probability increase of 70%. If the family size of a household head increases, there is 37% probability that it will lead to an increase in the household's WTP, whiles other factors that are not captured by this Probit regression model have a chance of affecting the WTP positively by 60%, for instance proper maintenance of the lake area. The relationship between Age and WTP is negative implying that the present state of the lake is not attractive enough as compared to its state in the past years. Education has a positive influence on WTP. This phenomenon could be attributed to the fact that most people through the attainment of formal education are now conversant with the need to conserve our natural resources for posterity. The attitude of respondents towards their WTP for OV at its present state is negative. Again, this is also due to the fact that respondents see the present state of the lake as unsuitable and hence, bad. There is a positive relationship between the family size and the WTP. This is explained that for the sake of posterity, households are willing to pay more for the future use of the lake.

The overall explanatory power of the entire regression is also tested against the hypothesis using the analysis of Probit model, which utilizes the Chi-squared statistic. The Chi-squared statistic from the results is 23.84 and at 5 degrees of freedom, the critical value of Chi-squared that is found in the Chi-squared Distribution Table for 5% level of significance is 11.07. The Pseudo R-square value of 0.569 is quite reasonable thus more than 56% of the variation in WTP is explained by the model, moreover, the Chi-squared value of 23.84 and the general economic consistency and rationality of the responses appear to be reasonably high. Thus, the model, given the equation is considered as a good fit and is similar to most

Contingent Valuation Method (CVM) of study. Based on the discussed results of the Probit model for WTP Option Value, one can conclude that households have altruistic motive for OV of the Lake and do not want to consume the fish species or destroy the Lake now. This study has confirmed that Option value is still an important component of Total Economic Value of the lake which can be estimated by the use of the CVM. Let us now tend our attention to policy and recommendation for this study.

## V. POLICY IMPLICATIONS AND RECOMMENDATIONS

All environmental policies aim at protecting the environment, promoting sustainable growth and development, and ensure intra and intergenerational equity (Environmental Protection Council, 1991; Lssewski, 2003). According to Baa-Nuako, et al., (1995), there was the need to articulate a clear plan of research work to guide the implementation of the new Environmental Protection Act 490 which was passed in 1994. This need was partially addressed by the preparation of the Forestry Development Master Plan 1996-2020 (Wildlife Development Plan, 1998).Therefore, for public ownership; this paper thus provides a complete framework and should be used as a guide to the sector institution in the preparation of its own work plans for the lake.

The Lake should be commercialized by the District Assembly through ecotourism because there is maximum WTP OV for it to be conserved as the only nature's most valuable assets in Ghana.

Moreover, it must also be mentioned that the communities around LB depend on it for their livelihood. Therefore, there is the need for an alternative source of livelihood policy for the people such as training some of the people into tourist guides, basketry, waitresses and waiters in the hotels, and restaurants, etc. Hence the proceeds realized from the commercialization could be the source of funding for these projects. There are a number of organizations in the community which influences the lives of the people. Some of them could offer an alternative source of livelihood services to the people.

There should be the need for complementary inputs from all stakeholders in the form of active community participation and support, adequate facilities for operation and maintenance and the utilization of appropriate technology for the development of the Lake.

The WTP gate fee of (¢3) could be used as part of the determinant of the extent of the value consumer's expressed for the Lake. The information provided can help any investor in the Lake area decide on how to allocate scarce capital resources.

The aggregation of the OV of ¢10,542 that is captured through the WTP variant should explicitly be valued together with the Use-Values in the benefit cost analysis (CBA) to determine the profit level of investing in the Lake. This paper captured only OV which is part of the total Economic Value of the lake therefore; future research could be conducted to capture the total Economic Value. The next section leads us to the conclusion of this paper.

## VI. SUMMARY AND CONCLUSION

Natural resources in Ghana are becoming endangered at an alarming rate. The rate of this destruction as a result of human encroachment and deforestation is accelerating and this is occurring with gross apathy for long-term management of conservation areas over the country. The depletion and degradation of these resources have implications for the nation's environment and posterity. LB and other protected areas may contribute to the national economy in less direct ways by protecting vegetation cover, soils and environmental conditions that help sustain water supplies, protect inland and fisheries and ensure climatic conditions favorable to agriculture. Their rapid destruction will impede biodiversity conservation and sustainability, and aggravate rural poverty. Indeed, an updated valuation technique such as this is timely and imperative to make the economic analysis which will help guide decision making on the sustainability of LB and its Valuable resources. This was the mandate of this paper.

This study used the application of Contingent Valuation Method (CVM) for estimating OV of the Lake and its resources based on the WTP. The study also, looked at the socio-economic factors influencing households' WTP and thereby tested the theoretical validity of the results obtained from the study against the hypothesis. A Probit regression analysis was run in order to test the theoretical validity of the valuation technique applied and thereby examined the determinants of household's WTP. According to the Probit regression results of the estimated model, income, age, educational attainment, attitude towards the present state of the Lake and family size were statistically significant throughout the analysis as they explained the variations in the dependent variable WTP. The results indicated that respondent's WTP is directly related to their income levels, educational attainment and the family size but negatively related to the age of household heads and their attitude towards the Lake probably because the lake is in its bad state. Consequently, the Free-riding problem was found to be negligible. In general, the sign and the significance of the income and other independent variables indicate that empirical findings of the research are consistent with the underlying economic theory. Private or Public ownership policy as well as an alternative source of livelihood policy are recommended.

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