HOUSEHOLDS WILLINGNESS TO PAY FOR IMPROVED WATER QUALITY AND RELIABILITY OF SUPPLY IN CHOBE WARD, MAUN

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Abstract: *This survey investigated the willingness to pay for an improved water quality and reliability in Chobe ward in Maun. On average, 54% of the households are willing to pay for improved water quality. It is therefore apparent that Chobe Ward, Maun residents in general regard water as an economic good as they are willing to pay for its provision. Those with a higher income were willing to pay for an improved water quality and reliability of supply. This finding corroborates the environmental economic theory which assumes that the demand for an improved environmental quality increases with income. The older the person the more they are willing to pay for improved water quality and reliability. Larger families are not willing to pay for an improved provision of water services. Also, educated people are lesser willing to pay for improved water quality and reliability.*

Keywords: Willingness to Pay, Environmental good, Contingent Valuation Method

1 Introduction

The purpose of this paper is to determine whether people in Chobe Ward, Maun are willing to pay for improved water quality and reliability of supply. The survey is in the quest of finding out the monetary value that households are able and willing to attach for an improved water service. The study determines the coping mechanisms adopted by households in Maun to mitigate the impacts of unreliable water supply and poor or unsafe water, and the related costs incurred.

Good quality water is vital for health and improvement of the well being of human beings. If the piped water distribution does not provide good quality water continuously, concerned and private agents might intervene. Therefore, this paper brings in the required information on the willingness of people of Chobe Ward, Maun, not only for paying water bills, but also for an improved and sustained service provision.

Maun, as a tourist centre and the North-West District headquarters is the centre of many social and economic activities. This has led to the rapid population increase (see, Table 1 below), increased consumption of water and the cost of getting water to the consumers. Therefore, there is need to investigate factors influencing the households' water consumption patterns and their willingness to pay (WTP) for improved water services, such as quality and reliability.

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Table 1: Population Growth in Maun between 1964 and 2001

1964	1971		1981		1991		2001	
Population	Population	Annual growth rate	Population	Annual growth rate	Population	Annual growth rate	Population	Annual growth rate
4 549	9 614	11.3 %	14 925	4.5 %	26 768	6.0 %	43 776	5.0 %

Source: Republic of Botswana, 2001

There is a concern that water in Maun is of poor quality and its supply is unreliable. Preliminary investigations have revealed that the water has some of the following characteristics: 1) it is saline, 2) it has bad taste, 3) it has residual sediments and 4) it also stains the surfaces of bathtubs. The threats for water pollution are due to the fact that the Gomoto and Upper Boro areas have a number of lodges, whose sewage disposal could be detrimental of the water quality in the neighbouring rivers in Maun.

Recent investigations have shown that there is evidence to suggest that the capacity of the current water sources in Maun as a whole is overstretched. For instance, water availability in Maun is erratic. Furthermore, as a result of poor water quality and unreliability of its supply, residents in other parts of Maun embark in what Gnedenko, *et al* (2000), refers to as "avoidance expenditure". This is the household's expenditure related to reducing health risks from environmental pollution such as buying and boiling the water and filtration of tap water. This implies that the residents incur the costs of water bills and personal water treatment costs. This necessitates the improvement of both water quality and quantity. The foregoing raises the following question to be answered by this investigation. Are Maun residents Chobe Ward in particular, willing to pay in order to increase water quality, reliability and improved supply?

The paper is organised as follows. Section 2 summaries water supply and quality in Maun. Section 3, highlights economic valuation of an environmental good. Section 4 provides an overview of previous studies. Methodological procedures are discussed in Section 5. Empirical findings are presented in Section 6, while concluding remarks are given in the last section.

2 Water Supply and Water Quality in Maun

Maun is provided with a water reticulation system under the programme of major villages` water supply. It is planned, constructed, operated and maintained by the department of Water Affairs. All fresh water in Maun is obtained from boreholes along the northern side of the Thamalakane River near the central parts of the village. Surprisingly, in Maun water shortage is not a pressing issue considering the fact that the seasonal floods from the Okavango Delta feeds the Boro River. The

problems are, first, the reticulation system and the distribution of water which is an on and off thing. This therefore constitutes unreliability of water supply. Second, for chemical parameters, the water quality does not meet the Drinking Water Quality Guidelines set by the World Health Organisation (WHO) of 1984 and also for Botswana. Third, the Faecal coliforms are generally low implying that the water is safe for human consumption. For instance, in Botshabelo and Chobe the water does not pose any threat for bacteria since very low values (0 or 1 faecal coliforms per 100ml of water) were recorded. Fourth, village pit latrines and industrial sites to an extent have affected some of the boreholes, hence polluting ground water near rivers. To avoid future pollution problems, Water Affairs has recommended a protection zone to be reserved free from any land use that could affect the ground water in this area.

Table 2: Drinking Water Quality Guidelines

Substance	Units	WHO	Botswana Desired	Botswana Permissible	Botswana Max Permissible
PH		6.8-	6.5-8.5	6.5-9.2	6.5-9.2
Total Dissolved Solids	Mg/l	8.5	1000	1500	2000
Sulphate	Mg/l	1000	400	-	600
Chloride	Mg/l	400	200	600	800
Nitrate	Mg/l	250	45	100	100
Fluoride	Mg/l	45	1.5	3.0	3.0
Iron	Mg/l	1.5	0.3	1.0	3.0
Manganese	Mg/l	0.3	0.1	0.5	0.5
Sodium	Mg/l	0.1	200	-	-
Turbidity	NTU	200	5	25	-
Zinc	Mg/l	5	5.0	15	15
Copper	Mg/l	5.0	1.0	1.5	-
Taste and Odour	-	1.0	Inoffensive to most consumers		
Dissolved Oxygen			No value set		
Hydrogen Sulphide			Not detectable by consumer		
MICROBIOLOGICAL VARIABLES					
Total coliform	Per 100 ml	10	100		

Source: Department of Water Affairs

Total hardness classification

0-50 mg/l soft water; 100-150 mg/l slightly hard water; 150-200 mg/l moderately hard water; Over 200 mg/l hard water; Over 300 mg/l very hard water; Over 500 mg/l extremely hard water

3 Economic Valuations of Environmental Goods

Economic Valuation is about “measuring the preferences” of people for an environmental good or against an environmental bad. The economic value of something is measured by a summation of many individuals` willingness to pay (WTP) for it. The WTP reflects individuals` preferences for

the good in question. Valuation is in money terms because of the way in which preference revelation is sought. i.e., by asking people how much they are willing to pay.

Many of environmental goods and services are provided freely. Therefore, they have zero prices because no market place exists in which their true values can be revealed through acts of buying and selling. Water is generally under-priced. Therefore, valuation is important for proper pricing. Projects and programmes appraisal cannot be ample or adequate without valuation. National priorities for environmental policies are better informed if economic values are known with a degree of certainty (Pearce, 1993). Economic valuation of environmental goods has found vast application in (1) option appraisal, (2) in the design of economic instruments and (3) in determining compensatory payments for environmental damage (Willis and Corkindale, 1995). Valuation techniques are also applied to the more immediate human environment, such as water supply and sanitation.

This paper employs the Contingent Valuation Method (CVM) to determine the willingness to pay for improved water quality and reliability of supply in Maun. The CVM is a survey-based technique of monetary valuation used to elicit people's preferences expressed in terms of WTP. The CVM utilises an appropriately designed questionnaire (or experiment) to elicit the valuations or bids of households about a decrease or increase in the amount of an environmental good, and how much they are willing to pay or to accept compensation in order to avoid an environmental damage. The assumption is that a market for environmental goods and services exist (Pearce and Turner, 1990). It makes use of bidding games for approximating the willingness of households to pay for an environmental good.

The CVM can be carried out by several ways such as the use of (1) direct questionnaires, (2) face-to-face interviews, (3) mail surveys, and (4) telephone. Single bid games, also known as the single open-ended, is used in this study. This is where the respondent is asked to mention the amount he or she is willing to pay for a good/service described by the interviewee.

A CV study needs three basic things. First, the respondent should be given detailed information about the commodity to be valued and the hypothetical scenario under which it is made available. For example, the structure under which the commodity is provided, the range of available substitutes and the method of payment. Second, a method which elicits respondent's willingness to pay (WTP) is required. The respondents are asked for their maximum WTP (e.g., per month or per year). Third, demographic information (such as age, gender, income) is needed to estimate the valuation function for the environmental commodity. The data obtained here are used in regression analysis to estimate how the values are related to the respective demographic variables based on theory.

A CVM exercise basically involves informing the respondent about the prevailing situation (prices, environmental conditions, etc), and then informs him/her about a change. The individual is asked to value an 'event', or a particular change in environmental conditions in a future hypothetical scenario. Contingent Valuation evolved as a method to quantify the benefits of non-market environmental goods and attributes in order to enable them to be entered directly into cost-benefit calculations. CVM have the following advantages over the other methods of environmental valuation such as the travel-cost and hedonic pricing techniques. First, it is applicable to all situations. Second, the method is able to quantify some types of benefits, such as non-use or passive use benefits, which lie outside the scope of travel-cost and hedonic pricing studies. Third, CVM was given official recognition by the US Water Resources Council as a recommended valuation technique. Fourth, CVM is able to measure passive use values and this has led to many applied environmental economists choosing it (Hanemann, 1991).

However, critics of CVM are critical of the reliability and validity of answers to hypothetical WTP questions. They argue that the method is prone to a number of difficulties (or biases). First, there is always the possibility of strategic behaviour. Respondents may understate their willingness to pay if they feel that they can free-ride or they may overstate their willingness to pay. This can arise if they feel that the provision of the improved situation is not conditional on their actual payments. Therefore, a careful design of the questionnaire and description of the good is needed to minimize this kind of bias.

Second, respondents may become 'yea-sayers'. i.e., the respondents may answer only to please the interviewer. This behaviour of supporting environmental 'good causes' without attaching the cost the individual will incur seems to be quite pervasive in literature. Third, there exist the hypothetical nature of the process calling for careful structuring of questions to inform respondents about the salient points, and not overloading them with unnecessary description. It is therefore argued that precise assessments of the environmental change need appropriate information provision. Fourth, a variety of other problems that are associated with contingent valuation include responses bias and starting point biases (Mitchell and Carson (1989)). Additionally, the cross-sectional Contingent valuation studies have tended to have low R-squared, though, R-squared is used to demonstrate that WTP amounts are not random responses. Mitchell and Carson have indicated that the reliability of a CV study which fails to show an R^2 of at least 0.15, using only a few key variables, is open to question. These biases are a result of difficulties for households in perceiving the hypothetical or

contingent market or from choice of starting point of bids (Pearce and Turner; 1990, Jimson, 2001). Despite all these biases, accurate estimates of WTP can be made.

Generally, the CVM has found vast applications in cases especially in developing countries. It has surpassed other environmental resources valuation techniques. Contingent Valuation can precisely estimate WTP for an environmental good. The main factors affecting WTP are: income level, age of the respondent, gender, and availability of information about water quality and associated health risks.

4 Review of Previous Studies.

Most empirical studies on the WTP for improved water resources and supply indicate that income, household size, education, age, distance from existing water source, employment status and gender influence willingness to pay for improved water resources. For instance, Otsetswe (2001) found that the above parameters were the main determinant for WTP for private water connection in Kanye village in Botswana. In 2004, Pham Khanh Nam and Tran Vo Hung Son did a study on Household Demand for Improved Water Services in Ho Chi Minh City, Vietnam. The study assessed the willingness of people in Ho Chi Minh City to pay for improvements in their water supply system. It also investigated what aspects of water supply, such as quality and water pressure are most important. Many households surveyed already had to do a lot and spend lot of money to cope with unreliable poor quality public water supply they currently use. The study found that people are on average willing to pay between VND 148,000 and VND 175,000 for improvements in their water supply. Also, households without piped water are more willing to pay for improved services than those that already enjoy fixed supply. Non-piped households place more importance on water quality than water pressure. The studies reviewed above have all employed CVM to solicit WTP for improved water services.

5 Methodology

In this section we focus on data collection, methodological procedures and sampling strategy. Two methods of Data collection were used to collect household data in the study area. These are household questionnaire and key informant interviews.

5.1 The Questionnaire

A questionnaire with open-ended questions was administered to households. The questionnaire consisted of the following five sections: i) introduction, household location, ii) demographic information, iii) socio-economic information, iv) water quality and willingness to pay, v) water availability/supply and willingness to pay. Sections four and five are basically Contingent valuation

questions which emphasized two aspects of the proposed improved service: good quality water meeting standards of Drinking water quality, reliable and predictable water supply. The questions were designed to get the most precise data for econometric analysis of willingness of pay.

Interviews were conducted with the head of the household. Vacant households were replaced by next one in the list. After entering and cleaning data, the data was ready for analysis. For individuals who were sharing, that was treated as two households. The interviews lasted 15-30 minutes.

5.2 Key informant interviews

Officers from the Department of Water Affairs and any other relevant authority that was resourceful were also interviewed in order to get some more information on the ground. For instance, the chiefs gave information on status of water supply and quality.

5.3 Sampling procedure/strategy

Chobe ward, an area with a high concentration of the working population was purposively selected. It was thought that Contingent Valuation would be appropriate to apply in this area, as the population is relatively more educated. This is mainly because Contingent Valuation works effectively if it is applied to a more educated and informed population. All households in Chobe ward were listed, and a total of 310 households were estimated. Of the total number of households in Chobe ward, 30 percent or 92 households were selected for an interview using systematic sampling.

5.4 Model Specification

The specification of the equation below was primarily motivated by theory and relevant literature. In the model, WTP is endogenously determined and is a function of the following independent variables income level, gender, age, education, household size and avoidance expenditures.

Thus,

$$WTP= \beta_0 + \beta_1 INC + \beta_2 HHOLD\ SIZE + \beta_3 AGE + \beta_4 AE + \beta_5 GEN + \beta_6 EDU + \varepsilon$$

Where; $\beta_1>0$, $\beta_2< 0$, $\beta_3<0$, $\beta_4> 0$, $\beta_5> 0$, $\beta_6 > 0$

Where,

WTP: Willingness of Maun residents to pay for improved water quality and reliable supply (in monetary terms, Pula)

β_0 : Constant

β_i: Coefficients where i= 1 to 6

INC: Household income level

HHOLD SIZE: Household size

AGE: Age of the respondent

AE: Avoidance expenditures

GEN: Gender of the respondent where GEN= 1 for male respondent and GEN= 0 if respondent is female

EDU: Education of the respondent (in terms of number of years at school)

ε: Error Term

Priori Expectations

INC; Income is expected to be positively related to WTP. Environmental economic theory assumes that the demand for an improved environmental quality increases with income. Consequently, those with a higher income are expected to be more willing to pay for an improved water quality and reliability of supply than those who have little or no source of income.

HHOLD SIZE; Household size is expected to be inversely related to WTP. It is assumed that big households will be willing to pay relatively less due to the associated high running costs (i.e. budgetary constraints). Thus, the study expects the sign of its coefficient to be negative.

AGE; Respondents were asked their age. *A prior*, it is not possible to know how a respondent's age may impact WTP. However, in general, it is hypothesized that as people grow older, they become more politically conservative, and their WTP will decrease. Consequently, the estimation coefficient of this variable is expected to be negative.

AE; Avoidance expenditures refers to undertaking personal water treatment measures such as boiling the water, filtering or means of getting water when the supply is down i.e. buying good quality, storing water in containers etc. The study expects a positive relationship between the variable WTP as per economic theory. Households will be willing to pay since they incur so many costs including paying the water bill and hence cannot afford an extra burden.

GEN; Gender (1 = male and 0 otherwise) is suppose to affect WTP. A positive relationship between WTP and GEN might exist when the respondent is female because they are the ones who take care of domestic household chores such as travelling to other places to fetch water in times of need, hence they will be willing to pay.

EDU; WTP for improved water quality and reliability of supply is expected to be positively related to education. The longer time in formal schooling (years), the more people understand better the consequences of using unsafe water and the need to have reliable water supply. Therefore, the educated will be more willing to pay than the illiterate.

6 Empirical Findings and Analysis of Data

This section is divided into descriptive analysis and regression results. The findings of this study are based on the sample data collected from Chobe ward in Maun. Ninety-two (92) households were covered with three refusals encountered. The survey covered ninety-two (92) households out of a total of 310 (Population Census, 2001) households in Chobe ward. This means that the survey covered only 30 percent of the households in Chobe ward. The results of this study show that on average, 54 percent of the households in Chobe Ward are willing to pay for improved water quality. Despite the smallest of the sample relative to population size and for the sake of argument, assuming that the sample is nevertheless representative, it means that 167 households in Chobe Ward are willing to pay for improved water quality. Consequently, if all households in Chobe Ward who are willing to pay are going to be charged P54.59 per month, P9138 (167*P54.59) will be collected from such a service.

6.1 Descriptive Analysis

This sub-section is composed of some descriptive statistics on Willingness to pay for improved water quality and also on Willingness to pay for improved reliability of water supply.

6.1.1 *Perceptions of Households about the water quality*

Sample respondents perceived considerable differences in taste, colour and health hazards of water from boreholes, which are the main water sources in this area. About 95 percent of the respondents did not find water as of good quality. This is not surprising since 57.6 percent of the interviewed households said that the water was salty. One would expect it to be so because it is ground water. Forty-three (43.5) percent of the households reported that the water had residual sediments. Residual sediments are usually an acute problem during winter. This is the period when the floods from the Okavango Delta arrive in the village and boreholes along the Boro River start operating. Sixty five percent of the households reported it was brownish in colour, 19.6 percent were

complaining about the surfaces of their bathtubs, which have been stained. The remaining 46.7 percent said the water possessed other characteristics. The findings are summarised in Table 3.

Table 3 Perceptions of households about the water quality

Response	Characteristic											
	Salty		Bad taste		Residual sediments		Brownish in color		Stains surfaces of bath tubs		Other	
	Freq	%	Freq	%	Freq	%	Freq.	%	Freq.	%	Freq.	%
Yes	53	57.6	20	21.7	40	43.5	60	65.2	18	19.6	43	46.7
No	39	42.4	72	78.2	52	56.5	32	34.8	74	80.4	49	53.3
Total	92	100	92	100	92	100	92	100	92	100	92	100

Source: Field Survey Results

Since the quality of the water from the piped distribution system was widely perceived to be poor, the majority of the households (70.7 percent) embarked on coping strategies (termed as avoidance expenditures) in order to make the water user-friendly. These strategies include among others filtering or boiling it, buying good quality water etc. About thirty two percent (31.5%) of the interviewed households buy good quality water, 27.2 percent boil it and 20.7 percent reported they just leave it to settle- an opportunity cost time wise. Another 20.6 percent embark on other mechanisms of treating the water. On average, households spend P71.21 per month as avoidance cost.

Table 4 Common Coping Strategies amongst households

Coping Strategy	Percentage (%)
Buy good quality water	31.5
Boil	27.2
Leave it to settle	20.7
Other mechanisms	20.6
Total	**100**

Source: Field Survey Results

Table 5: Total Avoidance Cost Incurred by Households (Avoidance expenditures)

		Frequency	Percent
Valid	P.00	42	45.7
	P 10.00	2	2.2
	P 20.00	3	3.3
	P 30.00	1	1.1
	P 40.00	5	5.4
	P 50.00	3	3.3
	P 54.00	1	1.1
	P 60.00	5	5.4
	P 65.00	1	1.1
	P 74.00	1	1.1
	P100.00	5	5.4
	P 110.00	2	2.2
	P112.50	1	1.1
	P 140.00	2	2.2
	P150.00	2	2.2
	P 170.00	1	1.1
	P180.00	1	1.1
	P 190.00	3	3.3
	P 200.00	4	4.3
	P230.00	1	1.1
	P260.00	1	1.1
	P300.00	1	1.1
	P344.00	1	1.1
	P 410.00	1	1.1
	P 422.00	1	1.1
	P 500.00	1	1.1
	Total	92	100.0

Source: Field Survey Results

The analysis in Table 5 indicates that more than half of the interviewed households (54.3 percent) incur various costs on monthly basis. Total monthly avoidance costs ranges from P10 to P500 per month. This implies that apart from the fixed water bill charged by the Water Affairs Department, households spend a lot of money through unofficial channels and coping strategies; termed as total avoidance costs.

The majority (54 percent) of the households confirmed that there was need for an improved water quality. They were willing to pay because they believed the problem of poor water quality is a health risk. The mean maximum amount they were willing to contribute is P54.59 per month.

6.1.2 Descriptive statistics on reliability of water supply

Respondents were asked what they liked most about their water service from the piped distribution system. Out of the 92 respondents interviewed, 89.1 percent reported it is unreliable and

unpredictable. The majority (73.9 percent) reported that they experience water shortages all year round, 18.5 percent reported that they had on and off supply problems during the dry season. Water supply in Chobe ward in Maun is very much unreliable. Water supply is an on and off thing especially during weekends, all year round regardless of whether it is winter or summer. This has led households embarking on certain alternatives in order to mitigate the situation.

Table 6: Alternatives embarked on when there is no water

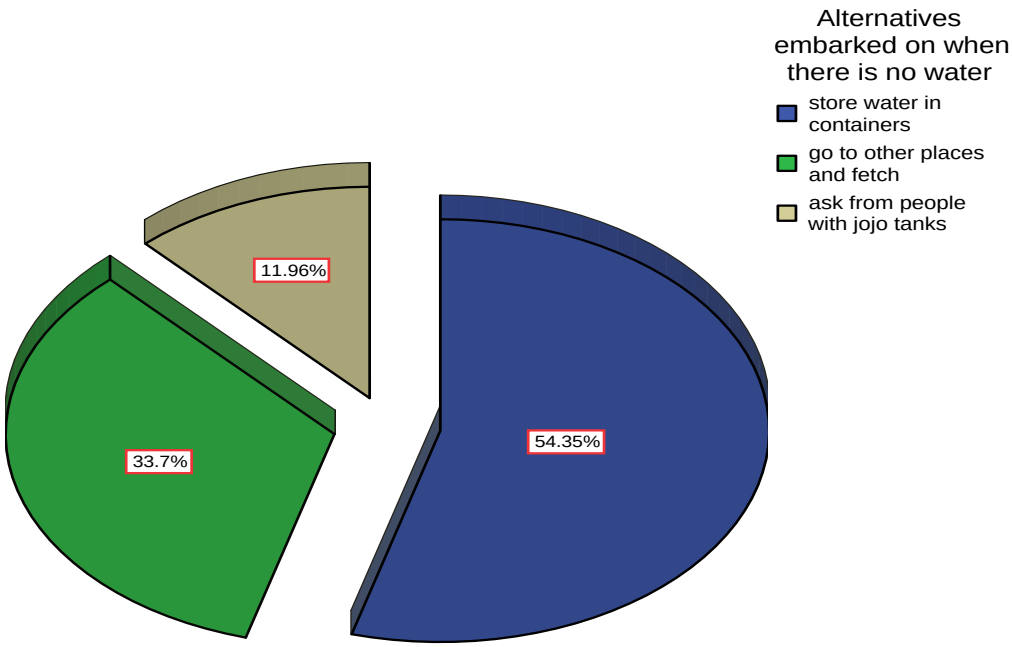
Alternative	Frequency	Percentage (%)
Store water in containers only	49	53.3
Store water in containers / Ask from people with jojo tanks /Travel to other places and fetch	31	33.7
Ask from people with jojo tanks only	11	12.0
No Response	1	1.0
Total	**92**	**100**

Source: Field Survey Results

In order deal with this unreliability of supply, households engage in storage of water, travelling to other places in search of water and asking from people with overhead water storage tanks (Jojo tanks). Fifty three percent of the households have adopted the habit of storing water in containers, 33.7 percent fetch water from other places, 12 percent do ask for water from people with Jojo tanks[5]. Such households incur indirect (i.e. "Avoidance") costs for them to get water.

[5] Jojo Tank is a name given to an overhead storage green plastic container that collects rainwater when it is raining.

Figure 1: Alternatives embarked on when there is no water



Since Maun water is provided by the water reticulation system there was substantial evidence to suggest that the Water Affairs Department left much to be desired. The equipment and machinery dates back to the early 1970s when the first boreholes were drilled, and this adversely affects the reliability of water supply. The issue of power cuts at some boreholes does affect the continuity of the water supply. This means breakdowns here and there are really an order of the day. This means that the consumption and demand for water is at its peak in Maun and yet water supply sources remain unchanging. This implies that vast pressure is exerted on the available resources to keep up with the prevailing situation. The Department of Water Affairs spends a lot of money through maintaining and installing collector reservoirs, additional pipes, booster pumps, water filters and purifiers.

About eighty-four percent (83.7%) of the households believed that the establishment of a fund to improve the reliability of supply was necessary. The average maximum WTP for improved reliability of supply was P76.78 per month. The remaining 15.2 percent did express reservations because they regarded water services as an entitlement to them that should be provided by the government. This can be attributed to the fact that people are getting water as a social service from government. However, due to the problem of sustainability of services, it is vital that people view water as an economic good (see, Tables 7 and 8 for more information).

6.2 Regression Results

The Willingness to pay equation was estimated using SPSS Version 12.0 to determine the relationship between WTP and each of the variables as earlier discussed.

Table 7: Descriptive Statistics on WTP for improved water quality and reliability of supply

Dependent Variable	N	Range	Minimum	Maximum	Mean	Std. Deviation
Maximum amount you are willing to contribute for improved reliability of supply (per month)	90	P1,000.00	P.00	P 1,000.00	P 76.7778	P 169.95695
Maximum amount you are willing to contribute for improved water quality (per month)	88	P 1,000.00	P.00	P 1,000.00	P 54.5909	P 125.24455

Source: Field Survey Results

Table 8: Descriptive Statistics In Relation to the Variables

Variable	N	Range	Minimum	Maximum	Mean	Std. Deviation
household size	92	7	1	8	3.16	1.799
age	92	34	21	55	36.28	8.738
Total avoidance cost(Avoidance expenditures)	92	P500.00	P0.00	P500.00	P71.2120	P105.22337
gender[6]	92	1	0	1	.47	.502
education level (No. of years)	92	18	7	25	14.92	4.779

Table 9 Results of the Regression Analysis to the WTP Model

Variable	Coefficient	Std Error	t-statistic	p-Value
Constant	-16.2440	1.6805	-3.7781**	0.0291
INC	0.4834	1.3990	2.9100**	0.0420
HHOLD SIZE	-0.6879	0.9943	-2.1349***	0.0541
AGE	1.0330	2.1630	-4.8219*	0.0021
AE	-41.139	5.687	0.7940	0.4293
GEN	0.6658E-3	2.471	1.4823	0.1640
EDU	-0.8923	1.0032	2.0473***	0.0637
R-squared 0.5591		R-Bar-squared		0.4762
Mean WTP_2 P76.78		No. of observations		92
DW-statistic 2.040				
F-stat 2.521				

Source: Field Survey Results

[6] Gender was a dummy variable which assumed the following values; 1 for male respondent and 0 otherwise.

* Statistically Significant at 1% level
** Statistically Significant at 5% level
*** Statistically Significant at 10% level

The coefficient of determination of the model shows that 55.9 percent of variations in WTP_2 is attributed to the explanatory variables and the remaining 44.1 percent is unexplained.

In Table 9, half of all estimated coefficients had expected signs except Age (AGE), Avoidance expenditures (AE) and Education (EDU). Furthermore, two of the variables were found to be statistically insignificant, implying that they do not affect WTP.

Household Income (INC) has the expected positive sign and is statistically significant at 5 percent. This implies that with increased monthly income, the household WTP_2 will increase. From Table 9, estimation coefficient of income suggests that a unit increase in household income will result in a P0.4843 increase in WTP .

Household size (HHOLD SIZE) is significant at 10 percent and has the expected negative sign. The estimation coefficient of household size implies that a unit increase in household size will decrease WTP by P 0.6879. This suggests that the bigger the family size, the more difficulties encountered in terms of budgetary constraints, hence the decreased WTP.

Age (AGE) does not have the expected negative sign even though it is the most significant variable at 1 percent level. The variable age affects willingness to pay for improved reliability of supply positively. This suggest that the older the person the more she/he is willing to pay for improved water quality. This was evident since most respondents' reason for contributing was for the future of their children. The coefficient of age can be interpreted as follows, holding everything else constant; a one-year increase in the respondent's age will increase WTP by P 1.0330.

Avoidance Expenditures (AE) are statistically insignificant. The variable does not explain WTP.

Gender (GEN), a dummy variable, is statistically insignificant. According to this model, the variable does not explain WTP. This might be attributed to the fact that most respondents interviewed were males; therefore, they were no distinct variations in the dummy to effectively depict the significance of the variable.

Educational level (EDU) has a negative sign and it is significant at 10 percent level of significance. This is contrary to expectations. This means that the higher the number of years for schooling, the lesser the WTP_2. The slope coefficient of education can thus be interpreted as follows, holding everything else constant; a one-year increase in education level will decrease WTP_2 by P0.08923.This might be attributed to those respondents who regarded water services as an entitlement that should be provided by the government. They were cases where the respondents

who are PhD holders were not willing to pay for WTP_2 because they strongly believed it is the responsibility of government.

7 Conclusions

This paper examined the WTP for an improved water quality and reliability in Chobe ward in Maun. The study's findings can be summarized as follows. First, on average, 54% percent of the households in Chobe Ward Maun are willing to pay for improved water quality. Second, in Chobe ward in Maun those with a higher income were willing to pay for an improved water quality and reliability of supply. This finding corroborates the environmental economic theory which assumes that the demand for an improved environmental quality increases with income. Third, the older the person the more they are willing to pay for improved water quality and reliability in Chobe ward in Maun. The aforementioned suggest that Chobe ward residents in general regard water as an economic good as they are willing to pay for its provision, as opposed to a public good. Fourth, larger families are not willing to pay much for an improved provision of water services. This implies that the bigger the family size, the more difficulties are encountered in terms of budgetary constraints which decrease their WTP. Lastly, in Chobe ward Maun educated people are lesser willing to pay for improved water quality and reliability. This might be suggesting that they regard water services as an entitlement that should be provided by the government.

References

Gnedenko, E., Gorbunova, Z., Safonov, G. (2000), *Contingent Valuation of drinking water quality in Samara city,* EERC, Samara City.

Hanemann, W.M. (1991), "Willingness to Pay and Willingness to Accept: How Much can they Differ?" *American Economic Review*, 81(3): 635-647.

Jimson, L.S (2001), *Valuation of Solid Waste Removal Services in Northern Lesotho: Contingent Valuation Approach,* Unpublished, M.A. Dissertation, Dept. of Economics, University of Botswana.

Mmolawa B. And Narayana N. (2006), "Estimating Households' Willingness to Pay for Improved Solid Waste Disposal: A Case of Gaborone City, Botswana," *International Journal of Environment and Development*, 3(1), 115-135.

Otsetswe, M. (2001), *Willingness to Pay For Private Water Connection in Kanye; a Contingent Valuation Approach,* Unpublished B.A. Project, Department of Economics, University of Botswana.

Pearce, D. (1993), *Economic Values and the Natural World,* Earthscan Publications Ltd, London.

Pearce, D., and Barbier, E.B. (2000), *Blueprint for a Sustainable Economy*, Earthscan Publications Ltd, London.

Pearce, D.W., and Turner, R.K. (1990), *Economics of Natural Resources and Environment*, Harvester Wheatsheaf, London.

Phu Le V. (2004) "Urbanisation and Water Management in Ho Chi Minh City Vietnam – Issues, Challeges and Pespective" *Geojournal,* 70(1), 75-89.

Republic of Botswana (1997a), *Environmental Health Department Annual Report*, Gaborone, Botswana.

Republic of Botswana (1997b), *Environmental Health Department Annual Report*, Gaborone, Botswana.

Republic of Botswana (2001), Population and Housing Census, Gaborone, Botswana.

Warmeant, P. (1997), *Review of Water Chemistry and Water Quality in the Okavango Delta*, Department of Water Affairs, Government Printers, Gaborone.

Willis, K.G., and Corkindale, J.T. (1995), *Environment Valuation, New Perspectives,* CAB International, Oxon.

Appendix 1

Correlation Coefficient Matrix for WTP_1

	WTP	INC	HHOLD SIZE	AGE	GEN	EDU
WTP	1.0000					
INC	-0.010	1.0000				
HHOLD SIZE	-1.292	-0.1050	1.0000			
AGE	5.448	-0.5130	-0.1700	1.0000		
GEN	-4.113	-0.0750	0.2430	-0.1390	1.0000	
EDU	3.140	-0.662	0.0550	0.1609	-0.1502	1.0000

Correlation Coefficient Matrix for WTP_2

	WTP	INC	HHOLD SIZE	AGE	AE	GEN	EDU
WTP	1.0000						
INC	0.4834	1.0000					
HHOLD SIZE	-0.6879	-0.1206	1.0000				
AGE	1.0330	-0.5110	-0.1520	1.0000			
AE	-41.139	-0.0690	-0.0091	0.1091	1.0000		
GEN	0.6658E-3	-0.7100	0.2440	-0.167	0.0960	1.0000	
EDU	-0.8923	-0.6710	0.0540	0.1860	-0.218	-0.007	1.0000