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Willingness to pay for improved water supply services in Phaleng ward, Shoshong, Botswana: Application of Contingent Valuation Method (CVM)

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WILLINGNESS TO PAY FOR IMPROVED WATER SUPPLY SERVICES IN SHOSHONG, PHALENG WARD, BOTSWANA: APPLICATION OF CONTINGENT VALUATION METHOD (CVM)

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A thesis submitted in partial fulfillment of the requirements for the Master of Science Degree in Integrated Water Resources Management

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DECLARATION

I, Kago Kadisa, declare that this dissertation report is my own work. It is being submitted for the degree of Master of Science in Integrated Water Resources Management (IWRM) of the University of Zimbabwe and all the sources that I have quoted have been indicated and acknowledged by means of complete citation and reference. This work has not been submitted before for examination for any degree in any other University.

Date: ________________________

Signature: ____________________

The findings, interpretations and conclusions expressed in this study do neither reflect the views of the University of Zimbabwe, Department of Civil Engineering nor of the individual members of the Msc Examination Committee, or their respective employers.

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LIST OF ABBREVIATIONS AND ACRONYMS

AE	Avoidance Expenditure
BNWMP	Botswana National Water Master Plan
BWP	Botswana Pula
BWSR	Botswana Water Statistics Report
CAR	Centre for Applied Research
CEEPA	Center for Environmental Economics and Policy
CSO	Central Statistics Office
CV	Contingent Valuation
CVM	Contingent Valuation Method
CWS	China Water Sector
DCE	Discrete Choice Experiments
DEA	Department of Environmental Affairs
DW	Durbin Watson
DWA	Department of Water Affairs
EAs	Enumeration Areas
HPM	Hedonic Pricing Method
IWRM-WE	Integrated Water Resources Management Water Efficiency
KCS	Kalahari Conservation Society
LDCs	Low Developed Countries
MDGs	Millennium Development Goals
MEWT	Ministry of Environment, Wildlife and Tourism
MMEWR	Ministry of Mining, Energy and Water resources
MoA	Ministry of Agriculture
OLS	Ordinary Least Squares
QG	Queensland Government
RP	Revealed Preference

SADC	Southern Africa Development Committee
SP	Stated Preference
SPSS	Statistical Package for Social Scientist
SRS	Simple Random Sampling
TCM	Travel Cost Method
TEV	Total Economic Value
TWTP	Total Willingness To Pay
UFW	Unaccounted for Water
UN	United Nations
UNDP	United Nations Development Programme
VDC	Village Development Committee
VIF	Variance Inflation Factor
WDM	Water Demand Management
WHO	World Health Organisation
WISER	Water is a Social and Economic Resource
WTA	Willingness to Accept
WTP	Willingness to Pay
WUC	Water Utilities Corporation

DEDICATION

Better is not good enough, the best is yet to come. This dissertation is dedicated to my late mother, brother and sister. Thank you for watching over me. May your souls rest in peace.

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ABSTRACT

Developing countries face the mammoth task of providing basic services and infrastructure. Amongst the top services that have proven most difficult to provide is the provision of water supply. Since many rural people are poor, it is usually assumed that rural water supplies must be financed by the government or by its agencies, as was the case with Botswana before the Water Utilities Cooperation (WUC) take over. However, the government has faced difficulties in maintaining the infrastructure and cost recovery measures have failed, thereby affecting service delivery. Governments' efforts to solve water problems have in the past been supply driven. They mostly focused on damming, drilling and diverting water, which proved to be a short term solution. In the long run, the pipes, dams and all infrastructures need maintenances, which most governments fail to carry out owing to financial constraints. To address these problems, the demand side for the value attached to water should be well understood. It is now widely recognised that many rural people can and are willing to pay for improved water supplies and that sustaining and extending services depend on mobilizing their Willingness to Pay (WTP). The pricing of water is the key component to providing an appropriate incentive for sustainable investments. In this way, it is hoped that an optimum price which reflects household's WTP and which can be used as a strategy for cost recovery be established.

This study used the Contingent Valuation Method (CVM) to analyze the willingness to pay for improved water supply services in Phaleng ward, Shoshong. This study had three objectives, namely to quantify the WTP for improved water supply services by Shoshong residents; to examine the determinants of willingness to pay for these services; and to estimate avoidance expenditure. Data used was collected from households in Phaleng ward using a contingent valuation method survey, and analysis was done using ordinary least squares (OLS), Chi square and descriptive statistics.

Results from OLS compare favorably with empirical findings from other studies. Variables such as education level, family size, and income were significant and positive. The volume of water consumed and gender of the respondents were significant but negative. Other variables (Avoidance expenditure and BILL) were not significant. Assuming that the WTP for the sampled households can be generalized for the entire population of the ward and of the village, mean WTP for Phaleng ward and total willingness to pay (TWP) were calculated to be BWP31.38 per household per month in addition to what they are currently paying and BWP39, 664.32 per month respectively. Using bivariate cross tabulation and Chi square test, analysis was carried out between willingness to pay and the socio economic and demographic aspects including some variables that were not included under ordinary least square was done. Results indicate that age and the amount of water consumed in a month (volume) were significant at 5 percent level. Income, gender, and level of education (tertiary and no formal education) were significant at 10 percent level. The study recommends that an intensive publicity campaign to educate people about the benefits associated with the need to pay for an improved water services is a necessary and sufficient condition for the sustainability of the resources. This recommendation is made in the light of the strong positive relationship between education level and willingness to pay by households.

Key words: *Contingent valuation method, willingness to pay, improved water service, Shoshong, Botswana water services*

1. CHAPTER: INTRODUCTION

1.1 Background to the study

Water is important for human survival and economic development. Providing an adequate supply of potable water in both rural and urban areas is of paramount importance to sustain life and facilitate socio-economic development (CSO, 2009). Limited access to water can have adverse effects on human health and may lead to poverty and loss of life due to water related diseases caused by poor water quality and insufficient quantity of water, queuing for water and walking long distances to the water source is also a challenge. In developing countries, adequate potable water supply improves health by reducing these incidents. Cases of mortality and morbidity can also be reduced drastically. It is therefore important to plan for efficient, equitable and sustainable water delivery so as to curb some socio economic challenges. However, to do this, money must be channeled into the system to enable service providers to fully execute their mandate of providing water. In most countries like Botswana, water supply is in the hands of the parastatals, who profit from provision of such services and mainly make use of cost recovery measures, such as water[1] pricing. This element of cost recovery may play an important role in curbing socio economic challenges that arises within the community. This study tries to assess the willingness to pay (WTP) for improved water supply services by Shoshong residents, case study of Phaleng ward.

The assessment of willingness to pay (WTP) for improved water supply services provide the basis for analyzing how households benefits from water of good quality and quantity (Kanyoka, 2008). Studies of this nature are not common in Botswana’s rural areas. To date only a handful studies have been carried out in Botswana on WTP[2]. However, such studies have lately been the centre of attraction for most researchers, especially in developing countries.[3]

Water resources in Botswana are generally considered to be locally contaminated, wide spread stressed and the object of competition by main users for the resources (CSO, 2009). Considering this, it becomes important to investigate the willingness of users to pay for improved water supply services (both in terms of quality and quantity) so as to establish appropriate water pricing or tariff structures which is consistent with government policy. In Botswana, elements of water pricing are provided for in the Acts, but the Acts do not provide detailed pricing principles (CSO, 2009). Currently, Department of Water Affairs (DWA) and Water Utilities Corporation (WUC) use progressive block tariffs, which distinguish government and domestic/ business uses (CSO, 2009). The DWA tariffs apply country wide while the WUC tariffs differ by region. No tariffs apply as yet to wastewater (CAR, 2010). CSO (2009) further stated that, though the DWA is not a profit driven entity, government obtains some revenue out from water production. In

[1] . Water pricing is seen as an important economic instrument for improving water use efficiency, enhancing social equity and securing financial sustainability of water utilities and operators. Tariff setting practices vary widely around the world. Here, we will introduce uniform volumetric charge as a type of water tariff that is simple to manage and that enables to achieve various objectives of sustainable water management

[2] Studies carried out in Botswana include; Moffat *et al*., (2006) on WTP for improved water supply services in Maun, Otsetswe (2001) on WTP for private water connection in Kanye village, to mention a few.

[3] . Some studies for the last ten years in Southern Africa include; Kanyoka (2008), on “Water value and demand for multiple uses in the rural areas of South Africa: The case of Ga-Sekororo”, Ntshingila (2006), carried out the other in Swaziland on “Domestic water uses and value in Swaziland: Application of CVM, Banda *et al*., (2004), did the other on “Determinants of quality and quantity values of water for domestic uses in the Steelpoort Sub-Basin: A Contingent Valuation Approach

urban areas, the parastatal WUC needs to recover costs and may propose new water tariffs, which have to be approved by the Minister of Minerals, Energy and Water Resources (MMEWR). Charges for water consumed are based on a unit of one cubic metre and meter readings are made to the nearest whole unit. According to DEA (2006), the current tariffs for WUC are based on the full recovery of the marginal supply costs as expressed in the long run marginal costs of the North-South Water Carrier. This excludes environmental costs and the forgone benefits that are part of the environmental pricing (*ibid).*

According to Whittington *et al*. (1998), efficient, equitable and sustainable investment in improved domestic water services should be demand driven. Goldblatt (1999), further states that understanding effective demand by consumers is central to cost recovery of current investments and future up scaling of water services.

This study focuses on Shoshong village, which is supplied by water through Mahalapye-Shoshong transmission line, which was completed in the year 2010. Preliminary investigations showed that there are water problems in Shoshong, especially quantity related ones. The National Assembly report of July 2012 states that Shoshong and surrounding areas are equipped with seventy five boreholes of which three have been sold to private owners, seven leased to private companies, thirty eight are on standby to be equipped subject to availability of funds and demand, and 27 of which are completely dry. This has led to problems relating to water quantity and quality: boreholes operate beyond recommended ten hours, dry up due to inadequate rainfall and over extraction; poor water quality of high yield boreholes, thus requiring treatment, boreholes collapse, transmission failure and breakdown of engines and pipes resulting in high leakage problems (National Assembly Report, 2012). Even though the Government of Botswana tries to alleviate shortages using water bowsers, the problem has persisted owing to the high population and competition between users.

To address the above problems, additional capital expenditures are needed, thus the service beneficiaries are required to pay for the improved water services. Demand side information is needed for WUC to understand actual household use behavior and observe ability and willingness to pay for improved water services. This would enable policy makers to design appropriate water tariffs that are consistent with government policy and enhance the long term viability of the service (Bantie, 2011).

In this study, the contingent valuation method (CVM) is applied to elicit determinants of water demand for households and to estimate the relative importance of several attributes (characteristics) of water services. The CVM approach is used to estimate local households' willingness to pay (WTP) for water service improvements.

1.2 Statement of the problem

The water sector in many developing countries in the world is characterised by inadequacies and inefficiencies in terms of service delivery and Botswana is no exception (Gardner-Outlaw and Engelman, 1997). Botswana is plagued by a fragmented institutional approach to water development, top down management approach and a lack of skilled manpower in spite of the country's water scarce situation which requires efficient service delivery overseen by enabling institutional structures in place. Water development inefficiencies in Botswana are reflected in the disrupted flow of water, the frequent breakdown of the water distribution system breakdown, long waiting periods for connection and unsatisfactory customer relations, to mention but a few. According to Whittington *et al*. (1998), efficient, equitable and sustainable investment in improved domestic water services should be demand driven. As such, understanding WTP by customers could be a powerful tool for effective water management. In Botswana, studies of this nature are lacking, there is a knowledge gap in understanding the demand side of water supply and WTP. To date, only two studies have been carried out in the past 10 years in Botswana on WTP (Moffat et al., (2006) and Otsetswe, (2001)). This study therefore seeks to bridge that knowledge gap by assessing WTP for improved water supply services in Shoshong village with a view to availing information for effective policy and planning by the utility management and ensure the sustainability of the service.

1.3 Research Objectives

The general objective of this study is to estimate household willingness to pay (WTP) for improved water supply services in Shoshong village so as to set the correct price information for effective policy and planning by the utility management to ensure the sustainability of the service.

Specific Objectives

1. To quantify the WTP for improved water supply services by Shoshong residents.
2. To examine the determinants of willingness to pay in Shoshong in order to highlight important aspects to consider when water pricing.
3. To estimate avoidance expenditure.

1.4 Research Hypotheses

The following hypotheses will be tested during the study.

1. WTP depends on the situations of the existing drinking water services or more specifically, on quality of the existing water supply and the time taken to fetch water from the existing source.
2. Households without close supply or piped water supply register a higher WTP for a more readily available and closer source than their counterparts who enjoy such services (Banda *et al*., 2004).
3. Household income positively and significantly affects the WTP for improved water services.

1.5 Justification

As stated earlier, water is a natural resource that is vital for development. It is also critical to the attainment of the United Nations Millennium Development Goals (MDGs) whose targets need to be reached by 2015. One of the MDGs is reducing the proportion of people without access to safe and adequate drinking water by half by 2015 (United Nations, 2013). The rationale behind this study is driven by this goal and one of the Dublin statements that recognised that water has an economic value in all its competing uses and therefore should be recognised as an economic good. Assessing the WTP for improved water supply services will help determine whether Shoshong residents conform to what Turton and Meissner (2000) refers to as “second order focus”. This is where residents treat water as a social and an economic resource (WISER) which is finite and vulnerable, essential to sustain life, developments and the environment.

1.6 Scope and limitations

This study is limited to the analysis of the demand side about water supply service for household domestic purposes based on cross section data of households. Thus, while users of the improved water service also include public bodies and commercial sectors, this study deals only with improved water services of households in Shoshong. Limited time for the study and financial constraints made it practically impossible to carry out the study in the whole village. The sample size was therefore only limited to 150 from one ward.

1.7 Structure of the thesis

This thesis is divided into six chapters. Chapter two is a literature review of water challenges in Botswana and its villages as well as valuation concepts and the WTP. It also gives an insight into types of environmental valuation method, then CVM in details, theoretical basis of CVM and historical background, sources of potential bias, usefulness of this method and lastly the empirical literature on CVM. Chapter three covers the study area, socio economic aspects and the water supply situation in the area. A detailed explanation of the survey methodology used in this study, issues concerning research design, data collection and analysis as well as the model used are covered in chapter four. Chapter five present the results and an analysis of the results. Discussion of these results in terms of comparison to other researchers’ findings is covered in this chapter as well. Finally, Chapter six gives a summary of the study and recommendations.

2 CHAPTER: LITERATURE REVIEW

According to MMEWR (2006), potable water is becoming one of the world's scarcest resources. As the human population and economic activities increase, pressure on potable water allocation and management increases resulting in an increase in the value of water (MMWER, 2006). A United Nations report (2006), states that water resources are abundant, but approximately only 2.5 percent of the world's water is fresh-water. The magnitude of the global freshwater crisis and the risks associated with it have been greatly underestimated (Wouters *et al*., 2009). Many people especially in developing countries do not have access to safe and adequate water services which affects their lives in various ways. One billion people on earth are without reliable supplies of water. In Sub Saharan Africa, only 61 percent of the population has access to improved water supply sources compared with 90 percent or more in Latin America, the Caribbean, Northern Africa, and large parts of Asia. Over 40 percent of the global population who lack access to drinking water live in sub-Saharan Africa (UNDP, 2001) and (WHO, 2012). According to (Torres, 2011), a major challenge facing water supply in Sub Saharan Africa is the high levels of non-revenue water.

On average, a service provider in the region loses 39 percent of its water production. Some utilities present losses as high as 68 percent of their revenue while some register levels of non-revenue water of only 12 percent of their revenue (*ibid*). Torres (2011) further stated that the high levels of non-revenue water in Sub Saharan Africa are explained by limited and dilapidated infrastructure that creates physical losses. Physical losses include leakages from the system and overflows from storage tanks. At present, many developing countries have difficulties in supplying the minimum annual per capita water requirement of 1,700m^3 of drinking water necessary for an active and healthy life (Tiroyamodimo, 2007). Most economically developed countries in Southern Africa like Botswana, South Africa and Namibia are among the most stressed (Turton., 2000 (b)). It can be argued that if left unchecked, water scarcity could impact negatively on the economic growth potential of those three countries specifically, and therefore affect regional economic growth in a negative way (Falkenmark *et al*., 1990). Projections indicate that by 2050 at least one in four people is likely to live in countries affected by chronic or recurring shortages of fresh water (Gardner-Outlaw and Engelman, 1997). In light of this crisis, there have been efforts to counter the water crisis situation dating as far back as the 1980s with the inauguration of the UN International Drinking Water Supply and Sanitation Decade in 1981 (Tiroyamodimo, 2007). However, current approaches to water management focus mainly on technical improvement and sectoral solutions without paying sufficient attention to the social and sustainability aspect.

2.1 Water scarcity in Botswana

Botswana is a water stressed country that has inadequate water supply. Both surface and underground water resources are scarce in relation to the country's population growth. Rainfall is low over most parts of the county, varying from 250 mm/pa in the far south-west to 650 mm/pa in the extreme north; the national average is only 450 mm (CSO, 2009). Most of the rainfall, surface water and water in the soil are lost through evaporation and evapotranspiration, as open water evaporates at a rate of about 2 000 mm/pa (CSO, 2009). Recurrent periods of drought exacerbate water scarcity. Water sources in Botswana consist mainly of surface water (in rivers, pans and dams) and underground water in aquifers, some of which are of a fossil nature without recharge (UNDP, 2012). There are eight dams in the country, of which the Dikgatlhong is the largest with a capacity of 400Mm^3. The 2005/06 Review of the Botswana National Water Master Plan (BNWMP) concluded that the construction of the Dikgatlhong dam and expansion of the North South Water Carrier would not be able to meet future water demand in Botswana beyond 2030. This suggests that water supply measures under the 'business-as-usual' scenario will be inadequate in future and have high costs, hampering Botswana's competitiveness, economic growth and diversification (DEA, 2006).

In a bid to avoid such a scenario and ensure Botswana's competitiveness and economic growth, the country has prepared an Integrated Water Resource Management Plan Water Efficiency (IWRM-WE) which is meant to use water resources more efficiently and to increase participation of various sectors in the planning and management of water resources. The plan was facilitated by Centre for Applied Research and Kalahari Conservation Society (KCS)[4] as the secretariat of the Botswana Global Water Partnership. Botswana, the SADC region and the global community have by and large accepted the concept of integrated water resource management (DEA, 2006). Box 2.1 gives an outline of Dublin principles of IWRM which were adopted by Botswana in a bid to increase water use efficiency and participation.

Box 2.1: Dublin Principles of IWRM

1. Water should be treated as an economic good with a price. Managing water as an economic good is an important way of achieving efficient and equitable use, and of encouraging conservation and protection of water resources.
2. Water management should be participatory, that is involving the stakeholders; decisions should be taken at the lowest level with full public consultation and involvement of all users in the planning and implementation of water projects.
3. Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment. Effective management of water resources demands a holistic approach, linking social and economic development with protection of natural ecosystem
4. Women should play a central role in the provision, management and safeguarding of water. Acceptance and implementation of this principle requires positive policies to address women's specific needs and equip and empower them to participate at all levels in the water sector

Source: DEA (2006) and UNECO/UNEP-DHI (2009*)*

[4] The Kalahari Conservation Society (KCS) is a Botswana-based non-governmental organization. The Society was formed in recognition of the environmental pressures being placed upon Botswana's wildlife and habitats and has subsequently evolved into one addressing a diverse range of environmental issues - a strategic and holistic approach encompassing wildlife and biodiversity conservation, community based natural resource management projects, sustainable development, as well as sustainable agriculture and latterly, water resource and waste water management.

Making potable water easily accessible in developing countries like Botswana is hampered by many constraints such as the lack of trained manpower, financial constraints and poor infrastructure. Moreover, water use is unevenly distributed over the residential user groups and among economic sectors. Firstly, the poor tend to have the lowest consumption as they rely on standpipes outside the yard or struggle to keep their water bill from a private connection down. Secondly, agriculture is the largest water consumer even though it creates less value added and formal employment than other sectors (Arntzen *et al*., 2000). The apparent misallocation of water is common in the entire region, while irrigation is the main 'culprit' in South Africa, Zimbabwe and Namibia, the livestock sector takes the largest share in Botswana. It is doubtful whether this situation can continue with increasing water scarcity (Arntzen *et al*., 2000). Solving the potable water problem of the people of Botswana has proven a difficult task. According to CSO (2009), the proportion of the population with access to piped/tapped water whether from a private connection or communal tap is 87.0%. A comparison between cities/towns and villages (urban and rural) shows that 99.5% of the population in cities/towns have access to piped or tapped water while in villages the proportion is 84.1%. According to UNDP (2012), this success has had positive impacts on health and sanitation thereby contributing to the other MDGs, especially those relating to gender equality and child mortality. Women and the girl child are normally responsible for collection of water and ensuring that there is enough water for household use. This together with other household chores can be labour intensive and time consuming. UNDP (2012) further states that challenges in the water sector in Botswana in the context of Green economy[5] which for the water sector (as with other sectors) implies ecological and socio-economic efficiencies, increasing the numbers of decent jobs available and reinvesting in the environment can be discussed in relation to the following;

2.1.1 Dam development

Botswana has no further opportunities to develop large dams owing to the flat topography of the country. With the opportunity for dam development declining with any additional sites, the need for efficient use of existing dams becomes even greater. Since dams also act as wetlands, the challenge of managing them as wetlands is prominent (UNDP, 2012, Seanama Conservation Consultancy, 2012).

2.1.2 Integration Water Resources Management

IWRM is probably the most significant challenge as without it, a number of the opportunities may prove unattainable (Seanama Conservation Consultancy, 2012). Education, training and extension, entrepreneurial capacity, sectoral programmes (agriculture, energy, fisheries, tourism) need to be coordinated in setting the agenda for a green economy (*ibid*). Table 2.1 shows the opportunities, risks and barriers faced by Botswana in the context of green economy.

[5] A system of economic activities related to the production, distribution and consumption of goods and services that result in improved human wellbeing over the long term, while not exposing future generations to significant environmental risks and ecological scarcities (UNEP Green economy initiative)

Sector	Opportunity	Barrier and risks	Barrier Removal
WATER	***Dams*** ➢ Food Security through fisheries and green jobs in harvesting, processing and transportation. ➢ Green jobs in tourism hotels, boathouses, water activities and green taxes. ➢ Biodiversity conservation of water dependent species (the ecosystem to support fisheries) ➢ Maintenance of downstream riverine ecosystem	Absence of of institutions with capacity for integrated natural resources management.	Establishment of Dam Management Authorities where a Water Utility is one of users of the dams as could Fishing Companies
		Upstream catchment areas are not managed and siltation is an eminent risk.	-Policy briefing on the economics of dams, revision of WUC mandate -Include in MEWT and MoA plans, targets catchment areas for land husbandry.
	WDM ➢ Assisting industry and households to achieve the same with less water. Process-mapping for industries; ➢ Reducing the need for infrastructure expansion to meet false-demand, improving climate change resilience	-False-sense of water being available for those who can pay. -Utility company interested in sales -Perverse economic incentives (e.g. water consumption subsidy)	-Awareness of Botswana's critical water situation -Review of Water Tariffs to increase precision of subsidy targets and Redirect subsidies to small-holder farmers, especially women.
	Increased storage capacity ➢ Additional Dams ➢ Aquifers ➢ Reduces water transfer infrastructure costs ➢ Reduces water loss from evaporation	-Technology for aquifer mapping lacking -Legislative reform to increase monitoring of aquifer use -Economics of alternative technology not understood	Technology acquisition through South-South Partnerships and Increase knowledge generation through research partnerships on underground water science.
	Water Recycling ➢ Increases availability for non-drinking purposes, especially opportunities food irrigation & food security ➢ Strengthens the economic case for investing in high quality wastewater treatment infrastructure	Low social acceptance -Infrastructure for distribution of recycled water insufficient -Treatment centres overwhelmed by current volumes, Private sector exclusion	Public education on wastewater health concerns -PPP

Table 2.1: Aspects of the Green economy

Source: Seanama Conservation consultancy (2012) in UNDP report

Botswana's strategy is to provide its citizens with reliable and affordable water. Guaranteeing access to potable water and improved sanitation for poor households is already a priority of the GoB. Thus, Government efforts have focused on establishing water reticulation in cities, towns and villages to ensure adequate access to water for domestic use and for productive sectors based there (DEA, 2006). Current instruments used for water supply are stand posts with free water (with or without tokens) and a social life line tariff for the initial amount of metered water (World Bank, 2009).

2.1.3 Pressure on resources in Botswana

The growing pressure on available water resources in Botswana is a result of the increases in population, rapid urbanization and developments (CSO, 2009). With more people moving into the cities and major settlements, the demand on water resources has increased, presenting a serious problem to the country which is drought prone. In response to this problem, the Government has come up with the National Water Master Plan which contains measures aimed at conserving the country's water resources. Amongst these measures is the recommendation to restructure the water sector which includes separating water resources management from water service delivery and tasking WUC with the mandate to take over all water and wastewater service delivery in the country. According to CSO (2009), water in Botswana is subjected to a lot of stress due to, over-exploitation, pollution and aquatic weeds. Different sectors compete for water such as domestic, industry and agriculture to mention a few. Water pollution is a growing problem that affects both surface and ground water. Discharges from agriculture, mines, industries and domestic pollute surface water. Ground water is polluted primarily through pit latrines and livestock excrements (Arntzen *et al*., 2000). These pollutants reduce the available water for domestic use.

Although Botswana is recognised as one of the most water scarce country in Southern Africa (SADC Regional Water Strategy; SADC, 1999-2004),in some regional assessments, the country is not considered to be water scarce (DEA, 2006). According to Ohlsson, (1995), per capita water availability in Botswana is at 14,107m^3. Falkenmark and Lundvist (1997) argue that Botswana uses less than 1% of the available water resources, and is much better off than countries such as Malawi. These assessments include the large perennial resources of the Okavango and Chobe, which are shared with other countries (DEA, 2006).

2.2 The concept of total economic value

Some environmental goods and services often have no market price tag and are characterised as public goods with a considerable amount of uncertainty surrounding their true value and significance. In order to determine the value of the environment, the unpaid prices of the environment must first be revealed (Mayor, 2006). Revealing these prices suggests that they can and should be paid for (*ibid*). The concept of Total Economic Value (TEV) constitutes a watershed in the importance accorded to the environment within the decision theory (Plottu and Plottu, 2006). According to Mayor (2006), total economic value (TEV) suggests the existence of an extended economic value for the goods and services provided by the environment. Figure 2.1 shows the main categories of values used to determine the TEV.

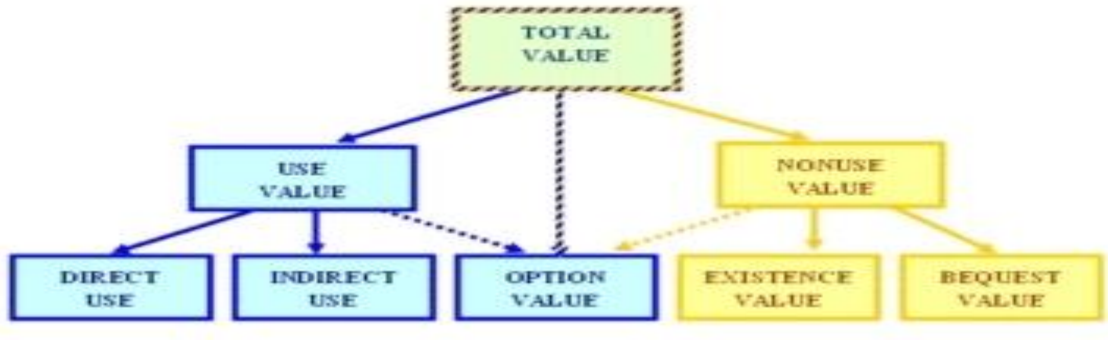

Figure .2.1: Total economic value (*Source; Plottu and Plottu, 2006)*

2.2.1 Use value

According to Awad *et al*., (2010), use value can be subdivided into direct use value or indirect use value. Direct use value is consumptive, extractive, or structural use value. For instance, direct uses of water include drinking, waste disposal, industrial use, recreation or sport and fishing. In contrast, indirect use values are those in which water is indirectly used to produce a good (*ibid*). Awad *et al*., (2010) further stated that the indirect use values occur from the natural functioning of ecosystems, for example, an indirect use of water received is characterized by its fewer benefits, which are not traded in any market and are sometimes referred to as un-priced benefits to water users.

2.2.2 Non-use value

Defined in monetary terms within the concept of TEV, option and nonuse values can carry weight in the analysis of the costs and benefits of a project where environmental goods are at stake. This value of domestic water supply services includes intangible benefits that households derive without any direct or indirect use. The non-use value can, however be subdivided into existence, bequest, and option value (Dixon, 2008). Existence value is the value of knowing that something exists, regardless of the fact that we have never seen or used the resource, or intend to see or use it in the future and bequest value is the value an individual places on the ability to conserve a resource so that it can be used by future generations (Farolfi, 2011). In other words, respondents might be willing to pay to restore water quality for the time being and in future, in the knowledge that their heirs and future generations will have good water quality (Farolfi, 2011). Carson and Hanemann, (2005) gave another example on bequest value that some people would be willing to pay to protect a national park because they want to preserve it for their children and grandchildren. The third part of non-use value is option value; a concept of option value refers to the value placed on a resource's future use. Example; some people who do not now visit a national park may still be willing to pay money to protect it from destruction or irreversible damage because they want to preserve their option of visiting it in the future (Carson and Hanemann, 2005).

2.3 Economic valuation methods

There is no single economic value for water, as is the case for most environmental and natural resources (Farolfi, 2011). According to Hoevenagel (1994), various valuation methods are available which can be used to determine economic values of environmental resources, including water. When a value for water is being estimated, what is being measured is the welfare change associated with some induced changes in the attributes of the commodity (Farolfi, 2011). The main concern of environmental valuation is to attach monetary values for nonmarket environmental goods and services so as to integrate their values into economic decision making processes (Berihun, 2010). Dixon, (2008) in (Berihun, 2010) further states that environmental valuation is fundamentally based on the assumption that individuals are willing to pay for environmental improvements and conversely are willing to accept compensation for some environmental deterioration.

Various classifications of the valuation techniques to measure the economic value of unmarketable environmental goods and services have been extensively studied. These methods can be distinguished on the basis of the process by which they retrieve people’s environmental preferences. According to Pearce and Turner (1990) and Turner *et al.* (1994), the two main methods of environmental valuation methods are direct (or stated preference) and indirect valuation (or revealed preference). Moreover, Stephens *et al*., (2010) highlight that at the highest level; literature classifies the different methods for estimating WTP into revealed and stated preference methods as shown in figure 2.2.

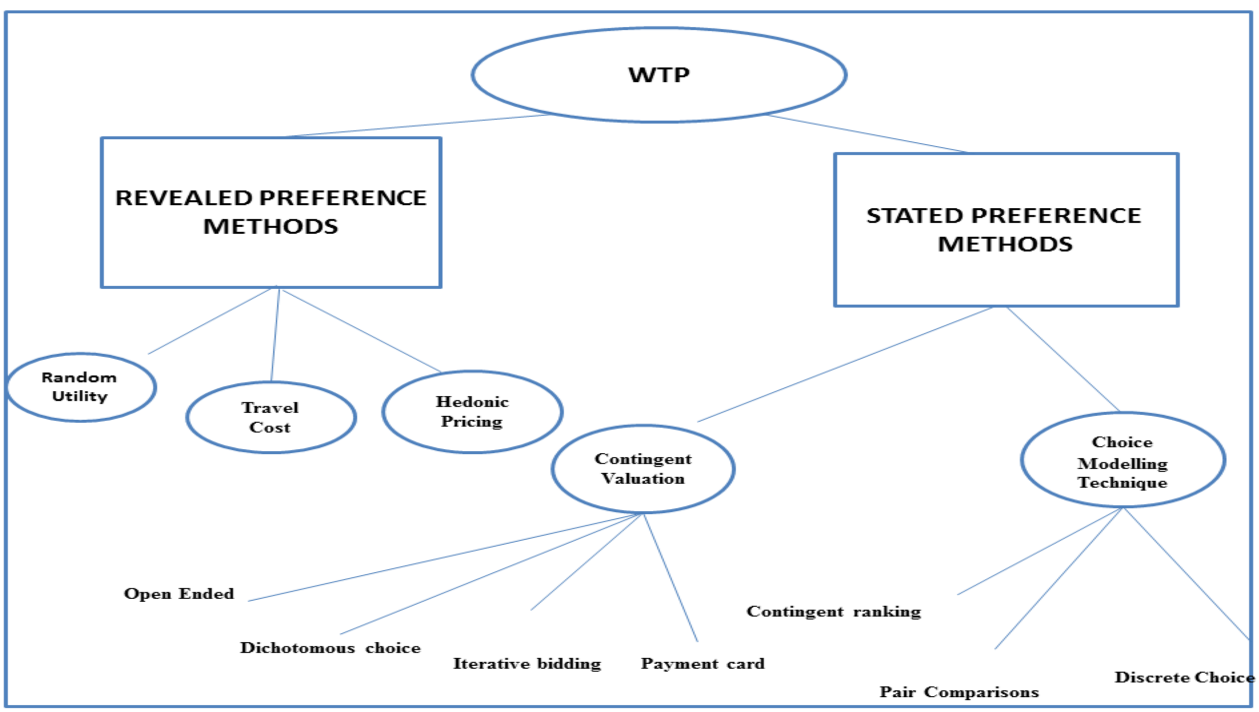

Figure .2.2: Environmental valuation methods. *(Source; Stephens, 2010)*

2.3.1 Stated Preference Methods

The family of stated preference (SP) methods can measure the total economic value (see table 2.2); they incorporate both non-use value and option value (Stephens, 2010). This characteristic has far-reaching potential, as it implies that SP can be used to value potential future or hypothetical (but realistic) goods and interventions (*ibid*). According to Berihun (2010), these methods seek to directly measure the monetary value of environmental services by attempting to elicit environmental values directly from respondents by asking them about their preferences for a given environmental good or service. Farolfi (2011) and Stephens (2010) stated that when considering stated preference methods, the main categories are the Contingent Valuation Methods (CVM) and Choice Modelling, techniques including Discrete Choice Experiments (DCE).

2.3.2 Revealed Preference Methods

Revealed preference methods (RP) refer to the observation of preferences revealed by actual market behaviour and represents real-world evidence on the choices that individuals exercise (Stephens, 2010). These methods make use of individuals' behaviour in actual or simulated markets in order to infer the value of an environmental good or service (Loomis *et al*., 1999). In this method, we observe a real choice in some market and cleverly infer information on the trade-off between money and the environmental good (Kolstad, 2000 in Berihun, 2010). Most commonly used revealed preference methods are the travel cost method (TCM) and hedonic pricing method (HPM) which are discussed in detail in box 2.2.

2.3.3 Replacement / Substitution Valuation Method

Replacement and substitution cost methods are related methods that estimate the values of ecosystem services based on either the costs of avoiding damages due to lost services, the cost of replacing ecosystem services, or the cost of providing substitute services (Queensland Government (QG), 2003). These methods do not provide strict measures of economic values, which are based on people's willingness to pay for a product or service. Instead, they assume that the costs of avoiding damages or replacing ecosystems or their services provide useful estimates of the value of these ecosystems or services (*ibid*). The method is most appropriate when applied in cases where damage avoidance or replacement expenditure have actually been or will actually be made. Examples as stated by Queensland Government (2003) include:

- valuing improved water quality by measuring the cost of controlling effluent emissions
- valuing the water purification services of a wetland by measuring the cost of filtering and chemically treating water;
- loss of habitat by establishing a similar habitat elsewhere

Box: 2.2: HPM and TCM in Practice

HEDONIC PRICING METHOD

The hedonic pricing method looks at price and quality variation across goods to infer implicit value of an environmental resource. Goods are considered as bundles of characteristics one of which is the environmental resource of interest. These goods are sold at different prices. Once all other characteristics have been taken into account the differences in price reflect the market value for the environmental resource.
An example could involve differences in property values because of differences in air quality:
- $HP = a + bQ + cZ$

With b being the marginal effect on price of a unit change in air quality Q, and c the marginal effect of other features (Z) that affect house's price such as size, relative location to public transportation, bathrooms, etc.

TRAVEL COST METHOD

The travel cost method is mainly used for the valuation of environmental services from recreational sites (eg national parks). This method measures the benefit (WTP) for a recreational experience by examining household expenditures on the cost of travel to a desired recreational site. There are single-site models and multiple-site models. The multiple-site model explicitly considers the fact that people can make trips to alternative recreational sites. This is important because the existence of relevant substitutes will influence the valuations. Data is needed on the characteristics of individuals, the number of visits to the site, information about travel costs etc.

The procedure for conducting a travel cost method analysis involves the following steps:
- Define the benefit to be valued
- Collect the necessary data
- Define the zones of recreation origin
- Calculate the visit costs for each zone
- Determine the visit rate for each zone
- Recognise the model assumptions and constraints
- Apply appropriate statistical methods to calculate WTP

The recreation demand model examines the following relationship:

COST OF VISIT = TRAVEL COST + OPPORTUNITY COST + COSTS DUE TO THE DURATION OF THE VISIT

Table 2.2: Taxonomy of nonmarket valuation methods

Valuation Method	Description of Method and Data Sources	Useful for Valuing Water as:
Travel Cost Method (TCM)	Revealed preference method using econometric analysis to infer the value of recreational site attributes from the varying expenditures incurred by consumers to travel to the site	Valuation of recreational services and derived at source valuations for changes in water supply.
Hedonic Property Value Method (HPM)	Revealed preference approach using econometric analysis of data on real property transactions with varying availability of water supply or quality	At-source demands for changes in quantity or quality revealed by transactors in residential or farm properties, environmental quality, including air pollution, water pollution, or noise
Choice Modeling (CM)	Expressed preference method using statistical techniques to infer WTP for goods and services from survey questions asking a sample of respondents to make choices among alternative proposed policies	At-source valuations of environmental (e.g. in stream) water supplies. Also at-site valuations of changes in residential water supplies
Contingent Valuation Method (CVM)	Expressed preference method using statistical techniques for analyzing responses to survey questions asking for monetary valuation of proposed changes in environmental goods or services	At-source valuations of environmental (e.g. in stream) water supplies. Also at-site valuations of changes in residential water supplies
Replacement value method		Valuing improved water quality by measuring the cost of controlling effluent emissions, valuing the water purification services of a wetland by measuring the cost of filtering and chemically treating water.

Source: Farolfi, (2006)

2.4 Contingent Valuation Method

Contingent valuation (CV) is an important survey-based procedure for determining the economic value of the quality and availability of non-market commodities. It can be used to estimate both use and passive values and is the most widely used method for estimating passive values (QG, 2003). The method is particularly attractive because of its simplicity and flexibility and it is commonly applied to cost-benefit analyses and environmental impact assessments (Farolfi, 2011). Furthermore, it is the only technique theoretically capable of estimating the benefits produced by water quality improvements, including non-use values (Bantie, 2011). Thus based on the reasons mentioned above CVM is employed for this study.

The CV framework is based on maximizing utility from the consumption of market and non-market goods such as environmental quality. In recent years, this method has been commonly used in developing countries to elicit the individuals' preferences for the basic infrastructural projects such as water supply and sanitation (Banda *et al*., 2004). The method is called "*contingent*" valuation because people are asked to state their willingness to pay, *contingent* on a specific proposed scenario and description of the environmental service (QG, 2003). It involves directly asking people in a survey how much they would be willing to pay for specific environmental services (Ntshingila, 2006). In some cases, people are asked for the amount of compensation they would be willing to accept to give up specific environmental services.

The contingent valuation method is referred to as a "stated preference" method, because it asks people to directly state their values, rather than inferring values from actual choices, as the "revealed preference" methods do (Ntshingila, 2006). The fact that CV is based on what people say they would do, as opposed to what people are observed to do is the source of its greatest strengths and weaknesses (Carson, *et al*., (1994) in Ntshingila, 2006). In CVM, values are generally measured in terms of what Hicks (1946) refers to as "the compensating variation" or WTA for damaged environment and the "equivalent variation" or WTP for improved service. For a 'proposed welfare gain' due to the provision of public good, Venkatachalam (2003) states that the compensating variation refers to the amount of money and income that has to be given up by the consumer to attain increased level of utility (i.e. WTP measure). The equivalent variation refers to the amount of compensation required to be provided to the individual to allow him/her to attain an improved utility level in case the provision of the public good does not take place (i.e. WTA) (*ibid*). Moreover, Awad *et al*., (2010) state that most WTP studies use CVM in order to identify the potential demand curve for improved water supply and quality, and many of these identified current water markets and compared them with WTP, further to other advantages such as:

1. It can take non-use values, use values, optional value, and quasi-option value into account for environmental goods.
2. It can be designed to include only the variables of the market relevant to the study objective (e.g., WTP for improved water supply). In case of a water system, it is possible to test the results of a contingent valuation survey by comparing the responses given when the water system was hypothetical to the actual behavior once the water system becomes available
3. It also enables individuals to consider the true cost to themselves of a particular injury or illness.

4. The applicability of this method is larger compared with the other valuation methods in terms of completeness

A CVM usually involves designing a questionnaire where respondents are presented with materials, often in the course of personal interviews conducted face to face. According to Banda *et al*., (2004) and Fryblom (1997), the CVM should include a detailed description of the goods being valued and a hypothetical circumstance under which it is made available to the respondents. Policy analysis and academic research have made extensive use of the CV technique. It is utilized to elicit people's preference expressed in terms of WTP. CVM is widely used to evaluate WTP for social projects not only in developed countries, but also in developing countries especially those countries facing political, social and water scarcity problems.(Wattage, 2002).

Even though economists have largely focused on market prices as the indicator of economic value, earlier writers such as Clark (1915) and Hines (1951) clearly saw that much of an individual's utility was driven by unpaid costs and uncollected benefits and that "market prices" did not exist for many of the more interesting quantities to economists (Carson and Hanemann, 2005). The CVM was originally proposed by Ciriacy-Wantrup (1947) who was of the view that the prevention of soil erosion generates some 'extra market benefits' that are public goods in nature, and therefore, one possible way of estimating these benefits is to elicit the individuals' willingness to pay for these benefits through a survey method (Portney 1994, Hanemann 1994 and Venkatachalam, 2003). However, it first came into use in the early 1960's when Robert K. Davis (1963) used questionnaires in his dissertation to estimate the benefits of outdoor recreation in a Maine backwoods area (Wattage, 2002, Carson and Hanemann, 2005). According to Venkatachalam (2003), this method gained popularity after the two major non-use values, namely, option and existence values were recognised as important components of the total economic values in environmental economics literature, especially during the 1960s. Ronald Ridker (1967) under the influence of Davis, used the CV method in several studies of air pollution benefits (Carson and Hanemann, 2005).

2.5 Usefulness of CVM

The CVM is best for resource valuation studies because of the importance of non- use values and their potentially significant levels, where other methods such as TCM will underestimate the benefits of preserving the non-market value, in this case water (Ntshingila, 2006). A major benefit is that it captures the consumer surplus unlike replacement valuation. Some of the advantages are that it is very flexible and can be used to estimate the economic value of virtually anything. However, it is best able to estimate values for goods and services that are easily identified and understood by users and that are consumed in discrete units. CVM has several advantages over the other methods of environmental valuation such as the travel-cost and hedonic pricing techniques as stated by Moffat (2006) and Hanemann (1991); 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 has been officially recognised by the US Water Resources Council as a recommended valuation technique. Fourthly, CVM is able to measure passive use values and this has led to many applied environmental economists choosing it.

However, opponents of CVM are critical of the reliability and validity of answers to hypothetical WTP questions. According to Venkatachalam (2003) and Hausman (1993) critics argue that this method is not capable of estimating the economic values, especially the non-use values. They argue that the method is prone to a number of difficulties (or biases). There is always the possibility of strategic behaviour (Venkatachalam, 2003 and Hanemann, 1996). 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 to their actual payments (*ibid*). Therefore, a careful design of the questionnaire and description of the good in question is needed to minimize this kind of bias. Supporters of CVM on the other hand argue that the problems associated with the CV method are mainly due to the poor administration and implementation of the CV survey, and therefore the CV method is capable of eliciting the true economic values of the environmental resources if properly conducted (Carson and Hanemann, 2005, Venkatachalam, 2003). In view of this, different guidelines and procedures (termed reference operating conditions by Cummings *et al*., 1986) for conducting the CV method that could elicit valid and reliable results were developed by supporters of this method (Carson and Hanemann, 2005).

2.6 Designing CV questions

According to Stephens, (2010), the objective of a contingent valuation (CV) questionnaire is to elicit preferences in monetary terms, more specifically the maximum WTP or minimum Willingness to Accept (WTA) for changes in the quantity or quality of a good or service from a random sample of respondents. These changes may refer to a hypothetical or an actual good or service *(ibid*). Bateman *et.al*, (2002) as quoted in Stephens (2010), point at three differences. Firstly, CV questionnaires ask respondents to consider how a change in a good or service might affect them. The policy change (real or hypothetical) should be perceived as being realistic and feasible and is described in detail before respondents are asked to evaluate it. Secondly, the hypothetical good or policy may be complex and unfamiliar to respondents which may result in inconsistent and unreliable observations. Finally, respondents are asked to state their WTP or WTA for the change in the good or policy in question. Figure 2.3 shows three main stages of formulating a CV questionnaire as stated by Stephens, (2010).

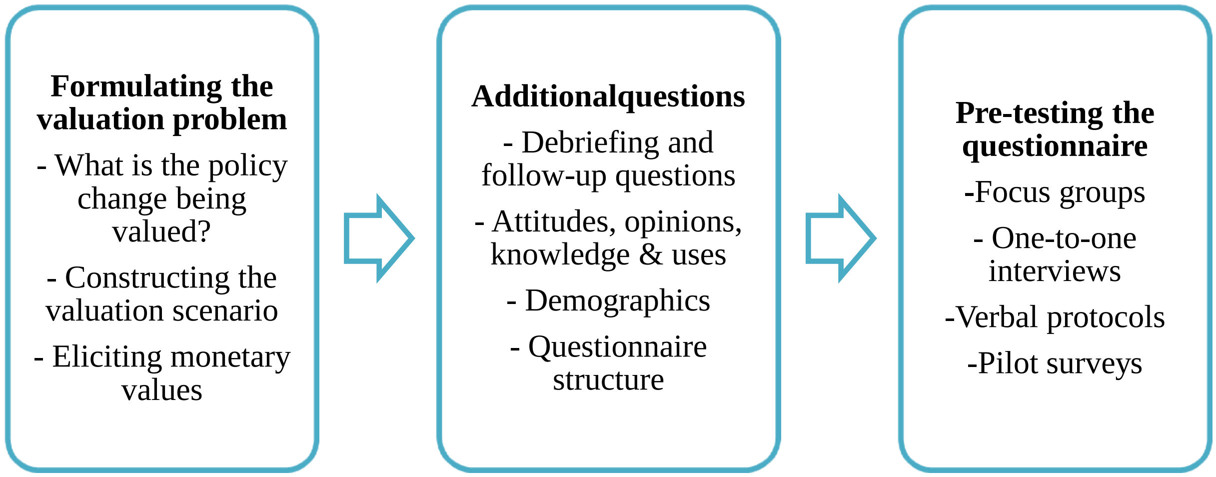

Figure .2.3: Stages of formulating CV questions

According to Murphy (2004), a basic reason contingent valuation results may be inaccurate is the possibility that the responses are biased away from the unobservable true maximum WTP (or accept). CVM is often associated with the following types of biases; hypothetical bias, strategic bias, starting point bias, vehicle bias and information bias.

2.6.1 Hypothetical bias

Hypothetical bias can be understood as a dilemma for contingent valuation. Murphy (2004) defined this type of bias as the lack of any consequences associated with an individual's response. One of the most appealing explanations is that if the respondent has a positive value for the good, and if his/her response to the valuation question may increase the likelihood of the good's provision at little or no cost to him/ her, then it makes sense for him/her to report an inflated value (Bohm 1984; Harrison and Rutström as quoted in Murphy, 2004). Individuals merely express a positive attitude for the good without necessarily agreeing to contribute towards its provision (Murphy, 2004).

2.6.2 Strategic bias

Respondents provide a biased answer to influence the outcome. If the respondents realize that the interviewer is an official from government, they may modify their answers thinking that it will increase their chances of getting better water services.

2.6.3 Information bias

This is usually the most significant bias (Murphy 2004), an increase in information given to respondents would allow them to think more comprehensively about the cost and benefits accruing from the proposal for them and their families (Farrington 2003 in Ntshingila, 2006).

2.6.4 Interviewer bias

This occurs when the respondent's impression of the interviewer affects the answers of the respondents, the interviewer gestures may intimidate the respondent or the respondent may be looking down on the interviewer, and therefore gives a biased answer.

2.6.5 Communication bias

This kind of bias normally occurs where there is a communication barrier: the interviewer may not be familiar with the language of the respondent, hence making communication difficult. Normally translators may be employed for ease of communication between the two, but either party cannot express themselves clearly through the translator.

2.7 Willingness To Pay Theory

Some of the key concepts involved in assessing the costs and benefits of improved water services are social costs, private cost and externalities. Underlying these concepts is the notion of willingness to pay and/or willingness to accept (Ntshingila, 2006). According to Frew *et al*., (2003), the WTP technique was pioneered by environmental economist as means of valuing non-traded goods with public characteristics and ill-defined property rights. WTP theory describes the consumers' preferences in relation to changes in water services and prices (Phiri, 2007). According to China Water Sector (CWS) (2006), WTP is the expected payment a user is willing to pay for a given service or product or a given change in service level or product attributes. Thus WTP reveals the level of increase in payment that leaves the consumer indifferent as to the situation before and after the change. Phiri (2007) further stated that, to avoid a deterioration of the situation, the WTP represents the compensation in payment which will be necessary to leave the consumer indifferent. It is often associated with the attitude and behaviour of an individual.

Gunatilake *et al*., (2007) stated that WTP is the ideal method for ensuring better services in designing water supply. WTP for water services is determined by a large number of factors including but not limited to, demographic factors, the existence of alternative sources of water to the consumer and quality of water services (Farolfi 2006, Banda *et al*., 2004, Phiri, 2007, Carson *et al.,* 2005). WTP questions adopt an open ended approach so as to avoid potential bias. This type of question is called "open-ended" CVM because the respondents are open to indicate any amount that they want. Despite the increasing usage of WTP and the open ended questionnaire approach, questions of validity and reliability of the method have been raised by many authors. Stavins (2004) raised questions of whether neglected attributes in WTP influence the choice decisions of the respondents and hence bias the WTP values obtained (respondents bias) (Ntshingila, 2006). According to Rodgerson (1996), it is evident that the principal challenge of the next decade will not be technological questions relating to the "hardware of water supplies and sanitation" but the "software issues", most notably questions relating to the organisation and financing of water and sanitation programmes. One key software issue concerns the issue of household and community "willingness to pay" for water supplies or sanitation. Progress and continuing success in the water sector hinges upon the response to consumer demand, and a first step in that response is to understand household or user willingness to pay (*ibid*).

2.8 Empirical CVM studies on water

The Contingent Valuation Method has been repeatedly used in recent years in valuing of environmental benefits such as the benefit of reduced air pollution, the valuing of water quality and improved solid waste management and the option or existence value of ecologically important species (Bantie, 2011). Kundy, (1998) stated that with arising awareness of the cost of environmental degradation in less developed countries, coupled with the pressure from donor organizations about the inclusion of environmental impact assessment in project designs, the CVM technique is now widely used to evaluate the benefits of water, tourism and forestry projects.

This section of the chapter reviews recent studies that have been carried out in developing countries. This serves mainly to draw comparisons with the current study, as it is also carried out in a developing country. Most empirical studies on 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 (Moffat *et al*., 2006).

Griffin *et al*., (1993) used the CVM to assess the WTP for an improvement in the quality of water services in several rural villages in India. Respondents were allowed to consider hypothetical changes in water supply characteristics and respond to questions about the effect on connections, monthly services and improved quality of services. The results of this study suggest that the local water authority can lead the way to a better water service by making some critical policy changes, encouraging private water connections by incorporating the cost of connection into the monthly tariff, charging a higher monthly tariff and using the resulting increased revenues to invest in and maintain a higher quality on water services. Moreover, Amoah and Adzobu (2013) carried out another study in Ghana on 'Application of Contingent Valuation Method (CVM) in determining demand for improved rainwater in Coastal Savanna Region of Ghana, West Africa. This study used the CV method as a valuation technique for non-marketed goods to estimate the demand for clean rainwater for domestic use. The ordered probit model was used to determine the various factors that can influence respondents' willingness to pay for clean rainwater. The study found that about 93.2% of respondents are willing to pay GH ₵ 0.025[6] daily for a 34cm container of clean rainwater and this amount was observed to be influenced by some socioeconomic factors.

Banda *et al*. (2004) carried out a study to determine the quality and quantity values of water for domestic uses in Steelpoort Sub basin, in South Africa. The general results of the study were that

[6] GH ₵ 0.025 is equivalent to 0.01 USD

rural households stand to benefit more than urban households from improved availability of water (Banda *et.al*. 2004).

In addition to the study by Banda *et.al* (2004), Tsegaye (2005) used CVM to elicit the WTP of fishermen to the improvement of Lake Chamo in Ethiopia. His analysis showed that there is a positive and significant correlation between WTP and income of households and educational level of the respondent. However the response is negatively and significantly correlated with the age, and sex of the respondent (male).

Another study that used CVM was that by Moffat *et al*., (2006). The study investigated willingness to pay for improved water quality and reliability of supply in Chobe ward, Maun. The study found out that on average, 54% of the households are willing to pay for improved water quality. Moffat *et al*., (2006) further stated that the results indicate that in Chobe Ward. residents in general regard water as an economic good as they are willing to pay for its provision. It was further discovered that 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 is the more they are willing to pay for improved water quality and reliability (Moffat *et a*l., 2006). Moreover, it was discovered that larger families are not willing to pay for an improved provision of water services.

The study by Moffat *et al*., (2006) was further supported by Ntshingila (2006), who assessed on determinants of Swazi households' willingness to pay (WTP) for an improvement in their water quantity and quality. The findings of this study indicated that household income had a positive and statistically significant impact on WTP for both quality and quantity. Distance to the water source is positively associated with WTP regardless of the location (rural or urban) and of the household head's age, education, and gender (Farolfi *et al*., 2007). This study further concluded that current water consumption was also statistically significant for WTP for improved quantity, but with a negative sign, implying that the more a household consumes water, the less that household is willing to pay to have improved water quantity. Moreover, rural households showed a much higher WTP for improved water provision services than urban households (Farolfi *et al*., 2007).

Montes *et al* (2003) conducted a study assessing the WTP for maintained and improved water supply in Mexico City. The result showed that the poorer households were mainly concerned with securing reliable services while wealthier households who already enjoy better services were willing to pay higher amount to avoid service deterioration than for improvements. It was further demonstrated in the study how WTP results can be used to create equity based policy of water tariffs reflecting income distribution. The aggregate WTP amounts showed that the authorities could collect sufficient resources for both service modernization and could also reduce existing subsidies by 70%. Kundy, (1998) compiled table 2.9 showing WTP for domestic water based on literature.

Table 2.8: Literature in numbers

Study	Area	US$	WTP	Tariff module
Bah, I (1997)	Siera Leone	1679.27	Le 7,266,073.04	Per 100 gallons
Carson *et al*., (1993)	Carlifornia	$8.83	$8.83	Per 1,000 gallons
Briscoe *et al*., (1990	Brazil	4.47	Cruzado 100	Monthly flat rate
Griffin *et al*., (1990)	Kerela, India	0.32	Rs 19.3	Monthly flat rate
Whittington *et al*., (1991)	Onitisha, Nigeria	0.04	Naira 6.0	Monthly flat rate
Whittington *et al*., (1990a)	Anambra, Nigeria	0.12	Naira 20	Monthly flat rate
Aguilar, (1995)	Costa Rica	0.7	US$0.7	Per cubic metre

Source; Kundy (1998)

Concluding this chapter, one can deduce that CVM is widely applied as a valuation method despite its limitations. It has more potential application to a wide range of environmental goods than other valuation methods. Even though economists have largely focused on market prices as the indicator of economic value, earlier writers such as Clark (1915) and Hines (1951) clearly saw that much of an individual's utility was driven by unpaid costs and uncollected benefits and that "market prices" did not exist for many of the more interesting quantities to economists. In order to determine the value of the environment, the unpaid prices of the environment must first be revealed (Mayor, 2006). Revealing these prices suggests that they can and should be paid for.

Reviewed studies have shown that economic valuation of environmental resources attempts to bring out public preferences for changes in the state of the environment in monetary terms (Turpie and Barnes, 2003). The major goal of valuation is therefore to determine people's preferences about how much they are willing to pay for, and how much better off or worse off these people would consider themselves to be due to alterations in the supply of various goods and services provided by a particular good. CVM has been identified and proven as an economic tool that can be used to directly to estimate of the value that a person places on non market goods and services (Ntshingila, 2006). Water management in developed countries is relatively simple as all potential users are connected to the system such that one can easily project future use and revenues for a given tariff (Kundy, 1998). This is not the case with developing countries like Botswana where majority of rural communities are served primarily by unprotected wells, lakes and ponds and only a few are served by a piped water supply. With the state of water in Botswana generally being perceived as contaminated, water stressed thereby restricting future socio economic developments of the country, it becomes important to investigate the ability and willingness to pay of the users for improved water supply services (both quality and quantity) so as to set appropriate water pricing or tariff structures which is consistent with government policy, hence motivation behind this study.

3 CHAPTER: STUDY AREA

This study was carried out in the Central District in Shoshong village in Botswana. Botswana is a landlocked, semi-arid country with an approximate area of 582,000 km^2 between latitude 18^{0}S and 27^0 S and longitudes 20^{0}E and 29^{0}E in the centre of Southern Africa (Figure 3.1). The population is estimated at about 1.9 million (CSO, 2009). The country is an almost plateau with an average altitude of 1,000m and elevation ranges between 700m and 1300m (*ibid*).

Rainfall ranges in Botswana varies from 650mm per annum in the extreme north to 250 mm per annum in the south west. Most rainfall occurs in the summer period between December and March (Tiroyamodimo, 2008). Potential evaporation is about four times the average precipitation at 2,000mm, creating an endemic water deficit especially when rainfall is erratic and patchy (MMWER, 2005).

According to the Botswana National Water Master Plan (BNWMP) (1992) and Botswana Water Accounts Report of 2009, Botswana relies on both ground and surface water to meet the growing demand.

3.1 Groundwater Resources

This is the main source of potable water supply in Botswana. Much of the country (about 66%) depends entirely on groundwater (CSO, 2009). However, the rate of groundwater replenishment relative to the rate of extraction and its quality is a major issue. Groundwater is limited, thus making the resource finite and non-renewable (CSO, 2009). Only a small part of the groundwater resources can be economically abstracted due to high abstraction costs, low yields, poor water quality and remoteness of aquifers in relation to consumers centres (SMEC *et al*, 1991, Masedi *et al*, 1999). The estimated mean annual recharge is 2.7mm, being zero in western Botswana to 40mm in the north.

3.2 Surface water (Rivers and dams)

Botswana is generally an arid country with little surface water except in the far north, where Okavango and Chobe Rivers, the only perennial rivers in the country are both situated (CSO, 2009). The rest of the rivers are ephemeral, which are, however, important as they provide locations for dam sites and contribute to the recharge of ground water (DEA, 2006 and CSO, 2009).

3.3 Geographical Location of Shoshong

Shoshong village is one of the oldest villages in Botswana. The village is located at latitude -22.95, longitude +26.48 in the Central District. It is 40 km west of Mahalapye. The village is situated 3,000ft (910 m) above sea level in the valley of the Shoshong River, an intermittent tributary of the Limpopo. It is a hot and rocky place which receives sometimes heavy rains in summer and is often windy. The village is enclosed by hills used for grazing cattle.

The village has community chief who is responsible for decision making at community level. However, the decisions do not necessarily influence the infrastructural development because such powers lie with political leaders such as councilors and members of parliament.

3.4 Socio economic aspects

According to the Household Income and Expenditure Survey of 2002/2003, 40.8 % of the economically active populations aged between 15 to 64 years in rural villages (including Shoshong) are formally employed, 22.5 % depend on family farms, lands and cattle posts for survival and 7.6% own businesses or are self-employed. Amongst the major sources of income for the villagers are arable and livestock farming as well as the collection of veld products. Social welfare programs also play an important role in availing income for the community. This is mainly through programs such as drought relief or Ipelegeng which are also undertaken in other villages throughout the country. Shoshong Hills plays a bigger role as a tourism attraction in the area. Figure 3.1 shows maps of Botswana, Shoshong and a zoom in to the study area (Phaleng ward).

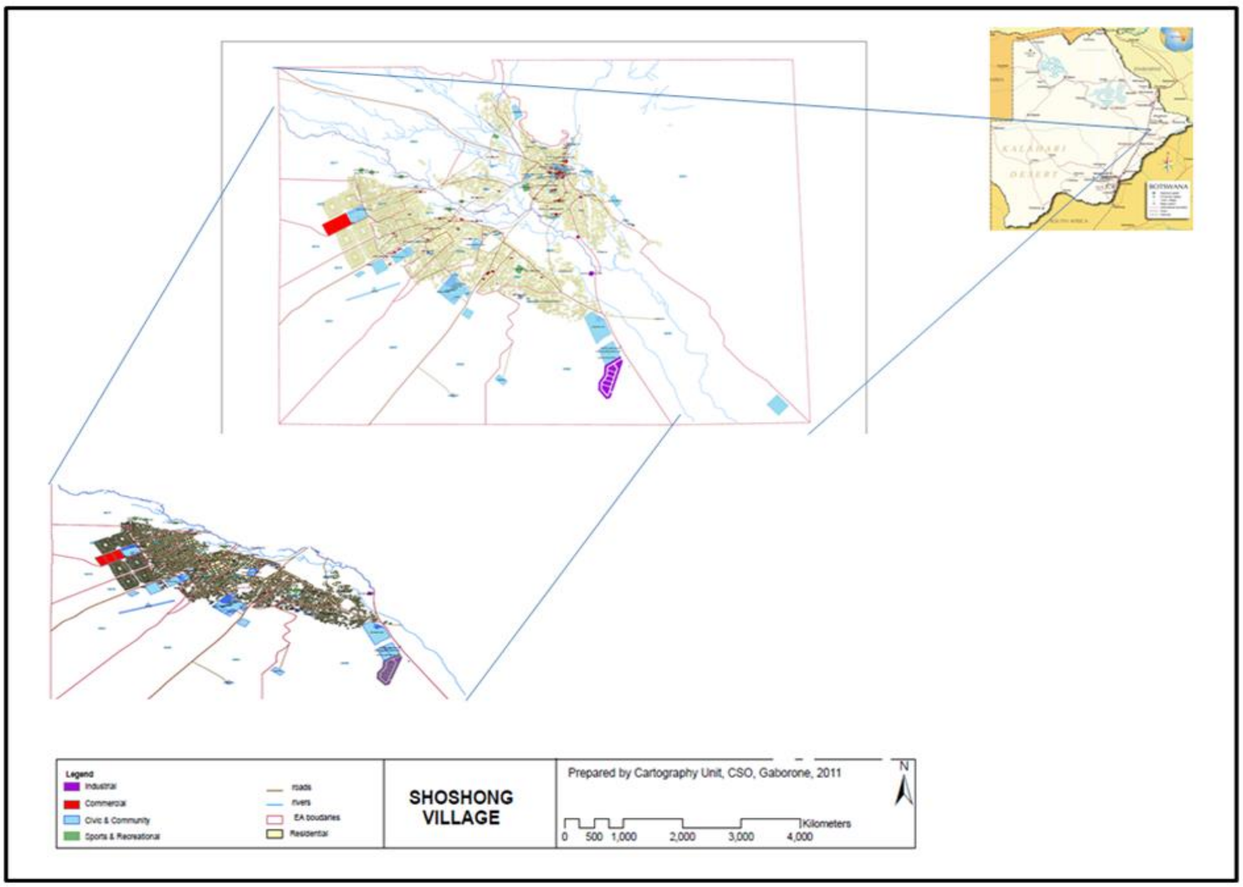

Figure .3.1: Location of Shoshong, Phaleng ward, Botswana (*CSO, 2011)*

3.5 Water supply situation in Shoshong

As stated earlier, Shoshong village is supplied with water through the Mahalapye-Shoshong transmission line which was completed in the year 2010. About 30% of the village population depends on stand pipes for water consumption. According to information from the WUC, households depending on standpipes used to get water for free, hence making it difficult for the supplier to monitor the usage of standpipe water. People with private connections would often revert to unpaid standpipes when they failed to settle their bills. This situation prompted WUC to introduce the token system for standpipes with effect from January 2013. Each household without a private tap was registered with WUC and given tokens. The household credit tokens with units so as to be able to access water.

3.5.1 Water produced, consumed and lost in Mahalapye management area

The table below shows figures on water produced, consumed and lost through leakages in Mahalapye Management Area (MMA) which Shoshong is part of. According to information from WUC, water management is done through management areas, where several villages fall under a single management centre. Shoshong village together with 33 other small villages falls under the Mahalapye Management area. Table 3.1 is for all the villages under that management area for the population of 111,617 (2011 Census).

Table 3.1: Water produced, consumed and lost in Mahalapye

Year	**produced**	**consumed**	**UFW (m^3)**	**UFW (%)**
2010/2011	2,541,090	1,647,896.9	893,193.1	35.1
2011/2012	2,139,697	1,405,780.9	733,916.1	34.3
2012/2013	n/a	n/a	n/a	36

Source: Water Utilities Corporation (2013)

As indicated in table 3.1, water production volume has decreased from year to year in the past three years. Losses (UFW) are high (around 35%) and consumption has decreased, suggesting that that the area has serious supply constraints and problems.

3.5.2 Water tariff structure

Prior to WUC taking over water services, the tariff structure for MMA under DWA was as shown in table 3.2 using the DWA charges. But upon taking over and coming up with different approaches, the tariff structure for the area increased by about 11% for the lowest consumption. The consumption blocks also changed with BWP14.00 for consumption over $26m^3$ under WUC as compared to BWP15.00 for consumption of $41m^3$ under DWA. As for the token system, WUC adopted the prices that were used under DWA.

Table 3.2: Prepaid token charges

	Consumption Block (M^3/month)	**Tariff (BWP/M^3)**
PREPAID TOKEN	0-5	1.90
	6-20	5.90
	21-40	12.10
	41+	15.00
	Minimum charge	10.00
DWA CHARGES	0-5	1.90
	6-20	5.90
	21-40	12.10
	41+	15.00
	Minimum charge	11.20
WUC CHARGES	0-5	2.10
	6-15	7.95
	16-25	10.10
	26+	14.00

Source: Water Utilities Corporation (2013)

4 CHAPTER: METHODS

4.1 Data source and type

This study used both the qualitative and quantitative approach. The qualitative approach was used to examine the determinants of WTP and qualitative one was used to quantify the WTP by residents. Primary and cross sectional data for the year 2013 obtained through a questionnaire survey based on the contingent valuation method was used for this study. The study was also supplemented by secondary data from government publications, research publications and reports, students' theses and reports from WUC. Secondary data were collected through literature review aimed at identifying attributes and determinants of household‘s WTP. Government publications (census reports) and reports of other similar studies carried out in the area were used to assess the current situation in terms of water services in the area and identify household preferences on water services.

4.2 Sampling design and methods

4.2.1 Determination of the population

The identification and determination of the population of Shoshong was an important prerequisite for the field survey. The target population of this study was defined as the households that use water for domestic purposes in Shoshong (that is all village households). Fourteen (14) enumeration areas (EAs) in Phaleng ward (Shoshong) as demarcated by Statistics Botswana during the 2011 population census were used for this study. The ward has a population of 5,100 and 1,260 households distributed amongst the EAs (CSO, 2011).

4.2.2 Sample selection method

The selection of the representative sample from the population requires the use of sampling techniques like simple random sampling, systematic sampling, stratified sampling, clustered sampling and multistage sampling (Farolfi, 2011). The choice of the sampling method depends on the objective of the study, the information available before the survey and the size of the population in the studied area (Ntshingila, 2006). Since the study was carried in Phaleng ward (one of the two main wards in Shoshong), which was divided into 14 enumeration areas, simple random sampling was used to select half (7) of the enumeration areas for sampling. The researcher had limited time and finances, and could not do a survey for the entire ward.

Simple random sampling (SRS) is a method of sample selection which gives each possible sample combination an equal probability of being selected and each item in the population to have an equal chance of being included in the sample (Cochran, 1963). The implications of random sampling are that it gives each element of the population an equal probability of being part of the sample and all choices are independent of one another. All the fourteen EAs were listed down in a piece of paper; strips of papers with each EA were torn and put in a container and mixed up. Then the first seven strips of papers pulled out of the container one at a time were used as the sampling areas.

4.2.3 Selection of the sample from the EAs

There is no set percentage that is accurate for every population. In determining a sample size, this study followed the five steps of determining the sample size as indicated by Jeff (2001) and Israel (2009). The steps involved include; determining the goals, determining the desired precision of results, determining the confidence level, estimating the degree of variability and estimating the response rate.

Having stated these five steps of determining the sample size as outlined by Jeff (2001) and Israel (2009), this study adopted a formula outlined by Jeff (2001), which captures all the five steps;

$$\boldsymbol{n = [P\,(1-P)\,/\,(e2\,/\,Z2)\,+\,(P\,(1-P)/N)]\,/\,R}$$

Equation 4.1: Sample Size

where;
n = required sample size
N = number of people in the population (1,264 households in Phaleng ward, (CSO, 2011)
P = the estimated proportion of the population size (0.5 for this study, best conservative measure (Jeff, 2001)
e = precision desired or standard error (0.075 for this study).
Z = is the coefficient corresponding to the chosen confidence interval (1.96 for c.i. = 95%).
R = Estimated response rate, as a decimal (1.0 or 100%)

The required sample for this study is therefore calculated as follows:
n = [0.5 (1-0.5) / (0.075^2 / 1.96^2) + (0.5 (1-0.5)/1264)] / 1.0
= *150*

Table 4.1 shows different sample sizes with different sampling errors. The motive behind selecting the sampling size with sampling error of 0.075 was resource availability, time and financial constraints. The sample size of 150 out of 1264 is also acceptable and gives reasonable accuracies, it falls within the 10 to 15 percent requirement of the sample size set by United Nations.

Table 4.1: Different sample size with different sampling errors

N	**P**	**E**	**Z**	**R**	**n**
1264	0.5	0.1	1.96	1.0	89.25
1264	0.5	0.09	1.96	1.0	108.399
1264	0.5	0.08	1.96	1.0	134.1376
1264	0.5	0.075	1.96	1.0	150
1264	0.5	0.07	1.96	1.0	169.69
1264	0.5	0.06	1.96	1.0	220.3
1264	0.5	0.05	1.96	1.0	294.6
1264	0.5	0.04	1.96	1.0	406.9

Source: Own calculation

After determining the sample size, systematic sampling[7] was used to select the households according to the proportion on the number of households in each EA for face to face interview. Systematic sampling was selected because it is easy and flexible to implement.

The village of Shoshong has two main wards, with a population of 9,678 and approximately 2,420 households, each of which has approximately 4 members (CSO, 2011). Phaleng ward (which is the study area) has a population of 5,056 and 1,264 households distributed amongst the EAs (table 4.2).

Selection of the sample was done in such a way that proportionality was ensured according to the number of households in each EA using the formula below;

$$\textit{Sample in each}\textbf{:}\ \boldsymbol{EA} = (\boldsymbol{n} * \boldsymbol{K})/\boldsymbol{M}$$

Equation 4.2: Sample in each EA

where
n = sample size
K = No of household in a given EA
M = Total no of households in the 7 selected EAs

Table 4.2: Sample size of selected EAs

EA number	Population size	No of house holds	No of selected h/h
0872		76	150*76/601 = 19
0874		87	150*87/601 = 22
0875		78	150*78/601 = 19
0876		91	150*91/601 = 23
0877		89	
0878		54	150*54/601 = 13
0881		70	
0882		77	
0884		72	
0885		155	
0886		122	150*122/601 = 30
0887		93	150*93/601 = 23
0888		123	
0892		77	

Source: Own calculations

To carry out systematic sampling in this study, places of importance were selected in each EA to be used as a reference or starting point (schools, Kgotla, burial society, police station). Using equation 4.3, the researcher moved from the reference point and selected every 8th household going north, south, east and west. To avoid bias in the selection process, the researcher selected the same number of households going in each direction.

[7] Random method of sampling that applies a constant interval to choosing a sample of elements from the sampling frame (Encyclopedia of Survey).

K = N/n

Equation 4.3: Selection criteria

= 1264/150 = 8 (every 8^{th} *household was selected counting from the reference point)*
K is the sampling interval
N is the total number of households
n is the sample size

Example: for EA number 0872, the place of importance or starting point was Mahutagane Junior School so since 19 households were to be selected in that area, the researcher selected 5 households going north, south, and west and 4 households going east. House number 8 from the school going north was selected, and then house number 16, 24, 32 and 40. The same was done going other directions.

In the event that the selected household had no occupant, the next household was selected to replace it. The interview was done with the head of household, in the event the head was not available the spouse or anyone related to the household head and over 30 years of age (referred to as the respondent in the questionnaire) was interviewed.

4.3 CVM Questionnaire design

Contingent valuation survey procedure does not follow any standard procedure although virtually all contingent valuation surveys consist of several well-defined elements (Farolfi *et al*., 2007).This study combined and adjusted two questionnaires; one developed by the Centre for Environmental Economics and Policy (CEEPA) for the study by Banda *et al*., (2004), the other by Widiyati, (2011) for his study on WTP to avoid the cost of intermittent supply; Case study of Bandung, Indonesia.

To identify the water supply services problems of the village and design a draft questionnaire, interviews were carried out with key resource personnel (Village Chief, Village Councilor, members of the Village Development Committee (VDC) and elders in the village). A focus group discussion was also held during one of the Kgotla meetings, where the issues on reliability of the service providers in terms of water availability on daily basis, turn-around time of bills and back up plans in times of shortages were discussed. Findings from these meetings were used as a guideline to come up with a questionnaire. After designing the draft questionnaire, pre testing was conducted by selecting a random sample of six households in villages surrounding Gaborone and facing the same problems as the study area. The pre testing was done around Gaborone due to funding constraints. This pre testing enabled the interviewer to observe the time spent on each questionnaire and make some adjustments to the survey questionnaire and whether the instrument was good enough to provide the required data for this study. Pretesting showed that the respondents were reluctant to give their exact income. To counter this, the final questionnaire was designed in such a way that respondents were given a range of income classes and selected the range in which their income falls within. The final questionnaire was divided into 4 sections as outlined below.

1. Section A covered socio demographic characteristics of the respondents and household (characteristics such as age, occupation, sex of the respondents, household income and education level)
2. Section B: Sources of drinking water for the household (water sources in the household; private yard tap or public standpipe)
3. Section C: Opinions about each source of drinking water and towards the service provider (opinions of household towards the source of water they use)
4. Section D: WTP for different types of improvements and the avoidance expenditure techniques adopted by the household (back up plans to counter water shortage and the WTP for improved services).

4.4 Model specification

Since improvement in water services is considered as an economic good, WTP is expected to be non-negative random variable (Larson *et al.*, 2001; Hanemann, 1989 as quoted in Kamaludin, 2012). This study relied on the Ordinary Least Squares (OLS) method to assess the impact of some variables on willingness to pay. Although in most cases rural households are willing to pay little or nothing at all for improved water services, the *a priori* expectations (see hypotheses) are that several factors have an impact on WTP for improved water services. Since our data had some missing data because some respondents gave answers as “not known” Bivariate cross tabulation and Chi square analysis were also applied on the data to improve the reliability of our results. Section 4.31 discusses the functional form of the OLS method and section 4.32 discuses bivariate cross tabulation and chi square.

4.4.1 Functional form of OLS model.

Binam *et al*, (2003) as quoted in Amoah and Adzobu (2013), indicated that in literature, some authors have concluded that the willingness to pay is influenced by economic and socio-demographic characteristics and the characteristics of the good itself (which in this study is water). Moffat *et al*. (2006) further highlighted the same on his study that, WTP is endogenously determined and is a function of the independent variables such as income level, gender, age, education, household size and avoidance expenditures. Thus the estimatable model of WTP as used by Briscoe *et al*. (1990), (Binam *et al*, 2003.), Kundy, (1998) and Moffat *et al*. (2006), which will also be adopted in this study is given as.

$$WTP_i = \boldsymbol{f}(\boldsymbol{INC}, \boldsymbol{EDU}, \boldsymbol{FAM\ SIZE}, \boldsymbol{TIME}, \boldsymbol{AE}, \boldsymbol{GEN}, \boldsymbol{AGE}, \boldsymbol{HOUSHEAD}, \boldsymbol{SOURC}, \ldots\ldots\ldots.)$$

Equation 4.4: Functional form of OLS

Where WTP_i = the dependent variable which stands for WTP for improved water services. This variable is expressed in monetary terms as monthly payment consumers of the service are WTP. For purposes of estimation, the equation above is expressed as follows’

$$MWTP^*_I = \beta 0 + \beta 1 INC + \beta 2 HHOLD\ SIZE + \beta 3 AGE + \beta 4 AE + \beta 5 GEN + \beta 6 EDU \ldots\ldots\ldots .. + \varepsilon$$

Equation 4.5: Estimation of WTP

where:
$MWTP^*_i$: Maximum willingness of Shoshong residents to pay for improved water supply services (in monetary terms, BWP)
β_0 = Constant term in the model

β_1, β_2, β_3 , β4 , **…………** β_i = regression parameters

έ = (error term), added to the function because the researcher does not observe all components of WTP for improved water supply (Mcfadden, 1974). This relates to the amount that the respondents are willing to pay to be beneficiaries of improved water supply services. The principle of WTP is that the preferences of individuals must serve as basis for the evaluation of gains and losses of non-market goods and services (Amoah and Adzobu, 2013).

Since mean measure is an appropriate method for welfare measures in cost benefit analysis, for open ended survey responses, maximum WTP reported by the respondent can be simply averaged to provide an estimate of mean WTP assuming that WTP from the sample can be generalized for the village population (Bantie, 2011).

Thus mean WTP = $\mu = \sum Ti/n$

Equation 4.6: Mean WTP

where;

n = sample size

T = reported amount by surveyed household (*ibid*).

4.5 Bivariate cross tabulation and Chi square

Bivariate analysis involves looking at how two variables or questions relate to each other. This can be done by putting them in a two way table format known as SPSS as a crosstab. According to Michael (2001), cross tabulation is a joint distribution of cases based on two or more categorical variables. Displaying a distribution of cases by their values on two or more variables is known as contingency table analysis and is one of the more commonly used methods in social sciences (*ibid*). The joint frequency distribution can be analyzed with chi square statistic to determine whether the variables are statistically independent or if they are associated.

To test for the relationship, our data in line with the hypothesis for the study was categorized or recoded into different classes to be able to decide the pair of relationship wanted. Thus WTP was recorded as 1 (willing to pay /YES) and 0 (not willing to pay / NO). Other variables which affect WTP were recoded as shown in appendix 1. A cross tabulation of independent variable (YES/NO) was done with each of the dependent variables for all bivariate relationships and Chi square was used to test the distribution of scores across the groups against null hypothesis.

4.6 Chi square test

The Pearson Chi square test is used to test whether a statistically significant relationship exists between two categorical variables (e.g. gender and WTP) (Devonish, 2000). It is a useful technique because you can use it to see if there's a relationship between two ordinal variables, two nominal variables, or between an ordinal and a nominal variable. You look at the assymp. Sig column and if it is less than .05, the relationship between the two variables is statistically significant (www.american.edu/provost/ctrl/pclabs.cfm). It accompanies a cross tabulation between the two variables and categorical independent and dependent variable are required (Devonish, 2000). In order to perform a chi-square test, all data needs to be coded as numbers in SPSS, even though these numbers actually represent groups, not something measured on a scale. It is a positively skewed distribution. The research hypothesis for the chi square is always a one-tailed test and chi square values are always positive. The chi square test is given by the following formula;

$$X_{\theta}^{2} = (R-1)(C-1)$$

Equation 4.7: Chi square

Where R is the number of rows, C is the number of columns; θ is the number of degrees of freedom.

4.7 Model variables and their description

Model variables adopted for this study are explained below as stated by Amoah and Adzobu (2013) in their study on application of Contingent Valuation Method (CVM) in Determining Demand for Improved Rainwater in Coastal Savanna Region of Ghana, West Africa and by Moffat *et al*., (2006) in the study on willingness to pay for improved water supply services by Chobe ward residents in Maun.

INC; 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 (Moffat *et al*., 2006 and Whittington *et al*. 1993).

TIME; Time spent collecting water from a chosen source and is expressed as the number of hours taken to fetch water which may include travel from home to water source, filling as well as queuing time. In most LDCs, women tend to spend most of their time hauling water from distant water sources. Women in Phaleng ward are no exception to the general observation. According to Whittington *et al*., (1990), one benefit accruing from improved water services is the saving in time spent while fetching water. The time has tremendous opportunity costs as it could be used on some other economic activities such as child care, agriculture, food preparations or gainful employment. Looking at activities forgone in order to go and fetch water, the study expects the variable time to be positively related to WTP.

FAMSZ; In keeping with African cultural practices, the majority of the poor rural households such as those found in our study area tend to have larger family sizes due to extended family relations. Rural poor families do not practice births control and tend to have numerous young children, the majority of whom may not assist in the process of fetching water from distant wells because of their tender age (Kundi, 1998). It is therefore assumed demand for water for domestic purposes in these areas will increase with family size. In view of this, we expect that big households will be willing to pay more for improved water supply services. Thus, the study expects the sign of its coefficient to be positive.

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. Moreover, older households' heads are traditionally used to free water services from public facilities, therefore they may be unwilling to pay for services which entail payment of some fees. 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 supposed 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.

Regression Results: SPSS Version 16.0 was used to estimate willingness to pay and to determine the relationship between WTP and each of the variables as earlier discussed.

5 CHAPTER: RESULTS AND DISCUSSIONS

5.1 WTP for improved water supply services

The results in this section were obtained through a dichotomous open ended interview with the household head (or the respondent in the event the head was not available). Table 5.1 presents the results obtained on WTP.

Table 5.1: WTP variables

Variabl	Description	Mean	Med	Std D	Min	Max
Y/N	Household WTP for improved services, 1 yes, 0 otherwise	0.76	1.00	0.484	0	1
$MWTP_1$	Household max WTP for continuous supply	31.23	10.00	37.81	0	200
$MWTP_2$	Household max WTP for yard connection	48.84	20.00	53.24	5	200
$MWTP_3$	Household max WTP for any other improvement	9	0.00	15.77	0	50

Individuals were asked which services they would like to see being improved in their village with regard to water supply services. Upon stating the services for improvement, they were asked whether they would be willing to pay for such services and how much in addition to what they are currently paying. If they were not willing to pay, respondents were asked for reasons. Of the 150 surveyed households, 76% or 115 were willing to pay for different improvements ranging from payment for continuous supply, payment for connection and payments for other services such as billing. Out of the 115 households willing to pay, 73 or 63.5% of the households are willing to pay for improvement of continuous water supply of BWP31.23 on average, and range a of BWP0 to BWP200 per month in addition to their monthly bill. Comparing mean willingness to pay for continuous water supply with the WUC tariff structure in Chapter 3, one can deduce that villagers in Shoshong are willing to pay almost twice what WUC are charging for the highest consumption block of 26+ m^3/month in rural areas.

According to the survey, the villagers were complaining about high WUC pricing, yet the mean WTP calculated from the survey results is almost twice the price for the highest consumption block. A possible explanation for this could be that, even though the villagers are already paying high prices, under WUC, the service they pay for is not up to standard. In other words they pay for the service that is not reliable. Villagers are therefore willing to pay so that this service could be improved, hence a high mean WTP. As for private connection, 39 or 33.9% of the households are willing to pay an average payment of BWP48.84, minimum BWP5 and maximum BWP200 per month. For other improvements like billing, token system improvement and more standpipes, only 3 or 2.6% of the households are willing to pay with an average of BWP9, minimum BWP0 and maximum BWP50 per month.

5.1.1 Expected Total WTP

According to Hanemann *et al* (1991), one of the main objectives of estimating empirical WTP based on the CV survey response is to derive the central value (mean) of WTP distribution. As stated in the model specification, mean measure is an appropriate method for welfare measures in cost benefit analysis. For open ended survey responses, maximum WTP reported by the respondent can be simply averaged to provide an estimate of mean WTP assuming that WTP from the sample can be generalized for the population of the village (Bantie, 2011). According to Kumar (2001), total WTP can be calculated as follows:

$$TWTP = Mean\,WTP * Total\,Population$$

Equation 5.1: Total WTP

where mean WTP is an average of maximum WTP reported by the respondents during the survey. Therefore, the expected total WTP per month for Phaleng ward can be given as:

TWTP = 31.23 * 1,260
TWTP = 39,349.80 per month.

5.1.2 Cost of production in water supply

Prior to the WUC take over, the recurrent costs were low in the early years between 2000 and 2003 (from BWP157 million to BWP 170 million (CAR, 2013) However thereafter, the costs increased moderately but increased sharply after 2008 as WUC started its takeover of village water supplies. The average annual recurrent expenditures were BWP8.00/m^3 while 2011 recorded a high of about BWP19.80/m^3 From the surveyed households, Shoshong residents falls within the lowest block of consumption (0-5m^3 per month) which is charged BWP1.90/m^3. Comparing this tariff structure with recurrent costs, one can deduce that WUC charges the consumers about 9% of their production cost of water supply.

5.1.3 NON WTP

As stated above, 76% of the households were willing to pay. In most cases, a respondent's refusal to pay is associated with a lack of interest in the topic of the survey (Ntshingila, 2006). Therefore it seems reasonable to assume that people who are less interested in the good will value it differently than their more interested counterparts (*ibid*). However, in our study quite a number of reasons were given for unwillingness to pay. One major reason was that they could not afford to pay for such services. Moreover, most of these households have until this year (2013) been using standpipes for which they were not charged, and therefore they believed that water was a public good which government should provide free of charge. In other cases, households just had no trust in the service providers and believed they are already paying enough to guarantee quality water supply services from WUC.

5.1.4 Opportunity cost

It has come to light during the survey that, the time spent queuing for water and travelling to neighbouring villages to fetch water can be used on other household chores. Woman would be cooking, cleaning the yard and children (boys) would be herding cattle and girls would help their mothers. During the planting season, instead of taking care of crops they would have to take a break early so the women and children could fetch some water. This was because of a prevalent traditional belief that collecting water after dark would bring bad luck (Ntshingila, 2006). This will have an effect on yields.

5.2 Willingness to pay determinants

Table 5.2 present the summary statistics from each variable that have an impact on WTP.A total of 150 households were interviewed and all questionnaires were analyzed. In terms of the socio-economic and demographic aspects of the village, 54% of the surveyed respondents were male while 46% were female. Out of the 150 sampled households, 84% of the respondents were heads of their households while the rest (16%) were not. As for age of the respondents, the data showed that the average was 45.7 years with the oldest respondent being 67 and the youngest being 25 and the median age being 41. The average family size was 3.9 with a minimum of 1 household member to maximum 7 and median family size was 4. Education levels were found to be varied, 20% of the respondent did not have any formal education, while 11.3% had completed 7 years of primary education as per the Botswana standard of schooling, 28% had completed secondary education (thus 12 years of schooling) and 40.7% completed tertiary education. The employment structure of the surveyed households revealed that 46.6% (69) of the respondents were formally employed, either by government or in the private sector. The rest (53.4%) were not formally employed, falling into the category of not gainfully employed, self-employed (including farming), informally employed or any other type of employment.

On average, the surveyed households earn BWP3, 873.05 per month with the minimum total household's monthly income being 0 and the maximum being BWP18, 000. The median monthly income was found to be BWP2,260.00[8].

Table 5.2: Demographic characteristics

Var	Description	Mean	Med	Std Dev	Min	Max
Gen	Dummy variable, 1 if male, 0 otherwise	0.54	1.00	0.5	0	1
HHD	Dummy variable, 1 if head, 0 otherwise	0.84	1.00	0.36	0	1
AGR	Respondent's age in years	45.7	41	13.07	25	67
EDU_0	Education level of the respondent, dummy variable 1 if no formal education, 0 otherwise	0.2	0.00	0.4	0	1
EDU_1	1 if primary education, 0 otherwise	0.11	0.00	0.32	0	1
EDU_2	1 if secondary education, 0 otherwise	0.28	0.00	0.45	0	1
EDU_3	1 if tertiary education, 0 otherwise	0.41	0.00	0.49	0	1
OCC	Occupation of the respondent, dummy variable 1 if formal sector salary employment,0 otherwise	0.47	0.00	0.5	0	1
INC	Household average monthly income in BWP	2,992.93	2,260	3,164.88	0	18,000
FAMS	Family size of the respondent in number	3.76	4.00	1.20	1	7

Source: own calculation

5.2.1 Existing water supply

Of the 150 households surveyed, 55% of the households use private tap water and 45% use public stand pipes with the token system. Private tap users paid BWP96.27 on average towards water bills, with the minimum bill being BWP30 and maximum BWP350 for water consumption

[8] Income include income from formal employment, farm output, cash in kind and remittances

per month, where the average consumption was found out to be 2.20m^3 per month, minimum 1.20m^3 per month, a maximum 4.80m^3 per month and a median of 2.4m^3 per month (Table 5.2).

Table 5.3: Existing water supply variables

Variabl	Description	Mean	Median	Std Dev	Min	Max
SOURC	Household main water source, dummy variable 1 if piped, 0 other wise	0.55	1.00	0.497	0	1
VOL	Volume of water used by household in m^3 per day	2.20	2.4	0.7	1.20	4.80
BILL		96.27		46.97	30	350
TIM	Time taken to fetch water from the existing source in minute	24.3		11.12	10	60
TOKEN UNITS	Amount stand pipe users load on to the token per month to access water.	10.63	10.00	6.07	5	40
COLLE	Responsibility of fetching water for stand pipe users, 1 if husband, 0 otherwise	0.031		0.173	0	1

Source: own calculation from the field

5.2.2 Token system

As stated above, 45% of the surveyed households use public standpipes which use the token system and of these, 3.1% of the households depend on the husband to fetch water for the. The rest (96.9%) of the households depend on the children or children and wife to fetch water. The distance travelled to fetch water was found to range from 100m to 500m. On average, the respondent load units for BWP10.63 with a minimum BWP5 and maximum BWP40. According to information obtained from WUC, BWP10 units are equivalent to 2,207litres of water. According to the respondents this system is quite affordable especially for the households that do not have the financial means and cannot afford to pay for yard connection. Appendix 5 and 6 show a token and a set up for standpipe that makes use of the token system.

5.2.3 Reliability and Satisfaction

In this study, reliability was measured in terms of the number of hours that the households receive portable water in a day and satisfaction was measured in terms of turnaround time for billing. For satisfaction, the respondents were asked how long it takes for WUC to disburse monthly bills after taking metre readings. A one month response was termed as a required or appropriate turnaround time and anything over one month was termed unsatisfactory. Table 5.3 summarizes findings on the reliability and customer satisfaction.

From the surveyed households, 12% (18) households deemed the current water supply of the village reliable (in this case they stated that water is available all day every day or 14 to 24 hours per day), the rest (88%) highlighted that the water supply services in the village is unreliable, thus water availability in a day ranges between 0 to 8 hours. Clearly, the majority considers water supply in the village to be unreliable. As for satisfaction with billing, none of the household surveyed are satisfied with the turn-around time for billing, thus 100% of the surveyed households are not satisfied. It takes WUC over two months to disburse the bills, sometimes they have to travel to the offices to collect for themselves.

Table 5.4: Reliability and satisfaction variables

Variabl	Description	Mean	Med	Std D	Min	Max
SATLV	Level of satisfaction with the existing service dummy variable 1 if not satisfied,0 otherwise	0	0	0	0	0
RELIAB	Reliability of the existing source, dummy variable 1if not reliable,0 otherwise	0.13	0.00	0.338	0	1
AE	Avoidance expenditure practiced by the household (in BWP per annum)	670.73	300	844.7	0	4200

Source: field results

5.3 Estimating Avoidance expenditure (AEs)

As stated earlier, Avoidance expenditures represent the extra costs incurred by the households to counter water shortage problems, or to counter the existing status of the water services. In water quality terms it can be boiling the water, purifying or buying and in quantity (supply) it is mostly storing for future use or fetching from neighbouring villages. When asked about the AE measure they practice and how much they spend on such measures, respondents stated that they store water in Jojo tanks, 200 litre tanks, containers, fetching from the neighbouring village (Tobela) and fetching from the other ward. On average, the households spend BWP670.73 per annum on such measures with the minimum expenditure being BWP0, maximum BWP4, 200 per annum and median being BWP300. On average a household spends BWP55.90 per month in addition to their bills. Figure 5.2 shows some of the AE measures exercised by Phaleng residents.

Figure 5.1: AE measures (Jojo tank and some containers)

5.4 Statistical results and discussion

This section analyzes the results obtained from the regression analysis thereby addressing objectives one and two. Before estimation is done, data exploration is an important step (Bantie, 2011). This is discussed first below.

5.4.1 Testing for multicollinearity

Multicollinearity is the undesirable situation where the correlations among independent variables are strong (Gujarati, 2003). According to Kundy (1998), a number of socio economic variables used to characterize households might themselves be correlated, so multicollinearity diagnosis is an important step. If one or more of the variables do not have much independent variation, the coefficient estimates may become unreliable and might shift drastically with small changes in the sample model. Moreover, multicollinearity misleadingly inflates the standard errors. Thus it makes some variables statistically insignificant while they should be otherwise significant. If the explanatory variables are highly correlated it is difficult to distinguish the effects of one explanatory variable on the dependent variable (Maddala, 1992 as quoted in Bantie, 2011). To test for multicollinearity, a simple technique which involves calculating the simple correlation matrix of independent variables was used to test for presence of multicollinearity. Variance Inflation Factor (VIF) was also used to further eliminate any chance of multicollinearity. The results are presented and discussed in the following sub sections. According to Gujarati (1998), multicollinearity is a serious problem when a pairwise correlation coefficient between two regressors is high (i.e. greater or equal to 0.8).

The correlation matrix shows that multicollinearity is not a serious problem with our data set as shown in Appendix 1, correlation between EDU3 and OCC has the highest value of 0.7, which according to Gujarati (1998) falls below the threshold of 0.8 for serious multicollinearity. Correlation alone cannot entirely rule out multicollinearity problem (Gujarati, 1998), so to further lament the absence of multicollinearity, variance inflation factor and Durbin Watson test were further done in our data.

5.4.2 Variance inflation factor

The variance inflation factor (VIF) quantifies the severity of multicollinearity in an ordinary least squares regression analysis (Chatterjee *et al*., 2000). It provides an index that measures how much the variance of an estimated regression coefficient (the square of the estimate's standard deviation) is increased because of collinearity (Chatterjee *et al*., 2000). For the multicollinearity to cause less concern, the VIF column should give a low mean VIF. However, the main question to ask is: how much variance inflation is too much?. Chatterjee, Hadi, and Price (2000) suggest that an indication of the presence of multicollinearity is shown by the largest VIF being greater than ten. To analyze the magnitude of multicollinearity the size of the vif is considered, a common rule of thumb is that if VIF is greater than ten then multicollinearity is high and therefore has been proposed as a cut off value. Table 5.5 shows VIF values for different variables. All variables with VIF greater than 10 were dropped from our model to remain with only 9 variables listed below.

Table 5.5: Multicollinearity analysis (VIF)

Variable	VIF	1/VIF
(1)	(2)	(3)
Ae	2.416	0.414
Volm	6.715	0.149
Bill	1.870	0.535
Edur0	2.863	0.349
Edur3	2.496	0.401
Income	9.09	0.110
fams	2.829	0.353
HHD	5.553	0.180
Gen	3.465	0.289
Mean VIF	4.1	

Source: field results

5.5 WTP determinants using OLS regression

The constant term in our model is positive. This indicates that people will associate a value to an improved water service irrespective of the effects of the independent variables. Thus even if the dependent variables remained 0 (zero) households in Shoshong would have a positive attitude towards water supply improvements. Table 5.6 shows regression results for the model.

Table 5.6: OLS regression results of WTP for a more reliable water supply

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.153	0.186		0.825	0.411
	AE	-3.377E-5	0.000	-0.059	-0.716	0.475
	VOLM	-0.126	0.062	-0.174	-2.037	0.044*
	BILL	0.001	0.001	0.063	0.682	0.496
	EDU_0	-0.071	0.105	-0.059	-0.676	0.500
	EDU_3	0.267	0.098	0.271	2.731	0.007*
	INC	2.500E-5	0.000	0.163	1.935	0.055*
	FAMSZ	0.130	0.038	0.323	3.375	0.001*
	HHHD	0.261	0.113	0.195	2.313	0.022*
	GEN	-0.258	0.085	-0.265	-3.038	0.003*
a. Dependent Variable: YESNO						
Significance= * significant at 5% level						

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.495[a]	.245	.196	.43583
a. Predictors: (Constant), GEN, AE, FAMSZ, INC, EDUR0, HHHD, VOLM, BILL, EDU3				

The estimator coefficients for the model show inconsistencies. Some show the expected signs while others show the opposite sign. Even though population in Shoshong is homogenous, there are some cases where socio economic and demographic aspects of some certain groups differ drastically from the entire population, example of such cases include civil servants (teachers, nurses, police officers) who mostly adopt urban life upon being posted to go and work in villages. This may be a reason for some inconsistencies in some estimators. Analysis of WTP determinants below tries to tackle objective 2 of this study which aimed at examining the determinants of willingness to pay. Regression results are discussed in terms of the Beta (β) value and the p value (sig). Beta value is the standardized version of B. It indicates the effect that one standard deviation unit change in the independent variable has on the dependent variable (also measured in standard deviation units). The determinants are further discussed below and compared with findings from literature.

5.5.1 Avoidance expenditure (AE)

Avoidance expenditure was found to be insignificant and negative. As stated in the model variable description, AEs are encountered in addition to the monthly bill. This implies that as people encounter some additional costs, they tend to be less willing to pay. There is an inverse relationship between AE and WTP. (*β = -0.059, P value = 0.475)*

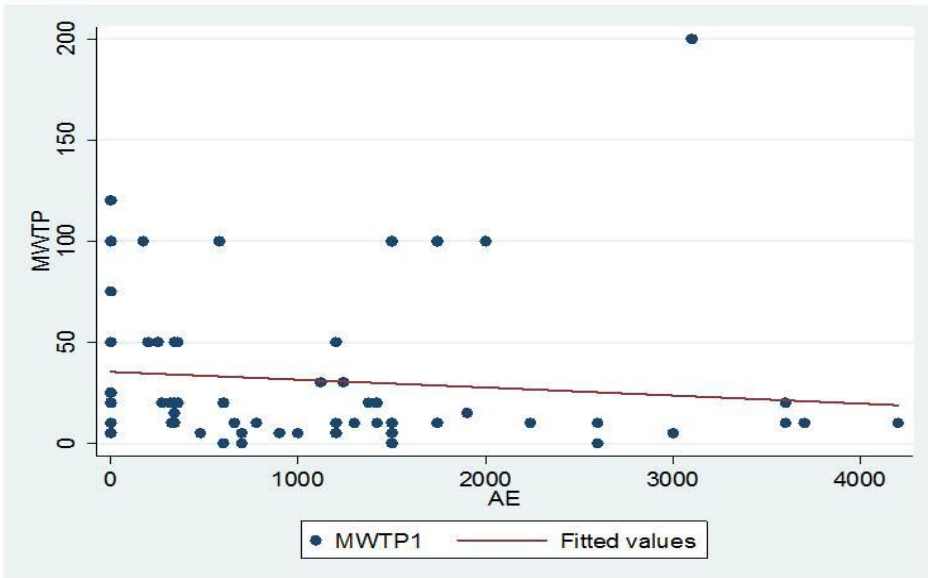

Figure 5.2: Partial correlation for MWP and AE

5.5.2 Level of education (EDU_0 and EDU_3)

A variable EDU_0 representing persons with no formal education was negative and insignificant. This may be due to the fact that in some cases, low levels of education result in people not having well paying jobs or not having formal jobs. Such households are likely to have less income and may not have the necessary income to pay for improved water services. Another possible explanation could be that less educated people attach a lower value to a reliable water supply. As for EDU_3 which represent people with tertiary education, the variable is significant at 5 percent level and positive. Thus the more an individual get educated the more they value water. People with higher level of education treat water as an economic good with value attached to it. These results conform to our a priori expectation that level of education significantly affect WTP. These findings are also consistent with empirical literature by for example Whittington *et al* (1988), Kamara, 1996 and Bah 1997 and with the study by Kundy (1998), Bantie (2011), Tsegaye (2005) and Banda *et al* (2004). A possible explanation for this relationship is that as levels of education increases among households members, those households would be more aware of health the health benefits of improved water supply as well as the opportunity cost of time spent collecting water. (*EDU_0 (β = -0.59, p value = 0.500), EDU_3 (β = 0.271, p value = 0.007*)*)

Graphical partial regression between WTP for continuous water supply and formal education (EDU_0) and highest level of education (EDU_3) is shown in figure 5.5.

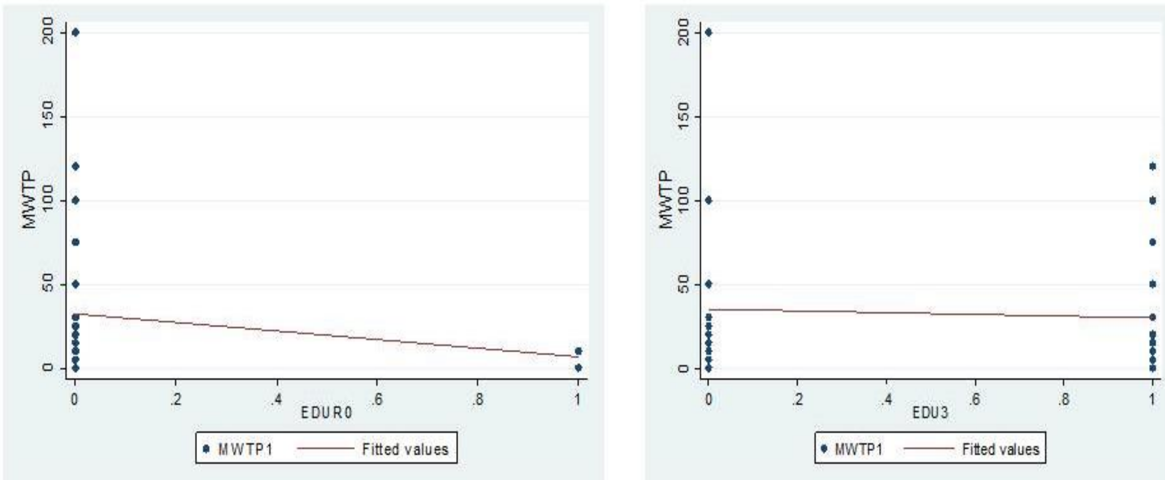

Figure 5.3: Partial correlation for MWTP and EDU_0 and EDU_3

5.5.3 Family size (FAMS)

This variable was found to be positive and significant at 5 percent level. This implies that as the number of members in the household increases, the household will be willing to pay for continuous supply of water to avoid shortages. As stated in our variable description, a good number of family members in rural areas are young children who cannot assist in fetching water far from the yard in times of shortage. So in this event, household heads were willing to pay to have continuous supply of water. Moreover, the larger the household the more water they need, therefore they are more willing to pay. This finding is however different from the study by Moffat *et al* (2006), where family size was significant but negative (*β = 0.323, p value = 0.001*).*

5.5.4 Income (INC)

The sign for this variable is positive and significant at 5 percent level. This is consistent with the expectation that there is a positive and significant relationship between WTP and income. The relationship is further shown in figure 5.7. This variable is consistent with the study by Banda *et al* (2004), Tsegaye (2005) and Ntshingila (2006). This implies that household with more income are willing to pay for improved water supply services. The plausible explanation is that the majority of respondents would wish to improve their welfare as well as productivity. They seem to be conscious of the opportunity cost of their time used in collecting water. So as their income increases, households become willing to pay substantial amounts of their incomes so as to save energy and time for other productive activities (*β = 0.163, p value = 0.055*)*

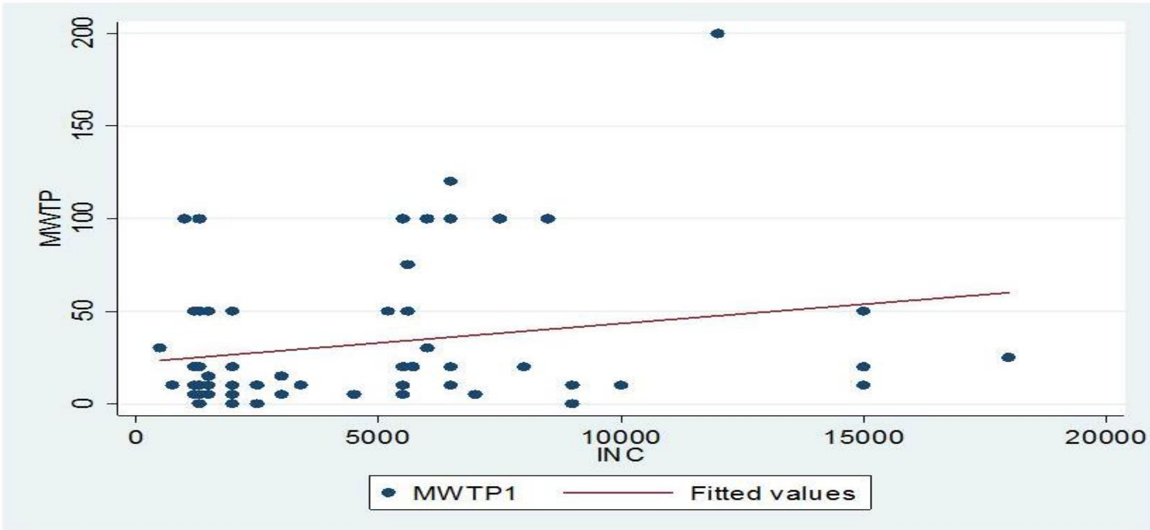

Figure 5.4: Partial correlation for MWP and Income

5.5.5 Volume of water consumed (VOLM)

The variable volume (VOLM) is significant at 5 percent level and negative. This result is quite intuitive. This negative signs implies that as volume of water consumed increases, the WTP for continuous supply decreases. Household consuming less water are those living in rural areas, characterised by large families and lower income, so they are more likely to be WTP than urban counterparts, who already have more reliable and better water services (Farolfi *et al*.,2007) (*β = -0.174 p value = 0.044*).*

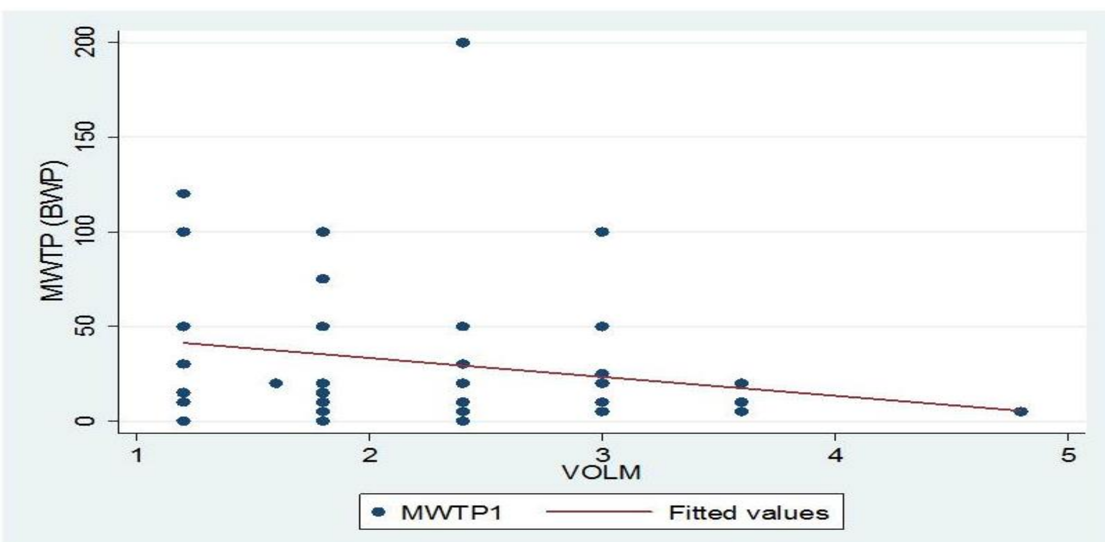

Figure 5.5: Partial correlation for MWP and VOLM

5.5.6 Gender (GEN)

The variable gender of respondent is negative and significant (*β = -0.265, p value = 0.003*)*. This implies that the variable gender has a negative effect on WTP. In most cases female headed households are most likely to be willing to pay for improved services than male headed households. As shown on the graph below, female headed households (coded as 0) during the surveys were more willing to pay, but the level of willingness reduced towards variable coded 1 during the survey which represents males.

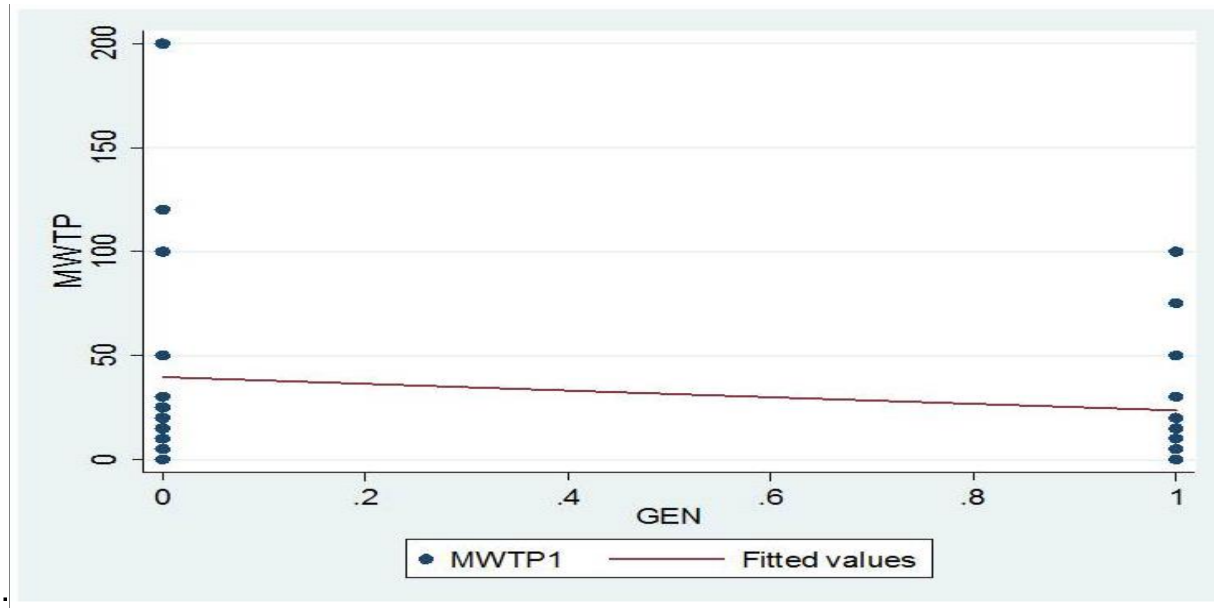

Figure 5.6: Partial correlation for MWP and GEN

As discussed in Chapter 4, chi squared test was further used to explain relationship between WTP and some variables that were not included in the model. OLS (regression analysis) above gave logical and reasonable results but some "not known" responses in some questions may have influenced our findings and lead to some variables to be dropped from the model. Thus large number of list-wise missing values was observed during OLS regression hence a need for Bivariate Cross Tab and Chi Square test to further assess the impacts of some variables on WTP. This is also in line with trying to address objective 2 and test our hypotheses. When using Bivariate Cross Tab and Chi Square analysis, some variables may differ from the results obtained using OLS. This is expected since data has now been recoded into different classes (as shown in Appendix 1) to improve reliability of the results. The table 5.8 shows results obtained from cross tabulation.

Table 5.7: Cross tabulation and Chi square results

Variable	WTP	NOT WTP	P value	DF	Chi square value (χ^2)
Agegroup	93 (62%)	57 (38%)	0.10*	3	6.215
Incgroup	62 (65.3%)	33 (34.7%)	0.02**	3	14.994
Famsize	93 (62%)	57 (38%)	0.33	1	0.93
Volmgroup	44 (57.9%)	32 (42.1)	0.10*	1	2.433
AEgroup	93 (62%)	57 (38%)	0.4	3	2.604
BILL	61 (71.8%)	24 (21.2%)	0.4	3	2.568
Gengroup	93 (62%)	57(38%)	0.002**	1	9.684
HHD	93 (62%)	57 (38%)	0.68	1	0.163
EDU0	93 (62%)	57 (38%)	0.019**	1	5.546
EDU	93 (62%)	57 (38%)	0.000**	1	12.153
time	33 (50.8%)	32 (49.2%)	0.19	3	4.719
distance	33 (50.8)	32 (49.2)	0.35	2	2.083

** Significant at 10% level * Significant at 5% level

As shown in the table above, some variables show some significance at different levels. Some are consistent with the hypotheses, while others are not. As compared to OLS results, some variables are consistent with what was obtained we got from the OLS analysis, while some are not. FAMSZ and HHD were significant under OLS but they are not significant under chi square. A possible explanation could be that, as stated earlier, in OLS regression we have some missing data and some of the variables were dropped due to the multicollinearity problem, so these variables were included under chi square. So Chi Square test was used mainly to improve the reliability of the results obtained under OLS and check consistent variables.

Under Chi Square test, the lower the p-value, the more dependent is WTP on the variables and the reverse is true. Looking at the table above, variables that are consistent with both methods (OLS and Chi square test) include income, gender of the respondent and education of the respondent and volume of water consumed. These variables are all significant in both methods, therefore they have a significant impact on WTP. In addition to these consistent variables, age of the respondent was found to be significant under Chi square, but was not significant under OLS.

6 CHAPTER: CONCLUSIONS AND RECOMMENDATIONS

This study attempted to assess the willingness to pay (WTP) for improved water supply services by Shoshong residents using a case study of Phaleng ward. The Contingent Valuation Method (CVM) was used and data were collected using face to face interview with 150 randomly selected households. From this study, the following conclusions were drawn:

1. Willingness to pay by Phaleng residents (Shoshong) was high (76%) compared to the same study by Moffat *et al*., (2006) which was carried in Chobe Ward, Maun (54%). However, this WTP was lower than the result found by Amoah and Adzobu (2013), in Ghana (92.5%). The mean WTP value (BWP31.23) is about 1.5% of the average monthly income of the households. This is within the World Bank threshold where by 5% on monthly household should be dedicated to utilities.

2. Of the nine variables that were included in the model during this study, six were significant at five percent level, meaning that an increase or a decrease in any of the six variables will have an impact on WTP. Volume of water consumed, education level, income, family size, gender of the respondent were all significant. These variables are consistent with the study by Moffat *et al*, (2006), Banda *et al*, (2004) and Kundi, 1998.

3. Households spend BWP55.90 on avoidance expenditure measures; this is 1.8% of the average monthly income of the households. As these AE measures are incurred in addition to the bill, this two combined makes up 5% of the average monthly income. So costs incurred by the household alone on water and related activities takes up the whole 5% which according to World Bank should be covering all utilities.

Recommendations

The results obtained from this study showed clearly that local inhabitants are concerned with water availability in their area. As a result, households are willing to pay for improved water supply and services. This study therefore recommends the following.

1. Households' WTP demonstrates that there is room for policies aimed at improving rural domestic water infrastructures and services through cost-recovery mechanisms. Water tariffs based on quantity consumed is commendable, but subsidies targeted to the poor should be introduced so that all the households can afford private connection.

2. In designing rural water systems, the Government and water suppliers must pay attention to the needs of the local communities. That is, water schemes must be demand driven rather than supply driven as has been the case in the past.

3. It is recommended that an intensive publicity campaign to educate people about the benefits associated with the need to pay for an improved water services is a necessary and sufficient condition for sustainability of the resources. This recommendation is made in the light of the strong positive relationship between education level and WTP by households.

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APPENDICES

		GEN	HHH	AGE	EDU0	EDU1	EDU2	EDU3	FAMS	OCCU	INC	SOUR	VOLM	AE	BILL
N		150	150	150	150	150	150	150	150	150	95	150	76	150	85
Normal Parameters[a]	Mean	.54	.84	45.79	.20	.11	.28	.41	3.76	.47	3.8731E3	.55	.0758	6.7073E2	96.2706
	Std. Devi	.500	.368	13.069	.401	.318	.451	.493	1.208	.501	3.68945E3	.499	.02362	8.44693E2	4.69672E1
Most Extreme Differences	Absolute	.361	.508	.210	.491	.526	.453	.389	.229	.358	.224	.368	.219	.237	.201
	Positive	.320	.332	.210	.491	.526	.453	.389	.229	.358	.224	.313	.219	.237	.201
	Negative	-.361	-.508	-.158	-.309	-.361	-.267	-.292	-.145	-.323	-.153	-.368	-.150	-.214	-.090
Kolmogorov-Smirnov Z		4.424	6.224	2.567	6.012	6.441	5.547	4.760	2.801	4.381	2.184	4.508	1.907	2.901	1.851
Asymp. Sig. (2-tailed)		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.001	.000	.002

Test distribution is Normal.

Appendix 1: Sample Kolmogorov - Smirnov test

	GEN	HHHD	AGER	EDU0	EDU1	EDU2	EDU3	FAMS	OCCU	INC	SOURC	VOLM	AE	BILL
GEN	1													
HHHD	0.436	1												
AGER	0.368	0.342	1											
EDUR0	0.294	0.173	0.604	1										
EDU1	0.035	-0.073	0.156	-0.179	1									
EDU2	-0.139	-0.092	-0.033	-0.312	-0.223	1								
EDU3	-0.135	-0.009	-0.563	-0.414	-0.296	-0.516	1							
FAMSZ	0.049	-0.072	0.444	0.238	0.159	0.112	-0.399	1						
OCCU	-0.209	-0.029	-0.617	-0.468	-0.334	-0.196	0.776	-0.346	1					
INC	-0.288	-0.355	-0.550	-0.371	-0.24*	-0.170	0.688	-0.108	0.742	1				
SOURC	-0.183	-0.099	-0.496	-0.489	-0.229	-0.156	0.689	-0.335	0.706	0.657	1			
VOLM	-0.071	-0.082	-0.073	-0.181	-0.136	0.095	0.230	0.566	0.363	0.400	0.160	1		
AE	-0.046	-0.035	-0.129	-0.170	-0.119	-0.038	0.250	0.048	0.305	0.295	0.436	0.215	1	
BILL	-0.174	-0.022	0.234	0.120	0.494	-0.093	-0.184	0.318	-0.173	-0.003	-0.096	0.074	0.115	1

Appendix 2: Correlation matrix

Category	**1**	**2**	**3**	4
Age	25 -35	36-45	46-55	56-65

Category	**8**	**9**	**10**	**11**
Income (BWP)	0-4500	4501-9000	9001-13500	13501-18000

Category	**12**	**13**
Volm (m^3)	0-2.4	2.41-4.8

Category	**14**	**15**	**16**	**17**
AE (BWP)	0-1050	1051-2100	2101-3150	3151-4200

Category	**18**	**19**	**20**	**21**
Bill (BWP)	0-87.50	87.60-175	176-262.50	262.60-350

Category	**5**	**6**
famsize	1-3	4-7

Category	**1**	**2**	**3**	**4**
Time (min)	0-15	16-30	31-45	46-60

Category	**1**	**2**	**3**
Distance (m)	0-200	201-400	401-600

Appendix 3: Categories for different variable

.

Name of Interviewer……………………………………………..

Date of interview…………………………………………….

Date of revisit……………………………………………………….

Questionnaire ID #……………………………………………..

Checked date……………………………………………………..

Starting time……………….Ending time……………..

Section 1

DEMOGRAPHIC AND SOCIO-ECONOMIC CHARACTERSTICS

This section of the study covers demographic aspects. As stated earlier, personal information provided is strictly for this study and confidential. For question 1 to 3, please tick in the box under respondent or household head.

1) **GENDER**	**RESPONDENT**	**HOUSEHOLD HEAD**
Male		
Female		
2) **AGE** *(years)*		
<18		
19-25		
26-35		
36-45		
46 – 55		
56 – 65		
Over 65		
3) **HIGHEST LEVEL OF EDUCATION ATTAINED**		
0		
1		
2		
3		
4		

(NB 0=No formal education, 1= Primary, 2= Junior, 3 = Senior School, 4= Tertiary

4) What is the size of your family (*including yourself*)?

a) No of adults __________, ≥18 years old
b) No of children _________, <18 years old

5) Gender composition in the h/h:

a) Male_____ b) Female_____

6) What is the occupation of the h/h head or respondent? (*Please tick in the box provided*)

OCCUPATION	**RESPONDENT**	**HOUSE HOLD HEAD**
Formal employment (state type of employment)		
Informal employment		
Self-employed (incl farming)		
Not gainfully employed		
Other (specify)		

7) Do you have any livestock?

a) Yes______ b) No______

7.1) If yes, how many do you have? (*Please tick where applicable)*.

Number	Cattle	Donkeys	goats	sheep	Other (specify)
01 – 10					
11 – 20					
21 – 40					
Over 40					

8) How much is the h/h head earning per month (in BWP) (indicate in which category his/her income falls)?

0	1<400	400 -1400	1401 - 2400	2401-3400	3401-4400	4401-5400	>5400	Not known

9) State the amount of the total h/h's monthly income from each source

Source	Amount per month		
	In kind	Cash	Not known
Farm Income			
Salary (monthly from formal employment)			
Social welfare			
Remittances			
Piece jobs			

10) From what source do you get your water for h/h use?

SOURCE OF WATER	Yard connection	Stand pipe	Other(specify)	Not known

(If yard connection, go to section 2 part A, if stand pipe, go to part B)

Section 2

This section covers sources of water available in the household and their reliability, compares current and previous situation concerning water supply. The section is divided into part A and B.

Section 2; Part A) Users of private tap water (yard or house connection) and neighbor's tap

11) How much water does the h/h use per day? (*State number of containers used under each box or tick in the last box if you do not know*) (*NB: one 5 litre container = 0.005*m^3.

Container	5 litre	10 litre	20 litre	200 liter (Drum)	Do not know

Number of containers					
Total Amount per day				Total per month =	

12) When did WUC take over water supply services from council?

Date	Not known

13) How often is water available from your tap?

< 4 hrs/day_______, 4 – 8 hrs/day_______, 9- 13hrs/day_______, 14 – 18 hrs/day______, whole day______

14) In your opinion, this water availability situation under WUC as compared to under council is:

Better_______, No difference_______, Worse________

Explain……
………………………………………………………………………………

15) If water is not available all day every day, what are measures taken by the h/h to survive (avoidance expenditure). (*Please tick next to the measure taken, multiple answers allowed)*

a) Depend on water bowsers from WUC

b) Fetch from neighbouring village

c) Store water in Jojo tanks

d) Fetch from Bokaa ward

e) Other (specify)

16) How much do you spend on such measures?

Measure	Monthly Expenditure	Annual Expenditure
Jojo tanks (Buying, transporting and installing it		
Transport (if not using own car)		
Price for fuel (if using own car)		
Price of containers for fetching water		
Other (specify)		
Total Expenditure		

17) Do you pay for the current water services?

Yes______, No______

18) If yes, how much do you pay per month for the current water services? *(Ask for exact amount and request to see the latest bill)*

Bill figure in BWP ______ Estimate from the respondent in BWP______

19) In your opinion, how is this payment as compared to the previous one under council?

Lower______, Same______, Higher______

Explain………
……
…………………………………………………………………

20) How long does it take to receive bills from WUC?

Monthly bills (on time) ______, 2 months______, more than 2 months______

21) How is this turnaround time for bill dispersion as compared to under council?

Better ______, same______, Worse______

Explain………
………………………………………………………………………………………

WTP by private tap users

22) If the piped water service in your neighborhood was to be improved what changes would you like to see being made to the system? *(Please tick all that is applicable to you).*

Continuous supply without breakdown	
Regular monthly billing	
Own connection if fetching from neighbor	

23) How much would you be WTP per month in addition to your bill? *(Please give exact amount)*

WTP	Continuous supply	Monthly billing	Own connection if fetching from neighbor
0			
Amount			

If 0 WTP please explain why…………………………………………………………………

Section 2; Part B) Users of collective tap/ stand pipe

24) How much water does the h/h use per day? (*State number of containers used under each box or tick in the last box if you do not know*) (*NB: one 5 litre container = 0.005m^3).*

Container	5 litre	10 litre	20 litre	200 liter (Drum)	Other (specify	Not known
Number of containers						
Total Amount per day						
Total amount per month						

25) How far is your collective tap from your home? (*Consider round trip and include time taken to fetch water)*

Distance in (m) ______ Time in (min). _____

26) What means of transport do you use for fetching water?

Walking (wheel barrow)	car	donkey cart	bicycle	Other (specify)

27) How often do you collect water? *(Number of trips to the stand pipe)*

1 trip/day	2 trips/day	3 trips/day	Twice/week	3 times/week	Other (specify)

28) Who usually fetches water from the collective tap?

Husband	wife	Husband and wife	Wife and children	Children	Other (specify

29) What type of container do you use to fetch water?

5litre container	10litre container	20litre container	200litre drum	Other (specify)

30) How many containers do you normally carry per trip?

1	2	3	4	5	6	Not known

31) What measures does the h/h take to avoid opportunity cost of using stand pipes? (*Please state them in the table below)*

32) What are the costs associated with such measures?

Measure	Monthly Expenditure	Annual Expenditure

<u>WTP by stand/public pipe users</u>

Standpipes are currently pre-paid once, so the amount of credit one puts in the card determines how much water they will use. This section cover expenditures associated with collecting water, storages and later WTP for private connection

33) How does the prepaid system work in your neighborhood?

Explain………

34) How much credit do you normally put in your token and what amount of water do you get per month with that credit?

Units per month	

Amount of water	

35) What are the costs associated with fetching water from a collective tap or stand pipe

Expenditure	Monthly cost	Annual cost
Transport (if not using own)		
Fuel (if using own car)		
Cost of buying container		
Storage tanks cost		

36) If the piped water services in your neighborhood were to be improved what changes would you like to see being made to the water system in your neighborhood? (***Please tick all improvements that you would like to see being made)***

Yard connection	
More stand pipes according to demarcations	
Improve token system	
Do away with the prepaid system for stand pipes and adopt postpaid ones	

If toke improvement, explain how…………………………………………………...

37)How much would you be WTP per month for such improvements? *(If WTP state the exact amount under each improvement, otherwise tick 0 if not)*

WTP	Yard connection	More standpipes	Token improvement
0			
Amount			

If you are not WTP for such improvements *(having ticked 0 WTP)*, state why.

……

38) General comments:

Appendix 4: Questionnaire

Appendix 5: Token system set up

Appendix 6: Consumer's token and where the token in inserted