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INFLUENCE OF WATER SOURCE POINTS LOCATION ON HOUSEHOLDS' WILLINGNESS TO PAY FOR WATER SUPPLY RELIABILITY IN MASERU, LESOTHO

By

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DECLARATION OF ORIGINALITY

I hereby declare that this dissertation which I submit for the degree of MSc Agric (Agricultural Economics) at the University of Pretoria is my own work and it has not been previously submitted by me for a degree at any other institution of higher learning.

Signature ……..
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Signature ……..
Prof. E.D. Mungatana
Date …….

DEDICATION

I dedicate this dissertation to the Heavenly Father for of Him, and through Him, and to Him, are all things. Had He not been on my side throughout this demanding task, it could not have been a possibility on my own.

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Influence of water source points location on households' willingness to pay for water supply reliability in Maseru, Lesotho

By

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ABSTRACT

This study uses the double-bounded bid elicitation format to test whether the location of water source points significantly influences households' WTP for improved water supply reliability in Maseru City, Lesotho. Maseru was purposely selected on account of its documented water supply unreliability problems that cause suffering and welfare losses to households. WTP was thus elicited when location of the water source points was on-yard, and when it was communal. Purposive and random sampling methods were used to collect survey data from 104 households that access water from on-yard sources, and 107 households that access water from communal sources, making a total of 211 households.

The analysis shows that Maseru households have high levels of factual knowledge on challenges associated with unreliable water supply, and display attitudes and perceptions that are receptive to a policy designed to redress the *status quo*. The mean WTP was [1]M1.49 per 20 litre jerrycan (LB M1.38 and UB M1.59) when location of water source points was on-yard, and M1.39 per 20 litre jerrycan (LB M1.30 and UB M1.47) when location of water source points was communal. The null hypothesis of equality of the two mean WTP values could only be rejected at the 10 % level of significance (t = 1.44, p = 0.076), suggesting that location of water source point might not be a powerful determinant

[1] 1 Lesotho Loti equals approximately 0.067 American dollar

of household WTP. This could possibly be attributed to the fact that the welfare losses associated with unreliable water supply might not powerfully discriminate between households based on the location of water source points.

The study further established that mean WTP for water supply reliability was higher than what households currently pay for water. For example, households currently pay M0.10 per 20 litre jerrycan to the Water and Sewerage Authority (WASA) of Lesotho when they access water on-yard or from communal sources. In addition, households pay a minimum of M1.00 per 20 litre jerrycan when obliged to buy water from vendors when water is not available from regular sources. Given that the analysis shows that households are WTP up to M1.49 per 20 litre jerrycan for improved water supply reliability, it appears that a policy that improves water supply reliability at a fee would result in a Pareto improvement.

Double-bounded models, differentiated by location of water source points, were used to determine factors that influence households' WTP. Results show that WTP is positively related to the following variables: age and educational level of household head, monthly income, average duration of water supply interruption, time spent making a round trip to alternative sources of water during supply interruptions, households' level of awareness regarding past unsuccessful attempts made by WASA to improve water supply reliability, and household perceptions regarding enactment and passing of a parliamentary bill that improves water supply reliability. WTP was negatively related to period household has lived in the current house and gender (males had a less WTP than females).

It can thus be concluded that households have a positive WTP for improved water supply reliability, and that their mean WTP for the same is higher than what they currently pay for water. In addition, location of water source points is not a strong determinant of WTP. Following from the above, the study recommends that WASA should consider investing in projects that improve water supply reliability, and in particular ensure that whenever supply is interrupted, the interruption does not last for more than one day per month. To fund such a scheme, the analysis suggests that WASA could consider levying a fee that ranges between M1.00 and M1.60 for each 20L jerrycan. The actual value of the fee should, however, be determined through a stakeholder engagement process. Finally,

additional studies would be required to determine important factors that influence households' WTP for improved water supply reliability.

Key words: valuation of water supply reliability, willingness to pay, contingent valuation method, double-bounded bid elicitation format, Maseru (Lesotho)

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

CS	-	Compensating Surplus
ES	-	Equivalent Surplus
WTA	-	Willingness to Accept
WTP	-	Willingness to Pay
CVM	-	Contingency Valuation Method
KM	-	Kilometre
TAMS	-	Technology Acceptance Models consultants
WHO	-	World Health Organization
M	-	The currency of the Kingdom of Lesotho
VND	-	Vietnam national currency
Rs	-	Official currency of Pakistan
R	-	The currency of the Republic of South Africa
L	-	Litre
UNICEF	-	United Nations Children's Fund

CHAPTER 1:
INTRODUCTION

1.1 BACKGROUND

Water supply service is increasingly becoming a subject of important concern for many water supply utilities and governments worldwide (Kanayo *et al*., 2013; Wendimu & Bekele, 2011; Adenike & Titus, 2009; Hensher *et al*., (2005, 2006); Moffat *et al*., 2011; Baisa *et al*., 2010; Olanrewaju *et al*., 2012; Vasquez *et al*., 2009). Indeed, Topfer (1998) argues that adequate supply of safe and clean water is the most important precondition for sustaining human life, for maintaining ecosystems that support all life, and for achieving sustainable development. Water supply service involves the provision of water by public utilities, commercial organisations, community endeavours, or by individuals, usually through a system of reservoirs, pumps, and pipes. In most cases, governments hold the responsibility to finance the provision of the basic water supply infrastructure such as treatment plants, reservoirs, pumping stations and distribution pipes for the public (David, 2008). There is a wide range of attributes that categorise efficiency levels in water supply services to consumers. For instance colour, taste and odour of water, which result in health risk perceptions, and the reliability of the service (free from interruptions) (Doria, 2010; Beaumais *et al*., 2010; Jiang *et al*., 2010; Wang *et al*., 2010). Thus, shortcomings in regular and certain access to safe water affect households' health and productivity, which results in social welfare losses.

The importance of a reliable water supply service to Maseru city in Lesotho cannot be overstated. According to the World Health Organization (WHO, 2007), a reliable supply of safe water is defined as being less than a kilometre from the point of use, where there is a possibility to sustainably get 20 litres of water per person per day. Being the capital city, Maseru accounts for about one tenth of the country's population and half of the total urban population (Lesotho Bureau of Statistics, 2006). Most importantly, the economic activity of Lesotho is centred around Maseru. The industrial sector of Maseru is split into two main areas: the one to the north deals with flourmills together with major companies, while the one to the south deals mainly with textile and footwear companies. Commerce in Maseru

is located towards the centre, with larger office buildings, department stores and several banks situated towards the west, while the eastern region mainly hosts small businesses, markets and street hawkers. Thus households in the city directly benefit from water supply and indirectly through the use of water for the sustenance of daily activities at the industries, businesses and offices where they are employed.

However, water supply service reliability remains an increasing challenge in Maseru for most people (Leshoboro, 2009). According to Technology Acceptance Models (TAMS, 1996) consultants, this unreliability emanates mainly from the high urbanisation rate and lack of a well-defined water policy, resulting in augmented pressure on water resources. Indeed, Drakakis-Smith (2000) indicated that the high growth of urban centres requires enormous volumes of water and extensive infrastructure to fulfil consumer demand, which governments and water utilities often fail to provide, thus rendering the service unreliable. In the same way, the challenge is for the water supply authority of Lesotho to sustainably meet water demands to keep pace with this rapid population growth rate in Maseru. The rate of urbanisation in Maseru ranges from 7 % to 11 %, resulting in more people per water source point over time (Bureau of Statistics Lesotho, 2003). Most of these people migrate to Maseru to seek for jobs mainly in the private sector, due to declining agricultural productivity in the rural areas of Lesotho. The textile industry is the main employer, accounting for nearly 80 % of the private sector employment (Ministry of Labour and Employment, 2012). The textile industry also consumes about one third of water in Maseru, reducing the quantity available for distribution to households leading to periodic water supply cut-offs (Salm *et al*., 2002). Hence, there is a conflict of interest, as the population influx requires large volumes of water, while the water supply authority caters for fewer people owing to capacity restrictions imposed by its financial constraints.

Irrefutably the Water and Sewerage Authority (WASA) of Lesotho, which falls under the Ministry of Natural Resources, has over the years struggled to meet regular water supply. For instance, it could not maintain its resources to improve service delivery due to financial challenges and thus has failed to efficiently meet the city's required water demand (TAMS 1996). It consequently changed from supplying water to the public using the public standpipes system that existed earlier and introduced the pre-paid system to encourage people to account for their water use (Letsatsi, 2008). The challenge with the

former system was that it was mainly based on a pre-determined monthly pricing for operations, maintenance costs and system replacement while the latter attempts to incorporate consumption levels in the tariff structures. Unfortunately, WASA seemed to have only made a change in the water supply system with a negligible impact on water supply service reliability to the residents. This was realised by Linn (1983) who showed that the provision of environmental amenities in urban centres of many Third World countries seems to be a complete struggle. Thus, the existing capacity of WASA seems to be below the required service level for the residents, hence the poor services.

Furthermore, because the new pre-paid system did not have a discernible effect on improving and maintaining a regular supply of water to the residents, most women and girls in Maseru still walk long distances in search of water as a result of service interruptions, despite the fact that the pre-paid system makes them account for their own water use. Indeed, United Nations Children's Fund (UNICEF) and WHO (2015) show that women and girls bear the burden, both physical and time, in water hauling, and are responsible for this task in seven out of ten households in forty-five developing countries, and often walk on dangerous paths. Again, some people even go without water for days due to very long queues at water vendors' source points in times of water supply disruptions at normal source points, and face inflated prices. At times, some people even wait in long queues for water from wells, puddles and streams, from as early as 01:00 hours. In such circumstances, Letsatsi (2008) argues that workers are the ones that suffer most, as they are usually away for work during the day. Queuing for long hours for water denies them the opportunity to rest or do other developmental activities at home after their daily duties at work.

On the other hand, Eales *et al*. (2000) maintain that water resources in Lesotho far exceed the nations' present and future needs. Indeed, Leshoboro (2009) estimates Lesotho's surface water resources at 4.73 cubic kilometres per year, which is far in excess of the country's requirements. This is however misleading as residents only access a fraction of such water because of high run-off and the mountainous catchment areas are unreachable due to the topography. As a result, about half of Maseru's inhabitants lack an adequate water supply and join long queues for service (Leshoboro, 2009). To solve this problem, a costly and highly capital-intensive technology is required to harness this water (called the

'white gold' of Lesotho, due to its abundance). WASA must thus consider investing extra resources in improving the existing infrastructure and supplementing the existing reservoirs in its endeavour to redress unreliable services experienced by the residents. This necessarily will have important implications for cost recovery since high service levels can only be sustained through prices that reflect the cost of provision (Hensher *et al*., 2005).

In searching for solutions to Maseru's water supply reliability challenges, it is also important to consider the levels of factual knowledge that residents have concerning the current potable water supply services and whether their attitudes and opinions are conducive for the improvement of the reliability of water supply, and the value that they place upon the same. As affirmed by Vasquez (2009), a better understanding of consumer awareness and preferences helps decision-makers to forecast market responses to price changes, to design appropriate policies for recovering the service improvement costs, and setting the project sustainable. Furthermore, in order to come up with the proper tariff structure, the heterogeneity of the city in terms of service conditions and socio-economic characteristics resulting from the location of the water source points in Maseru should be taken into consideration. Within the city, some residents have water source points that are located on-yard, while the rest of them rely on communal sources. Based on this diversity, it is important to find out the extent to which the valuation of a reliable water supply by the residents relies on the water source points' location within the city. Therefore, on the basis of the above information from the demand side of the water supply service, efficient investment decisions can be made.

Consequently, the contingent valuation method (CVM) was used in this study to determine the willingness to pay (WTP) for improved water supply reliability in Maseru shown by both the residents that access water from the on-yard source points and those that use communal source points. Indeed, CVM has been successfully used in the valuation of a wide range of water supply attributes and other non-market goods and services (Haq *et al*., 2007; Lipton *et al*., 1995; Hensher *et al*., 2005; 2006; Kanayo *et al*., 2013; Wendimu & Bekele, 2011). According to Yang *et al*. (2007), CVM is a method that is used to determine the economic value of a commodity to an individual, while Agudelo (2001) indicated that it establishes the maximum WTP for availability or an increase in quality or quantity of a natural good or service. To the knowledge of the researcher, even though

early studies in Maseru have already addressed different aspects of water supply (Masupha, 2007; Letsie, 2005; Molapo, 2005; Motŝoene, 2013), none of them has ever determined the value of water supply service attributes. As a result, the study investigates the influence that the location of water source points has on households WTP for regular supply of water to the city.

1.2 PROBLEM STATEMENT

As has been shown above, the use of market prices as a mechanism to supply water resources to the residents in Maseru has not promoted sound natural resources supply strategies, in particular the reliability of the services for consumers. Previous studies (Kanayo *et al*., 2013; Hensher *et al*.; (2005, 2006); Moffat *et al*., 2011; Baisa *et al*., 2010; Olanrewaju *et al*., 2012; Vasquez, 2009) have already indicated that it is detrimental to supply water to the public without analysing the value placed by the residents on the attributes of water supply services. Indeed, even though Lesotho has water resources that are more than the present and future needs of the citizens, as asserted by Leshoboro (2009), the service interruptions continue to occur due to the lack of knowledge available on the non-market value of water supply reliability. Again, the deterioration of the quality of the service is exacerbated by the high urbanisation rates that increase the trade-off between reliable water supply services and the influx. Furthermore, further pressure on water resources in Maseru is exerted by the massive water consumption from the textile industry, hence the periodic disruptions in the service. Moreover, WASA as a utility, could not maintain and improve its infrastructure owing to previous financial challenges (TAMS, 1996) and has been sub-optimal to date. Even though WASA attempted to redress poor services through the pre-paid system, it has made a negligible impact because the prices fail to reflect the value of water supply reliability.

As a result of the above-mentioned worsening efficiency levels in water supply reliability, most women and girls in Maseru continue to walk long distances in search of water in an attempt to reduce the effect of lengthy water supply interruptions on their daily house chores. Unfortunately, reports (UNICEF and WHO, 2015) on water supply challenges also indicate that the security of women is often compromised, as they sometimes have to walk on long dangerous paths during extreme service cut-offs. As declared by Letsatsi (2008),

some residents even go for days without access to water supply services, due to long queues at water vendors' water source points in times of service interruptions at their normal sources, and they also face inflated prices. Under such circumstances, workers suffer the most as they are mostly away from home during the day, and compromise their time to rest or do other activities as they have to search for water. On the other hand, some people usually opt for wells, even during the night (Letsatsi, 2008), while compromising their health when using such unprotected sources of water. Therefore, the study employed CVM as a technique to reveal the value of water supply from the demand side in an attempt to respond to the following questions:

1. Does the factual knowledge, attitudes and perceptions of Maseru residents regarding current water supply service levels show that they are concerned about the lengthy water supply interruptions that they currently experience?
2. How much are Maseru residents WTP for improved water supply reliability?
3. Does the WTP of Maseru residents for improved water supply reliability vary with the location of water source points?
4. Based on the findings of this study, is there a case for WASA to invest in improving water supply reliability?

1.3 OBJECTIVES OF THE STUDY

The overall objective of the study is to establish if WTP estimates for improved water supply reliability by Maseru residents warrant service improvement, more specifically to:

i. Assess household knowledge, attitudes and opinions regarding actions that could potentially improve water supply reliability in Maseru.
ii. Determine the WTP of households that access water from on-yard source points for improved water supply reliability.
iii. Determine the WTP of households that access water from communal source points for improved water supply reliability.
iv. Determine whether the location of water source points significantly influences household WTP for improved water supply reliability.

v. Draw policy recommendations relevant to the design of sustainable improved water supply service strategy in Maseru based on the study findings.

1.4 HYPOTHESES

i. The awareness and perceptions residents have about the water supply service attribute under consideration are expected to have an effect on WTP decisions. According to Khuc (2013), when residents find it unbearable to continue with the *status quo*, it is not uncommon for them to be supportive towards improvement of their water supply system. In addition, increased factual knowledge that a respondent has concerning the water supply services in his or her community seems to result in more value being attached to the improved reliability of water supply (Ntshingila, 2006). Thus, the study tests the hypothesis:

High level of factual knowledge on water supply system, and attitudes and perceptions that are conducive for improved services have no influence on WTP for improved water supply reliability.

ii. The WTP of residents for the availability, and improved quality or quantity of a good or service is influenced by some key socio-economic variables. For instance, the more enlightened population will always have an impact on advocacy for welfare facilities like water, health and sanitary conditions due to their degree of awareness (Kanayo *et al*., 2013; Bogale & Urgessa, 2012). Furthermore, those that have high average monthly incomes usually prefer better and higher quality water supply services as demand theory predicts that the income of a household is positively related to the demand for normal goods (Moffat *et al*., 2011; Kanayo *et al*., 2013). Theory (Bogale & Urgessa, 2012; UNICEF and WHO, 2015) also shows that the gender of the respondent also has a significant effect on WTP regarding water supply issues; females are generally more concerned about reliable water supply, as they are normally responsible for water collection and they usually do most of the household chores. They therefore do not want to bear the risk of walking long distances in search of water during supply interruptions. Lastly, as asserted by Bogale and Urgessa (2012), older people are expected to be receptive of a policy that is geared towards improved water supply services. Considering the

deteriorating health situation of the elderly, they are not capable of fetching water from distant alternative sources during the cut-offs in water supply. Again, they are also expected to be WTP to ensure that their children will have better services after them. Hence, the test of the following hypothesis:

The WTP for improved water supply reliability is not related to the following key socio-economic variables: The highest educational level and age of the household head, the average household monthly income, and gender of the respondent.

iii. Previous studies (Hensher *et al*., 2005; Akcura, 2011) hold that extremely long interruptions faced by residents in water supply services usually result in lower WTP for improved services than when they experience relatively shorter interruptions. For instance, it is argued that it makes sense for residents to be WTP to reduce water supply interruptions from three hours to one hour in a day, than to reduce the length from twelve hours to nine hours. This is because residents respond to lengthy water supply service interruptions by resorting to adaptive measures like investing in water storage facilities. On the other hand, residents in developed countries like Australia seem to be WTP to reduce the duration of the water supply interruptions at all levels of the their lengths (Wahid & Hooi, 2015). Thus, the study tests the hypothesis:

The duration of water supply interruptions has no impact on the WTP estimates for improved water supply reliability.

iv. The location of water source points in Maseru can be attributed to heterogeneity of the city in terms of service conditions and socio-economic characteristics. Firstly, since communal source points are used by relatively more people, there are more chances for them to try to rely on others for provision of resources (free-rider problem) and place more burden on those that use on-yard sources. Again, as it is more expensive to stay in apartments that have on-yard water sources compared to staying in accommodations where residents access water from communal sources, it is likely that the residents that use on-yard sources have a relatively higher average monthly income. Olson (1965) hypothesizes that people with fewer resources will attempt to benefit without contributing to the provision of a resource or encourage under-provision, while those with greater resources carry the higher

burden for the provision of the good in question. However, this view has been recently challenged by Ostrom (2000) who argues that there is nothing like zero contribution in resource provision; the idea is that people usually invest in small resources in order to satisfy their common interests. Therefore, the last hypothesis of the study follows:

The location of the water source points within Maseru city of Lesotho does not significantly influence the households' WTP for improved water supply reliability.

1.5 IMPORTANCE AND BENEFITS OF THE STUDY

This research study is intended to contribute to encourage the use of stated preference surveys as tools for water supply service management in urban centres. It empirically seeks to establish whether the mean WTP of Maseru residents (those that access water from on-yard source points and those that use communal source points) for water supply reliability warrants service improvement. The study also intended to find out whether the location of water source points has a significant effect on the WTP of the respondents. In addition to the contribution that the study makes to the research community, it is expected that the results will be practically used to inform policy makers at WASA in decision-making processes and in formulating and reforming urban water supply policies. This will encourage conservation of water resources (households will see it as a valuable resource), sound management and promote sustainability in water supply. It will also promote the residents' acceptability of higher water charges as part of the water management policy in order to ensure that WASA reaches the level of cost recovery in the provision of services (Beall, 2000), where each beneficiary pays a fee that will at least contribute to the consistent supply of water to the city. The study will also help WASA in its endeavour to raise the awareness of the customers and policymakers of the economic value of water resources and the importance thereof. As Hensher *et al*. (2005) state, when water prices do not reflect the cost of its provision, the sustainability of uninterrupted supply is compromised. Thus, the results from the estimation of the WTP of Maseru residents for improved water supply reliability will help in justifying a project geared towards redressing the existing water access challenges. The additional charges that the water utility will place per 20-litre jerrycan of water for an improved service will be used

collectively for water conservation practices to avoid its depletion (Bogale & Urgessa, 2012).

The remainder of this dissertation is comprised of four chapters. Chapter 2 gives a review of theoretical and empirical literature on the use of CVM to value the improved water supply reliability and previous water supply studies in Maseru. Chapter 3 describes the study area, research design, data analysis procedures, and household characteristics of the sample, while Chapter 4 outlines the results and discussion of the study. Finally, the conclusion and recommendations of the dissertation are presented in Chapter 5.

CHAPTER 2:
THEORETICAL AND EMPIRICAL LITERATURE

2.1 INTRODUCTION

Natural resources mostly have the characteristics of public goods, in which case they generate externalities, so their market prices become unreliable (Whittington *et al*., 1991). Therefore, in order to estimate or identify a socially optimal decision, there is a need to obtain values for environmental resources (Kolstad, 2002; Hanley *et al*., 2003). This chapter presents the literature on CVM, reviewed on the basis of its relevance to elicitation of WTP for reliable water supply services. It is aimed at presenting the conceptual framework for the study using the concepts embedded in CVM as a method used to carry out the study. The section will also review the theoretical and empirical literature related to water supply in the study area and on the use of CVM in valuing improved water supply services. The entire literature covered in this section is aimed at identifying the knowledge gaps to justify the contribution of the study.

The chapter is organised into four main sections. Section 2.2 reviews the theoretical literature in the following sub-sections. Section 2.3 reviews the empirical literature, while section 2.4 presents the knowledge gaps. Lastly, the concluding remarks for this chapter are presented in section 2.5.

2.2 THEORETICAL LITERATURE

2.2.1 The CVM technique concept

The CVM is primarily a survey-based economic technique that is used to value non-market resources, mainly environmental resources. These resources give utility to consumers, even though some of their attributes do not have a market value, as they are not directly sold. For example, there is a benefit bestowed upon consumers from using pure and readily available water, but it is difficult to value such attributes. Consequently, CVM surveys are used as a technique to measure these aspects. The concept of CVM's origins can be traced

back to 1947, in Ciriacy-Wantrup's paper (1947) that was based on the benefits of preventing soil erosion. From the study, it was found that some of the complementary effects (like reduced siltation of streams) were public goods. The study consequently came up with the suggestion that, in order to find out information about the demand of the respondents for these goods, they should be asked directly how much they would be WTP for successive increments. According to Haq *et al*. (2007), CVM surveys ought to carefully describe the levels of these attributes (availability, increments in quality or quantity) and ask for the respondents' WTP for changes in such levels. Even though the method originated back in the late 1940s, it was never directly implemented and it was about two decades later that the method started to be applied in academic research (Portney, 1994). Davis (1963) designed and implemented the first CVM study where the attempt was to elicit the value of a particular recreational area to hunters and wilderness lovers. The results that were found from the CVM survey were further compared with the findings of Davis (1963) where WTP was estimated using the travel cost method (TCM). From the comparison, it was found that both CVM and TCM provided a similar answer for estimating WTP for visitors to a recreational area. Since then, CVM surveys have been implemented successfully for a variety of environmental goods and services, especially water-related issues (sanitation and water supply) in both developed and developing countries (Haq *et al*., 2007).

This survey technique is called *contingent valuation* because it determines the value of a resource that the respondents attach to it by directly asking them how much they would be WTP for it under certain circumstances or scenarios. It directly seeks to know what they are WTP for a benefit that is bestowed upon them, and or willing to receive in compensation for tolerating a cost that is imposed, with the use of a survey instrument or questionnaire. In this case, the personal valuations for the availability, increases or decreases in the quality or quantity of a good in question are obtained, contingent upon a hypothetical market, that is, under a proposed scenario or circumstances. The reason behind this exercise is to elicit the overall valuations or bids that are close to what would be revealed if a genuine market for the aspects of such good or service would exist. Again, CVM is also referred to as a *stated preference* method due to the fact that it asks the respondents to directly state their values or whether they are WTP for those that are already stated in the survey instrument, rather than asking them to position themselves on

the values of the actual choices in the market, as the *revealed preference* methods operate (Freeman, 1993). Therefore, the CVM method in essence is based on what the respondents say they would do under certain circumstances, as opposed to what they are observed to do, hence the source of its greatest strengths and its greatest weaknesses (Carson *et al*., 1994).

Since CVM surveys are implemented on hypothetical markets, the values for goods and services are generally measured primarily on the basis of the respondents' WTP for the improvement in environmental attribute or their willingness to accept (WTA) compensation for the damage to environment, or to accept being under the deprivation of the improvement in environmental characteristics (Frykblom, 1997). However, due to the possibility of exaggerated valuations associated with WTA surveys, there is consensus among researchers that the WTP format of elicitation performs relatively better than the WTA format (Mitchell & Carson, 1989; Cummings *et al*., 1986). Frykblom (1997) further states that CVM surveys inherently have the most appealing aspect as they allow for the estimation of the total value, rather than the components of the total value of the good or service. The CVM surveys often involve face-to-face interviews, conducted with a carefully designed survey instrument regarding the context of the study. Specifically, the good or service under consideration should be described in detail and the hypothetical circumstances or the scenario under which it will be provided to the respondent. Again, the questions concerning the elicitation of respondents' WTP or WTA for the service or good being valued, respondents' characteristics, their opinions and attitudes, and their use of the good should be clearly described in the survey instrument (Frykblom, 1997).

Furthermore, there should be much emphasis placed on the design of the survey instrument itself to ensure that all the aspects within the questionnaire that could potentially have an effect on the outcome of the CVM survey are taken into consideration to avoid wrong conclusions (Oates, 1994). The CVM survey should also be implemented in a clear context to all respondents throughout, and the services provided by the improved characteristics of the improved environment should be made known by all means to all the participants during the process of valuation. There are various formats of value elicitation in CVM surveys and they include open-ended, bidding game, payment cards, and dichotomous or discrete choice contingent valuation. The open-ended elicitation has been criticised by

researchers due to the fact that it suffers from shortcomings like strategic behaviour, protest responses, response bias and respondents' valuations that ignore income constraints. According to Whittington *at al*. (2002), CVM surveys can be administered in person (face-to-face), by telephone or through email. However, the use of face-to-face interviews is often preferred by most researchers due to the lower response rate and unreliability of emails and telephone calls. The major issues of concern regarding CVM surveys, after a careful design of the questionnaire, include pre-testing of the survey instrument, careful selection and training of enumerators, ethical considerations, and the cultural and traditional aspects of the area being surveyed (Whittington *et al*., 2002).

2.2.2 The reason behind the use of CVM

The CVM method was selected in this study because it caters more for the importance of non-use values and their potentially significant levels where other methods, such as the revealed preference (TCM) method, will underestimate the benefits gained from preserving the non-market values of environmental goods or services, for instance, water supply reliability in the case of the present study. In order to determine the socially optimal level of exploiting the natural resources, an environmental valuation and analysis ought to be carried out in an attempt to reach a balance between the costs imposed and the benefits bestowed upon people for informed policy-making decisions (Mitchell & Carson, 1989).

The main challenge that has been facing decision-makers in policy formulation processes has been the valuation of non-market goods and services, such as water supply reliability. Despite this main problem, it is of utmost importance that the non-market value of resources like water be captured to ensure that the policy recommendations on efficient resource allocation are rooted in economic principles. Indeed, as stated by Carson *et al*. (1994), there is a need for analysts to estimate the value of non-market commodities with a view to ensuring a full assessment of the economic desirability of the environmental policies. If used carefully, the CVM method offers the most appropriate technique for determining the WTP of the public for a variety of public goods and services (Mitchell & Carson, 1989). Since the method caters for the services provided by non-market commodities, the accuracy and relevance of the results in cost–benefit analysis and other empirical economic studies will be improved through it.

2.2.3 The theoretical base of CVM

Depending on the nature of the property rights and institutions involved in natural resources management, water may appear as a non-market good, so a non-market valuation method would be required to estimate the WTP for it. With the CVM approach, different environmental scenarios that are associated with the changes in characteristics of commodities can be applied with the use of the welfare measures (compensating surplus and equivalent surplus) approach (Bennett & Adamowicz, 2001; Bateman *et al*., 2002). Figure 2.1 below demonstrates how the two welfare measures work. Since *q* (reliable water supply) is not priced, the budget constraint in this case is a horizontal line at *z**, such that *pzz** is equal to income. Therefore, the household expenditure is just on *z* (goods that are already sold in the market). From the figure, the scenario under which the government considers to supply *q1* (the improved services) instead of maintaining the status quo (*q0*) is analysed. The units of *z* (other goods) equal to the distance *BC* under compensating surplus (CS) welfare measure. The increase in environmental improvement leads to a decrease in

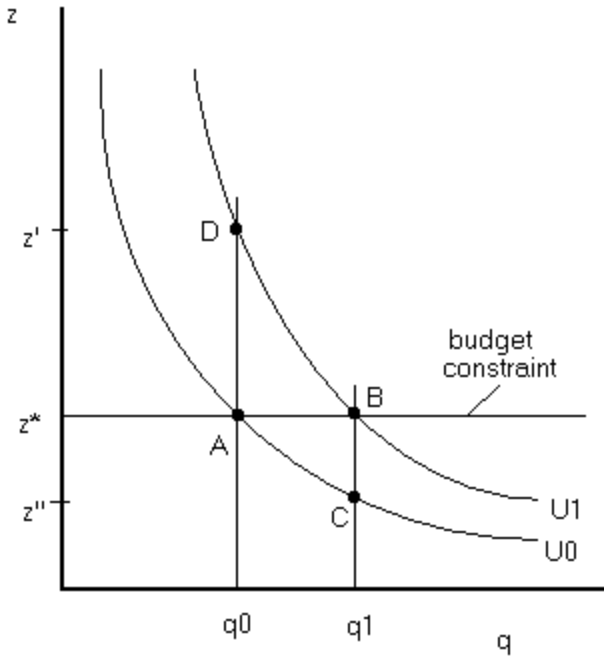

Figure 2.1: Compensating and equivalent surplus

Source: *Adapted from Kolstad (2000)*

income lowering *z* amount below *z** to only *z''*. This therefore keeps the individual at the old utility *U0*, even though there is an increase in environmental service quality. On the other hand, if the individual forgoes the benefit from the increase in environmental improvement, the equivalent surplus (ES) is adopted for analysis and the units of *z* equal to the distance *AD*. Thus, the compensation will make it possible for the individual to afford *z'* rather than just *z**, hence reach *U1* utility level that is allowed by the increase in *q1*. In this case, ES is not applicable because the interest is to find out about whether respondents are WTP for the improved attributes of water supply service, and not for the loss thereof.

Thus, as stated above, CS forms the basis of this study where the increase in water supply service reliability leads to the decrease in income of the respondent, with price *P* of other commodities remaining the same. This new environmental attribute leaves the individual at the initial lower utility u_o with improved environmental characteristics (Kolstad, 2000). In illustration, the compensating surplus can be presented as follows for the environmental good *q* in question, price *p* of other commodities, *r* representing increases in *q* (from q^o to q^1), while *M* represents consumer's income. The increases in *r* therefore forces each individual to increase the lump-sum payment by *rq*, whenever *r* is positive. This is called the income value of the change in *q*, meaning an increase in *q* has a negative income value on the respondent.

The conditional indirect utility function due to the increase in ***q***

$$V(P, M - rq^0, q^0) = V(P, M - rq^1 - CS, q^1)$$

The old utility is maintained though the environmental quality has increased from q^0 to q^1 and the lump-sum payment has now increased from rq^0 to rq^1 and *p* remains the same.

Using restricted expenditure function

$$CS = e(P, r, q^0, u^0) - e(P, r, q^1, u^0) = M - e(P, r, q^1, u^0)$$

In this case, the respondents would be WTP to get the higher environmental quality, since this maintains their previous utility with an indirect increase in satisfaction from an

improved attribute (from q^0 to q^1) of the non-market good (or at least no lower a utility level) (Kolstad, 2000).

The theoretical base of CS; Random Utility Maximization (RUM)

The data for CS are generated in such a way that there are systematically planned procedures that show the characteristics of the environmental good and the choice alternatives that go along with it. The CS approach has its theoretical foundations in RUM (Ben-Akiva & Lerman, 1985; McFadden, 1973). The idea behind the RUM is that when individuals make their choices, they consider the characteristics of the environmental good along with a random component. This random component may possibly result from the uniqueness of preferences of the respondent or because of the incomplete information that the researchers may have about the respondent during the survey. Therefore, the RUM theory shows that the utility U_{ij} of an individual i derived from a scenario j is unknown but can be decomposed into a deterministic component V_{ij} and an unobserved random component, ε_{ij}:

$$U_{ij} = V_{ij} + \varepsilon_{ij}$$

The term V_{ij} can further be expressed as a linear function of the independent variables as follows:

$$V_{ij} = x'_{ij}\beta$$

Where β is a vector of coefficients associated with the vector x' of explanatory variables, which are characteristics of scenario j, and these include price, and the socio-economic factors of individual i (Greene, 2000; Snowball *et al*., 2007).

There is also an assumption that respondent i would prefer to choose alternative j over alternative k if

$$U_{ij} > U_{ik}.$$

The elicitation format used during the implementation of the survey helps to decide which model is the best in analysing the WTP responses for scenario *j* (proposed improvement) over scenario *k* (*the status quo*). For the present study, the dichotomous choice question with follow-up question was used to elicit the non-market value of water resources. In this case, the respondent is asked one dichotomous question following the answer given to the first dichotomous choice question (Hanemann, 1991). The second question is endogenous due to the fact that it depends on the response given to the first question; if the answer to the first question is *yes*, the next question asks about the WTP for a higher amount. On the other hand, if the first response is *no*, the next question offers a lower amount. With this elicitation format there are two answers for each respondent (response to bid 1 and response to bid 2), which provide more information in which the single bounded models (Probit and Logit) would make inefficient use of the data if they were to be employed for analysis of WTP responses.

Before describing the model, the information that is gathered with this kind of survey instrument can be summarised in a following illustration; assuming that B_i^1 is the first bid and B_i^2 is the second bid for individual *i*, then each respondent will be in one of the following categories:

1. The respondent answers *yes* to the first bid, and *no* to the second one, then $B_i^2 > B_i^1$. It can be inferred that $B_i^1 \leq WTP < B_i^2$.
2. The respondent answers *yes* to both the first and the second bid, which implies that $B_i^2 \leq WTP < \infty$.
3. The respondent answers *no* to the first bid and *yes* to the second one, then $B_i^2 < B_i^1$. In this case, $B_i^2 \leq WTP < B_i^1$.
4. Lastly, if the respondent answers *no* to both the first and the second bid, it implies that $0 < WTP < B_i^2$.

In order to make the efficient use of the data for the study, the double-bounded model or interval data model was used. In this case, for each individual there is an initial bid B_i^I and one of the follow-up bid B_i^L or B_i^U depending on whether the first bid was accepted or rejected, where $B_i^L < B_i^I < B_i^U$. In essence, Baye's theorem (Edwards, 1986) shows that

the probability that the respondent will also agree to the second bid (B_i^U) , given that the response to the first bid (B_i^I) is yes, is given by:

$p(ytoB_i^U) = p(ytoB_i^U | ytoB_i^I)\ p(ytoB_i^I)$, where *y* denotes yes.

The WTP of a respondent is unobserved and it appears as a latent variable B_i^* in the model. The latent variable varies with the personal characteristics of a respondent and the error term is also unobserved and independent of these characteristics of a respondent (Verbeek, 2004). In particular, the error term ε_i is assumed to follow normal distribution, independent and identically distributed (IID) with mean zero and variance $\boldsymbol{\sigma}_i^2$, and WTP is estimated by the method of Maximum Likelihood.

The following function shows how the double-bounded model was estimated and specified:

$$B_i^* = x_i'\beta + \varepsilon_i$$

Where:

B_i^* - Latent variable for WTP

x_i' - Characteristics of a respondent

β - Coefficient of the x variable

ε_i - The error term

2.3 EMPIRICAL LITERATURE

2.3.1 The non-market value of water resources

There are many studies (Hensher *et al*., 2005; Bogale & Urgessa, 2012; Moffat *et al*., 2011; Haq *et al*., 2007; Kanayo *et al*., 2013; Dutta & Verma, 2009) that have been conducted on the subject of the non-market value of water resources. Water supply is a service of absolute necessity for all people at all times, hence its charge is expected to be affordable, even to the poor, and water is also regarded as a social need (Borgoyary, 1988). Indeed, Bogale and Urgessa (2012) added that the optimal pricing of water supply helps to ease the burden on governments and improve the reliability of the service to the consumers. However, due to emerging challenges like rapid population growth, especially

in the cities, water supply authorities fail to maintain a quality service and hence the urgent need for a strategy to make sure that water pricing reflects the costs incurred for a reliable service (Hensher *et al*., 2005). Hensher *et al*'s study further showed that the duration of an interruption in water supply service could be protracted by the problem of a water supply authority's low capital investment, relative to the required service level. Therefore, Engel *et al*. (2008) suggested that consumers ought to bear the total cost of the service for sustainability, in order to prevent overuse of depleting water resources (Bogale & Urgessa, 2012). Many scholars have so far concentrated on valuing mainly water quality of water supplied and the reliability of the service itself.

2.3.2 Studies on water supply services

2.3.2.1 Introduction

Literature shows that consumers are mainly concerned with the taste of water, presence of pollution and risk perceptions, and interruptions in water supply services (Doria, 2010; Beaumais *et al*., 2010; Jiang *et al*., 2010; Wang *et al*., 2010). For instance, Doria (2010) indicated that whenever consumers found out that the water they used had a strange taste, they perceived that quality had also been compromised and that was regarded by them as more important than odour and appearance. Again, Beaumais *et al*. (2010) stated that whenever respondents had problems with taste or health concerns regarding the water they used, a proposed improved supply was preferred. Furthermore, households in Fuzhou, China, also expressed WTP an extra 10 % tariff to control pollution in their water source (Jiang *et al*., 2010). In Southern Ethiopia, Behailu *et al*. (2012) found the same results for a similar study. Other studies included those relating to iron and sulphate concentration reduction in Minnesota (Cho *et al*., 2005), water chlorine smell (Genius *et al*., 2008), water contamination by nitrate and pesticides in Canada (Charrois, 2010) and water-borne disease interventions in rural communities of Pakistan (Malik *et al*., 2012). Therefore, Tanellari *et al*. (2009) noted that risk perceptions and attitudes towards water quality triggers consumers' WTP for its improvement.

2.3.2.2 Water supply quality and quantity

The studies of Ntshingila (2006), Banda *et al*. (2007) and Genius *et al*. (2008) used the CVM technique to estimate the WTP of the respondents for improved quality and quantity of water supply. Ntshingila (2006) found that the larger proportion of the rural households in the study area was WTP for both quality and quantity, relative to the urban residents. With regard to the amount, the study revealed that urban households were WTP more for the improved quality in water supply, relative to the rural dwellers, and the amount for improved quantity was almost the same for both groups of residents. The results from the Tobit model revealed that WTP was determined by age of the respondent, sex of the respondent, monthly income, water consumption, water source and practice of avoidance measures for improved water quality for Swaziland residents. In contrast, WTP for improved water quantity's last determinant was collection time, rather than practice of avoidance measures, while the rest of the variables were the same. The results obtained by Banda *et al*. (2007) from the study conducted in rural area of South Africa revealed that the factors that determined the WTP for both improved quality and quantity of water through the Tobit model were: households' income, availability of water, households' access to a tap, and water per capital and monthly water consumption. From the study conducted in Municipality of Rethymno, Greece, Genius *et al*. (2008) found that female respondents, households that had high income, households that had children, and those that did not use tap water for drinking, were on average WTP more for improved potable water quality and quantity.

The referendum-format CV survey was used by Vasquez *et al*. (2009) in a Third World country (Parral, Mexico) to elicit household WTP responses for safe and reliable drinking water. The main findings of the study indicated that the households had then adopted many averting and private investment measures, like bottled-water consumption, home-based water treatment, and water storage facilities, to adapt to the water supply challenges. The results demonstrated that the households were WTP from 1.8 % to 7.55 % of reported household income above the water bill rate charged by the water utility. In contrast, a study that provided a systematic overview of experimental evidence on WTP for safe drinking water in the less-developed countries was conducted by Null (2012). The study illustrated that there had been a major push for water utilities to expand access to safe water by promoting water quality improvements in recent years, with more emphasis on point-of-use water treatment technologies like filtration and chlorination. The study,

however, found that the WTP of the respondents for potable water quality improvements was less than the cost of the technology needed to implement the proposed project, hence it was difficult for households to observe the private benefits in terms of improved health.

Haq *et al.*'s study, in 2007, administered a CV survey in Abbottabad district, Pakistan, to estimate the WTP at the household level for safe drinking water. The findings from the study revealed that the supply system of drinking water in the case study was not reliable, in both services and quality aspects, for meeting the requirements of the households and that they placed more value on the reliability of both water services and quality. Furthermore, the location in urban areas was the significant factor that determined WTP for improved water services. In terms of the averting behaviour strategies, the study found out that education level of the respondents had a statistically significant influence on the water purification behaviour of the households. The study also found that the general public perception towards the opportunity cost for using unsafe water was significantly affected by the water quality and awareness.

Nam and Son (2004) did a CVM study on demand for improved water services in Ho Chi Minh City, Vietnam. The study assessed the willingness of people in Ho Chi Minh City to pay for a better water supply system. Furthermore, the study investigated the specific aspects regarding water supply, like quality and water pressure, that were most important to consumers. The findings indicated that many of the households surveyed already had to explore many options and invest more in their endeavour to cope with the unreliable and poor quality public water supply offered by the water utility. Furthermore, the results demonstrated that respondents were on average WTP between VND 148,000 and VND 175,000 for improvements in the water supply system. Again, households that had no piped water were more WTP for improved services than the ones that already enjoyed the fixed supply of water. The study also found that the households that had no piped water placed more importance on the quality of water than its pressure.

Moffat *et al*. (2011) did a CVM survey where they investigated the WTP of the Chobe ward residents in Maun, Botswana, for the improvement of water quality and reliability. The results showed that the residents generally regarded water as an economic good, as an estimated 54 % of the households were WTP for improved water quality. The regression

results indicated that the household income, the age of the respondent, and the gender of a respondent had a positive effect on WTP for improved water supply. However, gender of the respondent was statistically insignificant in determining the WTP, as males were over represented in the survey. On the other hand, the household size, avoidance expenditures (with statistical insignificance) and educational level had a negative influence on WTP.

Khuc (2013) used both CVM survey and averting behaviour methods to estimate households' WTP for safe drinking water in Hanoi and Hai Duong in the north of Vietnam, and in Ho Chi Minh, in the south of Vietnam. The internal and external factors, and their magnitude, that affected the WTP for clean drinking water were identified by the use of binary logit regression. The findings revealed that almost half of the households were WTP for better drinking water, even though the value of the WTP made up a small proportion of household income, at only 0.247 % of the overall household income. The WTP decision depended on level of education, household income and awareness as internal factors, while the living conditions, the existing water source and the status of water resources were external influences on WTP. In their endeavour to prevent diseases that could potentially result from the use of polluted drinking water, households in rural areas used boiled water, while those in city opted for bottled water. The results also showed that bottled water was used mostly by young people, while the use of water filtration increased the amount they would be WTP for clean water. In comparing the results from the two methods, the study found that WTP was always not greater than cost of averting expenditure.

Kanyoka (2008) used the choice modelling elicitation format to analyse the water value and demand for multiple uses in the rural areas of South Africa, being the Ga-Sekororo area in the Limpopo province. In the survey, the residents were asked to choose the levels of the attributes of the following alternative sets of water services: water quantity, water quality, frequency of water supply, price of water, productive uses of water, and source of water in order to measure the WTP for different aspects of water demand. The study adopted the mixed logit model to analyse the attributes that determined the demand for water services. The results indicated that the households in those rural areas were WTP for improvements of water services. Again, the respondents in areas with poor quality of water services were mainly interested in basic domestic uses, rather than the non-domestic water,

while the households that were already relatively well served were WTP more to engage in multiple water uses.

Wang *et al*. (2010) did a CVM survey in Chongqing, China, on water pricing with household surveys, a study of acceptability and WTP. The authors presented a multiple-bounded discrete choice (MBDC) survey model for collecting information on acceptability by varying water prices on different household types and estimated households' WTP for water service improvement. With a sample size of 1500 households in five suburban districts in Chongqing Municipality, the study showed that the WTP was significantly higher than the water charge rates of the water utility. Again, the results also revealed that the poorer households were WTP relatively less in absolute terms, but at a higher proportion of their income. Furthermore, the urban residents and male respondents, and those that paid higher water charges, were WTP more. The study recommended that special attention to the poor people and awareness campaigns might be warranted in order to ensure the general acceptability of price increases.

2.3.2.3 Uninterrupted supply

Hensher *et al*. (2005) also did a CVM study in Canberra, Tanzania, where they investigated households' WTP for water service attributes. The study was administered with the use of a series of stated choice experiments elicitation format and mixed logit models in order to find out how much customers were WTP for specific levels of water service attributes. Specifically, the authors were interested in establishing the WTP of the Canberra residents to avoid interruptions in water service and overflows of wastewater, differentiated by their frequency, timing, and duration. Through the study, the researchers wanted to establish service levels and tariffs through empirical evidence, and to provide necessary planning information for the agencies to engage in cost-effective ways in service delivery. The results of the survey indicated that the residents were WTP to avoid water supply interruptions that occurred on weekends in terms of the time. However, the consumers were WTP more to avoid interruptions that were infrequent and short, relative to regular and lengthy interruptions. The authors indicated that the increase in number and length of disruptions faced by consumers increased the chances of taking measures to reduce the impact on the household, like investing more in storing water. As argued by

Akcura (2011), consumers sometimes have low trust in the utility company when they habitually experience long interruptions, hence less WTP for the proposed water supply service improvements.

Asim and Lohano (n.d.) conducted a CVM study on WTP for uninterrupted and good quality supply of tap water in Karachi, Pakistan. The study employed both single and double-bound dichotomous choice elicitation formats to examine the households' WTP and its determinants. Three models (probit model, interval data model, and bivariate probit model) were adopted by the authors to analyse the survey results found from 373 households. The WTP of the residents was found to be influenced mainly by the household income, availability of water in terms of hours per week, satisfaction of the household with water quality, the residence type, and the bid amount. Furthermore, the results indicated that the WTP by households with monthly income less than Rs. 20,000 was in the range of Rs. 604–734 per month, on average. On the other hand, the overall average WTP from all income categories was in the range Rs. 1,922–2,126 per month, whereas the average monthly bill was Rs.703. The study therefore recommended that cost recovery would be possible by increasing tariffs for higher income households in order to subsidise lower prices for the poor.

Gumbo and Rananga (2015) conducted CV survey in the two communities in Mutale Local Municipality, South Africa, where they evaluated the respondents' WTP for water services. The study was administered through open-ended elicitation format with selected respondents. The data from the survey was analysed using the descriptive statistics and the Chi square test. The study indicated that about 89 % of the respondents were dissatisfied with the unreliable water supply, while the proportion of those that were WTP for improvement in water supply reliability was approximately 95.5 %. Again, the respondents that had tertiary level education were WTP about R150 per month per 6 kilolitres of water. The study also found that the municipality could provide the maximum 6 kilolitres free of charge as the basic water service. The Chi square results revealed that the monetary amount and WTP were influenced by the following variables: literacy levels, household size of 3 to 6 members, the age of 40, and monthly incomes, at 5 % level of significance.

Getahun (2013) employed a single-bounded dichotomous choice elicitation format to analyse the determinants of households' WTP for improved water supply services in Mekelle city, Ethiopia. The results from the CVM survey were analysed through descriptive statistics and econometric analysis by Probit and Tobit empirical models. The results showed that approximately 99 % of the respondents were WTP a positive amount for an improved water supply. That is, once the water needs of the households are satisfied with the implementation of the improved services, the city's water utility company would be able to collect more revenue. The results further revealed that the households were WTP approximately between 29.60 cents and 51.51 cents per jerrycan, depending on the method used for the proposed improved water service. The WTP of the households was found to be probably determined significantly by the gender of the respondent, education level of the respondent, monthly income of the household and the satisfaction with the present service.

Bogale and Urgessa (2012) implemented a CVM survey in Haramaya district, Ethiopia, to estimate the WTP of rural households for improved water supply service. The study was administered through the double-bounded dichotomous choice elicitation format and the bivariate probit model was employed for the analysis of the data collected. The results revealed that the households' mean WTP for improved water services was 27.30 cents per 20 litres. The WTP was mainly determined by the household income, respondent's education level, sex of the respondent, time spent to fetch water, water treatment practice, quality of water and expenditure on water, and age of the respondent.

Kanayo *et al*. (2013) implemented a CVM study in the Nsukka Area of south-eastern Nigeria to determine the factors that would influence peoples' WTP for improved water supply, and to estimate the amount of revenue that the government could generate at higher water charges. The study used the Tobit (censored) model to identify the variables that defined the WTP of the households for improvement in the water supply system. The results indicated that the WTP for water was influenced by the level of education and occupation of the head of the household, prices charged by water vendors, the amount spent on water vending, and the average household monthly income. On the basis of the findings, the study recommended that the government ought to ensure that it engages in public–private partnership in its policies and programmes.

2.3.2.4 Empirical literature from Maseru, Lesotho

A few studies have been implemented on water supply services in Maseru, to date (Masupha, 2007; Letsie, 2005; Molapo, 2005; Motŝoene, 2013). In 2007, Masupha did a study on the textile industry's water management, where it was concluded that water treatment from the factories lacked efficiency and reduced the welfare of users of water downstream. In addition to that, the study on the quality of water in Maseru's main water source (Maqalika dam) concluded that the waste from nearby houses (with high levels of detergent containing phosphorus), leaking sewage and littering from the catchment were the main pollutant generators to the reservoir (Letsie, 2005). Molapo's (2005) analysis of urban water provision in Maseru – a geographical analysis – found that the public standpipes were the main source points of water, mostly for the poor urban population. However, it was found that the amount of water consumed from the standpipes per unit was not recorded, which resulted both in the deprivation of income for the supply authority and overexploitation of water resources. Motŝoene (2013) also did a study on urbanisation and poverty in Maseru (a comparative study of Sekamaneng, Motimposo and Thibella), and concluded that the rapid urbanisation in Maseru placed even more pressure on the water supply authority, which had been battling with lengthy interruptions in an attempt to meet the required service level. The study also indicated that water supply to the city was unpredictable for most people, with significant impact on the poor. Consequently, the study was interested in establishing the WTP and the determinants thereof in Maseru for an improved potable water supply reliability on the basis of the existing literature (Hensher *et al*., 2005; 2006; Kanayo *et al*., 2013, Wendimu & Bekele, 2011).

2.4 KNOWLEDGE GAPS

From the literature reviewed above, the gaps in empirical knowledge regarding the non-market value of water resources in Maseru have been revealed. The main challenge noticed is that there is no information presently available to prove that the value can indeed be added on the reliability of water supply of which can reflect in the existing market of water. Implementing a survey on the WTP of Maseru residents for the improvements in water supply reliability could help to promote the conservation of water resources and

ascertain the water prices that reflect the cost of provision for sustainable water supply and cost recovery. A constant supply of water to Maseru would greatly help to improve the livelihoods of many people, especially in areas like Qoaling, Ha_Tsautse, Ha_Pita, and Tsoapo-le-bolila, where water supply interruptions seem to be common.

2.5 CONCLUDING SUMMARY

The main aim of this chapter was to review the literature on theory behind the technique adopted for the study and the relevant literature from the empirical aspect. The literature reviewed above undeniably revealed many gaps, especially in the empirical evidence on the non-market value of water resources in Maseru. The conclusion that can be drawn from this section is that the CVM technique had not been adopted as a tool for examining water resources management, policy formulation and in practice. Again, water is still regarded widely as free in nature, leading to over exploitation.

CHAPTER 3:
STUDY AREA AND RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter presents study area and research methods that were employed in this study and it is divided into nine main sections. Section 3.2 discusses the study area, while Section 3.3 presents the sampling. This is followed by discussion on the survey instrument and development in Section 3.4, and on survey implementation in Section 3.5, respectively. Data analysis is covered in Section 3.6, while variable description is set out in Section 3.7. The household characteristics of the sample are discussed in Section 3.8, followed by Section 3.9 which presents and discusses the empirical models for the study. Finally, Section 3.10 briefly summarises the aforementioned sections.

3.2 STUDY AREA

The topography of Maseru

Maseru is one of the ten districts of Lesotho. It is surrounded by the districts of Berea, Thaba-Tseka, Mohale's hoek and Mafeteng. The city is situated on the eastern bank of the border between the country of Lesotho and the neighbouring Republic of South Africa, in an area of rugged topography which has an estimated altitude within the city centre of about 1 550 metres above sea level. Maseru is divided into three agro-ecological zones, namely the lowlands, the foothills and the mountains. It has an elevation ranging from 1 200 to 1 800 metres in the lowlands, 1 800 to 2 300 metres in the foothills, and 2 300 to 3 000 metres in the mountains. It has five peaks, namely Qeme (2 027 m), Thaba-Telle (2 533 m), Thabana-li-'mele (2 660 m), Machache (2 886 m), and Thaba-Putsoa (3 096 m), and two well-known passes called Blue Mountain and Bushmen's passes (Ministry of Agriculture Cooperatives and Land Reclamation, 2002). In this district, most of the water is found abundantly in the mountainous areas, and less in the lowlands, leading to an uneven distribution of this indispensable resource. Indeed, the total geographical area for the district is 427 900 hectares, where approximately 41 % (17 5439 hectares) is the

mountains, 31 % (13 2649 hectares) in the foothills, and 28 % (119 812 hectares) in the lowlands.

Population

Since independence in 1966, the population of Maseru has risen from approximately 28 000 to 109 670 (1986 census) to the present estimate of 197 907 from the 2006 population census (Bureau of Statistics, 2006). This increase is due to the rapid expansion of the city, as well as changes in the city boundaries in 1980 which now define Greater Maseru. Greater Maseru now encloses an area some 5 to 6 times the original city area of about 23 square kilometres (km^2). In 1986, the population growth was estimated at about 4.3 % per annum, and was predicted to be 200 000 and 545 000 in 1995 and 2020, respectively (Bureau of Statistics, 1986). Approximately 9 % of this population resided in the mountains, 19 % (75 567) in the foothills, and 72 % (28 3847) in the lowlands (Bureau of Statistics, 1996), showing that more people live in the Lowlands where there is less water due to technological constraints in harnessing it. The figures indicate that the average population density in Maseru as a whole is 92 people per square kilometre. The total number of households in Maseru district is quoted as 83 961, of which 63 691 (76 %) are found in the lowlands, 13 831 (16 %) in the foothills, and 6 439 (8 %) in the mountains, with an average household size of 5 members. Therefore, due to the population pressure in Maseru, the present capacity of the water supply service level seems to be lower than its requirement. Therefore, Leshoboro (2009) stated that about half of the residents lacked reliable water supply, which resulted in lengthy water supply interruptions, as the population levels exceeded the supply capacity.

Climate

Generally, Maseru District is hot in summer, with mean maximum temperatures ranging between 22 and 31 degrees Celsius. The hottest areas are in the lowlands, while the foothills and the mountains are considerably cooler. Winter temperatures in this district range between cold in the lowlands to very cold in the foothills and mountains. The mean minimum temperature ranges from zero to six degrees Celsius. The hottest temperatures occur during November, December and January. The average daily mean hours of

sunshine throughout the year fluctuates from a minimum of 6.6 to a maximum of 10.3 hours per day (Meteorology Lesotho, 1996). Rainfall in the Maseru district is moderate, with a minimum of 500 mm per annum in the lowlands and a maximum of 1000 mm in the mountains. Obviously, these figures explicitly indicate that in the lowlands there is a relatively high struggle to get enough water for urban masses, due to the uneven distribution of rainfall throughout the district. The foothills receive between 800 and 1000 mm, except the areas between Machache Peak and Blue Mountain Pass, where the annual rainfall is above 1000 mm. The rainy season mostly starts in September and extends until March each year. During the winter months, the foothills and mountains commonly experience snowfalls. Most of the rainfall occurs in the summer months, with the lowest rainfall falling in July. Therefore, the general annual climatic conditions seem to favour the other regions of the district more than the lowlands, where Maseru City is located.

Water supply and reliability of the service

Potable water supply reliability is one of the greatest challenges faced by the households, especially in the lowlands. Indeed, the present lack of water supply infrastructure in most parts of the town obviously accounts for the long duration of water supply interruptions experienced by the residents. The existing water source points for the people in Maseru include mostly standpipes (on-yard and communal sources), while open springs and collected rainwater are options during extreme water shortages. Communal water source points and on-yard source connections were made through the Water and Sewerage Authority (WASA), and those who have access to them are liable for a certain payment, while other sources operate under open access. The authority has recently introduced a pre-paid system for water access at the source points, so that each individual accounts for his or her own water use per unit drawn (Letsatsi, 2008). In this new system, the residents have to purchase a payment card and load a certain amount onto it in order to draw water from the standpipe, and this card stops working immediately when the balance is exhausted. Once the card is inserted on the standpipe to draw water while still loaded, it it is charged approximately M0.10 per 20L jerrycan of water in the case of communal source-users, while the same rate is paid from on-yard source points as a monthly water bill based on the quantity consumed. On the other hand, the minimum of M1.00 cash per 20L jerrycan of water is paid directly to the on-yard source point vendor during supply

interruptions or by those who presently lack the loaded access cards. During water supply disruptions, most residents opt for such vendors, and under extremely long water supply-cut situations, the per unit charges seem to be very high. Therefore, this substantiates the argument made by other scholars that the urban services today are mostly accompanied by cost recovery, in that those that those who benefit from the provision of environmental amenity should pay a fee that contributes to its cost (Beall, 2000).

Water resources policy

Lesotho prepared the Water Resources Management Policy in its endeavour to address the need to manage water resources for the social, economic and environmental benefit of people all in the country. The policy was adopted in 1999 and contains six policy statements and strategies for implementing them. The statements are: rational exploitation and management of water resources, regular supply of potable water for all people at all times, water for basic human needs, and the "user pays" principle, protection of all environmental aspects of water resources, management of water for maximum benefit to the country while taking cognisance of obligations to neighbours and downstream users, and the involvement of stakeholders in every stage of water resources development projects and demand driven expansion of water supply (Department of Water Affairs, 2003). However, this sound water resources management policy seems to be in disarray, as there is presently no clear strategy on how to ensure the practical reliability of water supply service for all people at all times. Therefore, the non-market value of potable water supply reliability is a prospective solution to help inform policy-making decisions in order to ease the pain that many people continue to experience, especially in Maseru.

3.3 SAMPLING

The target population for the study comprised of households that access water from standpipes and those who collect water from other sources, like open streams. Both purposive and random sampling methods were used during the implementation of the study. The purposive sampling method was mainly used when identifying the residents that access water from on-yard source points and those that use communal source points to ensure the equality of representation of both groups in the study. Thereafter, a simple

random sampling technique was employed to select the residents that were to participate in the survey from those who presently fetch water from the standpipes (whether on-yard or communal source points). To improve the homogeneity of the sample, all people who presently reside in Maseru stood a chance to participate, although more interest was focused on those who use standpipes, as they form almost 100 % proportion of the entire population. Another reason for concentrating more on those who use standpipe source points is that they have the experience of possible recent water supply service interruptions; hence, they know the alternatives that they usually explore, and their perceptions and opinions concerning the water supply services offered by WASA. For the purposes of the split sample used, the residents that access water from the springs were regarded as those that access water from the communal source points, since wells are accessible to the community as a whole. However, due to the limited coverage of the study in terms of time and space, only the residents that use standpipes participated in the survey.

Based on the theory, a sample size of less than 1000 respondents is not reliable to represent the population for a CV survey (Stoker, 1989:130); however, Stoker added that a more homogeneous population can allow for a small sample size. Consequently, due to financial and time constraints for the study, a sample size of 211 respondents was selected. To improve the reliability of results, the sample comprising 100, 89, 10 and 12 respondents was randomly selected from the villages of Ha_Tsautse, Qoaling, Ha_Pita and Tsoapo_le_bolila, respectively, to participate in this study. The study concentrated mostly on Qoaling due to its relative distant water source points and lengthier interruptions. The other three villages experienced almost the same water supply-cut lengths that justified their inclusion though Ha_Pita and Tsoapo_le_bolila had comparatively less representations due to time constraint. On the other hand, the reason for the simple random selection approach of the residents that formed part of the survey from the four villages was to ensure the wide coverage of the study, and to analytically minimise both the sample selection bias and the standard error of the estimates (Leady & Ormrod, 2010:207).

3.4 SURVEY INSTRUMENT AND DEVELOPMENT

A considerable amount of time was spent on developing the survey questionnaire for this study. Many literature sources were used in developing the CVM survey questionnaire and

the study supervisor was also consulted on several occasions to ensure that the survey instrument would be sufficient for the task. The questionnaire was constructed bearing in mind that there was a possibility that some information that forms the basis of this study might have been forgotten by the respondents, such as the time and duration of water supply interruption occurrences, and so comprehensive questions were developed to help them to recall. In the case of the starting bid, the study used M1.00 per 20L jerrycan, while M0.50 and M1.50 were intended to minimise the starting bid bias. Since the present rate paid to WASA is M0.10 per 20L jerrycan of water, and a minimum of M1.00 per 20L jerrycan of water is charged by the vendors during supply interruptions from regular sources, M1.00 per 20L jerrycan was then chosen to be the starting bid. Therefore, the residents were asked for their WTP to ensure that whenever the water supply is interrupted in the future, whether planned or not, it does not last for more than a day per month.

Furthermore, before the actual implementation of the CVM survey, a pre-test of the instrument was done on only a few residents, especially those that the researcher knew had been in Maseru for over a year. Furthermore, a private, detailed discussion was purposely carried out by the researcher with one elder in Qoaling village to find out about the prospective responses on perceptions about the existing water supply service and the water supply authority's effectiveness. The main objective of the pre-survey exercise was to find out whether the survey instrument was strong enough to extract the true information about the reliability, consistency and user-friendliness of the existing water supply service in Maseru. Furthermore, the pre-test helped the researcher to know if the interview exercise implementation would go as planned, for example, as to the time spent per interview. The main findings from the pre-survey were that each interview took 45–60 minutes, on average, and that time was too long, according to the prior expectations of the study. Again, there were incidences where respondents asked for an identity document in addition to the consent form to ensure that the researcher was authentic. Further inconsistencies were identified, where the options given on the questions did not apply to some respondents, for example, the average household monthly income groups. Such challenges were then addressed to ensure that the survey instrument was clearly understood and in line with the ethics of the community, and lastly, two enumerators were trained.

Immediately after the consent form, the survey instrument started briefly by introducing the respondent to the interview. The main content was divided into four parts as follows; section A concentrated on the socio-economic information of the household, with emphasis on the head; section B collected information on the knowledge, opinions and perceptions of the household about the *status quo* and the proposed improved situation concerning water supply service reliability in Maseru; section C presented the contingent valuation survey scenario to the respondent to find out if the proposed improved attribute of water supply reliability would be preferred by the respondents; and the last part, section D, consisted of the debriefing questions where the interviewer analysed the level of understanding that the interviewee had and the reliability of the responses given.

3.5 SURVEY IMPLEMENTATION

Face-to-face interviews were conducted in Maseru at Qoaling, Ha_Tsautse, Ha_Pita and Tsoapo_le_bolila. The enumerators assigned themselves specific villages for each one of them; the researcher worked at Qoaling, the first enumerator at Ha_Tsautse, while the last one was at Ha_Pita and Tsoapo_le_bolila. The enumerators moved from house to house, implementing the study. The interviews took 15–30 minutes per interview, on average. The interviews that took a relatively long time per interview were special situations where respondents took time to understand questions, which had to be repeated until they were clear. There were incidences where the respondents were afraid to respond to personal questions, especially in the socio-economic information section, and the researcher had to keep on reminding them that they were participating anonymously, and that was when they felt free to respond. The respondents were more collaborative than the researcher had expected, due to the intensity of the challenge of water supply interruptions and that made their responses more reliable as they were more humble and willingly allocated their precious time to participate.

Before presenting the scenario, there were a series of questions on the knowledge, attitudes and opinions regarding water supply reliability. The first bids were M0.50, M1.00, and M1.50, followed then by the second bids of M0.30, M1.00, M1.50, M2.00, depending on the response given to the first bid. An additional open-ended question was also asked after each yes–yes or no–yes response to find out the true WTP of the respondent. Again, there

were some follow-up questions on affordability and financial situation after the WTP section to ascertain the validity and reliability of responses, and that was also complemented by the debriefing questions in the last section in the survey instrument.

3.6 DATA ANALYSIS

An Excel sheet was used to enter primary data from the survey before it was further imported into STATA, from which it was labelled. Again, data cleaning was performed, where summary statistics were obtained for the purpose of identifying and correcting possible mistakes that might have been made when entering data and outliers that would affect the results. The primary data that was collected from 211 respondents from Maseru was analysed using STATA software, version 12. The main aim of the analysis was to estimate the mean WTP of Maseru residents for improved water supply reliability and to identify the factors that determine WTP, and to test whether the location of the water source points had a significant impact on the WTP.

The first objective of the study, as well as other data reliability tests, was analysed using summary statistics, chi square magnitudes and p-values, while the analysis on bid 1 was done through the summary statistics. The main analysis was done using the double-bounded models due to the fact that the study used the elicitation format of a dichotomous choice question, with one dichotomous follow-up question. The unpaired t-test was run to test the main hypothesis of the equality of WTP of the two split samples.

3.7 VARIABLE DESCRIPTION

This section describes the main variables that were used in the analysis. The descriptive statistics were used to describe the variables in terms of frequencies and percentages. The main dependent variable in the binary model used in the analysis is the WTP for improved water supply reliability. Some of the variables used to capture the knowledge, attitudes and opinions also appear as explanatory variables in the WTP function.

In the model used for the analysis of WTP of the respondents that access water from on-yard source points, WTP was used as the dependent variable that indicated the probability

that the respondent was WTP for improved water supply reliability or not. The socio-economic variables used in that model were age of the household head, the average monthly income of the household, and the highest educational level of the household head. The age of the household head was categorised into five groups as follows: AGE_1 (25-34), AGE_2 (35-44), AGE_3 (45-54), AGE_4 (55-64), and AGE_5 (65 and above) in the model. The first four categories were the only ones that reflected in the model, and they were interpreted relative to the base category (of those 65 years old and above). The next variable was the average household monthly income and it was divided into three categories for analysis. The first category, INCOME_1, represented the respondents whose average household monthly income was below M2000, INCOME_2 was used to indicate the influence of the average household monthly income that ranged between M2000 and M4000, while the last group was used to capture the effect of being in a household that received more than M4000, on average, on a monthly basis. The two categories, INCOME_2 and INCOME_3, were interpreted relative to the base category (INCOME_1) which was reflecting the first average household monthly income level in the model. The third and the last socio-economic variable that was entered into the model was the highest educational level of the household head, with three categories. The first category, EDUCLEV_1, captured the impact of both the primary level and that of having never gone to school. The next highest educational level of the household head group's influence was captured by EDUCLEV_2 (high school level of education), while the last category (EDUCLEV_3) indicated the effect of having attained tertiary level education. The two other classes that captured the impact of highest educational level were interpreted relative to EDUCLEV_2, the category for those with high school level of education.

The model was also built by economic variables which were used to capture the effect of the time that the household head had lived in the house, as at the year before the study, the attitudes that the respondent had if the government were to enact and pass a parliamentary bill that would be geared towards improved water supply reliability, and the experience of the water supply service interruption that lasted for a period between a month and six months in a year. The first variable, Q6A_PERIOD, was entered into the model as a dummy variable that indicated whether the head of the household had lived in the house for the whole of the year before the study was implemented or not. Secondly, the variable Q8C_BILLGUD was also entered into the model as a dummy variable in the analysis. The

variable was intended to find out the influence on the WTP of whether the respondent perceived that it would be a good idea for the government to enact and pass a bill that would result in improved water supply reliability in Maseru. Lastly, since the study was primarily concerned about the duration of water supply interruptions, the variable Q178B_LSIXMYR was entered into the model as a dummy variable, capturing the effect of whether the respondent had experienced interruptions in water supply that lasted for a period that ranged between a month and six months in a year.

The next model was also a binary model, and it was used to determine the factors that influenced the WTP of the respondents that access water from the communal source points. The dependent variable was WTP as in the case of on-yard source points model. The model was also built with the socio-economic variables and economic variable, of which some still appeared in the previous model. Both the socio-economic and economic variables were entered as dummies and categories.

The socio-economic variables that were used to define WTP were the average household monthly income, the gender of the respondent, the age of the household head, and the highest educational level of the household head. Both the average household monthly income and the highest educational level of the household head were entered and used as in the first model. However, in the case of capturing the influence of the age of the household head, there was a sixth category which indicated the effect of the age group that ranged between 15-24 years (AGE_1) due to age distribution in this sample. Therefore, the age categories appeared as follows: 15-24 (AGE_1), 25-34 (AGE_2), 35-44 (AGE_3), 45-54 (AGE_4), and 55-64 (AGE_5), while AGE_6 represented the effect of the age class of 65 years and above. Therefore, the five categories appeared in the model and they were interpreted in relation to AGE_3, which captured the effect of the age group that in the range 35-44. The model also included the gender of a respondent as a dummy variable (Q40_GENDER), and it indicated the impact of being a male versus a female on WTP.

In the case of economic variables, the time spent per round trip to fetch water from the alternative source, the attitudes that the respondent had on whether it would be good for the government to enact and pass a parliamentary bill to ensure the improved water supply reliability, the experience of water supply interruption that lasted for a period more than a

year, and the awareness of the respondent regarding the unsuccessful attempts that WASA had explored to offer improved services were entered as dummies and categories. To capture the effect of the attitudes that the respondent had regarding the issue on whether it would be a good idea for the government to enact and pass a bill for improved water supply, Q8C_BILLGUD was used as a dummy, as in the first model. On the other hand, the variable used to reflect the effect of the time in minutes spent per round trip to fetch water from the alternative source was entered into the model as a categorical variable; the categories were TSOSTIM_1 (1-14), TSOSTIM_2 (15-30) and TSOSTIM_3 (above 30). The last two categories' influence on the WTP was interpreted relative to the base, which was TSOSTIM_1. The next variable, Q1710_MOTHNYR, was used to show the effect of the experience of water supply interruption that lasted more than a year and it was entered into the model as a dummy variable. Lastly, the dummy variable Q3C_ATTEMPT was used to analyse the effect of the awareness that the respondent had regarding the unsuccessful attempts that WASA had explored to improve their water supply service system.

The study also used other variables to capture the respondents' knowledge, attitudes and opinions concerning water supply services in their community. That analysis was used to assess whether there were enough proportions of the respondents that had factual knowledge regarding water supply challenges, how they felt (attitudes) about the lengthy water supply interruptions, and the views they had for improved services.

To capture the factual knowledge of the households concerning the water supply services, they were asked questions about their awareness regarding the unsuccessful attempts that WASA had explored to offer improved services, whether they used on-yard vendors or wells as alternative sources in times of water supply interruptions, the time they spent per trip to fetch water from the main source, as well as the alternative source, the number of trips they make to fetch water per day, the number of days of fetching water per week, the number of containers that they carried to the water source per round trip, the size of the container used to carry water, and finally, the amount that the household spent on water on a monthly basis and the charge they paid per 20 litres of water from the alternative sources in times of water supply service interruptions.

To assess the attitudes that the respondents had concerning water supply services, they were asked to rate the quality of the service that they got from alternative sources, whether they agreed that the alternative sources, like wells, could have negative human health implications, and whether they perceived that the government could enact and pass a parliamentary bill designed to offer improved water supply reliability. The last two questions concerned whether they considered WASA as being capable of offering improved services, if the government were to pass a parliamentary bill, and whether it would be a good idea for such a parliamentary bill to be enacted and passed.

Finally, to capture the opinions that the respondents had for improved services, they were asked to indicate the number of days they would expect to get advance notice before any planned water supply interruption in the future, and whether they would expect any up-to-date information during future water supply interruptions. Lastly, the respondents were asked to indicate the specific medium through which they would like to receive the up-to-date information during future water supply interruptions. Accordingly, they were asked to choose between an automated voice on call during the interruptions or whether they would expect a person to pick up their call. Furthermore, the respondents replied to the open-ended question regarding their preferred medium of information dissemination by mentioning radio, television and public gathering by the chief.

3.8 HOUSEHOLD CHARACTERISTICS OF THE SAMPLE

Table 3.1 below summarises the socio-economic characteristics of the sampled households

Table 3.1: Demographic and socio-economic characteristics of respondents

Variable	On-yard source	Communal source	Total
Gender:			
Male	54(51.9%)	53(50.0%)	107(100%)
Female	50(48.1%)	54(50.5%)	104(100%)
Average household size	4	3	4
Presence of children below 5 years:	55(52.9%)	39(36.4%)	94(44.5%)
Age:			
15 – 64	87(83.7%)	97(90.7%)	184(87.2%)
65 and above	17(16.3%)	10(9.3%)	27(12.8%)
Relation to the head:			
Head/spouse	72(69.2%)	84(78.5%)	156(73.9%)
Other	32(30.8%)	23(21.5%)	55(26.1%)
Marital status:			
Married	74(71.2%)	66(61.7%)	140(66.4%)
Unmarried	30(28.8%)	41(38.3%)	71(33.6%)
Period lived in the house for the past on year (months):			
Whole year	79(76.0%)	80(74.8%)	159(75.4%)
Otherwise	25(24.0%)	27(25.2%)	52(24.6%)
Highest education level:			
None	8(7.7%)	7(6.5%)	15(7.1%)
Primary school	28(26.9%)	45(42.1%)	73(34.6%)
High school	47(45.2%)	49(45.8%)	96(45.5%)
Tertiary	21(20.2%)	6(5.6%)	27(12.8%)
Monthly Income(in Maloti – M):			
0-2000	42(40.4%)	77(72.0%)	119(56.4%)
2000-4000	34(32.7%)	14(13.1%)	48(22.7%)
Above 4000	28(26.9%)	16(15.0%)	44(20.9%)
Employment status:			
Employed	74(71.2%)	66(61.7%)	140(66.4%)
Unemployed	30(28.8%)	41(38.3%)	71(33.6%)

Note: M denotes Lesotho currency

The observed difference in the distribution of responses regarding the presence of children below the age of five is not surprising; most of the on-yard sources are used by the people that own houses, rather than renters. Therefore, all the family, including children, live in the house, while communal sources are mainly used by those who stay in Maseru for work and have left the rest of their families back home. Since the rented houses with the on-yard sources are relatively expensive, those that afford them are likely to be well-off and more literate, hence most are people with tertiary education and monthly income above M4000.

3.9 EMPIRICAL STUDY MODELS

The study used T-tests and Chi-square tests models to ascertain the potential influence of the location of the source points (communal and on-yard source points) of water on WTP for improved water supply reliability, and the effect of the socio-economic variables (gender of the respondent, average household monthly income, highest educational level of the head of the household, and the age of the household head) as moderators on respondent' knowledge, attitudes and opinions regarding water supply services, respectively. Also, the Chi-square tests were run to find out how the location of the water source points influences the variables that were used to capture the respondents' knowledge, attitudes and opinions regarding water supply services. The double-bounded dichotomous models were used to analyse WTP of the respondents that accessed water from the on-yard source points, and of those that used communal sources. All those models were run in STATA software, version 12.

3.9.1 The Chi-square model

The study used a one-way Chi-square model to verify the potential influence of the categorical variables (household monthly income, age of the household head, and highest educational level of the head of the household) and the dummy variable (gender) moderators on respondents' knowledge, attitudes and opinions concerning water supply services. The models were run in STATA, version 12.

3.9.1.1 Model specification for Chi-square model

The function below shows how the Chi-square model was estimated and specified:

$$x^2 = \frac{(Observed - Expected)^2}{Expected}$$

where:

x^2 – Chi-square statistic.

Under the null hypothesis, this statistic has a t-distribution with *n*-1 degrees of freedom; where *n* is the number of classes.

3.9.2 The T-test model for regression coefficients

The simple t-test was used to determine the level of significance of the regression coefficients in explaining the mean WTP of the respondents for improved water supply reliability from both samples. The levels of significance were observed at 1 %, 5 % and 10 % for the mean WTP of participants.

3.9.2.1 Model specification for T-test model

The T-test model was specified and estimated, as shown below:

$$t_k = \frac{\beta_k - \beta_k^0}{se(\beta_k)}$$

where:

t_k - Test statistic

β_k - Estimated value

β_k^0 - Specific value chosen by the researcher

se - Standard error

Under the null hypothesis, this statistic has a t-distribution with *n*-*k*-1 degrees of freedom; where *n* and *k* respectively represent sample size and number of explanatory variables.

3.9.3 Model for on-yard source points

The model was developed based on the fact that the individual is presented with two bids, and the second bid is contingent upon the response given to the first bid. For the individual that responds "yes" to the initial bid, the second bid (denoted B_i^u) is the amount greater than the first bid ($B_i < B_i^u$); if the individual responds "no" to the first bid, the second bid (B_i^l) is the amount smaller than the first bid ($B_i^u < B_i$).

Therefore, there are four possible outcomes: (a) both answers are "yes"; (b) both answers are "no"; (c) a "yes" followed by a "no"; and (d) a "no" followed by a "yes" while their

likelihoods are π^{yy}, π^{nn}, π^{yn}, and π^{ny}, respectively. Under the assumption of a utility maximizing respondent, the formulas for these likelihoods are as follows (Hanemann *et al*. 2001). In the first case, there is $B_i^u > B_i$ and

(1) $\pi^{yy}(B_i, B_i^u) = \Pr\{B_i \leq \max WTP \text{ and } B_i^u \leq \max WTP\}$
$= \Pr\{B_i \leq \max WTP \mid B_i^u \leq \max WTP\} \Pr\{B_i^u \leq \max WTP\}$
$= \Pr\{B_i^u \leq \max WTP\} = 1 - G(B_i^u; \theta)$,

Since, with $B_i^u > B_i$, $\Pr\{B_i \leq \max WTP \mid B_i^u \leq \max WTP\} \equiv 1$. Similarly, with $B_i^l < B_i$, $\Pr\{B_i^l \leq \max WTP \mid B_i \leq \max WTP\} \equiv 1$. Hence,

(2) $\pi^{nn}(B_i, B_i^l) = \Pr\{B_i > \max WTP \text{ and } B_i^l > \max WTP\} = G(B_i^l, \theta)$.
When a "yes" is followed by a "no", we have
$B_i^u > B_i$, and

(3) $\pi^{yn}(B_i, B_i^u) = \Pr\{B_i \leq \max WTP \leq B_i^u\} = G(B_i^u; \theta) - G(B_i; \theta)$; and when a "no" is followed by a "yes", we have $B_i^l < B_i$ and

(4) $\pi^{ny}(B_i, B_i^l) = \Pr\{B_i \geq \max WTP \geq B_i^l\} = G(B_i; \theta) - G(B_i^l; \theta)$.

In (3) and (4), the second bid allows the researcher to place both an upper and a lower bound on the respondent's unobserved true *WTP*, while in (1) and (2) the second bid raises the lower bound or lowers the upper bound. Given a sample of *N* respondents, where B_i, B_i^u, and B_i^l are the bids used for the *i*th respondent, the log-likelihood function takes the form:

(5) $\ln L^D(\theta) = \sum_{i=1}^{N}\{d_i^{yy} \ln \pi^{yy}(B_i, B_i^u) + d_i^{nn} \ln \pi^{nn}(B_i, B_i^l) + d_i^{yn} \ln \pi^{yn}(B_i, B_i^u) + d_i^{ny} \ln \pi^{ny}(B_i, B_i^l)\}$,

where d_i^{yy}, d_i^{nn}, d_i^{yn}, and d_i^{ny} are binary-valued indicator variables and the formulas for the corresponding response probabilities are given by (7) - (10). The *ML* estimator for the

double-bounded model, $\hat{\theta}^D$, is the solution to the equation $\partial \ln L^D(\hat{\theta}^D)/ \partial \theta = 0$. The asymptotic variance-covariance matrix for $\hat{\theta}^D$ is given by the analog:

(6) $V^D(\hat{\theta}^D) = \left[- E \frac{\partial^2 \ln L^D(\hat{\theta}^D)}{\partial\theta \ \partial\theta'}\right]^{-1} \equiv I^D(\hat{\theta}^D)^{-1}$.

The doubled-bounded model was run to ascertain the factors that determined the WTP of respondents that access water from on-yard source points for improved water supply reliability. The best model was found through an iterative procedure to decide on the inclusion or rejection of variables. STATA software, version 12, was used to come up with best model.

3.9.3.1 Model specification for on-yard source points

The WTP of a respondent is unobserved and it appears as a latent variable in the model. The latent variable varies with the personal characteristics of a respondent. According to Jeanty *et al*. 2007, the econometric modelling for data generated by the double bounded question format relies on the formulation given by:

(7) $WTP_{ij} = \mu_i + \varepsilon_{ij}$

Where WTP_{ij} represents the j^{th} respondent's WTP and i=1,2 denoting the first and the second question. μ_1 and μ_2 are the means for the first and the second responses. Thus, setting $\mu_{ij} = X'_{ij}\beta_i$ allows the means to be dependent upon the characteristics of the respondents. The following function shows how the model for on-yard source points was estimated and specified:

$$WTP = -0.27 + 0.52AGE\_1 + 0.37AGE\_2 + 0.39AGE\_3 + 0.17AGE\_4 + 0.24INCOME\_2 + 0.32INCOME\_3 + 0.11EDUCLEV\_1 + 0.23EDUCLEV\_3 - 0.67Q6A\_PERIOD + 1.70Q8C\_BILLGUD + 0.70Q178B\_LSIXMYR$$

Where:

WTP - Willing to pay of on-yard source points users

AGE_1 - Household head age group (25-34)

AGE_2 - Household head age group (35-44)

AGE_3 - Household head age group (45-54)

AGE_4 - Household head age group (45-54)

INCOME_2 - Household average monthly income group (M2000-M4000)

INCOME_3 - Household average monthly income group (Above M4000)

EDUCLEV_1 – Primary school level of education and none

EDUCLEV_3 – Tertiary level of education

Q6A_PERIOD – Whether the head stayed for a period of a year in a house during a year before the study or not

Q8C_BILLGUD – Whether the respondent perceived that it would be a good idea for the government to enact and pass a parliamentary bill on improved water supply reliability

Q178B_LSIXMYR – Whether the respondent had experienced water supply service interruption that lasted for a period between a month and six months

3.9.4 Model for communal source points

The doubled-bounded model was further run to find out the factors that determined the WTP of respondents that access water from communal source points for improved water supply reliability. The iterative procedure was followed using STATA software, version 12, to come up with the best model for the analysis of WTP on this split sample. The same econometric techniques used on the above model were followed with this split sample.

3.9.4.1 Model specification for communal source points

The model for the respondents that access water from communal source points was specified and estimated as follows:

$$WTP = -0.96 + 0.48INCOME\_2 + 0.36INCOME\_3 - 0.26Q40\_GENDER + 0.31AGE\_1 + 0.16AGE\_2 + 0.25AGE\_4 + 0.21AGE\_5 + 0.10AGE\_6 + 0.04EDUCLEV\_1 + 0.16EDUCLEV + 0.35TSOSTIM\_2 + 0.55TSOSTIM\_3 + 1.39Q8C\_BILLGUD + 0.51Q3C\_ATTEMPT + 0.85Q1710B\_MOTHNYR$$

Where:

INCOME_2 – Average household monthly income group (M2000-M4000)

INCOME_3 – Average household monthly income group (Above M4000)

Q40_GENDER – Whether the respondent was male or otherwise

AGE_1 – The household head age group (15-24)

AGE_2 – The household head age group (25-34)

AGE_4 – The household head age group (45-44)

AGE_5 – The household head age group (55-64)

AGE_6 – The household head age group (65 and above)

TSOSTIM_2 – Whether the respondent spent 15 – 30 minutes per round trip to fetch water from an alternative source

TSOSTIM_3 – Whether the respondent spent above 30 minutes per round trip to fetch water from an alternative source

Q8C_BILLGUD – Whether the respondent perceived that it would be a good idea for the government to enact and pass a parliamentary bill on improved water supply reliability

Q3C_ATTEMPT – Whether the respondent was aware about the unsuccessful attempts that WASA had made to offer improved services

Q1710B_MOTHNYR – Whether the respondent had experienced water supply service interruption that lasted for a period more than a year

3.9.5 T-test model for differences in mean WTP

The unpaired data t-test was used to verify the potential influence of the location of the water source points on the WTP for improved water supply reliability. That was run in STATA software, version 12, to test the null hypothesis of the equality of the mean WTP of the respondents that accessed water from the on-yard source points and of those that used communal sources.

3.9.5.1 T-test model specification for mean WTP

The T-test model for mean WTP was specified and estimated, as shown below:

$$T = \frac{\bar{Y}_1 - \bar{Y}_2}{s_p\sqrt{1/N_1 + 1/N_2}}$$

Where,

T - Test Statistic

$\bar{Y}_1$ and $\bar{Y}_2$ - The sample means

N_1 and N_2 - The sample sizes

s_p - Population variance

Under the null hypothesis, this statistic has a t-distribution with N_1 + N_2 - 2 degree of freedom.

3.10 CONCLUDING REMARKS

This section outlined and discussed the methodology adopted in this study. The study was implemented in the Maseru urban area. The city is situated on the eastern bank of the border between the Kingdom of Lesotho and the neighbouring Republic of South Africa, in an area which has an estimated altitude of about 1 550 meters above sea level. Both purposive sampling and random sampling approaches were used during the survey and the sample comprising 211 respondents (104 respondents from on-yard source points, and 107 from communal source points) was selected and the respondents were interviewed using a questionnaire. The data from the survey was coded in a Microsoft Excel spreadsheet and then analysed in STATA software, version 12. The Chi-square, T-test, and double-bounded models were adopted for analysing the data for the study.

CHAPTER 4:
RESULTS AND DISCUSSION

4.1 INTRODUCTION

This chapter presents the results and discussion of the study and it is mainly organised into seven sections: Section 4.2 presents results and discussion on households' knowledge, attitudes and opinions regarding water supply reliability. Section 4.3 presents results and discussion on WTP of households that access water from on-yard sources for improved water supply reliability. Section 4.4 presents results and discussion on WTP of households that access water from communal sources for improved water supply reliability and Section 4.5 presents results and discussion on the influence of the location of water source points on WTP for improved water supply reliability. The affordability of WTP analysis is presented in Section 4.6, while Section 4.7 presents interview analysis of the survey. Lastly, Section 4.8 presents the summary of the results and discussion.

4.2 HOUSEHOLDS' KNOWLEDGE, ATTITUDES AND OPINIONS REGARDING WATER SUPPLY RELIABILITY

The first objective of the study was to assess households' knowledge, attitudes and opinions regarding water supply reliability. The results from the analysis of this objective are presented in Tables 4.1, 4.2, 4.3, 4.4, 4.5 and 4.6, respectively. Tables 4.1; 4.2, 4.3 and 4.4; and 4.5 and 4.6, respectively, analyse respondents' knowledge, attitudes, and opinions concerning water supply reliability.

4.2.1 Respondents' factual knowledge about water supply services in Maseru

According to the results reflected in Table 4.1, most of the respondents in both samples (on-yard and communal water source points users) have basic knowledge regarding the water supply service in Maseru, and the challenges facing the society as a whole regarding service reliability. For instance on both samples, over 70 % of the residents show that they rely on on-yard water vendors during supply cut-offs where they pay extra amounts with

over 80 % having factual knowledge regarding the unsuccessful attempts made by WASA to improve water supply services in Maseru. This may be attributed to the fact that water supply service interruptions affect all people staying in the same area, regardless of the water source point used by the household.

Table 4.1: Respondents' knowledge about water supply and service reliability

Variable	On-yard source	Communal source	x^2 tests (p-values)
Time taken to make one round trip to fetch water(minutes):			
1 – 14	103(99.0%)	57(53.3%)	60.3427
15 – 30	0(0.0%)	24(22.4%)	(0.000)***
Above 30	1(1.0%)	26(24.3%)	
Number of trips made per day to fetch water:			
1 – 3	87(83.7%)	99(92.5%)	3.9723
4 and above	17(16.3%)	8(7.5%)	(0.046)**
Number of days of fetching water per week:			
The whole week	76(73.1%)	56(52.3%)	9.6858
Otherwise	28(26.9%)	51(47.7%)	(0.002)***
Size of container used to fetch water (litres):			
5 – 15	13(12.5%)	9(8.4%)	3.1184
20 – 25	91(87.5%)	98(91.6%)	(0.210)
Number of containers carried per round trip:			
1	78(75.0%)	45(42.1%)	23.7984
2 – 3	23(22.1%)	52(48.6%)	(0.000)***
4 and above	3(2.9%)	10(9.3%)	
Amount spent on water monthly (Maloti):			
5 – 30	31(30.1%)	95(93.1%)	94.4143
31- 60	15(14.6%)	7(6.9%)	(0.000)***
Above 60	57(55.3%)	0(0.0%)	
Time taken per one round trip to fetch water from alternative source (minutes):			
1 – 14	24(27.3%)	24(24.0%)	2.3822
15 – 30	34(38.6%)	31(31.0%)	(0.304)
Above 30	30(34.1%)	45(45.0%)	
Amount spent per 20L of water from alternative source (Maloti):			
0.10 - 2.00	53(75.7%)	59(76.6%)	2.0230
2.50 - 4.00	17(24.3%)	16(20.8%)	(0.364)
26.00 & 90.00	0(0.0%)	2(2.6%)	
Awareness that WASA attempted to secure payment with prepaid system though water supply reliability could not improve	86(82.7%)	93(86.9%)	0.7312 (0.392)
Alternative source of water:			
On-yard sources	74(76.3%)	78(74.3%)	0.1086 (0.742)
Wells	8(8.2%)	14(13.3%)	1.3439 (0.246)

*Note: The top figure is the chi-square statistic, the bracketed figure below it is the p-value. *, **, and *** denote statistical level of significance at 10 %, 5 % and 1 % respectively.*

From the options that the residents explore during supply interruptions, there are two main alternative sources that are included in Table 4.1, which are on-yard sources vendors and wells. The other alternatives, such as storing water, getting water from the water utility, waiting for water, bringing water from work, buying water from shops and mobile vendors, and fetching water from other communal sources, were left out, as they individually had insignificant proportions to justify their inclusion in the analysis.

Table 4.1 also shows that for most of the variables (six out of ten) that were used to assess the knowledge regarding water supply service, the null hypothesis of equal distribution of responses between the two split samples could not be rejected (p values are above 10 % level of significance) from the x^2 test results. The general implication of this is that the water source points of the residents did not have an overall explanatory power on the variables used. However, in the cases of time taken per round trip to fetch water from the main source, number of trips made per day to the source point, number of days of fetching water per week and number of containers carried per trip, the location of the water source points had a significant effect at 1%, 5%, 1% and 1% levels of significance, respectively. This may be because in the case of communal source points, residents generally travel a relatively long distance and queue for services, making it less likely for them to fetch water frequently. Again, the amount spent on water per month differed on the basis of the water source points at 1% level of significance. This may be attributed to the relatively higher household monthly incomes that the residents that access water from the on-yard source points have, hence the higher monthly water bills for those that use on-yard water source points, as they also have higher water consumption levels.

Furthermore, x^2 tests were run on the whole sample to find out whether some socio-economic variables, particularly age of the household head, highest educational level of the household head, gender of the respondent and the average household monthly income, had any significant effects on the variables used. Accordingly, Table 4.2 reports the x^2 tests values, together with the p-values in brackets.

From the results obtained in Table 4.2, it can be concluded that at least one out of four socio-economic factors had a significant effect on at least one of the variables used to

capture the knowledge of the residents concerning water supply services in Maseru. The variable 'gender' had a significant effect on respondent's knowledge on the use of wells as alternative sources, the unsuccessful attempts made earlier by WASA to improve the services, the number of days of fetching water per week, and the size of container used to fetch water, at 5 %, 10 %, 5 % and 1 % levels of significance, respectively. Therefore, being a male resulted in awareness regarding the use of wells during water supply interruptions, the unsuccessful attempts of WASA in addressing poor services, the number of days of fetching water weekly, and the size of container used to fetch water.

Table 4.2: The impact of education, age, income, and gender on variables used to capture respondent's knowledge about a reliable water supply services

Variable	Age	Education	Gender	Income
On-yard source as alternative source	0.1616	1.7616	0.0065	0.0663
	(0.688)	(0.623)	(0.936)	(0.967)
Wells as alternatives	2.4393	5.7579	4.8817	0.0601
	(0.118)	(0.124)	(0.027)**	(0.970)
Amount spent per 20L of water from alternative source	3.3607	4.8765	0.0031	3.2767
	(0.186)	(0.560)	(0.998)	(0.513)
Amount spent on water monthly	5.5577	7.8277	0.0444	24.6932
	(0.062)*	(0.251)	(0.978)	(0.000)***
Awareness that WASA attempted to secure payment with prepaid system though water supply reliability could not improve	1.1983	9.7017	3.3568	1.7982
	(0.274)	(0.021)**	(0.067)*	(0.407)
Time taken to make one round trip to fetch water from main source	4.0275	10.6819	0.3861	9.7375
	(0.133)	(0.099)*	(0.824)	(0.045)**
Number of trips made per day to fetch water	5.8748	1.0607	0.5110	0.2515
	(0.015)**	(0.787)	(0.475)	(0.882)
Number of days of fetching water per week	0.8065	2.2024	3.8971	4.7811
	(0.369)	(0.531)	(0.048)**	(0.092)*
Size of container used to fetch water	0.9067	6.0527	13.5269	3.2540
	(0.636)	(0.417)	(0.001)***	(0.516)
Number of containers carried per round trip	6.0897	8.8552	2.9467	3.8779
	(0.048)**	(0.182)	(0.229)	(0.423)
Time taken per one round trip to fetch water from alternative source	2.8604	16.0360	0.1411	3.5891
	(0.239)	(0.014)**	(0.932)	(0.464)

*Note: The top figure is the chi-square statistic, the bracketed figure below it is the p-value. *, **, and *** denote statistical level of significance at 10 %, 5 % and 1 % respectively.*

Age of the household head had a significant effect on the knowledge of the respondents regarding the amount spent on water per month, the number of trips made per day to fetch water, and the number of containers carried per round trip, at 10 %, 5 % and 5 % levels of significance, respectively. That is, the older the household head is, the more the chances are of the household head having factual knowledge on the amount spent on water

monthly, frequency of fetching water daily, and the number of containers carried per round trip.

Furthermore, the highest education level of the respondent had a significant impact on the knowledge about the unsuccessful attempts made by WASA to improve the services and the time taken per round trip to fetch water from an alternative source, both at 5 % level of significance. The implication is that having a high literacy level leads to awareness concerning the failure of attempts made by WASA to improve water supply services and how long it takes to make on round trip to fetch water from the alternative source.

Lastly, the monthly income of the household had a significant effect on the knowledge that the respondent had on the amount spent on water on a monthly basis, time taken to make one trip from the main source of water, and the number of days of fetching water per week, at 1 %, 5 % and 10 % levels of significance, respectively. That is, the respondents with higher household monthly incomes had factual knowledge about how much they spend on water monthly, how long it takes to make one round trip to fetch water from the main source, and the number of days of fetching water per week.

However, all four socio-economic variables had no discernible impact on the respondents' knowledge regarding the use of on-yard source vendors as alternative sources of water and the amount spent per 20L of water from an alternative source.

4.2.2 Respondents' attitudes about water supply services in Maseru

To further address the first objective, the study investigated the attitudes that the residents had concerning water supply reliability. The results regarding this analysis are presented in Table 4.3. On the basis of the results obtained, it can be concluded that the residents have the positive attitudes towards the improved services proposed in the scenario of this study and they are unhappy with regard to the existing service quality levels. For instance, over 80 % of them are concerned with the health implications of wells as alternative sources during supply interruptions and over 90 % of the residents have positive views with the passing of a parliamentary bill geared towards redressing the *status quo*.

Table 4.3: Respondents' attitudes about water supply service reliability

Variable	On-yard source	Communal source	x^2 tests (p-values)
Rating service quality from alternative source:			
Good	47(55.3%)	58(58.6%)	0.6446
Not sure	13(15.3%)	17(17.2%)	(0.724)
Poor	25(29.4%)	24(24.2%)	
Alternative sources of water like wells can have negative human health implications	84(80.8%)	98(91.6%)	5.2077 (0.022)**
The government can enact and pass a bill that can improve water supply service reliability for Maseru residents	95(91.3%)	98(91.6%)	0.0040 (0.950)
WASA has the capacity to implement improved water supply service reliability if the bill is passed	96(92.3%)	96(89.7%)	0.4311 (0.511)
It would be a good idea for the government to enact and pass a bill on improved water supply service reliability	99(95.2%)	106(99.1%)	2.8636 (0.091)*

*Note: The top figure is the chi-square statistic, the bracketed figure below it is the p-value. *, **, and *** denote statistical level of significance at 10 %, 5 % and 1 % respectively.*

The results of the x^2 tests in Table 4.3 generally show that the location of the water source points had no discernible effect (most p values are above 10 % level of significance) in the distribution of the responses of the residents concerning their attitudes on water supply reliability. It can, however, be observed that the impact of the water source points location on respondents' attitudes regarding the possibility of the negative human health implications from wells as alternative sources of water was significant at 5 % level of significance. This can be attributed to the fact that there are relatively few residents that use wells as alternative sources of water from the residents that access water from on-yard sources.

In Table 4.4, the results obtained from x^2 tests run on the entire sample to find out if the socio-economic factors of the respondents had a significant effect on the variables used to capture their attitudes are presented. In this table, the magnitude of x^2 tests, together with the p-values in brackets, are reported. From the results obtained, it can be concluded that all the socio-economic factors generally had no effect on the variables used to capture the attitudes of the residents regarding water supply reliability (the p values are very high). That is, the selected social variables did not affect the residents' attitudes about the possible negative human health implications when wells are used as alternative sources of water, the fact that government can enact and pass a parliamentary bill that would improve water supply service, WASA has capacity to implement improved services if the

parliamentary bill is passed, and the fact that it would be a good idea for the government to enact and pass such a bill.

Table 4.4: The impact of education, age, income, and gender on variables used to capture respondent's attitudes about a reliable water supply service

Variable	Age	Education	Gender	Income
Rating service quality from alternative source	6.9267 (0.140)	21.5971 (0.042)**	1.5405 (0.819)	10.5508 (0.228)
Alternative sources of water like wells can have negative human health implications	0.1811 (0.670)	4.9847 (0.173)	0.8416 (0.359)	0.2683 (0.874)
The government can enact and pass a bill that can improve water supply service reliability for Maseru residents	0.2642 (0.607)	0.8509 (0.837)	0.0040 (0.950)	1.9708 (0.373)
WASA has the capacity to implement improved water supply service reliability if the bill is passed	1.0618 (0.303)	4.4092 (0.221)	0.4311 (0.511)	1.0179 (0.601)
It would be a good idea for the government to enact and pass a bill on improved water supply service reliability	0.0829 (0.773)	1.0695 (0.784)	0.6290 (0.428)	1.3479 (0.510)

*Note: The top figure is the chi-square statistic, the bracketed figure below it is the p-value. *, **, and *** denote statistical level of significance at 10 %, 5 % and 1 % respectively.*

In contrast, it is only in the case of rating the services that the residents get from the alternative source of water that their highest educational level had a significant effect (p value equal to 0.042) on their attitudes. This implies that more enlightened residents had attitudes towards the service quality levels from alternative sources of water.

4.2.3 Respondents' opinions about water supply service reliability in Maseru

To finalise the first objective, the study also assessed the opinions of the respondents concerning water supply services in Maseru. The results that were obtained from that analysis are presented in Table 4.5, together with the x^2 test magnitudes and p-values to establish the effect of the location of water source points. The results show that most of the respondents had positive opinions regarding the improved water supply service attributes listed in Table 4.5 for easing their struggle with water supply services. For example, over 90 % of the residents on both samples show that they would expect up-to-date information during future supply interruptions from the water supply system.

It can further be observed that, for most variables used to capture the opinions of the respondents regarding the improved water supply services in the Maseru, the null hypothesis of equal distribution of responses cannot be rejected (very high p values). On the other hand, the significant effect of the location of water source points was only noted in the case of their opinions regarding the number of days a notice is expected to be made before any planned interruption in the future. This can be associated with the fact that communal source point users are generally located far from water sources and mostly queue for water, hence more days are required for them to fetch enough water in advance.

Table 4.5: Respondents' opinions about water supply service reliability

Variable	On-yard source	Communal source	x^2 tests (p-values)
Number of days a notice is expected to be made before planned water supply interruption:			
1 – 3	79(76.0%)	62(60.8%)	5.4923
4 – 7	25(24.0%)	40(39.2%)	(0.019)**
Expectation of up-to-date information during future supply interruptions	102(98.1%)	101(98.1%)	0.0001 (0.992)
Preferred medium for up-to-date information:			
Radio	79(77.5%)	81(80.2%)	0.2294 (0.632)
Via phone messages	8(7.8%)	7(6.9%)	0.0617 (0.804)
A person picks a call	4(3.9%)	9(8.9%)	2.1077 (0.147)
Automatic recorded voice on call	8(7.8%)	1(1.0%)	5.6252 (0.018)**
Via TV	3(2.9%)	3(3.0%)	-
Public gathering by the chief	2(2.0%)	3(3.0%)	0.2153 (0.643)

*Note: The top figure is the chi-square statistic, the bracketed figure below it is the p-value. *, **, and *** denote statistical level of significance at 10 %, 5 % and 1 % respectively.*

The other influence that the location of water source points had was on the opinions of the residents regarding the use of automated recorded voice on call as a preferred medium of up-to-date information during water supply interruptions (5 % significance level). However, this information dissemination medium had insignificant proportions, compared with the use of radio for up-to-date information. The last observation in Table 4.5 is that the location of the water source points has no effect on whether the respondents expect up-to-date information during future water supply interruptions, and the use of radio, phone

messages, a person picking a call during up-to-date inquiries, the use of TV, and public gatherings by the chief to disseminate latest information during water supply interruptions.

Furthermore, the results of x^2 tests run on the entire sample to establish if the four social variables had a significant effect on the variables used to capture the opinions of the residents concerning water supply services are presented in Table 4.6. Generally speaking, at least one out of the four moderators (the age of the household head, the highest educational level of the head, the gender of the respondent, and the average household monthly income) had a significant effect on at least one of the variables used to capture the opinions of the residents regarding the improved services.

Table 4.6: The impact of education, age, income, and gender on variables used to capture respondent's opinions about a reliable water supply service

Variable	Age	Education	Gender	Income
Number of days a notice is expected to be made before planned supply interruption	2.4445 (0.118)	4.7036 (0.195)	4.6411 (0.031)**	10.3620 (0.006)***
Expectation of up-to-date information during future supply interruptions	0.5141 (0.473)	7.6478 (0.054)*	0.9616 (0.327)	1.2426 (0.537)
Preferred medium for up-date information:				
Radio	0.5886 (0.443)	18.5949 (0.000)***	2.2789 (0.131)	18.9604 (0.000)***
Via phone messages	2.3792 (0.123)	8.3908 (0.039)**	3.4533 (0.063)*	8.4524 (0.015)**
A person picks a call	0.3255 (0.568)	3.1515 (0.369)	0.7716 (0.380)	0.5252 (0.769)
Automatic recorded voice on call	15.4102 (0.000)***	61.3883 (0.000)***	5.6252 (0.018)**	36.1005 (0.000)***
Via TV	0.3398 (0.560)	3.6968 (0.296)	0.2853 (0.593)	2.1816 (0.336)
Public gathering by chief	0.2374 (0.626)	7.4429 (0.059)*	0.1951 (0.659)	1.6348 (0.442)

*Note: The top figure is the chi-square statistic, the bracketed figure below it is the p-value. *, **, and *** denote statistical level of significance at 10 %, 5 % and 1 % respectively.*

Firstly, the age of the household head had a significant effect on the use of automated voice on call as a medium for up-to-date information, at 1 % level of significance. That is, the older age of residents had influence on the choice of automatic voice on call when they make enquiries regarding the latest during future water supply interruptions.

Secondly, the highest education level of the household head had a significant effect on the residents' opinions about the expectation of up-to-date information during water supply interruptions, the use of radio, phone messages, automated voice on call, and public gathering by the chief in the dissemination of up-to-date information, at 10 %, 1 %, 5 %, 1 % and 10 % levels of significance, respectively. This implies that people with a higher literacy level had influence on opinions concerning the expectation of information on developments during future supply interruptions, and on the use of radio, phone messages, automated voice on call, and public gathering as the mediums for up-to-date information dissemination during future supply interruptions in water supply.

Thirdly, the gender of a respondent had a significant effect on the opinions of the respondents regarding the number of days a notice is expected to be made before a planned supply interruption occurs in the future, the use of phone messages and automatic recorded voice on call for up-to-date information during supply interruptions, at 5 %, 10 % and 5 % levels of significance, respectively. Accordingly, males had an influence on opinions about the length of advance notice of planned future interruptions in water supply, and on the use of automated recorded voice on call and phone messages to disseminate up-to-date information during future supply interruptions in water supply.

Lastly, the household monthly income had a significant effect on the opinions of the residents concerning the number of days a notice is expected to be made before a planned supply interruption occurs in the future and the use of radio, phone messages and automated recorded voice on call as the medium of up-to-date information, at 1 %, 1 %, 5 % and 1 % levels of significance, respectively. Thus, respondents with higher average monthly income had influence on opinions concerning the length of notice prior to planned water supply interruption in the future, and on the use radio, phone messages, and automated voice on call for up-to-date information during future water supply interruptions.

4.3 WTP OF HOUSEHOLDS USING ON-YARD SOURCES

The second objective of the study was to determine the WTP of households that access water from on-yard source points for improved water supply reliability. Before analysing

the results obtained from the respondents who access water from the on-yard sources, a distinction was made between genuine and protest zeroes from the respondents that voted against the project. Genuine zeroes mainly comprised respondents that declined to support the project because they could not afford it, while protest zeroes were those who said they rejected the project because the increment of charges was unreasonable, water should be free of charge due to its abundance, they do not trust the government, and the proposed improvement is not worth the amount charged. Therefore, out of 104 observations in this split sample, the analysis of WTP for improved water supply reliability used 89 observations, after dropping 15 protest zeroes.

4.3.1 Analysis of the first bid on on-yard sources

As the amount of the bid changes, the proportions of the respondents that say *yes* is also expected to change. That is, as the amount of the bid increases, the percentage of the *yes* responses is generally expected to decrease. The results for the first bid in Table 4.7 show that the proportion of the respondents who said *yes* to the first amount was 82.1 %, and there is an overall fall in chances of voting for the project with higher amount of the bid, as hypothesised.

Table 4.7: Proportional responses to bid1 amounts

Response	**Bid 1 (M)**			**Total**
	0.5	**1.00**	**1.50**	
No	5 (17.9%)	8 (25.8%)	7 (23.3%)	20 (22.5%)
Yes	23 (82.1%)	23 (74.2%)	23 (76.7%)	69 (77.5%)
Total	28 (100.0%)	31 (100.0%)	30 (100.0%)	89 (100.0%)

Note: M denotes Lesotho currency

The slight increase in percentage of *yes* responses from the second to the third amount is quite surprising, and it can be linked partly to the sample size. The results also reveal that about 77.5 % of the sampled residents from the on-yard sources said *yes* to the first bid, which is quite promising for the feasibility of the proposed project.

4.3.2 Analysis using double-bounded model on on-yard sources

From the results obtained from the double-bounded model without control variables in Table 4.8, the Beta coefficient is estimated to be 1.50. This shows that the mean WTP of the households that access water from on-yard sources for improved water supply service was approximately M1.50 per 20L of water.

Table 4.8: The double-bounded model without control variables

	Coefficient.	Std. Err.	z	P>z	95% Interval	Confidence
Beta _ Constant	1.497087	.0889637	16.83	0.000***	1.322722	1.671453
Sigma_ Constant	.7117407	.0822702	8.65	0.000	.5504941	.8729874
Number of observations	=	89				
Log likelihood	=	-112.94855				

*Note: *, **, and *** denote statistical level of significance at 10 %, 5 % and 1 % respectively.*

The double-bounded model was run to establish the factors that determined the WTP of residents that access water from on-yard sources for improved water supply reliability. The results obtained from this analysis are presented in Table 4.9. The variables were entered into the regression in the form of categorical and dummy variables. They also entered as socio-economic variables (categories of age of household head, monthly income of household, and the highest education level of the head) and as economic variables (the period lived in the house by the household head a year before the study, whether it would be a good idea to enact and pass a parliamentary bill that is geared towards improved water supply reliability, and the length of water supply interruption between a month and six months).

Considering the variable used to analyse the effect of the age of the household head on the WTP, there is a positive relationship between WTP and AGE_1, AGE_2, AGE_3, and AGE_4, relative to AGE_5, ceteris paribus. That is, holding all other variables constant, the respondents in the age categories of 25-34, 35-44, 45-54 and 55-64 were more WTP for improved water supply, relative to those who were aged 65 years and above. It can also be observed that AGE_1, relative to AGE_5, was the only significant age group in explaining WTP at 5 % level of significance, while other age groups had no explanatory power on WTP at all levels of significance relative to the base category. This implies that

the junior adults between 25 to 34 years were more WTP, relative to their senior counterparts who are 65 years and above (Bogale & Urgessa, 2012). The idea behind this may be attributed to the fact that they fall within the able-bodied group (mostly employed) where they still have relatively many activities to do with water and are not likely to be sensitive towards water expenses.

Table 4.9: The double-bounded model with control variables

Variable	Coefficient	Std. Err.	z	P>z	95% Confidence Interval	
Beta						
AGE_1	.5223586	.2352919	2.22	0.026**	.0611949	.9835223
AGE_2	.365698	.2344606	1.56	0.119	-.0938363	.8252323
AGE_3	.3867129	.2781796	1.39	0.164	-.1585091	.9319349
AGE_4	.1664266	.2708588	0.61	0.539	-.3644469	.6973
Q6A_PERIOD	-.66663	.2103848	-3.17	0.002***	-1.078977	-.2542833
Q8C_BILLGUD	1.702306	.5141423	3.31	0.001***	.6946059	2.710007
INCOME_2	.2425711	.1710118	1.42	0.156	-.0926059	.5777481
INCOME_3	.3197792	.209564	1.53	0.127	-.0909586	.730517
Q178B_LSIXMYR	.6979711	.3174141	2.20	0.028**	.0758509	1.320091
EDUCLEV_1	.1120175	.1838093	0.61	0.542	-.248242	.472277
EDUCLEV_3	.225295	.2357749	0.96	0.339	-.2368154	.6874053
Constant	-.2676338	.5699201	-0.47	0.639	-1.384657	.849389
Sigma _Constant	.515967	.0621006	8.31	0.000	.394252	.637682

Number of observations	=	82
Wald chi2(11)	=	37.43
Log likelihood	=	-87.050084
Prob > chi2	=	0.0001

*Note: *, **, and *** denote statistical level of significance at 10 %, 5 % and 1 % respectively.*

Again, the variable used to capture the impact of the household monthly income shows that WTP increased with INCOME_2 and INCOME_3, relative to INCOME_1, ceteris paribus. The results show that, with all other variables held constant, WTP increased with monthly household income levels that ranged between M2000 and M4000 and above M4000, relative to the monthly household income levels below M2000. Therefore, WTP seems to increase with high household monthly income levels of the residents, relative to the low household monthly income levels (Moffat *et al*., 2011). That is, the residents with relatively high household monthly incomes generally prefer better and higher quality water supply services, as hypothesised. However, the household monthly income did not have a strong explanatory power on WTP at all levels of significance.

Furthermore, for the variable that captures the influence of the highest educational level of the household head on WTP, there is a positive relationship between both EDUCLEV_1 and EDUCLEV_3 and WTP, relative to EDUCLEV_2, ceteris paribus. The results show that, holding all other variables constant, the chances of WTP increase with both primary and tertiary levels of education, relative to high school level education. The households whose heads had only primary level of education are more WTP, relative to their high school counterparts, and this is a rather peculiar result. However, this positive relationship can be linked to the fact that they have not come to a literacy level where they might consider service provision responsibility to be entirely upon the shoulders of the government (Moffat *et al*., 2011). On the other hand, the households whose heads had a tertiary level of education were more WTP for improved water supply reliability, relative to their high school counterparts, due to the fact that their literacy level may increase the chances of maximising their utility and welfare, as services improve (Kanayo *et al*., 2013; Bogale & Urgessa, 2012). This is what was a priori expected: that an enlightened population will always have an impact on advocacy for welfare facilities like water, health, and sanitary conditions. However, all the highest educational levels of the household head had no significant effects on WTP, at 1 %, 5 % and 10 % levels of significance, respectively.

Once again, for the variable used to analyse the effect of the period lived by the household head in the house in the year before the study shows that there is a negative relationship between Q6A_PERIOD and WTP, ceteris paribus. It can be realised that, for the households whose heads lived the whole year in the house a year before the study, their WTP was less, with all other variables held constant. This shows that, having spent the whole year experiencing poor water supply services, the residents may have developed negative attitudes towards the water utility. This was also an a priori expectation of the study that, with less confidence on the service provider, the WTP will be less (Ntengwe, 2004; Davis, 2004). Also, this may involve the information that they may have been gathering about the water supply authority over the entire year before the study; the negative information about the capacity of the service provider might lead to lower WTP for improved services (Kolstad, 2002). The period lived by the household head in the house during the year before the study is significant at all the levels (1 %, 5 % and 10 %) of significance in explaining WTP.

In addition, the variable that was used to capture whether the respondents perceived that it would be a good idea for the government to enact and pass a parliamentary bill geared towards improved water supply reliability in Maseru shows that there is an a priori expected positive relationship between Q8C_BILLGUD and WTP, ceteris paribus. That is, with all the other variables constant, the positive attitudes of respondents towards a bill designed to improve water supply reliability led to more WTP. Therefore, this also has to do with the way in which the residents perceive the proposed bill; positive perceptions of the beneficiaries result in greater WTP (Khuc, 2013). The attitudes of the residents towards whether it would be a good idea for the government to enact and pass a parliamentary bill for improved water supply reliability has a significant influence on WTP at all levels of significance (1 %, 5 %, and 10 %).

Lastly, the variable that was used to capture the influence of experiencing water supply interruption for a period between a month and six months a year shows that there is positive relationship between Q178B_LSIXMYR and WTP, ceteris paribus. This shows that the residents that experienced water supply interruptions for a period between a month and six months were more WTP for improved water supply reliability. This is in contrast with the a priori expectation due to the findings of Hensher *et al*. (2005) and Dutta and Verma (2009), who found that lengthy interruptions resulted in low WTP, in which case people adapted to poor services and developed coping mechanisms, like storing water, to reduce the impact on their livelihoods. The authors argued that with lengthy interruptions, people seem to invest more in adaptive mechanisms, like storing water, while others decline to support the project because they perceive that it is less practical for water utilities to address extreme interruptions (Hensher *et al*., 2005). On the other hand, the present study shows that lengthy interruptions result in greater WTP for improved water supply reliability. This surprising result may be attributed to the fact that Maseru residents mostly opt for on-yard vendors (76 %) and wells (8 %) during water supply interruptions, making it less likely for them to adapt to poor services, while a negligible proportion stores water (2 %).

4.3.3 The mean WTP at the mean values of variables on on-yard sources

To further analyse WTP for improved water supply reliability by households that access water from on-yard sources, the nonlinear combinations of parameters was run on all explanatory variables used on the double-bounded model at their mean values to find out their effect on mean WTP. The results of this analysis are presented in Table 4.10.

Table 4.10: Estimating WTP with control variables at their mean values

	Coefficient	Std. Err.	z	P>z	95% Confidence Interval	
WTP	1.489687	0.0726395	20.51	0.000***	1.347316	1.632058

*Note: *, **, and *** denote statistical level of significance at 10 %, 5 % and 1 % respectively.*

From the results, it can be concluded that the mean WTP decreased slightly from an estimated M1.50 to approximately M1.49 with the inclusion of explanatory variables at their mean values. This is what was a priori expected: that the two mean values should be close to each other. It can further be observed that the variables as a whole, at their mean values, had a significant influence on mean WTP at all levels of significance (1 %, 5 % and 10 %). Another measure of confidence given by these results is that zero does not lie between intervals at 95% level of significance.

4.4 WTP OF HOUSEHOLDS USING COMMUNAL SOURCES

The third objective of the study was to determine the WTP of households that access water from communal source points for improved water supply reliability. As in the case of the other split sample, protest zeroes were removed from the observations before analysis of WTP responses and only genuine zeroes were retained. In this case, genuine zeroes were for those that could not afford the high charges once the project is implemented, while protest zeroes were those who said that water should be free due to its abundance, and those who said that such improvement is not worth the charge rate proposed. Therefore, out of 107 observations under communal source points, the analysis of WTP responses for improved water supply reliability used 102 observations, after dropping 5 protest zeroes.

4.4.1 Analysis of the first bid on communal sources

The analysis in Table 4.11 shows the proportions of the respondents that said *yes* to the first bid as the amount was increased. The amount of the first bid was randomly presented to each respondent and the results indicate that the proportion of the respondents who said *yes* to the first amount was 85.7 %, and it is an a priori expectation that the same decreased with the amount of the bid.

Table 4.11: Proportional responses to bid1 amounts

Response	Bid 1 (M)			Total
	0.50	**1.00**	**1.50**	
No	5 (14.3%)	5 (14.7%)	14 (42.4%)	24 (23.5%)
Yes	30 (85.7%)	29 (85.3%)	19 (57.6%)	78 (76.5%)
Total	35 (100.0%)	34 (100.0%)	33 (100.0%)	102 (100.0%)

Note: M denotes Lesotho currency

Another observation is that there is a little difference between the *yes* response percentage of the first and the second amount of the first bid, while the third proportion (57.6 %) significantly differs from the second one (85.3 %). Lastly, approximately 76.5 % of the sampled residents that access water from communal sources said *yes* to the first bid.

4.4.2 Analysis using double-bounded model on communal sources

The double-bounded regression analysis without control variables was run to find the average WTP of households that access water from communal source points for improved water supply services in Maseru. Table 4.12 shows the results for this analysis. The results show that the mean WTP for improved water supply reliability is approximately M1.43 per 20L of water.

Table 4.12: The double-bounded model without control variables

	Coefficient	**Std. Err.**	**z**	**P>z**	**95% Interval**	**Confidence**
Beta _Constant	1.428361	.0807346	17.69	0.000***	1.270125	1.586598
Sigma_Constant	.6922572	.0780535	8.87	0.000	.5392752	.8452393

Number of observations = 102
Log likelihood = -126.69776

*Note: *, **, and *** denote statistical level of significance at 10 %, 5 % and 1 % respectively.*

To further analyse the WTP responses of the residents for improved water supply reliability, the double-bounded model was run with control variables to establish their effect on the WTP choices made by the residents. The results for the analysis of a double-bounded model with explanatory variables are presented in Table 4.13. The variables used in this regression were entered mainly as dummy and categorical variables. The model is also built with explanatory variables in the form of socio-economic variables (categories of household monthly income levels, gender of respondent, categories of age groups of the head of household, and the categories of highest educational level of the household head) and economic variables (categories of the time spent by the respondent to make one round trip to fetch water from the alternative source of water, the perceptions of the respondent regarding whether it would be a good idea for the government to enact and pass a parliamentary bill that would improve water supply reliability, the length of water supply interruption lasting for more than a year, and the awareness about the unsuccessful attempts made earlier by WASA to improve water supply reliability).

Table 4.13: The double-bounded model with control variables

Variable	Coefficient	Std. Err.	z	P>z	95% Confidence Interval	
Beta						
INCOME_2	.482922	.2429756	1.99	0.047**	.0066986	.9591455
INCOME_3	.3603548	.2737862	1.32	0.188	-.1762562	.8969658
Q40_GENDER	-.2624024	.1465973	-1.79	0.073*	-.5497279	.0249231
TSOSTIM_2	.3462041	.1973626	1.75	0.079*	-.0406194	.7330277
TSOSTIM_3	.5484479	.1939919	2.83	0.005***	.1682307	.9286651
Q8C_BILLGUD	1.390335	.5831918	2.38	0.017**	.2473	2.53337
AGE_1	.3097729	.2714553	1.14	0.254	-.2222696	.8418154
AGE_2	.1591469	.211003	0.75	0.451	-.2544114	.5727053
AGE_4	.2530205	.2360351	1.07	0.284	-.2095998	.7156408
AGE_5	.2134698	.2401624	0.89	0.374	-.25724	.6841795
AGE_6	.0987344	.2779758	0.36	0.722	-.4460883	.643557
Q1710B_MOTHNYR	.8480039	.4194346	2.02	0.043**	.0259272	1.670081
Q3C_ATTEMPT	.5125678	.2348658	2.18	0.029**	.0522394	.9728962
EDUCLEV_1	.0442998	.1846227	0.24	0.810	-.3175541	.4061537
EDUCLEV_3	.1622333	.359325	0.45	0.652	-.5420308	.8664974
Constant	-.958336	.6675053	-1.44	0.151	-2.266622	.3499503
Sigma _Constant	.5377511	.0628867	8.55	0.000	.4144955	.6610067
Number of observations	=	95				
Wald chi2(15)	=	32.74				
Log likelihood	=	-98.976232				
Prob > chi2	=	0.0051				

*Note: *, **, and *** denote statistical level of significance at 10 %, 5 % and 1 % respectively.*

The results from the analysis in Table 4.13 show that, for the variable used to capture the effect of household monthly income, the estimated coefficients indicate that WTP relates positively with both INCOME_2 and INCOME_3, relative to INCOME_1, ceteris paribus. These results show that, with all other variables held constant, both respondents with average monthly income ranging between M2000 and M4000 and those who earn above M4000 monthly are more WTP for service improvement, relative to their counterparts who get below M2000 on a monthly basis. This implies that, with high monthly income relative to the low monthly income, there is greater WTP (Moffat *et al*., 2011; Bogale & Urgessa, 2012; Kanayo *et al*., 2013). This finding is a priori, as it conforms to the demand theory which shows that income is positively related to the demand for normal goods. The monthly income level between M2000 and M4000, relative to the one below M2000, seems to be significant, at 5 % level of significance, in explaining WTP responses, while the household monthly income above M4000 relative to the base category lacked explanatory power at all levels of significance on WTP responses.

The gender of a respondent does not give uncommon results, as it can be observed that the variable Q40_GENDER relates negatively with WTP response, ceteris paribus. The results indicate that males are less WTP for improved water supply reliability, relative to females. This is indeed an a priori expectation, as women are the ones that feel the impact of the poor water supply services since they usually bear more pain than men regarding water collection, hence their higher WTP for improvement of water facilities (Bogale & Urgessa, 2012). This also arises from the fact that, for most of the household chores, women are the ones that are more responsible and they can, therefore, not bear the risk of walking long distances in search of water during the interruptions in water supply. Another observation concerning the variable used to capture the influence of gender is that it is statistically significant at 10 % level of significance in explaining WTP responses.

The results further indicate that for the household head age variable, AGE_1, AGE_2, AGE_4, AGE_5 and AGE_6 relate positively to WTP response, relative to AGE_3, ceteris paribus. The implication here is that, holding all other variables constant, there is greater WTP with respondents aged between 15 and 24, 25 and 34, 45 and 54, and 55 and 64 years, relative to their counterparts aged between 35 and 44. In the same way, there is also greater WTP with elders aged 65 years and above, relative to the base category of 35 to 44

years. The findings regarding those in the able-bodied group age is an a priori expectation, as it can be attributed to the fact that they still have high preferences and they are more WTP for improved water supply reliability (Bogale & Urgessa, 2012). The positive sign regarding senior adults relative to the base category on WTP is rather peculiar, but it can be linked to their concern to contribute to the future of their children (Moffat *et al*., 2011). Again, considering the distance walked by the residents in search of water from alternative sources during water supply interruptions, senior adults may see it as unbearable due to their deteriorating health conditions. However, at all levels of the age of household head, it can be observed that age does not have a strong explanatory power on WTP responses at all the levels of significance.

Furthermore, regarding the highest level of education attained by the head of the household, WTP relates positively with EDUCLEV_1 and EDUCLEV_3, relative to EDUCLEL_2, ceteris paribus. From the analysis, there seems to be greater WTP with both primary level of education and tertiary level of education, relative to the base category (high school level), with all other variables held constant. The positive sign in the first category is not a priori, but it can be attributed to the fact that at low levels of education, the residents are not much aware about the government's responsibility to provide basic services (Moffat *et al*., 2011), hence their greater WTP for improvement. On the other hand, the findings regarding the positive effect of tertiary education on WTP are as hypothesised: there is greater awareness with higher levels of schooling regarding negative health implications of poor water supply services and the opportunity cost of walking long distances in search of water from alternative sources during supply interruptions (Kanayo *et al*., 2013). Again, more enlightened people are more likely to get worthwhile jobs where they can make long-term decisions, like contributing to improved water supply facilities. However, both categories capturing the effect of education do not have a significant influence on WTP at all levels of significance.

In addition, the variable for the analysis of the impact of the time spent per round trip to fetch water from an alternative source shows that WTP has a positive relationship with both TSOSTIM_2 and TSOSTIM_3, relative to TSOSTIM_1, ceteris paribus. The idea here is that, with all other variables held constant, there is greater WTP when residents spend between 15 and 30 minutes, and when they spend time above 30 minutes, to make

one round trip to fetch water from the alternative sources, relative to spending time between 1 and 15 minutes. The findings from this analysis are a priori expectation, as people are more WTP for improved water supply services when they walk and spend longer times to fetch water (Ntshingila, 2006; Kanayo, 2013; Bogale & Urgessa, 2012), relative to shorter times spent. That is, there is greater disutility regarding longer times spent searching for water due to existing lengthy interruptions in water supply services, leading to greater WTP for improvement. The last observation that can be considered in this analysis is that the time between 15 and 30 minutes was significant at 10 % level of significance, while that above 30 minutes was significant at 1 % level of significance in determining WTP responses, relative to the base category of the time between 1 and 15 minutes.

Again, regarding the variable used to capture the influence of awareness of the respondents concerning the unsuccessful attempts made earlier by WASA to improve water supply reliability, the results show that there is a positive relationship between Q3C_ATTEMPT and WTP responses, ceteris paribus. That is, with all other variables held constant, the respondents were WTP for improved water supply reliability when they had factual knowledge about the attempts that WASA had explored earlier and failed to improve their water supply services. The vector of this variable is not unusual, as the extent of awareness regarding the good or service under consideration results in greater WTP for its improved provision (Khuc, 2013), hence more value is attached to improved water supply reliability. Therefore, when people are aware about the circumstances surrounding the services offered to them, they are likely to vote for new approaches geared towards addressing their challenges. The variable analysing awareness regarding WASA's unsuccessful attempts to improve their services is significant at 5 % level of significance in explaining WTP responses.

The next variable analyses the effect of whether the respondents perceive that it would be a good idea for the government to enact and pass a parliamentary bill to improve water supply reliability, and it shows that there is a positive relationship between Q8C_BILLGUD and WTP responses, ceteris paribus. It implies that, holding other variables constant, there is greater WTP when respondents have positive attitudes about the government's decision to enact and pass a parliamentary bill designed to improve

water supply reliability. The variable has an a priori expected positive sign, and it indicates that when beneficiaries have positive attitudes concerning the non-market good or service under consideration, they are more WTP for the provision thereof, as Ntshingila (2006) and Khuc (2013) have affirmed. The last observation about the variable used to capture the perceptions regarding whether it would be good for the government to enact and pass a parliamentary bill to improve water supply reliability is significant at the 5 % significance in determining WTP responses.

Lastly, the variable that was used to capture the impact of the length of water supply interruption that lasted for more than a year shows that there is positive relationship between Q1710B_MOTHNYR and WTP responses, ceteris paribus. The implication is that, holding all other variables constant, the residents that experienced water supply interruption that lasted for more than a year were more WTP for improved water supply reliability. This is in contrast with the findings of Hensher *et al*. (2005) and Dutta and Verma (2009), who found that people usually respond to extremely poor services in water supply by investing more in adaptive measures, like storing water, resulting in lower WTP under lengthy interruptions. Such dissimilarity of the results can be attributed to the fact that, in the present study, most of the residents opt for water vendors (74 %) and wells (13 %) during water supply interruptions, while a negligible proportion acclimatise by water storage (1 %). The variable used to analyse the effect of water supply interruption lasting for more than a year is significant at 5 % significance in explaining WTP responses of the residents.

4.4.3 The Mean WTP with variables at their mean values on communal sources

To further analyse WTP for improved water supply service reliability by residents that access water from communal sources, nonlinear combinations of parameters were run on all explanatory variables at their mean values to find out their effect on mean WTP. The results of this analysis are presented in Table 4.14.

The results from the analysis show that the mean WTP decreased slightly from M1.43 to approximately M1.41 per 20L of water with the inclusion of explanatory variables at their mean values.

Table 4.14: Estimating WTP with control variables at their mean values

	Coefficient	Std. Err.	z	P>z	95% Confidence Interval	
WTP	1.410318	.0707533	19.93	0.000***	1.271644	1.548992

*Note: *, **, and *** denote statistical level of significance at 10 %, 5 % and 1 % respectively.*

This finding is a priori, as the two mean values are expected to be almost the same. It can also be observed that the overall impact of the variables at their mean values is significant at 1 % level of significance.

4.5 THE INFLUENCE OF THE LOCATION OF WATER SOURCE POINTS

The fourth objective of the study was to determine whether the location of water source points significantly influences household WTP for improved water supply reliability.
To determine the effect of the water source points location on WTP, the unpaired t-test was run on the two variables (WTP1 and WTP2) that were used to analyse individual WTP on each split sample. The results for this analysis are presented in Table 4.15.

Table 4.15: Comparing the mean values for the two split samples

Sample	Observations	Mean	Std. Err.	Std. Dev.	95% Confidence Interval	
WTP1	104	1.486297	.0541537	.5522611	1.378896	1.593698
WTP2	107	1.386547	.0434112	.4490489	1.30048	1.472614
combined	211	1.435713	.034687	.5038581	1.367333	1.504092
difference		.099749	.0692037		-.0366771	.2361765

diff = mean(WTP1) - mean(WTP2)
Ho: diff = 0
Ha: diff < 0 **Ha: diff != 0** **Ha: diff > 0**
Pr(T < t) = 0.9245 **Pr(T > t) = 0.1510** **Pr(T > t) = 0.0755***

T statistic = 1.4414
Degrees of freedom = 209

*Note: *, **, and *** denote statistical level of significance at 10 %, 5 % and 1 % respectively.*

For the households that access water from on-yard sources, the mean WTP for improved water supply reliability is approximately M1.49 (LB M1.38, UB M1.59) per 20L jerrycan of water, which is above the current M0.10 per 20L jerrycan by an estimated M1.39 (LB M1.30, UB 1.47) per 20L jerrycan of water. On the other hand, for the households that

access water from communal sources, the mean WTP for improved water supply reliability is about M1.39 per 20L jerrycan of water, which is above the present rate by an estimated M1.29 per 20L jerrycan of water. Again, the combined mean WTP of households that access water from on-yard sources and those from communal sources is approximately M1.44 (LB M1.37, UB M1.50) per 20L jerrycan, which is above the prevailing cost per 20L jerrycan by approximately M1.34. The t-statistic for the difference in the two-sample t-test with equal variances is 1.4414, and the degrees of freedom equal 209. The difference between the mean WTP for the two water source point locations is about M0.10 per 20L jerrycan of water, and evidence that the study has against the null hypothesis of their equality is given by the one-sided p-value at only 10 % level of significance. Therefore, on the basis of the findings, it can be concluded that location of water source point might not be a powerful determinant of household WTP.

Indeed, Ostrom (2000) refuted Olson (1965)'s view of zero contribution idea of less resourced people by showing that such notion is not always observed in real life: people do not completely rely on others but they usually invest in small resources in order to satisfy their common interests. The results undeniably show that the average WTP for both groups of residents (from communal and on-yard sources) is individually over 1000 % and 39 % above WASA's existing water charge rate of M0.10 per 20L jerrycan of water and water vendors' minimum charge (M1.00 per 20L jerrycan) respectively. Thus, it appears that a policy that improves water supply reliability at a fee would result in a Pareto improvement.

4.6 AFFORDABILITY OF WTP

The survey instrument also catered for the affordability analysis after the dichotomous choice question, with one dichotomous follow-up. The reason for the analysis of the affordability of basic needs and financial situation of the households was to find out whether the respondents considered income constraints when voting for the project. The results from this analysis are presented in Tables 4.16 and 4.17, respectively.

From the analysis in Table 4.16, it can be concluded that the residents (close to 60% from both samples) in Maseru can generally afford basic needs, like food and water. Again, considering the proportions, there are many more respondents who always have access to

basic needs from on-yard source points, as opposed to those accessing from communal source points, while the respondents that afford basic needs even though sometimes difficult were many (43%) in communal source points users than in on-yard source points (32% only) users.

Table 4.16: Affordability of basic needs

Affordability of basic needs	On-yard sources	Communal sources	x^2 tests (p-values)
Always afford	70(67.3%)	60(56.1%)	2.8136
Afford but sometimes difficult	34(32.7%)	47(43.9%)	(0.093)*

*Note: Note: The top figure is the chi-square statistic, the bracketed figure below it is the p-value. *, **, and *** denote statistical level of significance at 10 %, 5 % and 1 % respectively.*

The p-value of 0.093 shows that the null hypothesis of the equality of the distribution of the responses is also rejected, at 10 % level of significance. This shows that the affordability of basic needs is relatively higher for those that access water from on-yard sources, which is in line with the fact that their WTP is slightly greater than that of those that access water from communal source points.

Again, considering the analysis of the financial situation in Table 4.17, it can be concluded that a large proportion of the households responded positively to the financial situation levels listed.

Table 4.17: The financial situation of the households

Financial situation	On-yard sources	Communal sources	x^2 tests (p-values)
We do not have enough money	23(22.1%)	27(25.2%)	0.2836 (0.594)
We have money for food but cannot pay for public utilities like water, electricity	1(1.0%)	4(3.7%)	1.7577 (0.185)
We can afford food and public utilities but it is difficult to pay for school fees	21(20.2%)	14(13.1%)	1.9259 (0.165)
We can afford food, public utilities and pay for school fees but cannot afford to buy durable goods like TV, fridge	17(16.4%)	25(23.4%)	1.6294 (0.202)
We have enough money to pay for our needs and can also afford to buy durable goods	42(40.4%)	37(34.6%)	0.7588 (0.384)

Note: The top figure is the chi-square statistic, the bracketed figure below it is the p-value.

Most people appear from the third to the fifth category, with even more proportions above 35% in the last class, showing that that most of them afford durable assets. The distribution of their responses also seems to be the same throughout all the p-value (with values close to one) results from the x^2 test results. Therefore, their financial situation, as a whole, indicates that they can afford to support a project designed to offer them improved water supply reliability.

4.7 THE ANALYSIS OF THE INTERVIEW

At the end of the survey instrument, there were a few debriefing questions where the interviewer assessed the level of understanding and the reliability of the responses given by the interviewee, which confirm that the questionnaire performed well in most cases. The results for this analysis are presented in Tables 4.18 and 4.19, respectively, with x^2 tests proportions and p-values in brackets. In Table 4.18, the levels of comprehension of the interviewee are presented in the following order; *well understood*, *understood*, *not well understood*, *not understood* and lastly *not understood at all*. Again, in Table 4.19, the order of reliability of responses of the interviewee is presented in the order: *very reliable*, *quite reliable*, *not quite reliable*, *not reliable*, and *not at all reliable*.

According to the results obtained in Table 4.18, it can be concluded that the interviewees generally understood the scenario. For instance, approximately 80% and 68% of the respondents fall within the first category (well understood) from on-yard and communal water sources respectively.

Table 4.18: Rating the understanding of the interviewee

Level of understanding	On-yard sources	Communal sources	x^2 tests (p-value)
Well understood	84(80.8%)	73(68.2%)	8.0479
Understood	19(18.3%)	25(23.4%)	(0.090)*
Not well understood	1(1.0%)	7(6.4%)	
Not understood	0(0.0%)	1(0.9%)	
Not at all understood	0(0.0%)	1(0.9%)	

*Note: The top figure is the chi-square statistic, the bracketed figure below it is the p-value. *, **, and *** denote statistical level of significance at 10 %, 5 % and 1 % respectively.*

Most respondents fall in the first and the second level of understanding, which is a quite impressive result. Another observation is that the null of equal distribution responses is

rejected, at 10 % level of significance. This may be attributed to the fact that the respondents who access water from on-yard sources were relatively more enlightened, hence they easily followed the interview.

Furthermore, regarding the reliability of the responses given, Table 4.19 generally shows that the responses were quite reliable for the analysis. Indeed, about 69% and 71% of the respondents using on-yard and communal source points respectively appear in the first level of reliability. Obviously, most respondents are in the first two levels and this is an impressive result.

Table 4.19: Rating the reliability of the responses of the interviewee

Level of reliability	On-yard sources	Communal sources	x^2 tests (p-value)
Very reliable	72(69.2%)	76(71.0%)	1.6309
Quite reliable	23(22.1%)	22(20.1%)	(0.803)
Not quite reliable	6(5.6%)	4(3.7%)	
Not reliable	3(2.9%)	4(3.7%)	
Not at all reliable	0(0.0%)	1(0.9%)	

Note: The top figure is the chi-square statistic, the bracketed figure below it is the p-value.

The p-value of 0.80 also shows that there is no strong evidence against the null hypothesis of equal distribution of the level of reliability. Therefore, the results of the interview generally give confidence in the information given by the respondents.

4.8 CONCLUDING REMARKS

The conclusions drawn from this chapter can be briefly summarised into seven parts. Firstly, the residents in Maseru have positive attitudes and opinions regarding the project proposed by the study, and a high level of knowledge about the water supply service and challenges that are currently endured by consumers. The level of education of the household head seemed to have an effect on all the constructs (factual knowledge, attitudes and opinions). Furthermore, the household monthly income and the gender of the respondent had influence on the factual knowledge and the opinions that the residents had concerning the proposed improvement of the water supply system. However, the location of the water source points only had more influence on constructs under the factual knowledge of the residents regarding water supply services.

Second, the WTP of the respondents that access water from the on-yard source points (M1.49 per 20L jerrycan of water) is higher than the existing water charge rates (M0.10 per 20L jerrycan of water), and the WTP decisions were affected by the following variables: the age of the household head, whether the household head had spent the whole year living in the house a year before the study, whether the respondent perceived that it would be a good idea for the government to enact and pass a bill on improved water supply services, the household monthly income, whether the household had experienced the water supply interruptions lasting for a period between a month and six months, and the educational level of the household head.

Third, WTP (M1.39 per 20L jerrycan of water) of the residents that access water from communal source points is also way above the prevailing per unit charge (M0.10 per 20L jerrycan of water) of the water utility. Their WTP was determined by the following factors: household monthly income, gender of the respondent, the time spent per round trip to fetch water from the alternative source of water, whether the respondent perceived that it would be a good idea for the government to enact and pass a parliamentary bill for improved water supply reliability, the age of the household head, whether the household had experienced the water supply interruption lasting for more than a year, the awareness of the respondent concerning the unsuccessful attempts explored earlier by WASA to improve the services, and educational level of the household head.

The fourth conclusion is that the location of a water source point might not be a powerful determinant of household WTP. This could possibly be attributed to the fact that the welfare losses associated with unreliable water supply might not powerfully discriminate between households based on the location of water source points. Thus, the result implies that there could be other important factors that influence households' WTP for improved water supply reliability.

Fifth, it can be concluded that the sampled residents generally can afford the basic needs for their day-to-day life sustenance. Again, their financial situation, assessed on the basis of the goods that the households can afford to buy, undeniably shows that they have the overall capacity to maintain their main household basic expenses. Lastly, it can be

concluded that the survey instrument generally performed well in extracting the intended information for the study.

The results show that the CVM technique is an appropriate tool that could be incorporated in water resource supply management in Maseru for achieving an improvement in the livelihoods of the residents and to control water consumption practices. The amount that the respondents are WTP, as well as the proportions of the consumers that are prepared to support the project once it is implemented, undeniably shows that they recognise the value of reliable water supply services. Again, the fact that the difference in mean WTP of the residents from the two water source points groups is only significant at 10 % level of significance shows that it is not important for WASA to consider the heterogeneity of the city brought by water source points location when implementing the new tariff structures. Again, the positive attitudes and opinions of the respondents towards the proposed improvement of the water supply service system is quite promising, thus supporting the feasibility of the project.

CHAPTER 5:
CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

The main objective of this study was to examine the WTP of Maseru residents for improved water supply reliability. Specifically, the study sought to analyse five objectives. The first was to assess households' factual knowledge about the existing water supply system and challenges they face, and their attitudes and opinions regarding improved water supply reliability. The study used the Chi-square to test for the potential influence that the main socio-economic variables (household monthly income, age, educational level and gender of household head) had as moderators on the variables selected to capture the constructs (knowledge, attitudes and opinions). The second and the third objectives established the WTP of the households that access water from on-yard source points and of those that rely on communal source points, respectively. Descriptive statistics were used to analyse the proportion of the respondents that voted for the project as the amount of the first bid increased, while the dichotomous choice questions with follow-up questions were analysed with the double-bounded model. Through the double-bounded model, the mean WTP and its determinants were established. Fourthly, the study sought to examine whether the location of the water source points in Maseru had significant influence on the WTP of the households for improved water supply reliability. To analyse the influence of the location of the water source points, evidence against the null hypothesis of the equality of the mean WTP of the residents that access water from the on-yard sources and those that use communal sources was determined through the t-test. In this chapter, the conclusion, recommendations and policy implications (the last objective), and the limitations and areas for further research are presented.

5.2 CONCLUSION OF THE STUDY

The findings of this study undeniably indicate that the residents generally possess high factual knowledge concerning the water supply system in Maseru and the challenges that they presently face. Also, the location of the source points of water seemed to have

influence on certain variables that were used to capture this construct: the time taken to make one round trip to fetch water, the number of trips made per day to fetch water, the number of days of fetching water per week, the number of containers carried per round trip, and the amount spent on water per month at 1 %, 5 %, 1 %, 1 % and 1 % level of significance respectively. That is, those that access water from on-yard sources fetch water relatively more often and take shorter time per round trip due to the closeness of their water taps, as opposed to their counterparts. Furthermore, it was found that on-yard source users pay a relatively higher monthly water bill, as they have convenient sources where they draw water more frequently. Moreover, the socio-economic information revealed that they generally have a higher monthly income and higher levels of education, which enable them to maximise the utility in using water for a wide range of activities.

Furthermore, the respondents also have positive attitudes and opinions regarding the proposed project, and negative views regarding the existing situation. The location of the source points only had an effect on the attitudes that the respondents had about the fact that the alternative sources, like wells, could have negative health implications at 5 % level of significance. This may have emanated from the fact that the proportion of the respondents that opted for wells during interruptions in on-yard sources was slightly lower than their counterparts that use communal sources. It also had an influence on the use of automated recorded voice on call as a medium of communication during future supply interruptions and on the number of days a notice would be expected to be made in advance before a planned water supply interruption occurs under the opinion construct at 5 % level of significance in both cases. This may be linked to the fact that the residents that access water from on-yard sources generally do not face challenges like queuing for water, hence they do not need many days for fetching sufficient water that would sustain them during the water supply interruptions.

The educational level of the household head seemed to have influence on certain variables from all three constructs (knowledge, attitudes and opinions). It had effect on the factual knowledge regarding the unsuccessful attempts that WASA explored earlier to redress water supply challenges and on the time spent per round trip to fetch water from alternative sources, both at 5 % level of significance. Generally, enlightened people are more likely to follow and analyse the alternatives that the service provider explores and

they can easily estimate how long it takes them to fetch water. Furthermore, the level of education affected their attitudes on the rating of the services from the alternative source of water, and their opinions concerning the expectation of receiving up-to-date information during future supply interruptions and the medium of communication to get the information at 5 %, 10 % and 1 % level of significance respectively. With higher levels of understanding, the residents are able to analyse the services they receive during water supply challenges and to suggest more efficient way of service provision in the future.

The age of the household head also had an influence on the factual knowledge that the residents had regarding the amount spent on water per month, the number of trips made per day to fetch water, and the number of containers carried per round trip to fetch water at 10 %, 5 % and 5 % level of significance respectively. Generally, the older people would be expected to be the ones that are directly involved in major household expenses like water, hence they know roughly how such costs reflect in their monthly budget. Again, since they have been involved in water collection over years, they know how long it takes them to complete the trips they make to fetch sufficient water for their households.

The gender of the respondent also had an influence on the knowledge that the residents had regarding the use of wells as alternatives during supply interruptions, the number of days of fetching water per week, and the size of container used to fetch water at 5 %, 5 % and 1 % level of significance respectively. Males seemed to have awareness concerning the fact that wells are alternative sources, as people rely on males (and even hire them) in certain areas to fetch water for the households, especially during the night, rather than on females. Thus, they know how often they fetch water per day and the size of containers used, as they are the ones capable of carrying bigger containers. Again, it is not surprising that the male gender seemed to have effect on opinions regarding the number of days a notice is expected to be made before planned supply interruptions occur and the medium of up-to-date information dissemination that is deemed to be efficient both at 5 % level of significance, as males usually carry a huge responsibility under certain circumstances, relative to their female counterparts.

Furthermore, the average monthly household income had influence on the factual knowledge that the respondents had on the amount spent on water per month, and on the

time spent per round trip to fetch water from the alternative source of water at 1 % and 5 % level of significance. The wealthier people normally use water for a variety of activities, for which they require much water, leading to high monthly water bills, hence they are aware of how much water expenses reflect in their budget. Therefore, they know how much time it takes to get water from alternative sources, due to the significant impact on a wide range of their activities which are affected by water supply interruptions. Thus, the variable reflecting those that are well-off seemed to also have influence on the opinions regarding the number of days a notice is expected to be made before a planned water supply interruption occurs and the mediums of information dissemination both at 1 % level of significance.

The mean WTP of the respondents that access water from the on-yard source points was found to be M1.49 per 20L jerrycan of water (LB M1.38 and UB M1.59) and the WTP decision was positively affected by the following variables: the household age groups of 25-34, 35-44, 45-54, and 55-64 years, relative to the age group 65 years and above; the household monthly income groups of M2000-M4000 and that above M4000, relative to the monthly income below M2000; primary and tertiary level of education, relative to the high school level of education; whether the respondent perceived that it would be a good idea for the government to enact and pass a bill on improvement in water supply service reliability or not; whether the respondent had experienced water supply interruption lasting for a period between a month and six months or not. On the other hand, WTP was negatively related to the variable that indicated whether the household head had lived in the house for the whole year before the study was implemented.

For the residents that access water from communal sources, the mean WTP was found to be M1.39 per 20L jerrycan of water (LB M1.30 and UB M1.47) and it was influenced positively by: the monthly household income category of the range M2000-M4000 and the one above M4000, relative to the group below M2000; the household head age categories of 15-24, 25-34, 45-54, 55-64, and that of 65 years and above, relative the household head age group of 35-44 years; household head's primary and tertiary level of education categories, relative to the high school level of education; the categories of time spent to fetch water from the alternative sources of 15-30 and above 30 minutes, relative to the group that spends 1-14 minutes; whether the respondent perceived that it would be a good

idea for the government to enact and pass a parliamentary bill on improved water supply reliability; whether the household had experienced water supply interruption for a period more than a year; and whether the respondent was aware about the unsuccessful attempts that WASA had explored earlier to redress water supply challenges. The only negative determinant of WTP was the gender of the respondent (males were less WTP than females).

As stated earlier, the mean WTP for improved water supply services in Maseru for the residents that access water from the on-yard source points was found to be M1.49 per 20L jerrycan of water, while the WTP for those using communal sources was M1.39 per 20L jerrycan of water. The only evidence that the study has against the null hypothesis of the equality of the two amounts was given by the one-sided p-value at 10% level of significance. That is, it can be concluded that location of water source point might not be a powerful determinant of household WTP. This could possibly be attributed to the fact that the welfare losses associated with unreliable water supply might not powerfully discriminate between households based on the location of water source points. Furthermore, the results show that the average WTP for both groups of residents (from communal and on-yard sources) is individually over a 1000 % and 49 % above WASA's existing water charge rate of M0.10 per 20L jerrycan of water and the minimum charge (M1.00 per 20L jerrycan) of the water vendors respectively. Thus, it appears that a policy that improves water supply reliability at a fee would result in a Pareto improvement.

5.3 RECOMMENDATIONS AND POLICY IMPLICATIONS

The last objective of the study was to draw policy recommendations relevant to the design of a sustainable, improved water supply service strategy in Maseru, based on the study findings. Considering the mean WTP of the sampled households, which far exceeds the existing water charge rates, this study recommends that WASA should implement a water supply reliability improvement scheme in Maseru to meet the water needs of the community. In particular, WASA should ensure whenever the water supply is interrupted, the interruption does not last for more than one day per month. To fund such a scheme, the analysis suggests that WASA should consider revising the cost of each 20L jerrycan it delivers to residents upwards. In particular, instead of charging M0.10 per 20L jerrycan as

it currently does, the analysis suggests WASA should charge between M1.00 and M1.60 per 20L jerrycan. The actual value of the charge per 20L jerrycan should however be determined through a stakeholder engagement process. This is because economic efficiency is only one input in determining how much water supplied to households should be priced. Finally, additional studies would be required to determine important factors that influence households' WTP for improved water supply reliability.

In policy formulation, the awareness (formal and informal) of the residents is a critical factor to promote public involvement in water management programmes and design. Undeniably, enlightened residents know more about the negative effects of prolonged water supply interruptions and are more WTP for improvement. It is also evident that even the informal awareness that the residents have regarding the activities that the service provider engages in seems to encourage the respondents to be more willing to support the proposed project. The positive perceptions regarding the potential influence of the government on improved water supply services also affect the likelihood of public support. It is therefore necessary for the government to invest more in awareness campaigns and formal education regarding water supply activities to attract the engagement of the beneficiaries and to promote public–private partnership in water supply. Investing more in infrastructure projects that improve water supply services will also empower women, as they are more WTP for improvement due to their relatively greater involvement in household chores and water collection. Obviously, redressing the challenge of lengthy water supply interruptions will improve the livelihoods of the households, considering their WTP to reduce them and the negative attitudes and opinions they have regarding the *status quo*.

5.4 LIMITATIONS OF THE STUDY AND AREAS FOR FURTHER RESEARCH

The study was limited in addressing the length of water supply service interruptions but important quality aspects of water (perceived partly by odour, colour and taste) were left out. In order to assess questions that relate to basic water supply challenges, the quality of water, which plays a critical role due to its absolute necessity for people's health (mostly young children), needs to be studied. Moreover, the intensity of water supply interruptions is not uniform in Maseru, and literature has revealed that the people that presently enjoy

consistent water supply services are also concerned with the quality of water (Ntshingila, 2006). There is a need to adopt other study methods, like the Averting Behaviour Method, and compare them with the CVM results to see if the WTP estimates generally reflect the cost of averting expenditure, that is, the amount spent on water resources by the residents in an attempt to reduce the level of impact of poor services. Also, in order to address a wider range of aspects concerning water supply in Maseru, advanced CVM techniques, like choice modelling, could be adopted. With this elicitation format, the WTP for varying levels of water supply attributes, like quality, quantity, duration of uninterrupted supply, productive uses of water and others, could be established. This would help researchers to analyse the attributes that determine the demand for water services, the appropriate levels deemed necessary by the consumers, and the respective tariff structures. Finally, the literature has associated the double-bounded bid elicitation format with endogeneity attributed to the follow-up bid (Jeanty *et al*. 2007). Response to the second bid turns to be dependent upon the first bid, which biases mean WTP downward and calls for analytical models like stochastic double-bounded models and the introduction of stochastic follow-up question during the survey implementation. Since this was not implemented in this study, it is probably the case that the mean WTP values reported in this study might under-estimate true WTP.

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APPENDIX A: LETTER OF CONSENT

Influence of water source points location on households' willingness to pay for water supply reliability in Maseru, Lesotho

Research conducted by: Mr. R. J. Lebabo
Cell: +27 (0) 73 779 8075/+266 586 08929
Email: rjlebabo@gmail.com

Dear respondent

You are invited to participate in an academic research study conducted by Julius, Masters Student in the Department of Agricultural Economics, Extension and Rural Development at the University of Pretoria. The purpose of the study is to investigate the households' willingness to pay for improved potable water supply reliability in Maseru in order to provide necessary information on how the unpredictable and lengthy interruptions on water access points can be reduced for the betterment of the livelihoods of the residents.

Please note the following:

The anonymity of the respondent is assured. Your name will not appear in the questionnaire and the information you give will be treated in strict confidentiality. Therefore you cannot be identified in person based on the information you provided.

1. Your participation in this study will be very important to us. You may, however, choose not to participate or stop participating any time without any negative consequences.
2. The results of the study will be used to inform policy making decisions and academic purposes only, and may be published in an academic journal. We will provide you with the summary of our findings on request.
3. Please contact our study leader, Prof. E.D. Mungatana on tel. +27 124 203253 (email: eric.mungatana@up.ac.za) if you have any questions or comments regarding the study.

Please sign the form to indicate that:

1. You have read and understood the information above.
2. You choose to participate on the study voluntarily.

Respondent's signature …… Date ……..

APPENDIX B: SURVEY QUESTIONNAIRE

Questionnaire Number		qustnum
Place of interview		intplc
Date of interview		intdate
Participant gender		gender
Interview start		
Interview end		

SECTION A: SOCIO-ECONOMIC INFORMATION OF HOUSEHOLDS

(a)Please provide the following information about the household in relation to the head:

Household size	Presence of children below 5yrs 1 = yes 2 = no	Age of the head (Years)	Relation to head	Marital Status	Period lived in this HH in the past one year (months)	Highest education level	Monthly income (M) 1= 1000….2000 2= 2000….4000 3= > 4000	Employed 1= no 2= yes
HHSIZE	PCHILD	AGE	RHEAD	MSTATUS	PERIOD	EDUCLEV	INCOME	EMPLOYED

CODES				
RELATION TO HEAD		MARITAL STATUS OF THE HEAD	HIGHEST EDUCATION LEVEL OF THE HEAD	
1= head 2= spouse 3= child 4= niece/nephew 5= parent 6=brother/sister	7=other relative 8= son/daughter in law 9= grand child 10 = worker 11= unrelated	1= Monogamous marriage 2= Polygamous marriage 3= never married 4= divorced 5= widow/widower 6= separated	0= none 1= primary school level 2= high school level 3= some college 4= completed college 5= some university	6= completed university 7= post-graduate

SECTION B: INFORMATION ON KNOWLEDGE, ATTITUDES AND OPINIONS ON WATER SUPPLY RELIABILITY

Below we summarise all the information regarding the present water supply for your household; how you generally rate the effectiveness of the existing water supply service, the extreme challenges experienced at times and the extent of their impact to your household. We would also like to know your perceptions regarding the length of the time of water supply service interruptions from your household.

1. What kind of water source do you use as your main source of water?

   ……

2. Where is your water source located? *(encircle an appropriate option)*

   1. It is an on-yard source
   2. It is communal source point
   3. Other (specify)

……..……..

3. How much time does it take you to make one round trip to fetch water?

…… min.

4. What means of transport do you use for fetching water? *(encircle an appropriate option)*

1. Walking 2. Car 3. Donkey 4. Bicycle 5. Other (specify) …….....

5. How many trips per day do you make to fetch water? …….

6. How many days per week do you fetch water? …….

7. What is the size of container you use for fetching water? ……..

8. How many containers do you carry per round trip on average? ……..

9. Who has the main responsibility of fetching water in your household? ……

10. Are people already queuing at the water source when you arrive to collect it? *(encircle an appropriate option)*

1. Yes always 2. Yes usually 3. Sometimes 4. No

11. Do you currently pay for the water supply service? *(encircle an appropriate option)*

1. Yes 2. No

12. If NO, why are you not paying? ……

13. If YES, how much do you spend on water service per month?

M…….

14. Do you consider this level of payment acceptable for the level of the existing service provided? *(encircle an appropriate option)*

1. Yes 2. No

15. Do you experience water supply service interruptions at your source point? *(encircle an appropriate option)*

1. Yes 2. No

16. If YES, when did the most recent water supply interruption take place?

……..

17. For how long did the recent water supply interruption last? *(encircle an appropriate option)*

1. Less than 3 hours a day
2. More than 3 hours a day
3. A day
4. Less than 3 days a week
5. More than 3 days a week
6. Other (Specify) ……..

18. In the event of planned water supply interruption in the future, would you like to be informed in advance? *(encircle an appropriate option)*

1. Yes 2. No

19. If YES, how many days in advance would you like to be informed?

…… days.

20. During future water supply service interruptions, would you like to receive any up-to-date information from time to time? *(encircle an appropriate option)*

1. Yes 2. No

21. If YES, how would you like to receive information? *(encircle an appropriate option)*

1. Automatic recorded voice on call
2. A person picks a call
3. Other media (specify) ……

22. In times of water supply interruptions, where do you usually get your water? *(encircle an appropriate option)*

1. On-yard sources 2. Well 3. River 4. Other (specify) …….

23. How much time does it take you to make one round trip to fetch water from the alternative source? ……...

24. Do you pay for water access from these alternative sources? *(encircle an appropriate option)*

1. Yes 2. No

27. If YES, how much do you pay for 20 litres (L) of water?

M …….

28. How would you rate the quality of the water supply service from your alternative source point? *(encircle an appropriate option)*

1. Very good 2. Good 3. Not sure 4. Poor 5. Very Poor

SECTION C: CONTINGENT VALUATION METHOD

The following section presents a scenario in which water supply reliability in Maseru would be improved and we would like to find out whether your household would be willing to financially support such a project.

The Willingness to pay for improved water supply reliability

Presently the water supply service offered by WASA to Maseru residents has lengthy interruptions in which case some people even go for days without water access from the source points at times. This burden is mostly borne by workers because they are mostly away during the day and do not have enough time to travel long distances in search of alternative sources. During supply interruptions, people walk long distances in search of water after work and experience long queues. Again, water charges from these alternative sources are relatively higher and for those

that opt for wells/springs/puddles, water is dirty and limited in supply. Therefore people do not have enough time to rest after work and are exposed to several health risks when using unhygienic source points.

1. Do you agree that people spend a lot of time searching for water during water supply service interruptions? *(encircle an appropriate option)*

   1. Yes 2. No 3. I don't know

2. Do you agree that other alternative sources of water like wells/springs can have negative human health implications? *(encircle an appropriate option)*

   1. Yes 2. No 3. I don't know

The existing water supply service offered by WASA continue to impose more challenges to Maseru residents due to these lengthy and unpredictable water supply service interruptions, and the condition will keep on worsening if there is no other alternative explored urgently.

Back in the year 2004, WASA noticed that it struggled much to secure payment from customers to sustain their services and introduced pre-paid meters system on standpipes so that each resident in Maseru would account for their own personal water consumption. The system uses water tags that are loaded with a certain amount of money to allow a person to draw water from the standpipes and the present charge rate is M0.10 per 20L of water. However, due to high population growth rate in Maseru, enormous volumes of water are needed to meet the daily requirement of consumers and this results in service cut-offs due to low capital investment relative to the water demand of the influx entering the city each year.

3. Are you aware that WASA has made an attempt to secure payment for water supply services with pre-paid system even though it has not improved water supply service reliability to Maseru residents? *(encircle an appropriate option)*

   1. Yes 2. No 3. I don't know

Following the failure, the government is now considering passing a bill that will ensure that you will receive improved and sustainable water supply services. If this bill passes, WASA has planned to ensure that, any time the water supply service interruption occurs, whether planned or not, it will have to take the maximum duration of one day per month. The survey study is conducted to establish if this project is worth anything

to your household. The project will involve the improvement of the existing infrastructure and the use of additional structures with a higher catchment capacity to control system failures and supplement existing reservoirs, and this has been successfully adopted in many developing countries.

Currently, this is how water supply service looks like because of water supply service interruptions

From the picture you can see that the residents have to opt for the wells in times of water supply service interruptions and there is a very high health risk implications as the area is not well protected. Others also have no option but to join long queues after work to get water for their households and this compromises their time to rest, to do other developmental activities and daily house chores.

This is how the water supply service will look like after the bill has been passed

As you can see from the picture, water is readily available and there is no longer any need to use unprotected wells. There are also no queues because there is regular water supply service. The residents no longer need alternative sources where they pay inflated charges, so they are able to use their time and money more efficiently.

4. In your view, can the government enact and pass a bill that can improve water supply service reliability for Maseru residents? *(encircle an appropriate option)*

   1. Yes 2. No

5. If NO in Q4, why? ……..

6. In your view, does WASA have the capacity to implement improved water supply service reliability if the bill is passed? *(encircle an appropriate option)*

   1. Yes 2. No

7. If NO in Q6, why? ……

If the project is approved, all the households in Maseru will be required to pay a specific amount per 20L of water in addition to the present M0.10 they pay per 20L of water consumed to ensure that water supply service for all people in Maseru is improved and sustained. The money will go to Maseru's water supply authority (WASA). This money will be used to purchase all necessary equipment for the project, payment of contractors and on-going maintenance of water supply infrastructure. By law, all residents in Maseru will not be required to pay any additional

amount for future water supply interruptions. Please remember that upon the implementation of this project, your household budget obligations like food, transport, school fees etc will be affected.

8. In your view, would the enactment of the bill be a good idea? *(encircle an appropriate option)*

1. Yes 2. No

9. If NO in Q8, why? ……

Since every household will bear some cost due construction of new infrastructure and upgrading of existing structures to ensure a more reliable water supply, we are conducting a survey to ask how they would vote if they had chance to do so. So far we have found that others will vote for the project while others will vote against it. Those who vote for it state that the project is worth the money to guarantee potable water supply reliability and improve the livelihoods of many people in Maseru. The ones who vote against it state that they alternatively use wells/puddles/springs. Others state that the money required is too much for them.

1. Suppose the WASA officials have estimated that this project will cost each household M0.50/20L of water to implement, given that all other households

will pay the same amount, would your household be willing to pay for it? *(encircle an appropriate option)*

1. Yes [go to 2], 2. No [go to 5], 3. Not sure [go to 5]

2. Suppose it turned out that the true total cost is M1.00/20L, would your household be willing to pay it? *(encircle an appropriate option)*

1. Yes [go to 3], 2. No [go to 4] 3. Not sure [go to 4].

3. What maximum amount would your household be willing to pay per 20L of water consumed for the project to be implemented?

……. [go to 4].

4. What encouraged you to vote for the bill? *(encircle an appropriate option)*

1. It will reduce the time I go without water access …,

2. I will have enough time for other family chores and developmental activities

3. I will have time to rest after work

4. Specify any additional reasons ……

5. Suppose it turned out that the true total cost is M0.30/20L, would your household be willing to pay it? *(encircle an appropriate option)*

1. Yes [go to 6]. 2. No [go to 8] 3. Not sure [go to 8]

6. What maximum amount would your household be willing to pay per 20L of water consumed for the project to be implemented?

……. [go to 7].

7. What encouraged you to vote for the bill? *(encircle an appropriate option)*

1. It will reduce the time I go without water access

2. I will have enough time for other family chores and developmental activities

3. I will have time to rest after work

4. Specify any additional reasons ……

8. Why did you vote against the bill? *(encircle an appropriate option)*

1. It is not worth the amount

2. I cannot afford it

3. Do not trust the government

4. Specify any other reasons ……

9. Do you think your household affords basic needs like food and water? *(encircle an appropriate option)*

1. Yes, always 2. It is sometimes difficult 3. No

10. Which of the following statements would best describe your family's financial situation? *(encircle an appropriate option)*

1. We do not have enough money

2. We have money for food but cannot pay for public utilities like water, electricity
3. We can afford food and public utilities but it is difficult to pay for school fees
4. We can afford food, public utilities and pay for school fees but cannot afford to buy durable goods like TV, fridge
5. We have enough money to pay for our needs and can also afford to buy durable goods
6. Other (specify) ……

SECTION D: DEBRIEFING QUESTIONS

The following analysis will help pinpoint specific problems in the questionnaire; as well confirm whether the questionnaire performed well in most cases.

1. How well do you think the interviewee understood the questions? Rank in order of comprehension, that is, 1 means the interviewee clearly understood while 5 means the interviewee did not understand at all *(encircle an appropriate option)*.

1. …. 2. … 3. … 4. ..... 5. …

2. How do you rank the reliability of responses given by this interviewee? Rank in order of reliability, that is, 1 means responses are quite reliable while 5 means the responses are not at all reliable *(encircle an appropriate option)*.

1. …. 2. … 3. … 4. …. 5. ….

3. Give reasons for your responses to question (1) and (2) above ……..

4. Any comment about this interview (or from this interview) ……

End of interview, thank you very much for your participation!