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Evaluating rural household demand for improved water quality: A case of rural settlements of Qiloane community in Lesotho.

By

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DECLARATION OF ORIGINALITY

I, Elliot Tsepiso Mokhothu, affirm that this dissertation, which I hereby submit for the degree of MSc Agric. (Agricultural Economics) at the University of Pretoria is my own work and has not been earlier submitted by me for a degree at this or any other institution of higher education.

Signature……

Elliot Tsepiso Mokhothu

Date …….

Approved by:

Signature……

Dr Babatunde O. Abidoye

Date ……

DEDICATION

This dissertation is dedicated to my beloved wife, Matankiso, and lovely son, Tankiso, for all the sacrifices they have made as an inspiration to my studies. It is further dedicated to a living God, my Father for His unwavering support: Without Him, nothing could have been possible**.**

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ABSTRACT

Evaluating rural household demand for improved water quality: A case of rural settlements of Qiloane community in Lesotho.

By

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Degree: MSc Agric (Agricultural Economics)

Department: Agricultural Economics, Extension & Rural Development

Study Leader: Dr B.O. Abidoye

This study analyses the demand for quality water supply services in the rural settlements of the Qiloane community. This is a non-market valuation of preferences for quality water supply services given no explicit market at the study location. The study was implemented in response to increasing problems regarding water supply provision in the Qiloane rural locations of Lesotho. Understanding the demand and willingness to pay for improved quality of water supply service is required to make a case for the provision of the service at Qiloane locations. The results provide evidence that in the Qiloane rural community locations, the households are prepared to pay more than the present price for water. The educational level of the household, spending power (monthly income), and households' perception regarding the existing water supply quality situation were perceived to be important factors establishing the willingness to pay (WTP) of the rural households. Hence, a beneficial policy decision, applied through a water tariff to enhance water supply services, would need to cautiously take into consideration the capacity to pay through expenditure classes. The results also showed that the demand-driven management technique might reinforce water supply enhancements and feasibility.

The study utilised a single-bounded format that elicited responses, expressed through respondents' WTP, to assess whether a presented improvement cost would influence the WTP of the households for satisfying their demand for water quality supply service enhancements in the Qiloane rural community locations of Lesotho. The Qiloane rural community locations were purposely selected because of the poor water supply services prevailing within the said communities. The WTP of Qiloane rural dwellers for enhanced water supply services was thereby educed through notionally acceptable levels of payment for water equipment installations and monthly water fees. Consistent with recent literature on choice elicitations, the referendum question was followed by a certainty calibration approach whereby respondents were requested to specify their extent of certainty to the referendum question for the purpose of mitigating hypothetical bias problem. The Qiloane rural community locations were identified owing to their depressing water supply services; accordingly, the survey data from 106 households was analysed using purposive and simple random sampling techniques, focus group dialogs, a structured questionnaire and in-person interviews.

Generally, the households of Qiloane rural residents demonstrated a high degree of knowledge concerning the dangers related to the poorly managed water supply service, and the perception of the health risk is high. Further analysis from the study indicated that in regions where water supply service management is presently offered at a fee, the households demonstrated a WTP considerably higher than the existing fees for reformed services. Additionally, the study revealed that in community locations where no water supply service management is presently provided, the households indicated that they are willing to pay a monthly fee of M250 or even more if such services were to be offered. The outcomes of this study can be used by the water supply service management to conduct a cost–benefit analysis, comparing tariff potential with the expense of delivering the service.

According to the outcomes of the survey, the Water and Sewerage Company (WASCO) has a potential to improve the quality of water supply service management practices in locations where they are presently offered at a tariff, and also to offer such services at a fee in regions where they are not presently offered. The analysis from the findings suggests that WASCO could impose a tariff from M250 to M350 for each household on a monthly basis, but still considering the average income classes of the households. However, the substantial monthly fee should be quantified through engagement with the stakeholders concerned.

Key words: household demand for water, water quality supply services, reclaimed or recycled water, contingent valuation technique, willingness to pay (WTP), single-bounded referendum elicitation approach, Qiloane rural community locations, Lesotho.

TABLE OF CONTENTS

LIST OF TABLES

ACRONYMS

AERC:	African Economic Research Consortium
ANOVA:	Analysis of Variance
CMAAE:	Collaborative Masters in Agricultural and Applied Economics
MSc:	Master of Science
PhD:	Philosophiae Doctor
WTU:	Willingness to use
DRWS:	Department of Rural Water Supply
WASCO:	Water and Sewage Company
GOL:	Government of Lesotho
MDGs:	Millennium Development Goals
MBIs:	Market-based instruments
CV:	Contingent Valuation
WHO:	World Health Organization
WTA:	Willingness to accept
WTP:	Willingness to pay
NOAA:	National Oceanic and Atmospheric Administration
CS:	Consumer Surplus
HCV:	Hicksian Compensating Variation
HEV:	Hicksian Equivalent Variation
MLE:	Maximum Likelihood Estimation
χ^2:	Chi-Square
WEI:	Water Equipment Installation

WMC: Water Monthly Charge

HHWC: Households with water charge

HHWTWC: Households without water charge

1 CHAPTER ONE
INTRODUCTION

1.1 THE SETTING OF THE STUDY

Lesotho is blessed with ample water resources which are mostly established in the rural, mountainous locations of the country. The water is consumed in both urban and rural regions. The water consumption in the urban regions of the country is entirely accessed through the payment of the municipality water tariff which is governed by the Water and Sewage Company (WASCO), while in the rural settings this is governed and regulated by the Department of Rural Water Supply (DRWS). The infrastructure at the rural area need rehabilitation and extension to other rural community locations. Currently, the authorities are not offering satisfactory water service provision and are not expanding the coverage in formerly remote rural community locations of the country that are un-served. According to Kingdom of Lesotho (2013), the reasons why most of the current water systems are in need of improvement and rehabilitation in the heavily populated rural regions is because most of them were constructed more than 35 years ago which is past their useful economic life. In addition, the increased population growth in the rural settlements has resulted in insufficient capability in the water systems to deliver the required capacity. Moreover, the insufficiency of the pipe network compels people to travel extended distances merely to fetch water.

Apart from the existing ancient infrastructure, the fact that a substantial section of the communities in the lowland are served by hand pumps as old as 37 years also provides a compelling indicator of the insufficiency of water provision in the rural settlements of Lesotho. However, the existing hand pumps are not adequate for supplying a sufficient or satisfactory level of service for satisfying the water demand of the escalating number of the consumers. The existing hand pumps are damaged and being overused due to the pressure of the increased population. Furthermore, they are avoided because they disadvantage the disabled, the old-aged, the women and children who consider them problematic to operate (Lesotho Country Proposal to the Millennium Challenge Corporation, 2006). Hence, there is a need for water reticulation extensions. This is consistent with the findings from the focus group discussions, conducted before implementing a final survey, to the effect that the demand for water by the

current population now exceeds supply within the community settlements of Qiloane in Lesotho. Moreover, the water was unsafe and was only available in the mornings and not every member of the community has daily access to water for household, day-to-day needs. Therefore, these rural communities lack access to sustainable and equitable, safe, sufficient, and improved water supply services. This weakness in the provision quality water services, specifically in the rural regions of Lesotho, is attributable to the government's insufficient financial resources for modernising water supply equipment in order to deliver improved water supply services. Thus, the state is failing to efficiently meet the water demand of the rural communities (TAMS, 1996).

The management of water resources in Lesotho needs careful consideration in formulating policy and influential management approaches (DRWS, 1998). A critical concern that the Lesotho government experiences is in meeting the water demand of the ever-growing population, specifically in the rural locations of the country, on a continued and sustained basis. Indeed, the Lesotho government has, as one of its MDGs, the aim to reduce the percentage of the public with no basic sanitation and access to safe drinking water that is not sustainable (Lesotho Country Proposal to the Millennium Challenge Corporation, 2006). Important features that explain access in this context are generally safe drinking water, adequacy, reliability, and reasonable or convenient distance to the main water source point (WHO/UNICEF, 2012).

Thus, economists recommended different policy tools for the purpose of lessening the unsafe and water shortage problems. Among them, market-based instruments (MBIs) were considered to be the more effective tools and are commonly used in practice (Sterner, 2003). According to Coggan and Whitten (2005), MBIs are important in inspiring friendly environmental behaviour through market signals, and these comprise pricing, taxes, tradable permits, subsidies, refunded emission payments, and direct regulations. Water pricing technique is fitting for this study given the explicit interest in an instrument that can be applied to internalise externalities pertaining to the poor quality of water resource in the open-access regime and to satisfy the prevailing high household demand for quality water supply services. As stated in Sterner (2003), water pricing is defined as a policy intervention that is meant to reduce the demand for a water resource by using price signals, while still upholding the viable and continued provision of such a resource. This water pricing policy, if executed effectively can be an impressive resource management tool for improving water conservation and the quality of the service supply. Prices are principal on how the markets grow and function. Specifically, the prices are

the signals that facilitate providers in establishing where they can provide resources with less expense (Sterner, 2003). Therefore, before deciding which approach to take to attach a monetary value to water consumed in rural regions, the regime under which the water is contributed was of paramount importance and needed to be considered.

In consideration of the fact that water consumed under an open-access regime is recognised as a non-market good, a non-market technique was established to assign a price to water to be obtained through improved quality supply services. Thus, the CV technique was utilised in this study as the non-market valuation tool for examining the willingness to pay (WTP) of the respondents for upgraded water quality supply services in Qiloane rural community locations. Undeniably, the CV format has been fruitfully used in the valuation of far-reaching areas of water supply and other non-market goods and services (Haq *et al*., 2007; Kanayo *et al*., 2013; Wondimu & Bekele, 2011). The CV technique is used to economically assess the value of a good or service to a person (Birol *et al*., 2007). By the same token, Agudelo (2001) further emphasised that the CV method establishes the maximum WTP of an individual for gaining access to a good or service and enhancement in its service quality.

However, payment for water supply services is very important because improved services will be made available whenever households have a need of the water. The most important aspect is to formulate relevant policy that considers the capability of the underprivileged individuals to pay. The policy should consider water provision at a cost that enables the recovery of a preliminary fee for supplying it, hence allowing its continuous and viable provision, but also ensuring that the resource is made available to the deprived individuals. Although the poor are presumed not to be able to afford to pay for water supply services in the rural regions, there is mounting evidence which affirms that they are undeniably prepared to pay even larger amounts than the rich do for water service provision (Wright, 2012). Given this scenario in Lesotho, and following this hypothesis, the Lesotho government has attempted to meet the demand for water and is currently establishing the fee recovery through the formulation of policy.

Generally, an appropriate water policy and management system that appropriately and efficiently manages the growing demand for rural water supply is non-existent, specifically in the rural locations of the country (Kingdom of Lesotho, 2013). However, if such policy is not presently implemented, the provision of water to the rural population of Lesotho on a continual and sustainable basis might become problematic.

1.2 PROBLEM STATEMENT

Lesotho is a tiny mountainous country that is surrounded by South Africa. Water flows from the high-altitude aquifers to the lowlands, where most of the communities lie. Lesotho is well known for the plentiful water that it generates to serve its population and neighbouring country, South Africa. According to Leshoboro (2009), Lesotho has water resources that exceed its current and future needs. However, there is mounting evidence to show that water shortages in some communities of this country remain a critical concern for the government and the policy makers (Kanayo *et al.*, 2013; Hensher *et al.*, 2005 & 2006; Moffat *et al*., 2011; Baisa *et al*., 2010; Olanrewaju *et al*., 2012, Vasquez *et al*., 2009). This is because the water systems in the rural settlements of Lesotho are consistently failing to supply enough and quality water to this area for quite some years now because of insufficient funds and poor maintenance. Therefore, the current situation of water shortage and quality in these rural communities is depressing due to the failure of the water systems to meet the communities' daily water demand, and other households get additional water from supermarkets which is very expensive and cutting through their limited monthly disposable income. The current possible way to get water in these communities is through waking up early around 4am and queuing up for water for almost 3 hours. This seems to cause inconvenience for many people which even compels other households to utilise surface water that is greatly contaminated as an alternative, and it is very far away from their dwellings. Although the country has highly abundant water in relation to its demand, water accessibility is a problem, specifically in some rural areas (Kingdom of Lesotho, 2013).

Lesotho remains poor, although its water remains its major valuable natural resource export (Lesotho Country Proposal to the Millennium Challenge Corporation, 2006). The country has four main dams and the average rainfall ranges from 1,400 mm in the highlands to 1,600 mm in the lowlands while access to water remains a constraint (Lesotho Meteorological Services, 2013). Out of Lesotho's average population of 2.204 million, some 307 000 lack access to improved water services. Nevertheless, access to water varies amongst the districts. Generally, over 60 per cent of households devote over 30 minutes to fetching water (Kingdom of Lesotho, 2013). During the rainy season, most people in rural regions depend on rainwater for all domestic water uses, while in the dry season the situation worsens. As indicated in World Health Organisation (2004) reports, the state of the poor quality of water as experienced in the country was noted when there were occurrences of infant mortality associated with water borne diseases. This is evidence from the 2008 epidemic of diarrhoeal diseases in rural settlements

that led to the deaths of approximately 10 per cent of children under five years of age. It was further emphasised in the Kingdom of Lesotho (2013) that infant mortality increased between 2010 and 2013 because of diarrhoea initiated by inadequate access to clean water, particularly in rural locations of the country. The water coverage levels that persist are low, primarily owing to insufficient improvements to water equipment systems, deficits in reliability, and poor maintenance of those water equipment systems in the rural settlements of Lesotho (World Health Organisation, 2004).

The water supply services in the rural regions could be improved through the installation of modern water equipment systems, such as the construction of an additional water pipeline distribution network with stand posts, pumps and storage tanks, while the replacement of the existing equipment is needed. Furthermore, the water has to be purified to avoid water-borne diseases in order to make it safe for human consumption. All these involve high capital expenditure which needs to be borne by the community (in the form of contribution) and/or the government. Whittington *et al*. (1990) noted that water systems need to be used most of the year in order to be economically justified because these costs are incurred regardless of whether the system is working or not. Goldblatt (1999) also argued that, for the improved rural water services to be sustainable, user fees should be introduced as partial recovery of investment and daily running costs. Varela-Ortega *et al.* (1998) also contended that the pricing of water is the significant factor in determining the proper incentive for efficiency, sustainability and accountability. Thus, to implement the existing policy for the improved water supply services within the Qiloane rural communities, the pricing mechanism has to be discussed specially to guarantee sustainability. There is a need to study the demand for the service and the willingness to contribute to service costs, as such evidence assists in gaining an understanding of the value that individuals attach to an improved rural water supply service. In such an analysis, a price that reveals the WTP of households for enhanced water supply services would be established.

Water accessibility is a problem, in terms of both quality and capacity, specifically in the rural regions of the Lesotho. Therefore, while there should be an opportunity cost for the use of the fund, it should not be a constraint on the country's economy. Assessing the demand for an improvement in rural water supply services provides the foundation for a micro-analysis of the water use consumption of the affected households. This will provide information for future studies and for planning improvements in the water supply systems in rural settlements. Gaining accurate information about the features of water supply systems in rural community locations could provide the understanding needed to develop a relevant policy that would

address the existing problems in the water supply services. Although there are previous studies that have addressed various attributes of the water supply controversy (Masupha, 2007; Letsie, 2005; Molapo, 2005; Mots'oene, 2013; Lebabo, 2016), none of these, to the best knowledge of the researcher, has determined the price of the water supply in the rural regions in Lesotho where water is mostly consumed under an open-access regime. Hence, this study economically evaluates the household demand for water quality supply service enhancements in the rural settlements of Qiloane community locations in Lesotho. Specifically, the study endeavours to respond to the subsequent questions:

1. What are factors influencing the WTP of the residents in Qiloane rural community locations for improved water supply services?
2. Are households in rural settlements in Qiloane community locations willing to pay for enhanced water quality supply services?
3. Will an upfront installation cost influence the WTP of the households in the rural settlements of Qiloane community regions of Lesotho?
4. Are households in rural settlements of Qiloane community locations willing to use recycled or reclaimed water to supplement current water supply services?

1.3 OBJECTIVES OF THE STUDY

Economic valuation quantifies, for the advice of policy makers, the preferences of the communities in relation to goods and services, together with their values for those goods and services. Thus, the prime objective of this study is to evaluate, through an application of a CV technique, the demand of rural households for enhanced water quality supply services in the Qiloane communities within the rural settlements of Lesotho. The CV technique was utilised to assess the rural households' WTP for improved water supply quality at Qiloane community locations of Lesotho and determine the potential for raising funds for improving access to good-quality water. Explicitly, the study will:

1. Evaluate the existing knowledge, perceptions and attitudes of the households pertaining to the demand for enhanced water supply service in Qiloane rural communities;
2. Elicit how much the residents of Qiloane rural communities will pay in securing a future improved water quality service;

3. Assess if the upfront connection cost would impact the WTP of the respondents in securing a future improved water supply service;

4. Determine the households' willingness to use reclaimed or recycled water to settle the increased demand for water supply services in Qiloane rural settlements of Lesotho.

1.4 HYPOTHESES FOR THE STUDY

Based on the reviewed literature regarding water supply services, the following hypotheses were established:

1. The knowledge, views and attitudes the households have pertaining water supply service are expected to have an influence on WTP conclusions. Knowledge based on the purification method followed to make water safer for consumption implies that the people have an understanding that consuming the water without applying proper treatment mechanisms to make it safer is unhealthy for their health and that of others. Furthermore, well-educated individuals are presumed to be aware that organisms causing diseases are contained in water that is uncleansed, unlike their counterparts with little or even no awareness that water that is consumed without being purified is more likely to be carrying organisms harmful to health because they are not visible to the naked eye. This is further emphasised by Moffat *et al*. (2011) who state that the greater the number of years spent by individuals in receiving formal education, the better they would understand the concerns in consuming unsafe water and the importance of having water quality supply service in their settlements. Therefore, the test of the following hypothesis:
   The awareness on water supply, and perceptions and attitudes that are advantageous for an enhancement of the quality service have no effect on WTP for improved water quality.

2. The WTP of the households for an improvement of the quality of the good such as water or service is greatly reliant on some key socio-economic variables (Kanayo *et al*. 2013). According to Kanayo *et al*. (2013), Moffat *et al.* (2011) and Ntshingila, (2006), those that receive high levels of monthly incomes prefer high and better quality water supply service because it is even predicted by theory of demand that the demand for normal goods is positively related to the income of the household. This implies that, as the income of the household is increased, he or she purchases more of the normal good.

Furthermore, the rural residents unveil less WTP for an improvement of water quality than the urban households, although the former have a more prevalence of water quality problems than the latter. This might be attributed to the fact that these residents receive less monthly income to manage paying more for water quality in their residences. It can also be assumed that income increases the likelihood of desiring enhanced water utility services (Ntshingila, 2006). The CV method is better appreciated by more well-educated individuals, as indicated by most studies undertaken in African countries (Turpie *et al*. 1999). This is also consistent with studies conducted by Whittington *et al*. (1989, 1990, and 1991) and Farolfi *et al*. (2007) which established that education increases individuals' cognisance and renders them more sympathetic to policy development and innovation. In addition, Wondimu and Bekele (2011) asserted that an educated person would have relevant information and the awareness that negative consequences result when individuals do not consider it important to have knowledge, be well equipped and to receive training pertaining to the water supply issues concerning the water they use in their homes. Therefore, these households particularly the females, are more likely to know the dangers posed by using contaminated water for domestic purposes. Lastly, respondent's age was also expected to have an effect on WTP decisions. This signifies that the older people become, the higher the likelihood is that older people are generally aware of the consequences of the current water they consume in their residences. Therefore, it is hypothesized that:

The WTP for an improvement of water quality is not reliant to the subsequent socio-economic variables: monthly income of the household, educational level of the household and age of the household.

3. The upfront connection cost for water infrastructure under consideration will not influence the respondents' WTP for improved water quality service.

4. The opinions that the residents have regarding the water supply service attribute being considered are expected to have an impact on the utilisation of recycled or reclaimed water in order to settle the increased demand for water. The households are more perceptive of the present vulnerable water supply in their locations, and the challenges they are faced with regarding the low supply that is insufficient to meet the demand for water, which resulted in occurrences of waterborne diseases. It has been emphasised by

Whittington *et al*. (2009) that high water demand negatively results in poor access to convenient and good-quality water sources. Thus, many individuals receiving higher incomes are likely to support and give finance for the utilisation of recycled water for household consumption purposes. Thus, the study tests the hypothesis:

The opinions of the households that are conducive for an improvement of water services have no influence on the willingness to use reclaimed or recycled water to settle the increased demand for improved water quality.

1.5 ORGANISATION OF THE THESIS

This dissertation is structured into five sections. Chapter One sets out an introduction to the study and comprises the setting for the study, a statement of the problem, specific research questions, objectives and the hypotheses for the study. The other parts of this thesis are structured as follows: Chapter Two covers a theoretical and empirical review of literature, including the conceptual framework. A description of the study area, sampling, focus group discussions (community members' group discussions and discussion with the water authority: Department of Rural Water Supply), survey design and development, implementation of the survey, variable description, use of single-bounded dichotomous choice versus double-bounded dichotomous choice, data analysis, households' socio-economic and demographic characteristics, and empirical models applied for data analysis are presented in Chapter Three. Chapter Four demonstrates the outcomes and discussion from the survey, while Chapter Five sets out the econometric estimated results and the statistical tests. Finally, the conclusion, recommendations, boundaries of the study and areas for future research are presented in Chapter Six.

2 CHAPTER TWO
EMPIRICAL AND THEORETICAL REVIEW OF LITERATURE

2.1 INTRODUCTION

This chapter demonstrates the conceptual and theoretical framework for the contingent valuation (CV) approach to analysing the demand for enhanced quality household water supply services. The chapter also discusses the welfare measurement theory. Finally, the chapter reviews the empirical literature that has been published through CV studies to assess households' demand for improved water supply services.

2.2 CONCEPTUAL AND THEORETICAL LITERATURE REVIEW

This section explains a theory for the economic valuation of environmental resources and the foundations of valuation techniques for non-marketed goods and services, which comprise water in this case. Since water is accessed freely in most rural settings, it is a non-market good. According to Hanley *et al*. (1997), environmental resources have no observable market price; hence, it is challenging to assign monetary values to them. Nevertheless, to sustain and secure the provision of the non-market goods for future generations, all resource users (consumers) are obliged to attach monetary value to them. Therefore, policy analysts should recommend monetary values for the utilisation of the water resources, through the WTP approach, for the users of the proposed improved water services in the rural villages to ensure the continuity and viability of the services for the future. Thus, non-market valuation techniques are the appropriate instruments to use to assess the WTP of the individuals for water service improvements in rural settings.

2.2.1 Economic Valuation techniques for environmental goods and services

As noted by Pearce *et al.* (1994), the market for environmental goods and services is infrequently observed. Water resources allocations in the market are perceived to fail because of high transaction costs and declines in supply, which are due to public goods and externalities (Young, 2005). Hence, the application of stated preference techniques such as the CV method will be appropriate for ascribing value and will aid in the design of sound economic policies.

Economic approaches are used to assess the demand of households for improvement of rural water valuation. The approaches are categorised under the direct or stated preference methods

of non-market valuation for commodities without a market, such as rural water, which is the major focus of interest in this study. As is indicated by Frey *et al.* (2004), these direct valuation methods are applied in cases where people face hypothetical scenarios and ascertain how much value they attach to environmental resources. WTP represents the amount of money an individual will be enthusiastic to offer in order to improve the service quality of a certain good, while willingness to accept (WTA) reimbursement is the least amount in monetary terms needed for a person to sacrifice a certain good or to forgo the environmental service improvement, or accept that the environmental degradation will occur. Revealed preference methods incorporate hedonic pricing, travel cost (TC) methods, etc., while stated/direct preference techniques involve contingent ranking, choice experiments, conjoint analysis and CV methods. However, for the purposes of this study, only the contingent valuation (CV) method was employed.

2.2.2 The Contingent valuation approach concept

The CV technique is a survey-based method that is extensively applied in welfare economics by which individuals are requested to disclose information concerning their preferences or values for a particular good (Freeman, 2003). Also, as explained by Haab and McConnell (2003), CV is a method which is applied to attain information on respondents' preferences or WTP from a direct question. Recently, the CV technique has gained momentum, not only due to its theoretical excellence, but also owing to its methodological modesty (Arrow *et al*. 1993). Welfare economics adapts basic assumptions in order to attach such monetary values. First and foremost, economic agents must have a choice for one bundle over another when they are presented with a choice between two or more bundles. Secondly, economists attempt to minimise costs, subject to utility level, or maximise absolute utility contingent on a budget constraint.

The contingent valuation technique is a direct, non-market valuation technique applied to elicit peoples' WTP for access to natural resources or to assess information about the value that individuals place on environmental resources in a survey (Mmopelwa *et al*. 2005 & Georgiou *et al*. 1997). The CV method attains a WTP of the individual or WTA the environmental quality change using a structured questionnaire (Hoyos & Mariel, 2010). It is further contended that most natural resources are non-marketed goods, meaning there is no market where they can be bought or sold; nonetheless, they can be valued economically through an application of a stated preference technique, such as the CV method. Furthermore, the CV technique is established on

expressed behaviour, and uses the WTP and WTA survey instruments to get data regarding the value that people put on environmental resources.

Findings from Freeman (2003) explain that a stated preference approach comprises a survey study where individuals are requested to reveal information about their preferences or the values they put on environmental resources. It was further stated that the CV technique involves asking questions based on monetary values for a described product or environmental service change. The CV method is used to obtain preferences or information concerning the WTP of individuals from a direct question on contributions for the anticipated environmental resource improvement services, or what they might be willing to accept (WTA) as compensation for the improved service not occurring (Whittington, 2002; Haab & McConnell, 2003; Turpie *et al*. 1999; Hoevenagel, 1994; Pearce & Turner, 1990). The CV approach is also considered to be the only technique that can be applied to elicit the WTP of individuals for passive use or existence values for the economic importance of environmental goods or services (Carson & Hanemann, 2005).

The survey instrument comprise of a CV hypothetical scenario with questions regarding respondent's monetary valuations for a certain resource service, in this case enhanced water supply services. The second aspect of a CV scenario is the payment vehicle applied for paying for the envisioned environmental service, which relates the payment with receipt of the service in the sense that there would be no service without the payment for it. The last feature of a CV scenario uses the approach of asking valuation questions. This section of the survey instrument presents an individual with a specified improvement cost so as to elicit his/her response to such cost.

Findings from Lopez-Feldman (2012) confirmed that contingent valuation surveys incorporate the WTP questions asked of the respondents for the distribution of the good in consideration for the payment. As pointed out by Arrow *et al*. (1993), a CV survey estimates the average WTP of the respondents for an environmental resource improvement, and the respondents have to justify their reasons by voting for or against the proposed service. Thus, the CV questionnaire is descriptive rather than being analytical. In using a CV approach, Dixon *et al*. (1994) and Abu Madi *et al.* (2003) justified that WTP can be elicited by using one of the following three different elicitation techniques: payment cards, dichotomous choice formats, or bidding games (Single-bid games or open-ended questions and interactive-bid games). With payment cards, the respondent is offered distinct types of potential payments and requested to choose from

such series of amounts, based on his/her valuation, as itemised (Hanley & Splash, 1993; Hoevenagel, 1994). The second approach is to use bidding games (open-ended questions and interactive-bid games) where a researcher begins by proposing a certain amount to the respondent, who may agree or disagree with that amount. The amount is increased if the respondent agrees, and such person is further requested to state his/her WTP. The procedure carries on until his/her exact WTP is established. However, if the individual rejects to pay an initial amount, the amount is decreased to find his/her maximum WTP (Dixon *et al*., 1994). Lopez-Feldman (2012) states that a respondent is requested to state his/her WTP for a good, using open-ended questions, as explained in the hypothetical scenario. Nevertheless, payment cards and open-ended methods were criticised because these approaches have experienced incentive compatibility problems, in that during survey implementation, respondents might influence potential survey results by providing manipulated values instead of their actual WTP. The final approach is the use of dichotomous choice questions, in which an individual has to state his/her WTP for Y amount and is expected to reply "yes" if his/her reservation price or WTP is equal or higher than Y amount, or respond with a "no" preference if her/his WTP is less than Y amount (Lopez-Feldman, 2012). Thus, the single-bounded dichotomous choice technique was employed in this study.

2.2.2.1 The dichotomous choice format

The dichotomous choice format incorporates both double-bounded and single-bounded formats. In the single-bounded format, which was first introduced by Bishop and Heberlein (1979), respondents are given one bid value about WTP only once, and they are expected to respond with either a "yes" response if their WTP exceeds the proposed amount, or a "no" response if their WTP is below the proposed amount or if they refuse to pay for the offered amount (Cooper *et al*. 2002; Haab & McConnell, 2002). Nonetheless, the single-bounded dichotomous format is statistically inefficient in estimating WTP because it yields less information relative to individuals' WTP (Lopez-Feldman, 2012:10). Hence, Carson *et al*. (1986) established a double-bound referendum choice technique to improve on the efficiency of the single-bound referendum choice technique. In this format, the individual is given a second WTP question, contingent upon the reaction to the first question about his/her WTP. The second WTP question has a higher amount if the respondent has a "yes" preference to the initial question, or a smaller amount if the respondent answered "no" to the initial question (Sidrat & Heman, 2015; Hanemann *et al*. 1991).

According to Cooper *et al*. (2002), although some studies demonstrate an affirmation that the first bid response amount may conflict with the second bid response, thereby producing a lower WTP, the double-bounded referendum was more favoured than the single-bounded referendum was because of it being statistically efficient in estimating the WTP of the individuals. The one-and- one-half-bound referendum was introduced whereby the individual is offered two amounts up front and informed that, while the absolute cost of the item is certainly unknown, it is recognised to be within the range enclosed within those two amounts. Some of the amounts are randomly chosen, and the individual is requested to state if he/she will be prepared to pay such a cost; the individual is then asked about another amount only if it would be consistent with the specified amount range. Therefore, this technique is considered to get rid of the surprise aspect; hence, it has the potential to clear away disparities in the reactions to the two referendums, although is costly not to always request the person to pose the second referendum question, on average, the second referendum question is convenient half the time, but not for entire remaining time (Cooper *et al*. 2002).

The researcher offered the respondents the charge that must be paid when implementing the dichotomous choice approach. In order for the researcher to retrieve credible and irrefutable information using the CV approach and to determine the responses of the individuals, the way in which WTP corresponds to respondent's characteristics has to be understood (Haab & McConnell, 2003). The parametric models for the dichotomous choice CV questions can be evaluated by estimating the preference function which complies with the WTP calculation, and calculate the WTP, provided with the estimated coefficients.

According to Arrow *et al*. (1993), the WTP valuation questions have to follow a single-bound dichotomous choice (yes/no) approach, and this requires a household survey population of at least one thousand individuals, as explained in the National Oceanic and Atmospheric Administration (NOAA) panel. However, such a large household survey population size might be inappropriate in a small country like Lesotho, as this figure was based on an American perspective. Thus, this study employed the use of a single-bounded choice dichotomous format, although the sample size determined was a bit smaller than suggested, due to the time frame and scarce resources available for the study. This is because in the case of a double-bound referendum elicitation format, empirical studies (McFadden, 1994; Cameron & Quiggin, 1994; Kanninen, 1995; Herriges & Shogren, 1996; Bateman *et al*. 2001; Burton *et al*. 2003; Bateman *et al*. 2008) have confirmed that the amounts of WTP from initial and second replies are not induced by similar veiled preferences, in which the first becomes notably smaller than the

second response. Indeed, McFadden (1994:705–706) demonstrated that the double-bounded dichotomous choice elicitation approach is basically incompatible, making some experts disregard such an elicitation technique.

However, the CV technique presents the problem of hypothetical bias, in which the respondents have a habit of specifying WTP amounts that contrast with what they would truthfully pay in a real context. Therefore, Champ *et al*. (1997) argued that the single-bounded referendum format provides good results when a certainty calibration approach was applied in order to lessen the issue of hypothetical bias, in which respondents who responded "yes" to the single-bounded dichotomous choice are asked to what extent they were certain concerning their response, on a numerical scale, immediately after the referendum question was posed. Hence, this is also practised in this study. In this technique (Blumenschein *et al*. 2008; Champ *et al*. 2009; Samnaliev *et al*. 2003; Loureiro *et al*. 2009), the "yes" answers are reported as "no" responses when a respondent is uncertain regarding his/her response, and this is considered to be an efficient method for mitigating the hypothetical bias problem. Nonetheless, this certainty calibration method was never applied in a double-bound referendum choice format, seemingly owing to the internal disparity concern. Moreover, the households are incurious about the institutional proceedings regarding the double-bound dichotomous choice format and they are confused by the follow-up questions (Bateman *et al*. 2008). By the same token, a double-bounded referendum choice raises the starting point bias problem because the initial bid amount can impact on a response to the second bid (Flachaire & Hollard, 2006).

Conversely, the double-bounded approach was preferred over the single-bounded because the latter experiences poor statistical efficiency (Hanemann *et al*. 1991). The findings from Kanninen (1993) further justified the view that the use of a double-bounded format is highly adopted because it improves the authenticity of responses. Moreover, the application of the double-bounded format can convey more precise welfare estimates (McLeod & Bergland, 1999).

2.2.2.2 Advantages of the Contingent Valuation technique

The CV method has several merits for estimating WTP for rural water service improvement. It is employed in estimating non-use and option values, while non-market techniques such as TC only cater for option values, but with exclusion of non-use values (Turpie *et al*. 1999; Perman *et al*. 2003). Existence values are substantial in the valuation of the environment, as most respondents indicate affirmative WTP values for environmental quality changes that were not

revealed in any observable behaviour (Hoyos & Mariel, 2010). In addition, based on technical terms of compensating and equivalent variations as indicated by Perman *et al.* (2003), the CV method is more advantageous than indirect or revealed preference valuation methods are because it is consistent with the underlying economic theory as described by the welfare measures. Since the CV method presents the consumers of a certain good with a choice, setting out where they can buy or sell the good in consideration, it resolves the issue of absence of markets for environmental resource services (Carson *et al*. 2003). Haab and McConnell (2003) provided evidence that CV was designed in order to determine the WTP determinants of respondents and also to ascertain the WTP of individuals for environmental quality of goods or service improvement.

Last but not least, since the CV method is the only method depending on a hypothetical scenario, it is appropriate for the valuation of water resources, as in this study. People express their behaviour when considering the forfeiting of some amount of their funds to secure a good being presented to them, instead of using that portion of their funds for other purposes (Day & Mourato, 1998). However, revealed preference techniques like TC are based on revealed preference behaviour, and thus cannot be employed in assessing the WTP of individuals for improving their water quality supply service. Based on this study, the CV approach, as applied in the form of hypothetical market survey, assesses the probability of increasing the water charges in order to develop water infrastructure for achieving a better water quality and its adequate supply in the Qiloane rural communities.

2.2.2.3 The drawbacks of the contingent valuation approach

Since the CV method relies on hypothetical behaviour instead of observing individuals' real behaviour, it is allied to a number of biases such as strategic, starting point, hypothetical, and information biases (Hanley & Splash, 1993). However, these biases have been taken into consideration and solutions have been recommended in order to minimise them (Bishop & Heberlein, 1979; Willis & Garrod, 1991; Cooper & Loomis, 1992; Carson *et al*. 1986). The starting point bias emanates when an interviewer wrongly selects a starting point bid amount that a respondent readily accepts. This can be resolved through the use of a payment card technique because the values indicated on the card denote the respondents' outlays in a given income group on other publicly provided services (Hanley & Splash, 1993; Georgiou *et al*. 1997; Hoevenagel, 1994). According to Hanley and Splash (1993), strategic bias occurs when respondents are not willing to disclose their exact WTP for environmental goods owing to their

non-excludability. Thus, they have confidence that the provision of goods and services will not be affected by their valuation, as these will be paid for by others. This means that respondents may (Turpie *et al*. 1999) understate or overstate their real WTP, anticipating that their responses may influence a policy decision concerned. On the one hand, as emphasised by Whittington *et al.* (1987), a respondent may overestimate his/her WTP with the hope that the government would instantly implement and pay for a provision, while on the contrary, the respondent might minimise his/her WTP with the hope that the purpose of the CV study is merely for the government to assess individuals' maximum WTP for the service so as to measure the costs to be incurred for service provision. Therefore, this can be corrected through the use of close-ended referendum or dichotomous choice elicitation techniques (Hoehn & Randall, 1983). Furthermore, strategic bias yields a problem in that the respondents tend to respond to the initial questions accurately, while responding to the second ones strategically (Mitchell & Carson, 1989). This suggests that they tend to lower the bid amount by denying further bids that the researcher proposes. Therefore, it is recommended by Cooper *et al*. (2002) that the one and one-half bound elicitation approach be applied in order to avert such a strategic behaviour, while improving efficiency.

Markandya (1992) highlighted the point that hypothetical bias may occur because WTP valuations are based on hypothetical markets; that is, they are not based on real market values. Whittington *et al*. (1989) emphasised the point that when the CV approach is used to value environmental resources quality through WTP for a service by individuals, the method yields a problem in that the good defined may not be comprehensible to respondents. Furthermore, since the improvement or service provision of that certain good is not going to be implemented by the researcher, respondents may provide invalid information or even not bother themselves to respond to the interviewer's questions. Finally, information bias may arise due to lack of adequate information on the part of the respondents about the existing environmental resource being valued. On the other hand, Farrington (2003) has argued that if respondents are given more than enough information, this will give them chance to think deeply concerning the benefits and costs ensuing from what has been proposed to them. In general, all the biases may be minimised through appropriate carefully designed surveys (Tietenberg, 2000; Perman *et al*. 2003; Kahn, 1997). One of the main critical things in the CV method is sample size. If the sample size is very small, the results of CVM are not valid and trustworthy enough for making policy decisions. This implies that if it is not administered properly, the data analysis will be done with biases, hence giving misleading results for policy formulation.

Findings from Arrow *et al*. (1993) pointed out that an application of the contingent valuation methods in valuation studies are perceived to be somewhat debatable due to these biases and encounter a difficulty to be resolved. Therefore, the need to examine the validity of this technique resulted in the establishment of NOAA panel in 1993 to address queries on CV validity, and to articulate procedures as to how it should be employed, especially concerning the non-use values. As long as it is accurately applied to reduce biases, the CV method is considered to be an efficient technique for eliciting decisive economic values through survey methods (Hausman, 1993).

2.2.3 Welfare change measurement theory

2.2.3.1 Economic theory of WTP

The indirect methods are employed to measure a change of welfare arising from policy change because the utility function of individuals cannot be observed. Therefore, a consumer surplus (CS) is a relevant mechanism for measuring welfare in this respect. Following Johanson (1991), CS plays a major role in changing the consumer' utility gains that is not observable into observable monetary terms. Findings from Hoyos and Mariel (2010) emphasised the point that there is an explicit relation between economic theory and a CV questionnaire, as the CV survey provides data needed to describe the WTP of respondents for an intended development of the environmental good or service. According to Fonta *et al*. (2007) and Freeman (2003), the fundamental neo-classical structure used to explain the CV approach commences with the utility function description.

Considering that a person maximises his/her utility contingent on a budget constraint, an indirect utility function for such an individual can be depicted as follows:

$I(w, r, m)$ …… [1]

where **w** represents a vector of the market prices for the services, **r** for a vector for non-market services, in this case, household demand for water quality services or the status of the water quality supply service, and **m** presents the household's monthly income.

The $\mathbf{r_0}$ can be denoted as the prevailing condition of the water supply services which the household experiences, and $\mathbf{r_1}$ is the enhanced water supply service. The scenario presents an enhanced situation in such a way that the individual will receive water of good quality without applying any treatment mechanisms, and the continued and adequate water supply services.

The Hicksian measure (Compensation Variation **V**) represents the value of change in monetary terms to the individual as illustrated in the equation below:

$I(w, r, m - V) = I(w, r_0, m)$ ……..... [2]

V will be positive because the change of the quality service **r** improves from $\mathbf{r_0}$ to $\mathbf{r_1}$, and this causes the social welfare or utility level of the household to increase. Therefore, V is a measure of WTP of the household, as demonstrated by Equation 3 below:

$I(w, r_1, m - WTP) = I(w, r_0, m)$ …… [3]

$I(w, r_0, m - WTP) = I(w, r_1, m)$ …… [4]

Equation [3] demonstrates the Hicksian Compensating Variation (HCV) change in welfare measurement. As is explained by Freeman (2003), the compensation variation measure asks a certain amount of money from an individual such that the individual will be indifferent from the original status and the new set price, if taken from the individual after the improvement in **r** from $\mathbf{r_0}$ **to** $\mathbf{r_1}$. However, Equation [4] illustrates the Hicksian Equivalent Variation (HEV) change in welfare measurement. The HEV employs the enhanced hypothetical scenario $\mathbf{r_1}$ and asks a household what change in his/her income at $\mathbf{r_1}$ would correspond to the envisioned development about its welfare effect (Fonta *et al*., 2007). The study by Freeman (2003) considered the HEV as the total amount of money the individuals would be willing to accept (WTA) in order to avoid the price change, if the change in **r** from $\mathbf{r_0}$ **to** $\mathbf{r_1}$ makes them worse off rather than making them better off. However, the compensating variation was defined as the total amount of cash the individuals are willing to sacrifice for an enhancement of the household water quality supply services. Therefore, HCV is the most appropriate welfare change measurement in this study because it measures the WTP of the households for improving their water quality supply services. HCV and HEV can both be represented by the Hicksian demand curve, as well as Marshallian consumer surplus.

WTP can be considered as the maximum cash a respondent will forgo in a transaction for the improvement of the household water quality supply services from r_0 to r_1. The WTP function derived in solving WTP from Equation [3] is presented as follows:

$WTP = WTP\ (w, m, r_0, r_1)$ …… [5]

The WTP from Equation [5] shows that WTP relies upon the prices of the service (w), the household monthly income (m), the status quo of a household's water quality supply services (r_0), and the upgraded conditions of the household's water supply services (r_1).

2.2.4 Econometric determination for the welfare measurement

This subsection targets the elicitation approach modelling, being the single-bound referendum choice utilised in the study. This section first presents an econometric specification of WTP, then the econometric estimation of the dichotomous model is presented, and finally the econometric estimation of WTP is made using a probit model in single-bounded format.

2.2.4.1 Econometric specification of WTP

The econometric model has to be stated for an estimation of WTP of the households when using the cross-sectional household data. In this analysis, it is hypothesised that all the individuals experience the unvarying prices for the environmental quality service (**w**) and the same enhanced household water supply service situation (**r_1**). Therefore, WTP differs across individuals and is contingent on the household's income (**m**) and the prevailing condition of the water supply services (**r_0**). Besides that, the WTP of the household may be influenced by other household attributes. Hence, the model can be established as:

$$WTP = w^{\alpha\beta+\mu} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad [6]$$

where α represents explanatory variables' vector, β represents the vector for unidentified coefficients, while μ presents the error term signifying the unexplained factors. The WTP exponential function from Equation [6] guarantees that the predicted WTP does not provide negative predicted values for WTP, and rather should provide positive predicted WTP values. Equation [6] can be re-written as follows in order to estimate the WTP function:

$$\ln(WTP) = \alpha\beta + \mu \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad [7]$$

2.2.4.2 Econometric estimation of the dichotomous choice using probit model

Having been provided with a previously determined amount that differs across respondents, individuals are given the questions that consist of "yes" and "no" preferences, in which the answer is $y_i = 1$, if the respondent answers "yes", and $y_i = 0$ if he/she responds "no". Therefore, WTP can be linearly modelled as shown by the linear function below:

$WTP_i(x_i, \varepsilon_i) = x_i\alpha_i + \varepsilon_i$ ……. [8]

where x_i is a vector representing independent variables, α_i for estimated coefficients, while ε_i represents an error term, signifying for unobserved factors. According to Lopez-Feldman (2013b), WTP from the preceding model (equation 8) can be estimated through an application of probit, or directly using Stata command *singleb*. As an assumption, a respondent is expected to respond with a "yes" preference if her/his WTP outweighs a recommended improvement amount, i.e., $WTP_i > m_i$ or with a "no" preference if his or her WTP is less than or is unwilling to pay the suggested amount, i.e., $WTP_i < m_i$ or $WTP_i = 0$ (Lopez-Feldman, 2013b). Thus, the probability that is observed for the respondent responding with a "yes" preference to the posed referendum question is given as follows:

$$\begin{aligned} \Pr(y_i = 1|\, x_i\,) &= \Pr(WTP_i > \, m_i) \\ &= \Pr(x_i\alpha + \, \varepsilon_i > m_i) \\ &= \Pr(\varepsilon_i > m_i - x_i\alpha) \text{ …….. [9]} \end{aligned}$$

Having assumed that ε_i is an independent and identically distributed normal variable with a zero mean and equal variance $\sigma^2(\varepsilon_i \sim N(0, \sigma^2)$, the Probit model can be used to estimate Equation [9] in which the probability that the respondent would pay the proposed amount m_i is illustrated as follows:

$$\begin{aligned} \Pr(y_i = 1|X) &= \Pr(\varepsilon_i > \frac{m_i - X_i}{\sigma}) \\ &= 1\text{-}\Omega\,(\tfrac{m_i - X_i\alpha}{\sigma}) \end{aligned}$$

$$Pr(y_i = 1|X_i) = \Omega(\mathrm{X}_i\,\frac{\alpha}{\sigma} - M_i\,\frac{\alpha}{\sigma}) \text{ …….. [10]}$$

where $\varepsilon_i \sim N(0,1)$ & $\Omega(.)$ represents a standard cumulative normal distribution function. Equation [10] is perceived to be the same as the probit model. However, Equation [10] differs slightly from the probit model in the sense that it includes an additional explanatory variable(m_i) .

Findings from Lopez-Feldman (2012) have pointed out that the model can be directly estimated either through the probit command available in Stata, or by using Equation [10] and maximum likelihood estimation (ML) to solve for α and σ using the singleb command from Stata. Since in the classical case there is no sufficient data convenient for estimating such a parameter, the

probit model considers that the variance is equivalent to one, although such an inference is worthless due to an extra variable m_i. Hence, the probit command from Stata consisting of an extra explanatory variable m_i can be employed in order to retrieve the estimates of α/σ and $-1/\sigma$. As explained by Hanemann *et al*. (1991), it is emphasised that where a single referendum question was posed, and the given amount was used as a starting point, Equation [10] can only be used to figure out the WTP of single-bounded referendum models. The respondent will respond 'yes' or else 'no' if he or she values water quality supply services more exceptionally than the amount of the starting point. Hanemann *et al.* (1991) went on to further justify the view that the single-bound referendum is a straightforward approach for an individual even though it is statistically less efficient, and thus demands a larger sample size in order to achieve an appropriate level.

2.2.4.3 Econometric estimation of the double-bounded referendum approach

The study by Sidrat and Heman (2015) further justified the point that an individual is to be followed up with a second WTP valuation question, contingent on the reaction to the initial WTP question in double-bounded referendum format. The second WTP question presents a higher amount if the respondent responds "yes" to the first question posed, or a lower amount if the respondent answered "no"' to the initial referendum question. The individual still has to respond with either "yes" or "no", contingent upon his/her underlying preferences. Therefore, either of an interval data model or a bivariate probit model is applied to estimate respondents' WTP in the double-bound referendum choice questions.

The Bivariate Probit model is another method that is similar to the interval data model used in surveys with a double-bound referendum questions format. Cameron and Quiggin (1994) first developed the model, in which they argued that respondents may reconsider their WTP when they are asked two WTP questions, and an allocation of WTP of the individuals may shift from the first WTP question to the next WTP question. Therefore, the model is of paramount importance because it integrates the probability of varied allocations of WTP across the first and subsequent WTP question, whereas the WTP distribution when the initial WTP question and subsequent WTP question were posed in interval data model is considered alike.

The binary referendum answers are conjointly modelled as single bounded, meaning that they are interrelated WTP questions consisting of the simultaneous distribution of standard error terms in the bivariate probit model. The Bivariate Probit model also relaxes unreceptive interval data model assumptions, and resolves the possible bias problem induced by these

assumptions. The bivariate probit model is applied because it further allows for a correlation of non-zero in contrast to the logit model (Sidrat & Heman, 2015). Thus, WTP functions for an individual i in the bivariate probit model can be depicted as:

$$\ln(WTP_{1i}) = \alpha_i\beta_1 + \mu_{1i} \text{ ……..... [11]}$$

$$\ln(WTP_{2i}) = \alpha_i\beta_2 + \mu_{2i} \text{ ……... [12]}$$

Sidrat and Heman (2015) further explained that error terms are assumed and have a normal distribution, with zero mean and corresponding variances, and have a bivariate normal distribution with the correlated coefficient. The bivariate probit model can also be estimated by a maximum likelihood estimation (ML) method through the Stata command *biprobit* command. A researcher has to establish which distribution to apply in order to evaluate WTP in the subsequent estimation of both the distributions within the bivariate probit model, considering that the WTP distributions are likely to vary across the first WTP question and follow-up question. The first WTP distribution is used as in Equation [11] in most CV approach studies. The anticipated WTP value for individuals might be calculated with specified independent variables after determining the bivariate probit model as denoted below:

$$E(WTP/Z) = e^{Z\beta i + 0.5\sigma_i^2} = e^{-\frac{Z\beta/\sigma i}{-1/\sigma i}} \text{ …… [13]}$$

The interval data or double-bounded model can also be estimated in double-bound referendum survey data. According to Lopez-Feldman (2012), based on the hypothesis of having a single estimate after both responses, the model permits the effective application of the data in estimating WTP. The dichotomous variables that can be used to define the response to the first and subsequent questions are anticipated as z_j^1 *and* z_j^2. Therefore, the probability that a respondent responds with a "yes" preference to the initial referendum question and "no" to the subsequent referendum question is stated below:

$\Pr\left(z_j^1 = 1, z_j^2 = 0 \middle| x_i\right) = \Pr(p, q)$. Based on the assumption that $WTP_i(x_i, \varepsilon_i) = x_i'\alpha + \varepsilon_i$ and $\varepsilon_i \sim N(0, \sigma^2)$, the probability of each one of the four circumstances is specified below:

1. $z_j^1 = 1$ and $z_j^2 = 0$

$$\begin{aligned}\Pr(p, q) &= \Pr(m^1 \leq WTP < m^2) \\ &= \Pr(m^1 \leq x_i'\alpha + \varepsilon_i < m^2) \\ &= \Pr\left(\frac{m^1 - x_i'\alpha}{\sigma} \leq \frac{\varepsilon_i}{\sigma} < \frac{m^2 - x_i'\alpha}{\sigma}\right) \\ &= \Omega\left(\frac{m^2 - x_i'\alpha}{\sigma}\right) - \Omega\left(\frac{m^1 - x_i'\alpha}{\sigma}\right)\end{aligned}$$

Hence, we have the following in applying the symmetry of the normal distribution:

$\Pr(p,q) = \Omega(x_i' \frac{\alpha}{\sigma} - \frac{m^1}{\sigma}) - \Omega(x_i' \frac{\alpha}{\sigma} - \frac{m^2}{\sigma})$ …… [14]

2. $z_j^1 = 1$ and $z_j^2 = 1$

$$\Pr(q,q) = \Pr(WTP > m^1, WTP \geq m^2)$$
$$= \Pr(x_i'\alpha + \varepsilon_i > m^1, x_i'\alpha + \varepsilon_i \geq m^2)$$

Applying Bayes rule which states that $\Pr(C,D) = \Pr(C|D) * \Pr(D)$, the following is stated:

$$\Pr(q,q) = \Pr(x_i'\alpha + \varepsilon_i > m^1 | x_i'\alpha + \varepsilon_i \geq m^2)$$

$m^1 > m^2$ and $\Pr(x_i'\alpha + \varepsilon_i > m^1 | x_i'\alpha + \varepsilon_i \geq m^2) = 1$. Therefore, this suggests that:

$$\Pr(q,q) = \Pr(\varepsilon_i \geq m^2 - x_i'\alpha)$$
$$= 1 - \Omega(\frac{m^2 - x_i'\alpha}{\sigma})$$

Hence by symmetry, there is a following:

$\Pr(q,q) = \Omega(x_i' \frac{\alpha}{\sigma} - \frac{m^2}{\sigma}$ …….. [15]

3. $z_j^1 = 0$ and $z_j^2 = 1$

$$\Pr(p,q) = \Pr(m^2 \leq WTP < m^1)$$
$$= \Pr(m^2 \leq x_i'\alpha + \varepsilon_i < m^1)$$
$$= \Pr(\frac{m^2 - x_i'\alpha}{\sigma} \leq \frac{\varepsilon_i}{\sigma} < \frac{m^1 - x_i'\alpha}{\sigma})$$
$$= \Omega(\frac{m^1 - x_i'\alpha}{\sigma}) - \Omega(\frac{m^2 - x_i'\alpha}{\sigma})$$

$\Pr(p,q) = \Omega(x_i' \frac{\alpha}{\sigma} - \frac{m^2}{\sigma}) - \Omega(x_i' \frac{\alpha}{\sigma} - \frac{m^1}{\sigma})$…… [16]

4. $z_j^1 = 0$ and $z_j^2 = 0$

$$\Pr(p,p) = \Pr(WTP < m^1, WTP < m^2)$$
$$= \Pr(x_i'\alpha + \varepsilon_i < m^1, x_i'\alpha + \varepsilon_i < m^2)$$
$$= \Pr(x_i'\alpha + \varepsilon_i < m^2)$$
$$= \Omega(\frac{m^2 - x_i'\alpha}{\sigma})$$

$\Pr(p,p) = 1 - \Omega(x_i' \frac{\alpha}{\sigma} - \frac{m^1}{\sigma})$…… [17]

Now we have to construct a likelihood function in order to directly get α and σ parameter estimates, applying maximum likelihood estimation. Thus, to obtain the estimates of the model, the following function has to be maximised:

$$\sum_{i=0}^{n}\left[r_i^{qp}\ln(\Omega(x_i'\frac{\alpha}{\sigma}-\frac{m^1}{\sigma})-\Omega(x_i'-\frac{m^2}{\sigma}))+r_i^{pp}\ln\left(\Omega\left(x_i'\frac{\alpha}{\sigma}-\frac{m^2}{\sigma}\right)\right)+\right.$$

$$\left.r_i^{pq}\ln(\Omega(x_i'\frac{\alpha}{\sigma}-\frac{m^2}{\sigma})-\Omega(x_i'\frac{\alpha}{\sigma}-\frac{m^1}{\sigma}))+r_i^{qq}\ln(1-\Omega(x_i'\frac{\alpha}{\sigma}-\frac{m^2}{\sigma}))\right] \ldots\ldots\ldots\ldots\ldots\ldots\ldots [18]$$

where $r_i^{qp}, r_i^{pp}, r_i^{pq}, r_i^{qq}$, are the variables taking on either 1 or 0 by individual. Hence, estimates of α and σ can be obtained directly, and WTP can be estimated as well.

The parameter estimates of α and σ for the double-bounded model are also estimated using maximum likelihood estimation. This can be done using Stata command *doubleb* (Lopez, 2012). The model can as well be understood as an improved, ordered probit model (Verbeek, 2008).

2.3 EMPIRICAL LITERATURE

2.3.1 The significance of the Contingent Valuation Approach in developing countries

The importance of CV approach studies in present-day welfare economics has been overvalued. Nonetheless, many critiques have been made regarding CV studies. Carson, (2012) indicated that thousands of CV surveys have been administered in many states, concentrating on transportation, health, cultural, and environmental concerns, together with many other facets. According to Hanley *et al*. (2001), CV has been considered as a resourceful and persuasive method to be used for valuing the monetary implications for gaining an improvement in the service of environmental resources because it can be appreciated by both academics and policy-making experts. By the same token, the study by Carson (2012) noted that the administration of CV studies is of paramount importance because even professionals such as engineers and other scientists are persuaded by them to shape how a project will assist the society to reap gains. It was further reiterated that the development of CV studies prompts the prior cooperation of the policy-making experts to seriously consider the project costs and benefits, and to recognise the resolutions to reduce the costs or increase the gains to the society. The CV is advocated as being an appropriate method for achieving accurate resolution, in consideration of the fact that many environmental resources have no market on which they are sold or bought. This means that they are non-market goods, according to Carson (2012), who further stated

that CV studies are efficient alternatives for explicitly solving the problem of the absence of the market prices for environmental resources such as water.

Nevertheless, the findings from Whittington (2002) attested the point that most CV surveys administered in developing countries have been awfully executed. It was further affirmed that the majority of economists or researchers conducting the CV studies are not well-trained in relation to the practicable concerns regarding sampling in developing countries or the methods adopted for the household surveys, and this is why they tend to undervalue the emphasis of the CV studies. By the same token, it is acknowledged that many perplexing, incompatible survey results that have been established in most CV survey results are due to disgracefully trained enumerators and the underlying biases encountered from the enumerators. As is also explained by Whittington (2002), the CV survey results produced from many studies administered in most developing countries yield imprecise and impractical results; hence, it is of paramount importance to advance the quality of CV surveys being executed in developing nations. It was further argued that if the CV studies are conscientiously designed and accurately executed, they can produce good quality results that are pertinent for policy formulation.

Accordingly, the study by Hoyos and Mariel (2010) established that the information crafted in the CV scenario must be comprehensive, or unvarying with the scientific knowledge for the respondents who probably have less or even no information or underlying understanding in relation to the envisioned service of the good being described. This is because even the best-crafted CV scenarios may make little impression on a respondent if a well-trained enumerator does not convey it competently and elegantly. It was also perceived that the ordinary way of asking valuation questions does not cater for local situations in developing countries where most transactions are administered in non-monetary means, and also where various activities are non-monetised (Alam, 2005).

To wrap up, Whittington (2002) asserted that the CV approach is considered an important technique to be applied as a resolution for many of the prevalent problems with environmental resources in developing countries, such as watershed management, valuation of ecosystems, water supply services and sanitation, vaccines for the underprivileged, biodiversity loss, soil erosion and deforestation. Thus, the livelihoods for million communities are undeniably influenced by a well-informed policy in these areas.

2.3.2 Addressing water quality supply services in developing countries

Several studies using contingent valuation techniques have been conducted in developing countries to assess household demand for water supply services. However, they became more popular for the urban regions than for rural regions. Wondimu and Bekele (2011) investigated factors regarding the WTP of households on Wonji Shoa Sugar Estate for quality water supply using a CV technique. A Tobit model was used to analyse both referendum and open-ended survey results. Results from the Tobit model confirmed that household age, household size, household educational level, income, respondents' perceptions about water quality, and water reliability significantly influenced the probability of producing decisive values of WTP. The positive relationship of education to the WTP of individuals for improved household water quality supply indicated that when an individual becomes educated, this results in a higher probability of him/her paying for improved water quality supply services, as well as agreeing to the proposed increase. This is consistent with the finding of Moffat *et al*. (2011) that when individuals devote most of their time (years) to formal education, this assists them in better perceiving the concerns about consuming untreated water and the need for having access to a safe supply that is reliable in their locations. Hence, those who are schooled would be more willing to pay than uneducated people would be.

The study report by Moffat *et al.* (2011) indicates that a CV approach was employed to determine WTP of households for improvements in the reliability and quality of water supply in Chobe Ward, in Maun. Lema and Bayene (2012) also used the same technique to examine the WTP of respondents for enhancements to the water supply services in the rural settlements of Goru-Gutu in Ethiopia. Both studies employed the binary logit and probit models, and it was established that the household size variable was statistically insignificant in influencing the WTP of the households. This means that individual household heads with larger family sizes are unwilling to pay for upgraded water supply services, and this is attributed to the fact that such households might be experiencing high running costs (budgetary restraints) for other necessities such as food. By the same token, the study by Minota (2014) also employed a CV survey to assess the WTP of the individuals for an enhancement of water quality services in Dilla town. The study employed both probit and Tobit models to analyse the results from the single-bounded referendum questions which was followed by open-ended questions. It was disclosed that the households' monthly incomes, employment status, water source, and wealth significantly influenced WTP, while water quality, household size and bid value insignificantly influenced WTP for improved water services.

2.4 CONCLUDING SUMMARY

The purpose of this chapter was to theoretically and empirically review the literature pertinent to the valuation technique applied for the study. However, some gaps have been irrefutably discovered from the literature review, particularly empirical section regarding the non-market value for water resources in the Qiloane rural settlements of Lesotho. Although water is considered as a free resource in nature, this leads to over utilisation that ultimately results to its degradation. Therefore, the conclusion drawn from this section is that, the CV technique as a non-market valuation tool has not been previously practised for an assessment of water resources management and policy design in the rural settlements of Lesotho.

3 CHAPTER THREE
METHODOLOGY FOR THE STUDY

3.1 INTRODUCING THE CHAPTER

This chapter presents the methods and procedures used for the study. Section 3.2 gives a narrative of the study area, section 3.3 explains the sampling, section 3.4 defines a method for data collection, and section 3.5 explains the questionnaire and its development. Section 3.6 describes how the study was implemented, section 3.7 sets out the analysis of data, and section 3.8 gives a description of the variables. Section 3.9 outlines the socio-economic and demographic characteristics of the households and finally, section 3.10 illustrates the empirical models used for analysing the results.

3.2 3.2 THE STUDY AREA

3.2.1 The geographical location of the Qiloane community settlements

Berea is a district of Lesotho, positioned in the northern part of the country between the Maseru and Leribe districts. It is the only district which is not named after its district capital. The district is also home to the Kome caves residences (a group of cave houses built with mud in the district of Berea, Lesotho) which are still inhabited by the descendants of the original people who constructed the cave dwellings. The cave homes are located about half an hour's drive from Teya-teyaneng (T.Y.), the capital of Berea district, described as the place of quick sands, and is a camp town for the district, being an hour's drive from Maseru, the capital of Lesotho and Maseru district. The total topographical area of the district is approximately 2,222km^2, including the lowlands, foothills and the mountains of the district.

3.2.2 Population

According to the Bureau of Statistics, Lesotho (2006), Lesotho's population from 1986, when the country gained its autonomy after being a British protectorate, to 2006 was approximately 1 876 633. Of this, males numbered 912 798, which is 48.6% of the total population, while females were found to number 963 835, or 51.4% of the population. The total population in the urban areas of the country was estimated to be 427 917 people. Of this, males represented 198 251 (46.3%) of the urban population, while females constituted 229 666 (53.7%). However, in rural settings, the overall population was estimated to be 1,448,716 people. Of this, males were

estimated to be 714 547 (49.3%) of the rural population, while roughly 734 169 (50.7%) were female. In the Berea district, the total population was estimated to have been 194 600 in 1986 when the country become self-governing, and had risen to approximately 241 946 (1996 census). From 1996 to 2006, the population generally increased to 250 006 (2006 census), which is the current data. The males were estimated to be 121 397 (48%) of the total population in the district, while females were estimated to be 128 609 (51%). In this district, the general population in the urban region was approximately 61,475, of which males were estimated to number 28 615 (46.5%), whereas females were estimated to number 32 860 (53.5%). However, the general population in the rural regions of the Qiloane rural settlements numbered almost 188 531. Of this, 92 782 (49.2%) were estimated to be male, while 95 749 (50.8%) were estimated be female. Owing to this high population pressure, the prevailing water scarcity clearly indicates that demand for water exceeds the present provisions.

3.2.3 Climate

The average annual temperature ranges from 15.2 degrees Celsius in the lowlands to 7 degrees Celsius in the highlands. During high temperature seasons, especially from November to January, the temperature ranges from 20 degrees Celsius in the highlands to 32 degrees Celsius in the lowlands of the country. However, the temperatures in June are very low, with average minimum temperatures ranging from -3 to -1 degrees Celsius in the lowlands, and -8.5 to -6 degrees Celsius in the highlands. Rainfall is considered to be both spatially and temporally variable from year to year in the country. The annual average rainfall ranges between 500mm and 1200mm in the Senqu River Valley region. During December to February, the country experiences a high precipitation rate of about 100mm, while from June to July it experiences the lowest amount of rainfall, estimated at 15mm. In general, the annual average precipitation for the entire country ranges from 1400mm in the lowlands to 1600mm in the highlands (Lesotho Meteorological Services, 2013). For the Berea district, the daily maximum average temperature is 27 degrees Celsius in January, with a minimum average of 15 degrees Celsius, whereas around June, the maximum average temperature falls to 17 degrees Celsius, with a minimum average temperature of 1 degree Celsius. When temperatures increase to highs from December to February, there is also a high rate of rainfall, averaging 98mm in February, while there is only 0.87mm in October (Bureau of Statistics Lesotho, 2006). Snowfall is more common in the higher altitudes where there is more rainfall. The evidence above confirms that

there are greater amounts of rainfall in the high-altitude area (highlands) than there are in the lower altitude area (lowlands) where there is severe water scarcity.

3.3 SAMPLING

Simple random and purposive sampling techniques were employed in this study to gather survey data from the Qiloane rural communities in Lesotho. These areas were purposely selected for this study not merely because they have been identified as being vulnerable areas regarding water supply by the Ministry of Water Affairs, but also because they represent the largest rural section of the country without access to modernised water supply service systems. Besides that, this area encapsulates the history of country because this is where the founder of the Basotho nation (Moshoeshoe 1) stayed and it is the foremost driver of economy in Lesotho due to higher number of tourists visiting the area, and which is likewise the preeminent determining factor for the establishment of the rural-based areas.

In consideration of the time frame available and the scarce available resources, such as the insufficient budget for the study, a sample of 120 respondents was used. This is because the sample size exceeding 120 will require additional fund. Thus, extending the sample size beyond such a sample size might have impaired the quality of response thereby leading to poor CV results. Therefore, a sample of 120 respondents was considered to be an appropriate representation of the population.

A household survey was developed and implemented to gather data from households for examining whether the households would be willing to pay for a reformed water quality supply services in the Qiloane rural community establishments of Lesotho. The survey gathered information pertaining to the WTP of individuals to receive improvements in the water supply services in their locations. Information was also gathered relating to whether the current water quality supply situation is a determining factor that influences the households' WTP for better water quality supply services. The study selected the heads of the households for interviews when gathering data on households; however, in some instances where the heads were not present, the spouse of the head, or any available elderly individual in the family who had applicatory information pertaining to water supply issues, was interviewed. For the purpose of this study, the head of the household refers to the individual who is in charge of the family or is the breadwinner of the family. Children and relatives who were only present during vacations were not interviewed because they are not the owners of the household premises, and similarly, those relatives who did not stay permanently in the households were not interviewed to gather

information relevant to the residents of the stated rural regions of Lesotho. In order to regulate the economic effectiveness of providing modernised water supply service systems, related information was also gathered from the government's Department of Rural Water Supply.

3.4 FOCUS GROUP DISCUSSIONS

The data for this study was gathered from primary sources. This was first implemented through a piloting of focus group discussions to find out the critical challenges and concerns facing the communities regarding the water supply situation among their residents, the proportion of people with access to upgraded water supply services, the number of water supply systems in the communities, and how community members were being affected by these water supply challenges. The focus groups comprised 10 or less individual members for each group of the community, and the sessions were each led by an enumerator. The respondents were informed that a microphone would be used to record the session in order to avoid missing some of their comments, as these are all helpful, and that there are no 'wrong' answers, but rather differing points of view. The respondents discussed the following key issues as their concerns regarding water supply service in their settlements:

- Lack of safe and potable water supply services and the use of water from unprotected wells as the major source of water for both drinking and other domestic purposes leads to water-borne related diseases. These water source points are releasing water that is unclean, with dark-brown colouring of the water in the containers with sediments settled at the bottom of the containers.
- People travel long distances to reach water source and fetching water is a daily activity for the communities. The issue of water quantity available for human consumption at Qiloane rural settlements was also noted.
- It was stated that each household is limited to only 2 containers (2*20 litres) of the water per day. This is attributed to the fact that the water source points are releasing small amount of water.
- Lastly, the long queues are also experienced as another challenge facing the households at their water source point's locations. This is also due to inadequate volume of water released by the water source points.

Other issues surveyed include what the reactions of the public had been in response to those challenges; what the government had done so far to address the challenges; which aspects of the water supply needed to be improved; and the plans and strategies to mitigate the challenges

of their water supply. Most of the households use rain water harvesting to address the prevailing increased water issues at their residences. Apart from that, several attempts were made such as requesting of well treated and potable water supply service that is accessible always from the government. However, the government has only delivered water through mobile water tanks to some, but not to all communities during drought period. The households also demonstrated that they requested private connection from the government. It was further explained that the government stated that there is no funds available for such project. The communities are also contributing some funds, although too small for maintenance and installation of some of the water infrastructure. Since the researcher employed a CV approach, the study was implemented based on relevant future needs and solutions contemplated by the affected communities.

In addition, informal interviews were held with water supply authorities in the DRWS. The purpose of these informal interviews was to validate the findings from the focus group discussion on the problems of water supply and the future plans, if any, to improve on the existing situation for the communities in their settlements. The water authorities from the DRWS also confirmed that they are attempting to deliver private connections to said communities. However, the attempts have been fruitless due to insufficient funds available from the government to provide improved potable water services. Furthermore, it was confirmed by the authority that most people now opt for unprotected wells which are not safe for their lives in which most people experience water-borne related diseases. Households, more especially elderly people, also travel long distances to reach water source points.

Interviews were also held to provide an overview of the activities performed by the department regarding the supply of water services, and to further assist with identifying specific villages that have problems of water shortage and the reasons why such communities were experiencing water supply challenges. The overall responsibility of the DRWS involves the provision of water for the rural dwellers of Lesotho, water policy making, planning, protection and development of the country. The Department further ensures that there is a sustainable supply of water to the households of rural settlements of Lesotho and keep a good level of service for customers. Moreover, the department warrants that there will be a delivery of improved water and sanitation services at rural locations of Lesotho to all households. The communities identified, have an increased water demand due to lack of modernised water infrastructure. However, due to increased population and insufficient funds, it was stated that the government is unable to satisfy the increased demand for water to the rural residents of Lesotho. In addition, all the communities at rural settlements use old hand pumps that are even in no operation.

The interviews also sought to ascertain what appropriate measures should be undertaken to assess the water shortages in these communities and strategic plans put in place to improve on the prevailing water supply situation. It was explained that, grants have been requested from donors regarding water infrastructure for provision of improved water services, because even the health services are badly affected due to lack of water supply infrastructure at rural settings of Lesotho. Therefore, in response to the existing situation of water supply, the department distributes the water to the communities through mobile water tanks during drought. The existing water related legislation which is explained to be outdated, was assured to be reviewed, and also gradually increasing communities' obligations to pay for their water supply services. Finally, the department pledged to connect treated water which will be available for 24 hours daily to every household so that WASCO starts collecting monthly water bills.

3.5 SURVEY DESIGN AND DEVELOPMENT

After the sample size has been determined, the focus group discussions and several pre-tests were conducted prior designing and implementing the final CV survey instrument for the study. The survey instrument used was a structured questionnaire. In order to produce good quality and policy-relevant results from the CV survey, the study followed suggestions from the NOAA Panel in which it was stated that if the guidelines are more closely and properly followed, the study will yield results that are more valid (Arrow *et al*., 1993).

The CV section, which incorporated the essence of the CV survey, and the CV scenario was deliberately described. The scenario in the final survey instrument for the valuation depicted the hypothetical scenario and the status quo (prevailing situation of the water supply services), detailing the existing situation of the water supply services of the specified Lesotho rural regions, while also explaining in detail the services to be provided. The scenario described how the services are to be financed, which was based on how the billing issue would be implemented; the institutional situation in which the proposed service would be provided; and further explained how the water supply service condition would be improved after employment of the billing. In explaining the CV scenario, the respondents were presented with three pictures. The first picture illustrated the current situation of the water supply services, while the other two demonstrated the proffered scenario. The objective behind these pictures was to ensure that respondents were genuinely familiar with the scenario presented before posing the questions to them regarding their WTP.

In consideration of the fact that the study employed a single-bound referendum choice to examine individuals' WTP, single-bound referendum questions were devised for this study. The respondents had to specify their WTP only once in order to receive an enhanced quality service for the environmental good in consideration. In this approach, a respondent was given a single bid amount and was anticipated to respond with either "yes" or "no" options, only once. The respondent was expected to reply with a "yes" preference if the bid amount was less than his/her WTP, and with a "no" preference if the bid amount was higher than his/her WTP. This is consistent with the view of Arrow *et al*. (1993) that there is no reason for an individual to respond with "Yes" if he/she is unwilling to pay a certain amount, and there is also no reason for an individual to reply with "No" if he/she votes for the project as far as it is concerned.

The respondents were asked about their degree of certainty to the referendum question and to state their reasons to vote for or against the proposed project, based on their responses to the dichotomous choice questions. Such certainty and reasons were further used to single out the unreliable responses from the WTP responses which were then excluded from the regression analysis. Therefore, it can be accepted that the respondents considered the CV scenario diligently if the test results demonstrated contrasting responses (Whittington, 2002).

Several pre-tests were conducted after the survey instrument was developed. During implementation of the pre-tests, the survey instrument was tested in actual, convenient locations. A total of 100 respondents for all conducted pre-tests were randomly selected, and in-depth interviews were conducted, one-on-one. The data obtained from the pre-test findings was further analysed in order to improve on the final questionnaire. Thus, the questionnaire was conscientiously amended in consequence of the findings of the administered tests.

3.6 IMPLEMENTATION OF THE SURVEY

The survey was implemented using an interviewer-administered survey instrument, face-to-face with each respondent. Household interviews were guided by four enumerators. The interviews were held with the heads of the households, as suggested by the NOAA panel, which advises that interviews should not be postal or telephonic, but rather have to be face-to-face, and furthermore should be pre-tested. This is consistent with the view of Hoyos and Mariel (2010) that although in-person interviews are costly, they are more flexible and reliable. The individuals were requested to reveal their WTP for an improvement in the good in question by contributing funds for improving the water supply services. This is done because it is not known at that stage how much value individuals attach to the improvement of water supply

services. Accordingly, a CV approach was employed to solicit the value that the respondents put on goods and services without a market, and also to obtain the value for that good on the hypothetical market. This was done during survey implementation by using a WTP format for the satisfaction of their improved demand for the quality of the said good.

To ensure the veracity of the information received concerning the utilisation of their water, the individual respondents were chosen from the household heads or people who have information about the water usage in their homes. Respondents were presented with clear information concerning the research project, and given an option to choose whether to participate in the study or not by providing their informed consent. This was performed to validate the information given by them before any question was posed to them. Furthermore, enumerators were trained prior to commencement of the survey implementation. This view is in accordance with the advice of Whittington (2002) that enumerator training is of paramount importance in the sense that enumerators should acquire the relevant skills to conduct in-person interviews of high quality and trustworthiness, and so ensure that they master the contingent scenario and objectives of the study very well.

The enumerators were also supervised by the researcher in order to obtain high quality CV survey results. This was done by daily reviewing each completed questionnaire to check if there were any typographical errors. Moreover, this was performed to evaluate the quality of the enumerators' performance and ensure that they were indeed performing their regularly assigned tasks properly. The survey questionnaire incorporated a section where enumerators had to write their full details to allow for a check to be made for each enumerator's bias. The study was directed at the heads of the households, and this was given as an instruction to the enumerators. However, where the heads were not present, their spouses or any available individual above 18 years old were to be interviewed. Individual enumerators were each conducting 5 interviews daily, with a general duration of 30 minutes per interview. The reasoning questions were engaged in to evaluate the legitimacy and authenticity of the responses given by the interviewees. The survey also catered for debriefing questions which assisted the interviewers to examine if responses by the respondents were consistent and that respondents clearly understood the questions, and also to assess the reliability of the responses that were given. It was revealed by the results that most of the respondents clearly understood the survey questions and their responses proved to be absolutely credible.

3.7 THE USE OF SINGLE-BOUNDED DICHOTOMOUS CHOICE VERSUS DOUBLE-BOUNDED DICHOTOMOUS CHOICE

During single bound dichotomous method survey implementation, the researcher informs the respondent that the change in the improvement of the service of the good will cost him or her a certain amount of money and he or she is then asked to state if he or she would be in favour of it at that given price. It must be noted that the price for such a service is given only once in this format. The respondent will respond with a "yes" preference if he or she is in favour of that price, or otherwise if he or she is not in favour of that price. In the double bound dichotomous choice survey implementation, (Hanemann *et al*. 1991 and Leon, 1995) respondents are confronted with a two sequence bid offer. In the first instance, they are asked to state if they would accept or reject the first bid amount, then they are offered a second bid. It must be noted that, the second bid amount is contingent upon the response to the first bid amount. This means that the second bid may be higher if the respondents responded in favour of the first bid, while it will be lower if they responded against the first bid.

As opposed to double-bound dichotomous choice, single bound approach has been a popularly practised technique among the experts of contingent valuation. This is because the single bound method presents attractive features in relation to double bound format in that, it requires less information, can avoid regular bias in responses that are due to the introduction of the follow-up, and it is easier to implement at estimation and data collection stages (Tapsuwan, 2011).

In contrast, it is popularly known that the single bound is statistically less efficient than the double bound estimator. Hence, it is curious to compare their behaviour in terms of ML estimates bias produced by either model, and to analyse the efficiency gain allied to the double bound model, in different experimental settings. The two models give no significant differences in point estimates, even for small sample size, so that no estimator can be considered to have less efficiency than the other. Although the greater efficiency of the double bound is noted, it can be realized that the differences have a tendency to be lower by increasing the sample size, and are frequently insignificant for medium sample sizes. On condition that the sample size is large, and several reliable pre-tests are conducted as is the case with this study, the results warrant an utilisation of the single bound instead of double bound method (Calia & Strazzera, 2006).

3.8 DATA ANALYSIS

The study utilised binary response models in order to evaluate whether the respondents are willing to pay from the survey sampled data. The probit model was estimated for the sampled data using the STATA statistical software package, utilising the probit Stata command. The purpose of estimating this model is that it allows for the incorporation of people's demographic factors into the WTP functions and helps in gaining an understanding of how the WTP reflected in individual characteristics allows a researcher to gain more information on the legitimacy and consistency of the CV technique. However, this depends on the number of covariates used to estimate the model. The probit model basically estimates the probability of a set level of WTP as a function of covariates. Following Carson (2012), the probit model used on the CV survey response is estimated mainly to obtain a mean WTP estimate.

3.9 VARIABLE DESCRIPTION

This section focuses on the narrative of the key variables employed for the analysis. The survey questionnaire also catered for the collection of information concerning the demographic characteristics of the households, which comprised the major variables used in the analysis. The households' conceptions, knowledge and attitudes are also examined in this section by applying descriptive statistics. It is also indicated that most of the independent variables were used as categorical variables, and these are illustrated in the table below. The table 3.1 gives a summary of the variables used in the study. The explanatory variables utilised are binary, meaning they are either one or zero.

Table 3.1 Description and summary of statistics for the covariates

Variables	Mean	Min	Max
Gender			
1= male, 0= female	0.56	0	1
Monthly Income			
1=less than M500, 0 otherwise	0.01	0	1
1=M500-M2000, 0 otherwise	0.23	0	1
1=M2000-M5000, 0 otherwise	0.34	0	1
1=above M5000, 0 otherwise	0.42	0	1
Age	44.25	26	77

Educational level			
1=no schooling, 0 otherwise	0.11	0	1
1=primary, 0 otherwise	0.16	0	1
1=high school, 0 otherwise	0.37	0	1
1=vocational, 0 otherwise	0.13	0	1
1=tertiary, 0 otherwise	0.23	0	1
Household size	4.55	2	8
Marital status			
1=married, 0 otherwise	0.54	0	1
1=unmarried, 0 otherwise	0.14	0	1
1=divorced/separated, 0 otherwise	0.12	0	1
1=widowed	0.19	0	1
Employment status			
1=formal employment, 0 otherwise	0.50	0	1
1=informal/self-employed, 0 otherwise	0.38	0	1
1=unemployed/pension, 0 otherwise	0.13	0	1
Relation to household head			
1=head, 0 otherwise	0.56	0	1
1=spouse of the head, 0 otherwise	0.44	0	1
Water quality from the alternative source	2.24	1	5
Current water supply quality from the main source	4.10	1	5
Health and economic consequences due to uncleansed and water scarcity	1.21	1	3
Accurate description of the status of water supply in this community	1.56	1	3
Shortage of water due to insufficient water equipment	1.55	1	3

Source: Own construct

3.10 SOCIO-ECONOMIC AND DEMOGRAPHIC CHARACTERISTICS OF HOUSEHOLDS

The table 3.2 displays the results of the analysis of the demographic characteristics for the sampled data. It is affirmed that 49% of the interviewed respondents pay a monthly water charge, while about 51% of the interviewed households do not pay water bills for their main water source points. However, many of them were paying for water from their alternative sources. The findings also indicated that about 29% of interviewed household heads were 51 years old and above, while about 71% of the interviewed individuals were between 18 and 50 years of age. The results further indicated that the households were characterised by large household sizes, indicated by 57% of the respondents with a household size of 5 people or more, while only 43% of the households have less than 5 persons per family. This is consistent with the WASCO Report (2016), in which the household sizes in the rural areas were found to be higher than in the urban areas, and in which is estimated that a household in the rural regions of Lesotho comprises 4.8 persons, on average.

The study targeted household heads as respondents, and the distribution of gender among the interviewees reflects a nearly equal representation of male and females, with about 56% being headed by males, while roughly 44% are headed by females. Based on these statistics, approximately 54% of household heads are married. The results also show that only about 23% of the respondents have received a tertiary education. An estimated 56% of the respondents stated that they are formally employed, whereas almost 36% of the respondents specified that they are either informally employed or self-employed. The findings of this study also show that nearly 43% of the respondents earn more than M5000 in a month.

Table 3.2: Demographic and socio-economic characteristics of respondents

Variable	Households with water charge	Households without water charge	Total
Gender			
Male	31(59.6%)	28(51.9%)	59(55.7%)
Female	21(40.4%)	26(48.1%)	47(44.3%)
Age			
18-50 years	36(69.2%)	39(72.2%)	75(70.8%)
51 years and above	16(30.8%)	15(27.8%)	31(29.2%)
Household size			
Less than 5 people	27(51.9%)	19(35.2%)	46(43.4%)
5 people and above	25(48.1%)	35(64.8%)	60(56.6%)
Marital status			
Married	29(55.8%)	28(53.8%)	57(53.8%)
Single	7(13.5%)	8(14.8%)	15(14.2%))
Divorced/separated	8(15.4%)	6(11.1%)	14(13.2%)
Widowed	8(15.4%)	12(22.2%)	20(18.9%)
Relation to household head			
Head	31(59.6%)	29(53.7%)	60(56.6%)
Spouse of the head	11(21.2%)	11(20.4%)	22(20.8%)
Other	10(19.2%)	14(25.9%)	24(22.6%)
Educational level			
None	6(11.5%)	6(11.1%)	12(11.3%)
Primary	9(17.3%)	8(14.8%)	17(16.0%)
High school	16(30.8%)	23(42.6%)	39(36.8%)
Vocational	7(13.5%)	7(13.0%)	14(13.2%)
Tertiary	14(26.9%)	10(18.5%)	24(22.6%)
Employment status			
Formal employment	31(59.6%)	28(51.9%)	59(55.7%)

Informal/self-employed	16(30.8%)	22(40.7%)	38(35.8%)
Unemployed/pension	5(9.6%)	4(7.4%)	9(8.5%)
Monthly income			
0-M500	0(0%)	1(1.85%)	1(0.94%)
M500-M2000	13(23.1%)	11(20.4%)	24(22.6%)
M2000-M5000	16(30.8%)	20(37.0%)	36(34.0%)
Above M5000	23(44.2%)	22(40.7%)	45(42.5%)

Source: own construct

3.11 EMPIRICAL MODELS USED FOR THE ANALYSIS

The analysis of variance (ANOVA) and Chi-square ($\chi 2$) test models were utilised in the study to verify the prospective effect of the socio-economic variables of age, education, income and gender regarding the perceptions, attitudes and knowledge of the respondents towards an enhanced water quality supply services in the Qiloane rural community settlements of Lesotho. Furthermore, for an economic evaluation, the study utilised the probit model to determine the WTP of respondents for the single bound referendum data. Therefore, STATA statistical software version 12 was employed to obtain the outputs of Chi-square, one-way ANOVA and Probit model.

3.11.1 One-way ANOVA test model

The study used a One-way ANOVA in order to authenticate the potential impact of socio-economic variables on the perceptions, knowledge and attitudes of the households concerning an enhancement of water quality supply services in the Qiloane rural settlements of Lesotho. This model was performed in the study due to a random assignment and equality of variance assumptions that reinforce this method. The STATA software has a routine that inherently runs the equal variances (Chi-square test), and this is indicated by Bartlett's test of equal variance that is inherently in STATA, an automatic test in One-way ANOVA model that demonstrates its outcomes in an arrangement of Chi-square and its probability.

3.11.1.1 Specification of One-way ANOVA model

The One-way ANOVA uses an F-distribution, which is an extension of t-distribution in order to determine the relationship of the two variables.

3.11.2 Chi-Square model test

The Chi-square test was also utilised in the study in order to validate the prospective impact of categorical data of socio-economic variables on the perceptions, attitudes, knowledge, and the current situation of water quality supply service of the households towards an enhancement of water quality supply services in the Qiloane rural settlements of Lesotho, and households' willingness to use recycled or reclaimed water. The Chi-square allows a comparison of observed and expected occurrences empirically, because it is impossible to convey by mere eyeing at them if they are dissimilar enough to be deliberated statistically significant or not. The ordinal variables that were used were in the form of a Likert scale like a 3-point scale, 4-point scale, 5-point scale, 6-point scale and 7-point scale respectively. Hence, these variables seemed to be accurate for this method because they were in the form a Likert 5-point scale.

3.11.2.1 Specification of Chi- Square test model

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

where;

χ^2 = Chi-Square statistics

3.11.3 Link test

The link test was also applied in the study to detect if there was any misspecification of the estimated probit model and validate if the model was appropriately determined. Once the probit model had been run, the *linktest, nolog* command from Stata was regressed immediately in order to rebuild the model if it had a specification error. In order to test and rebuild the model, the test employs predictors known as linear predicted value (_hat) and linear predicted value squared (_hatsq). Therefore, the _hat predictor has to be significant, but it is otherwise if there is a misspecification of the estimated probit model. However, if Probit is accurately estimated, the _hatsq predictor will be insignificant, because if it is significant, the linktest will be significant as well implying that there might be an omission of important variables in the model, or link function is incorrectly stated.

3.11.4 Probit regression model

The two functions of the probit models stated below were employed for the analysis of the single bound dichotomous choice data in this study. This was performed in order to authenticate the WTP of the respondents for an enhancement of the water quality supply services in the Qiloane rural settlements of Lesotho.

3.11.4.1 Specification of the probit model for the respondents' WTP the monthly water tariff to improve on the water supply services

The WTP was observed endogenously as a function of the explanatory variables from the estimated model as stated:

Thus:$WTP_i = \beta_0 + \beta_1 INC_i + \beta_2 GEN_i + \beta_3 AGE_i + \beta_4 EDUC_{1i} + \beta_5 EDUC_{2i} + \beta_6 EDUC_{3i} + \beta_7 EDUC_{4i} + \beta_8 MSTUS_{1i} + \beta_9 MSTUS_{2i} + \beta_{10} MSTUS_{3i} + \beta_{11} HHSIZE_i + \beta_{12} RHH_i + \beta_{13} EMPLY_{1i} + \beta_{14} EMPLY_{2i} + \beta_{15} EMPLY_{3i} + \beta_{16} EMPLY_{4i} + \beta_{17} EMPLY_{5i} + \beta_{18} WQLTYALT_i + \beta_{19} CRRNTQLTY_i + \varepsilon_i$

where

WTP_i = Willingness of Qiloane rural regions residents to pay for water supply services

β_0 = Intercept

β_{1-19}= Coefficients of the variables

ε_i = Error term for unexplained or unobserved factors

INC_i (Income of the household), GEN_i (Household's gender), AGE (Age of the household), EDUCs ($EDUC_1$: Primary education, $EDUC_2$: high school education, $EDUC_3$: vocational and $EDUC_4$: tertiary education), MSTUSs ($MSTUS_1$: Married households, $MSTUS_2$: unmarried households and $MSTUS_3$: divorced or widowed households), RHHs (Relationship to Household Head): Whether a household is a head, spouse to the head, or any other relative to the head), HHSIZE (The number of family members for the household), EMPLYs ($EMPLY_1$: Commercial farmer, $EMPLY_2$: subsistence famer, $EMPLY_3$: civil servant employee, $EMPLY_4$: private sector employee and $EMPLY_5$: self-employed household), WQLTYALT (Water quality from the alternative source), and CRRNTQLTY (Current water supply quality from the household's main source points).

3.11.4.2 Specification of the probit model for the respondents' WTP for an installation of water infrastructure

$$WTP_i = \beta_0 + \beta_1 INC_i + \beta_2 GEN_i + \beta_3 AGE_i + \beta_4 EDUC_{1i} + \beta_5 EDUC_{2i} + \beta_6 EDUC_{3i} + \beta_7 MSTUS_{1i} + \beta_8 MSTUS_{2i} + \beta_9 MSTUS_{3i} + \beta_{10} HHSIZE_i + \beta_{11} EMPLY_{1i} + \beta_{12} EMPLY_{2i} + \beta_{13} EMPLY_{3i} + \beta_{14} EMPLY_{4i} + \beta_{15} HEWSCTY_i + \beta_{16} ACCWDES_i + \beta_{17} WSHEQUIP_i + \varepsilon_i$$

where:

WTP_i= Willingness of Qiloane rural residents to pay for the installation of water infrastructure

β_0= Intercept

β_{1-17} = Coefficients of the variables

ε_i= Error term

HEWSCTY = Health and economic consequences due to uncleansed and water scarcity, **ACCWDES** = Accurate description of the status of water supply in the community, **WSHEQUIP** = Shortage of water due to insufficient water equipment

3.12 CONCLUDING SUMMARY

This section discussed and outlined the methodological approach that was adopted in this study. Qiloane is a rural-based community located in the middle veld region of Lesotho, a tourist area of the Basotho nation which is famously known as Thaba-Bosiu. Purposive sampling and simple random sampling techniques were employed in this study, and this was achieved through a sample of 120 respondents being individually interviewed using a structured questionnaire. The data were coded in Microsoft Excel, cleaned and analysed in STATA statistical data analysis software version 12. The study also employed ANOVA model, chi-square model, and probit model for econometric analysis.

4 CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 INTRODUCTION

This chapter presents the analysis of the results and a discussion of the study, which is organised into four sections. Section 4.2 presents the results for the knowledge, perceptions and attitudes of the households in relation to their water supply service within their locations; section 4.3 demonstrates the households' assessments of their current water quality supply service; and household willingness to use reclaimed water is presented in section 4.4. Lastly, the summary of the results and discussion are presented in section 4.5.

4.2 HOUSEHOLDS' KNOWLEDGE, AWARENESS AND ATTITUDES CONCERNING THE WATER QUALITY SUPPLY IN THE QILOANE RURAL REGIONS OF LESOTHO

The first section endeavoured to evaluate households' knowledge, perceptions and attitudes concerning the quality of the water supply in the Qiloane rural locations of Lesotho. The questions based on knowledge were asked to assess the respondents' levels of knowledge pertaining to the water supply situation within the specified regions. This was performed in order to ensure that the residents did indeed know about the state of the quality of their water supply situation and the associated threats that they are confronted with which are attributable to the type of water they consume. This part is also far-reaching in assessing whether the scope of knowledge has an influence on the WTP of households. The section also includes questions on the perceptions and attitudes of the households in order to examine the respondents' attitudes and perceptions towards the advancement of their water quality which it is presumed would have a positive impact on their WTP for improved water quality.

4.2.1 Households' perceptions concerning water quality supply in the Qiloane rural locations of Lesotho

The purpose of this section is to determine the respondents' impressions regarding the quality of the water they receive in the Qiloane rural locations in Lesotho. The households were given the following statements to determine their viewpoints pertaining to improved quality water supply services to households in the rural regions of Qiloane locations, Lesotho: (1) In your

opinion, does untreated water provide nutrients needed for crop production; (2) In your opinion, is untreated water (Untreated water means drinking the water that has not been chemically treated, boiled, or filtered to eliminate infectious parasites, bacteria, and viruses) frequently available at all times whenever people need to use it; (3) In your point of view, does untreated water have no health risk effects; (4) In your view, does untreated water ensure high yields of the crops grown; and, (5) In your point of view, is it less costly to use untreated water. The variables set out in Table 4.1 below are those that are employed in Table 4.2 that follows thereafter.

Table 4.1: Codes for questions regarding households' perceptions of improved water quality in the Qiloane rural regions of Lesotho

Question (variable)	Question code
In your opinion, does untreated water provide nutrients needed for crop production	**1**
In your opinion, is untreated water frequently available at all times whenever people need to use it	**2**
In your point of view, does untreated water have no health risk effects	**3**
In your view, does untreated water ensure high yields of the crops grown	**4**
In your point of view, is it less costly to use untreated water	**5**

Respondents were then asked to select a range of approval statements based on their best opinions regarding the specified statements below, which are then used to evaluate their views concerning the water quality improvement. These were established on a five-point Likert scale, in which 1 indicates "strongly agree", 2 "agree", 3 "neutral/not sure", 4 "disagree", and 5 "strongly disagree". Table 4.2 presents the analysis of the results.

Table 4.2: Households' perceptions concerning water quality supply in the Qiloane rural locations of Lesotho

Variable	Split sample	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Untreated water is a good source of nutrients needed for crop production	Households with water charge	14(26.9%)	20(38.5%)	8(15.4%)	3(5.8%)	7(13.5%)
	Households without water charge	19(35.2%)	27(50%)	5(9.3%)	1(1.9%)	2(3.7%)
	Total	33(31.1%)	47(44.35)	13(12.3%)	4(3.8%)	9(8.5%)
Untreated water is the most readily available water at all times	Households with water charge	10(19.2%)	16(30.8%)	1(1.9%)	9(17.3%)	16(30.8%)
	Households without water charge	8(14.8%)	5(9.3%)	2(3.7%)	13(24.1%)	26(48.1%)
	Total	18(17.0%)	21(19.8%)	3(2.8%)	22(20.8%)	42(39.6%)
Untreated water has no health risk effects	Households with water charge	4(7.7%)	3(5.8%)	4(7.7%)	14(26.9%)	27(51.9%)
	Households without water charge	6(11.1%)	3(5.6%)	1(1.9%)	7(13.0%)	37(68.5%)
	Total	10(9.4%)	6(5.7%)	5(4.7%)	21(19.8%)	64(60.4%)
Untreated water ensures high yields of the crops grown	Households with water charge	6(11.5%)	7(13.5%)	23(44.2%)	9(17.3%)	7(13.5%)
	Households without water charge	7(13.0%)	13(24.1%)	19(35.2%)	1(1.9%)	14(25.9%)
	Total	13(12.3%)	20(18.9%)	42(39.6%)	10(9.4%)	21(19.8%)
Untreated water is less costly	Households with water charge	28(53.8%)	15(28.8%)	6(11.5%)	1(1.9%)	2(3.8%)
	Households without water charge	32(59.3%)	14(25.9%)	4(7.4%)	0(0.0%)	4(7.4%)
	Total	60(56.6%)	29(27.4%)	10(9.4%)	1(0.94%)	6(5.7%)

Source: Own construct

Note: The percentages are shown inside the brackets, while the frequencies are shown outside the brackets.

Based on the statistical results derived from Table 4.2, the study ascertained that the respondents have positive perceptions when positive questions were posed to them, but negative opinions when they were asked negative questions pertaining to the situation of the water they use in their localities. The results revealed that many respondents have positive perceptions concerning an enhancement in the quality of the water supply in the Qiloane rural locations (Motloheloa, Mothae and Lesoiti) of Lesotho. Both positive and negative questions were posed to respondents in order to confirm if they had a precise perception concerning the prevailing quality of the water supply.

It is indicated in Table 4.2 that when respondents were asked negative questions regarding the present water quality, most of them displayed strong disagreement with such questions, while the opposite was true for the positive questions, which implies that the majority of the respondents have optimistic opinions on an improved water quality supply to households. As a further exploration on the robustness of the sample results, Chi-square (χ^2) and Analysis of variance (ANOVA) methods were employed to validate the prospective effect of socio-economic variables on the variables that are utilised to assess respondents' perceptions about the betterment of the water supply services in the Qiloane locations. Table 4.3 presents the χ^2 test results, with their p-values inside the brackets.

Table 4.3: Influence of age, gender, education, employment and income on respondents' perceptions regarding the water quality supply in the Qiloane rural regions of Lesotho

Variable	Age	Gender	Education	Employment	Income
In your opinion, does untreated water provide nutrients needed for crop production	0.3444 (0.300)	0.7897 (0.374)	6.3274 (0.176)	21.6677 (0.003)***	5.1533 (0.076)*
In your opinion, is untreated water frequently available at all times whenever people need to use it	0.7904 (0.997)	0.0865 (0.769)	1.5708 (0.814)	3.4134 (0.844)	0.2911 (0.865)

In your point of view, does untreated water have no health risk effects	0.9482 (0.903)	0.7561 (0.385)	2.0358 (0.729)	10.4085 (0.167)	2.4050 (0.300)
In your view, does untreated water ensure high yields of the crops grown	0.0353 (0.533)	1.1104 (0.292)	1.0262 (0.906)	6.7503 (0.455)	2.2167 (0.330)
In your point of view, is it less costly to use untreated water	0.9700 (0.176)	3.3765 (0.066)*	30.0358 (0.000)***	19.7293 (0.006)***	9.9297 (0.007)***

Source: Author's elaboration

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

The results depicted in the Table 4.3 indicate that gender, education, employment and income have an effect on the perceptions of respondents regarding the quality of the water supply to households in the Qiloane rural regions of Lesotho, with age as an exception. Gender has a statistical significance level of 10 percent, for positively shaping the perceptions of respondents regarding the improved quality of a water supply service to households for the question: "In your point of view, is it less costly to use untreated water". It can be said that females are more likely to recognise the conditions of the water they use by virtue of the fact that most of the household chores relating to water usage, such as cooking, are heavily reliant on females. Therefore, if the cost of the water could be upgraded, it is conceivable that the existing quality of the water could be improved for further improved welfare of the society.

Education positively influenced the respondents' impressions when they were asked if, according to their opinions, the water used in their households was accessed at lower costs in the rural areas of Lesotho. This relationship was found to be at the 1 percent level of significance. This suggests that the more educated an individual becomes, the higher the probability will be that such person has greater knowledge on how low costs of water can affect the quality of water, which ultimately affects health and welfare negatively, thus influencing households' viewpoints concerning improved quality of household water supply. However, those with lower levels of education, or who are absolutely unschooled, might be satisfied with the current costs of the water, and/or even demand that the water be made freely obtainable as it is a natural resource supplied by the environment from God, although they might not take consideration of the unfavourable consequences that may be experienced.

The employment variable has a statistical significance level of 1 percent in influencing the respondents' perceptions towards an improved quality of household water supply in respect of the question that asked if the uncleansed water was significant in providing nutrients needed for crop production. This implies that the individuals who are formally employed, as indicated by the higher number of formally employed persons in the demographic data, are more likely to regard uncleansed water as highly suitable for crop production, but not for human consumption purposes.

Income influenced the opinions of the respondents when they were asked if the uncleansed water is significant in providing nutrients needed for crop production in the rural areas of Lesotho. This reveals that households with higher incomes are more likely to have knowledge about irrigation for improved crop production, and the relationship was statistically significant at 10 percent. Moreover, income was statistically significant at 1 percent in influencing respondents' opinions on the question of whether the water used within their households was accessed at lower costs or not. Pertaining to the results attained, this suggests that most households with higher incomes are likely to know more about the existing cost of the water, based on their incomes. Therefore, this renders them more considerate with respect to the consequences encountered.

Age appeared to possess a positive sign, as expected, although it was statistically insignificant in influencing respondents' opinions about enhanced quality water supply services. The implication is that respondents' perceptions are not aligned with their ages, that is, the opinions of a respondent does not depend on how old or young the respondent is, but rather depend on his or her individual preferences towards an improved quality of household water supply service within his or her location.

4.2.2 Respondents' attitudes with regard to the quality of the water supply in the Qiloane rural locations of Lesotho

The purpose of this section is to determine the respondents' attitudes concerning the quality of the water supply in the rural areas of Lesotho. It is important to determine the households' attitudes because they reflect the impact of having and improved quality water supply, and hence respondents should show their WTP for that. Accordingly, the respondents were provided with the following concerns in order for them to disclose their attitudes towards an improved quality household water supply in the rural areas of Lesotho: Leaving the water to settle and careful collection; Promotion of health training for households, e.g. generating

consciousness, and sanitation education; Protection of rural water sources for consumption purposes against pathogens (pathogens are defined as disease-producing microorganisms, such as bacteria, fungi, and viruses, found in sewerage and run-off water); Boiling the water before being consumed; and Filtration of the water before discharging it for human consumption purposes.

The questions posed to respondents were presented using a five-point Likert scale in which 1 indicates “strongly agree”; 2 “agree”; 3 “neutral/ not sure”; 4 “disagree”; and 5 “strongly disagree”. These were based on the levels of their agreement with the statements which were used to evaluate their attitudes concerning improved water quality supply. Table 4.4 depicts the results of the analysis.

Table 4.4: Respondents' attitudes regarding the water quality supply in the Qiloane rural regions of Lesotho

Variable	Split sample	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Leaving the water to settle and careful collection	Households with water charge	14(26.9%)	20(38.5%)	1(1.9%)	13(25.0%)	22(42.3%)
	Households without water charge	8(14.8%)	27(50%)	0(.0%)	9(17.3%)	37(68.5%)
	Total	22(20.8%)	47(44.35)	1(0.94%)	22(20.8%)	59(55.7%)
Promotion of health trainings for households, e.g. generating consciousness, sanitation education, etc.	Households with water charge	0(0.0%)	2(3.8%)	2(3.8%)	12(23.1%)	36(69.2%)
	Households without water charge	1(1.9%)	0(0.0%)	0(0.0%)	7(13.0%)	46(85.2%)
	Total	1(0.94)	2(1.9)	2(1.9%)	19(17.9%)	82(77.4%)
Protection of rural water sources for consumption purposes against pathogens (Pathogens are defined as diseases producing microorganisms such as bacteria, fungi, and virus found on sewerage, run-off water)	Households with water charge	0(0.0%)	0(0.0%)	7(13.5%)	17(32.7%)	28(53.8%)
	Households without water charge	1(1.9%)	0(0.0%)	6(11.1%)	15(27.8%)	32(59.3%)
	Total	1(0.94%)	0(0.0%)	13(12.3%)	32(30.2%)	60(56.6%)
Boiling the water before being consumed	Households with water charge	6(11.5%)	0(0.0%)	0(0.0%)	12(23.1%)	34(65.4%)
	Households without water charge	7(13.0%)	0(0.0%)	0(0.0%)	14(25.9%)	33(61.1%)
	Total	13(12.3%)	0(0.0%)	0(0.0%)	26(24.5%)	67(63.2%)
Filtration of the water before discharge for human consumption purposes	Households with water charge	0(0.0%)	0(0.0%)	0(0.0%)	15(28.8%)	37(71.2%)
	Households without water charge	0(0.0%)	0(0.0%)	0(0.0%)	16(29.6%)	38(70.4%)
	Total	0(0.0%)	0(0.0%)	0(0.0%)	31(29.2%)	75(70.8%)

Source: Author's elaboration

Note: The percentages are shown inside the brackets, while the frequencies are shown outside the brackets.

According to the statistical results depicted in the Table 4.4, the conclusion drawn is that most respondents displayed negative attitudes regarding the conditions of the water they consume. In determining the respondents' attitudes concerning an enhancement of the water supply services, respondents were given positive questions relating to improvements to the prevailing water supply situation. However, it was anticipated that if households had positive attitudes, most of them would strongly agree or agree when a positive question was posed, or exhibit a strong disagreement or disagreement preference when a negative question was asked.

Nonetheless, the results revealed that when respondents were asked positive questions, most of them chose strongly disagree or disagree preferences, implying that they had negative attitudes pertaining to the existing water quality supply situation. Therefore, it is not surprising to have such results because the study was conducted in rural settlements where a high illiteracy rate exists among the households, indicating that the majority of households are not aware of water quality improvement practices. This is in agreement with Turpie *et al*. (1999) who argued that household members with formal education have more information on water quality supply services than those without formal education do. This implies that those household members who have received formal education would have greater awareness regarding the prevailing situation of the water supply quality, and the opposite is true for those without formal education. Hence, it is possible for them to adopt necessary measures for safe water drinking.

As a further investigation of the robustness of the results, χ^2 was employed to establish the potential relationship of socio-economic variables with the variables used in determining the attitudes of respondents concerning an improved quality water supply in Qiloane rural settlements of Lesotho. Table 4.5 presents the χ^2 test results, together with the p-values shown in the brackets.

Table 4.5: Effects of age, gender, education, employment and income on respondents' attitudes about the water quality supply in Lesotho rural areas

variable	Age	Gender	Education	Employment	Income
Leaving the water to settle and careful collection	0.1844 (0.175)	0.4149 (0.520)	3.9587 (0.412)	13.9514 (0.052)*	0.8808 (0.644)
Promotion of health trainings for households,	0.7326 (0.186)	24.7981 (0.000)***	9.0417 (0.060)*	24.1701 (0.000)***	0.7941 (0.672)

e.g. generating consciousness, sanitation education, etc.					
Protection of rural water sources for consumption purposes against pathogens (Pathogens are defined as diseases producing microorganisms such as bacteria, fungi, and virus found on sewerage, run-off water)	0.7490 (0.818)	1.1745 (0.278)	14.9266 (0.005)***	13.4973 (0.061)*	8.5939 (0.014)**
Boiling the water before being consumed	0.2805 (0.029)**	0.9404 (0.332)	34.7162 (0.000)***	21.6727 (0.001)***	1.0741 (0.584)
Filtration of the water before discharge for human consumption purposes	0.8678 (1.000)	0.1254 (0.723)	1.6368 (0.802)	0.7949 (0.997)	0.6963 (0.706)

Source: Own construct
*Note: *, **, and **** indicate statistical level of significance at 10%, 5% and 1%, respectively

The results in the Table 4.5 indicate that almost all socio-economic variables have an impact on some of the questions that were used to explain households' attitudes concerning an improved quality water supply in the rural regions of Lesotho.

Age does not seem to have an impact on most of the questions that were used to capture households' attitudes concerning improved quality water supply, except for one question, "The water in my household is boiled before being consumed". The relationship was statistically significant at the 5 percent level. The implication is that most of the younger generation (those below the age of 50 years) from the interviewed households are more likely to express a more affirmative attitude relevant to the water quality supply than the older individuals (those aged above 50) would. This is because this age group is assumed to represent those who frequently use water for domestic purposes, such as cooking and drinking, and thus they are aware of and

have realised the dangers inherent in consuming water without it first being boiled, whereas the older individuals are associated with a shorter planning horizon, more specifically in regard to water treatment practices. Respondents were asked why they were not treating the water, and they revealed that they are unaware that the water has to be purified before consumed. Therefore, they suffered from incidences of diarrhoea and stomach-ache that were confirmed by doctors to be caused by the water they consume. Therefore, this is an indication that older people in the rural areas generally have no information related to the consequences of using water that is uncleansed, as most of them claimed that they were used to it, since they had used such water from the time they born, many years ago.

Likewise, gender seems to have no influence on most of the questions that were used to capture households' attitudes relating to an improved quality water supply, except for the question of "Promotion of health programs for households, e.g. creating awareness, hygiene education, etc." This relationship has a statistical significance level of 1 percent. This means that females are more likely to have a positive attitude regarding an improved quality household water supply. Normally, women are responsible for family house chores, such as cooking and cleaning, which means that they regularly use the water for family matters, and thus they are aware of the uncleanliness or contamination of the water before it is consumed.

Education was statistically significant in influencing households' attitudes on an improved quality water supply in regard to three questions: "Protection of rural water sources for consumption purposes against pathogens (pathogens are defined as disease-producing microorganisms, such as bacteria, fungi, and viruses, found in sewerage and run-off water)"; "Promotion of health programs for households, e.g. creating awareness, hygiene education, etc."; and "Boiling the water before being consumed". As expected, the more educated an individual is, the higher the likelihood will be that such individual might have a positive attitude on households' improved quality water supply, since an educated person would have relevant information and the awareness that negative consequences result when individuals do not consider it important to have knowledge, be well equipped and to receive training pertaining to the water supply issues concerning the water they use in their homes. This relationship is statistically significant, at 10 percent, for this variable.

Additionally, education was found to have a level of significance of 1 percent for the variable designed to capture households' attitudes on an improved quality water supply to households, "Protection of rural water sources for consumption purposes against pathogens". The prior

expectation was that the more an individual is educated, the higher the likelihood will be that such individual will have a positive attitude towards an improved quality water supply. The knowledge that an individual has regarding an improved quality household water supply informs such a person that it is his or her responsibility to participate in safeguarding water sources for human health safety purposes, as it is a problem for public concern. This is because people without a clear understanding about an improved quality water supply might think that this is a responsibility of the government, even when people manage water supply in their areas of residence poorly.

Employment was found to be statistically significant in influencing households' attitudes concerning improved quality water supply on four questions that were used to capture their knowledge on an improved water quality supply to households: "I leave the water to settle and careful collection before being used"; "Promotion of health programs for households, e.g. creating awareness, hygiene education, etc."; "Protection of rural water sources for consumption purposes against pathogens"; "Boiling the water before being consumed"; and "Filtration of the water before discharge for human consumption purposes". This corroborates the expectations that individuals who are employed will display a higher likelihood of having a positive attitude concerning water quality supply. This is because it is assumed that a formally employed individual would possess more information, knowledge and means to avoid the use of uncleansed water because it threatens negative consequences for human health, more especially in the young children, as according to the descriptive statistics results depicted on Table 3.1, a larger number individuals have formal employment (55 percent). This relationship was statistically significant at 10 percent for the first variable, at 1 percent of the subsequent variable, at 10 percent for the third variable, and at 1 percent for the fourth variable, respectively.

Income was found to be statistically significant for the question used to capture the households' attitudes concerning an improved quality water supply: "Protection of rural water sources for consumption purposes against pathogens". This relationship was significant at the 5 percent level. As anticipated, individuals with higher incomes are likely to express positive attitudes towards enhanced water supply services. It suggests that households with higher incomes for this variable have the financial means to afford to pay for the safety precautions against waterborne diseases that are needed for the proper improvement of quality in a household water supply and contribute to the healthy betterment of their lives. This is opposed to their counterparts (those with low-levels of incomes) who might have a negative attitude and believe

that there is not a problem with the kind of water they use, or think that it is a government concern to finance such water supply services.

4.2.3 Respondents' knowledge concerning the quality of water supply in the Qiloane rural locations of Lesotho.

The purpose of this section is to determine respondents' appropriate knowledge regarding improved quality household water supply in the rural regions of Lesotho. In order to determine respondents' WTP for improved quality water supply services for households, the respondents' factual knowledge forms an important basis of their WTP for such services. Before respondents decide if they can pay for water services or not, they need to familiarise themselves with, or understand the obligations in respect of, improved quality household water supply services within their locations.

Respondents were given the following statements, based on the dangers of poorly managed household water supply services: The main source of water for household's domestic use; time taken (minutes) to fetch water from the main source to your household (including time taken for the round trip and queuing); number of daily trips taken to draw water from the main source; people queuing at the main water source on arrival to fetch water; present household amount spent monthly for water usage; alternative source of water; time taken in minutes per one round trip to draw water from the alternative source; the state of existing water quality from the alternative water source; amount spent on 20L from the alternative source; the accurate description of the status of the water supply in this community; the shortage of water experienced is because of poor management and water system maintenance; and the scarcity of water, in addition to huge economic loss, can lead to uncleanliness of the house and food consumed in the household, which has high potential for transmitting germs or pathogens which are the carriers of disease-causing organisms.

Respondents were asked the degree to which they agree or disagree with the subsequent statements by choosing from three options as outlined: "yes" if the statement is correct or they agree with the statement; "no" if the statement is wrong or they disagree with it; and "not sure" if they are uncertain whether the statement is correct or not. Furthermore, the individuals were requested to state whether they agree or disagree with the statements regarding the existing state of water quality from their alternative water sources, selecting from the options of "excellent", "very good", "good or average", "poor", and "very poor". They were also requested to state the extent of their agreement or disagreement by selecting from four options

as outlined for the statement "People queuing at the main water source on arrival to fetch for water": "Yes, always" if the statement is correct or if they agree with the statement that there is a constant queue whenever they have to fetch water from the main source point; "yes, usually" if they agree with the statement that there is frequently a queue whenever they have to fetch water from the main source point; "sometimes" if they agree that the queue at their main source point occurs occasionally; and "not at all" if they agree or disagree that there is no queue experienced whenever they have to fetch water from their main source point. Table 4.6 presents the results regarding this analysis.

Table 4.6: Respondents' knowledge on the prevailing circumstances of their water supply services at Qiloane rural locations of Lesotho

Variable	HHWC	HHWTWC	Total
The main source of water for domestic use of the household:			
Public well	0(0.0%)	41(75.9%)	41(38.7%)
Community standpipe	52(100%)	10(18.5%)	62(58.5%)
On-yard standpipe	0(0.0%)	3(5.6%)	3(2.8%)
Time taken in minutes to draw water from the main water source for a household (including time taken for the round trip and queuing):			
1-60	4(7.7%)	25(46.3%)	29(27.4%)
61-180	17(32.7%)	9(16.7%)	26(24.5%)
Above 180	31(59.6%)	20(37.0%)	51(48.1%)
Number of trips taken per day to fetch water from the water source:			
1-3	52(100%)	42(77.8%)	94(88.7%)
Above 3	0(0.0%)	12(22.2%)	12(11.3%)
People queuing at the main water source on arrival to fetch water:			
Yes, always	43(82.7%)	12(22.2%)	55(51.9%)
Yes, usually	7(13.5%)	1(1.9%)	8(7.5%)
Sometimes	2(3.8%)	11(20.4%)	13(12.3%)
Not at all	0(0.0%)	30(55.6)	30(28.3%)

Present household amount spent monthly for water usage (Maloti):			
0	0(0.0%)	54(100%)	54(50.9%)
5.00-10.00	51(98.1%)	0(0.0%)	51(48.1%)
10.50-50.00	1(1.9%)	0(0.0%)	1(0.9%)
Alternative source of water for the household:			
Well	24(46.2%)	10(18.5%)	34(32.1%)
We buy water from another communities	28(53.8%)	43(79.6%)	71(67.0%)
We only depend on rainwater collection	0(0.0%)	1(1.9%)	1(0.9%)
Time taken in minutes per one round trip to draw water from the alternative source:			
1-60	1(1.9%)	0(0.0%)	1(0.9%)
61-180	3(5.8%)	3(5.6%)	6(5.7%)
Above 180	48(92.3%)	51(94.4%)	99(93.4%)
The rate of existing water quality from the alternative water source:			
Excellent	22(42.3%)	30(55.6%)	52(49.1%)
Very good	9(17.3%)	12(22.2%)	21(19.8%)
Average	2(3.8%)	2(3.7%)	4(3.8%)
Poor	8(15.4%)	6(11.1%)	14(13.2%)
Very poor	11(21.2%)	4(7.4%)	15(14.2%)
Amount spent per 20L from the alternative source (Maloti):			
0 amount	24(46.2%)	11(20.4%)	35(33.0%)
2.00-3.00	22(42.3%)	43(79.6%)	65(61.3%)
4.00-5.00	6(11.5%)	0(0.0%)	6(5.7%)
The accurate description of the status of water supply in this community:			
Yes	32(61.5%)	38(70.4%)	70(66.0%)
No	0(0.0%)	13(24.1%)	13(12.3%)

Not sure	20(38.5%)	3(5.6%)	23(21.7%)
The shortage of water experienced because of poor management and water system maintenance:			
Yes	26(50%)	33(61.1%)	59(55.7%)
No	16(30.8%)	20(37.0%)	36(34.0%)
Not sure	10(19.2%)	1(1.9%)	11(10.4%)

Source: Author's elaboration
Note: The percentages are shown inside the brackets, while the frequencies are shown outside the brackets.

The results reflected in Table 4.6 indicate that most residents do indeed have clear knowledge of, and are cognisant of, the existing conditions of water supply services in the Qiloane rural regions of Lesotho, and of the challenges they are faced with concerning the quality of water supply services. This was reflected using the following statements: the description of the status of water supply in their communities; the shortage of water experienced is because of poor management and water system maintenance; and, the water scarcity can in addition to huge economic loss, lead to uncleanliness of the house and food consumed in the household, which has high potential for transmitting germs or pathogens which are the carriers of disease-causing organisms. The respondents were presented with a picture describing the residents having to opt for the unsafe surface water in times of water supply service shortages so as to prompt them to describe the status of their water supply situations during times of water scarcity. However, it was explained that this would result in very serious health implications owing to dirty water and unprotected water source areas. Accordingly, the majority of respondents demonstrated a high level of agreement by selecting the "yes" option from the sample for these statements, as designated by their correspondingly high significant figures.

Moreover, in response to the following statements – alternative source of water for the household; and the rate of existing water quality from the alternative water source – most respondents indicated a high level of agreement by selecting the "excellent" option from the samples regarding the rate of existing water quality supply from their alternative water sources, and this is indicated by their correspondingly high figures. Based on the evidence of the results obtained, most respondents were paying for water from other areas as their alternative water sources, which was reported as being safe, cleaned and treated water; hence, most respondents considered the water from the alternative source as excellent.

Besides that, respondents were asked the following statement to investigate whether their sources released adequate water for household domestic use, because it was assumed that sources releasing insufficient water would regularly produce dirty water: “People queuing at the main water source on arrival to fetch for water”. As shown by the results, most respondents revealed a high level of agreement by selecting the “yes, always” option from the sample. This implies that the main water source points release inadequate water for household domestic use, and this ultimately results in providing unsafe water for the households, as well as the society in the vicinity.

As a further investigation on the robustness of the sample results, Chi-square (χ^2) and Analysis of variance (ANOVA) methods were employed to validate the prospective influence of socio-economic variables on the variables that were used to determine respondents’ knowledge intended for the improvement of water quality supply services within Qiloane rural community settlements. Table 4.7 presents the χ^2 test results, while their p-values are shown inside brackets.

Table 4.7: Chi-square ($\chi 2$) test results: Influence of socio-economic variables on respondents' knowledge about the prevailing circumstances of their water supply services at Qiloane rural locations of Lesotho

variable	Gender	Education	Employment	Income
The main source of water for household's domestic use:	0.2811	31.6381	26.6298	20.2530
	(0.596)	(0.000)***	(0.000)***	(0.000)***
Time taken in minutes to draw for water from the main source to a household	0.9183	0.0195	2.3520	1.0134
(including time taken for the round trip and queuing)	(0.338)	(1.000)	(0.938)	(0.602)
Daily number of trips taken to fetch for water from the main source:	0.5169	10.2270	14.2141	6.6180
	(0.472)	(0.037)**	(0.048)**	(0.037)**
People queuing at the main water source on arrival to fetch for water:	0.1389	0.3606	3.5192	0.2556
	(0.709)	(0.986)	(0.833)	(0.880)
Present household amount spent monthly for water usage (Maloti):	20.8849	39.0672	43.6051	29.2029
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Alternative source of water for the household:	0.7823	4.9901	2.4357	0.0783
	(0.376)	(0.288)	(0.932)	(0.962)
Time taken per one round trip to fetch water from the alternative source	0.0079	7.4854	6.3812	3.5218
(minutes):	(0.929)	(0.112)	(0.496)	(0.172)
The rate of existing water quality from the alternative water source:	0.0321	1.0229	3.4441	1.2223

	(0.858)	(0.906)	(0.841)	(0.543)
Amount spent per 20L from the alternative source (Maloti):	0.2321	0.2003	1.4114	0.1165
	(0.630)	(0.995)	(0.985)	(0.943)
The accurate description of the status of water supply in this community:	0.1152	3.9012	1.8964	0.1579
	(0.734)	(0.420)	(0.929)	(0.924)
The shortage of water experienced is due to poor management and maintenance of water system:	0.2434	6.5017	6.8848	3.9735
	(0.622)	(0.165)	(0.441)	(0.137)
The shortage of water, in addition to huge economic loss, can lead to uncleanliness of the house and food consumed in the household which has high potential of transmitting germs or pathogens which are the carriers of disease causing organisms:	15.6529	23.8699	3.8429	28.8042
	(0.000)***	(0.000)***	(0.572)	(0.000)***

Source: Author's elaboration

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

The results in the table 4.7 indicate that income, employment, education and gender have an influence on the respondents' factual knowledge about the prevailing quality of the household water supply. Therefore, the conclusion drawn is that households are indeed familiar with the existing quality of the water supply in their respective settlements.

It was also revealed by the results that there is a statistically significant relationship between gender and the variable "Present household amount spent monthly for water usage". The relationship is 1 percent, at the statistical level of significance. It can be assumed that females have greater awareness or knowledge about the existing condition of the water supply in their homes. As expected, females are associated with greater awareness pertaining to water supply within their residences because all house chores are dependent on them, as water is mostly used by the females. This further suggests that the present monthly water payment was realised by females as constituting a substantial variable to be revised in order to meet the water quality improvement standard for sustaining healthy human livelihoods.

Likewise, gender has a level of significance at 1 percent for the variable "The shortage of water, in addition to huge economic loss, can lead to uncleanliness of the house and food consumed in the household which has high potential of transmitting germs or pathogens which are the carriers of disease causing organisms". As also expected, the more females are, because they are the ones taking care of the house chores, the higher the likelihood is that they will be intelligent enough to discern that there are improper conditions relating to the water presently being used, and that ultimately this can result in economic loss as most households will be affected by certain water borne diseases. This further builds on the aforementioned view that almost all water-related chores within households are attended to by women, which implies that females are accountable for and positively associated with the water usage in their homes.

The outcomes of the survey show that the socio-economic variables for education, employment and income exhibited a positive impact on the respondents' knowledge concerning the quality of the households' water supply. Education, employment and income were all statistically significant for the questions that requested the respondents to specify the major source of water they use for domestic purposes; number of trips taken per day to fetch water from the water source; and present household amount spent monthly for water usage. It was anticipated that the more educated an individual is, the higher the probability is that he or she will be capable of selecting potential drinking water sources that are appropriate or are of improved quality for

the water needs household members. This is because the type of water source indicated by an individual were used as indications of whether the drinking water was of appropriate quality for a healthy life for the people. This relationship is statistically at the 1 percent level of significance for the variable "the main source of water for household's domestic use". Furthermore, education has a statistical significance level of 5 percent for the variable "number of trips taken per day to fetch water from the water source". As expected, the more educated a respondent is, the higher the probability is that he or she would be aware that fetching water several times a day for the household negatively affects other important household activities. Well-educated individuals are presumed to be more committed to other responsibilities, such as research work, than to spending more of their time fetching water, as opposed to their less-educated counterparts. This can be further attributed to the fact that the water source point location is remote from the residences.

Furthermore, education exhibited a positive influence on respondents' knowledge regarding the quality of household water supply for the variable "present household amount spent monthly for water usage". It is anticipated that the more educated a respondent becomes, the higher the prospect is that he or she would be able to realise that the current amount spent on household water on a monthly basis was too low to secure a continuous flow of water quality supply for a healthy life. On the other hand, the less-educated respondents are assumed to consider the water charge as being the government's responsibility. This relationship is statistically significant at the 1 percent level.

Lastly, education is also statistically significant, at 1 percent, for the variable "The shortage of water, in addition to huge economic loss, can lead to uncleanliness of the house and food consumed in the household which has high potential of transmitting germs or pathogens which are the carriers of disease causing organisms". This is consistent with expectation because the more well-educated an individual becomes, the higher the likelihood is that he or she would clearly realise that the shortage of water can result in uncleanliness of the house and food consumed in the household, which has a high potential for transmitting germs or pathogens that are the carriers of disease-causing organisms. On the other hand, less-educated and uneducated individuals might not even know that water that is not treated has the potential for carrying germs which are disease-causing organisms.

The results also indicate a statistically significant relationship between income and the variables used to capture households' knowledge relating to the quality of their water supply:

"The main source of water for household's domestic use; and present household amount spent monthly for water usage". This relationship is significant at the 1 percent level for both variables. This suggests that people with higher levels of income make a clear distinction between water source points that provide safe household drinking water and those that are of poor quality. Hence, they considered their current monthly water payment as being too low for procuring improvements to the prevailing water supply situation. This further suggests that people with higher levels of income are associated with a higher likelihood of being able to finance their water supply service in order to receive improved, healthy water supply services. However, this is not surprising because the statistical results obtained revealed that the individuals with higher incomes were those who had received a formal education. Hence, most respondents noted that their existing water source points were in an intolerable condition for supporting their livelihoods and for society as a whole.

The positive relationship between income and the variable intended to capture respondents' knowledge pertaining to the household water quality supply, "number of trips taken per day to fetch water from the water source", implies that people with higher levels of income are sufficiently intelligent to finance their water supply service, instead of using free water supply source points. By doing this, they avoid having to undertake regular trips to fetch water that wastes time needed for other activities, and which sources do not release enough good-quality water for the entire household's consumption. It was ascertained by the survey that people are limited to the number of containers (to the size of 2*20 litres on average) of water that each household should receive per day so that every household is able to receive water. The relationship is at a 5 percent level of significance.

Lastly, income has a 1 percent significance level for the variable "The shortage of water, in addition to huge economic loss, can lead to uncleanliness of the house and food consumed in the household which has high potential of transmitting germs or pathogens which are the carriers of disease causing organisms". This implies that people with more money are aware of the prevailing situation of their water supply and the consequences it bears, and their wealth enables them to finance their water supply services for the benefit of the members of their households and the entire public.

There was also a positive relationship between employment and the variables considered to capture respondents' knowledge concerning the quality of the household water supply service, "The main source of water for household's domestic use; number of trips taken per day to fetch

water from the water source; and present household amount spent monthly for water usage". This suggests that many employed people are conscious of the conditions of the water supply they are experiencing in their residences, and are able to identify the conditions according to the kinds of the existing water source points and their locations, traveling to which consumes most of their time, to the detriment of other important activities. Since most people are found to be formally employed, based on the statistical results, this suggests that most of them will afford to finance their water supply service improvement, hence their WTP for a quality water supply is assumed to be higher. These relationships have the statistical significance levels of 1 percent, 5 percent and 1percent, respectively.

4.3 HOUSEHOLDS' ASSESSMENT OF THE CURRENT WATER QUALITY SUPPLY SERVICE

This section evaluates how the households assess their current water quality supply service in their dwellings. Therefore, this section is organised into two sub-sections. Sub-section 4.3.1 will present the respondents' assessments based on the attributes used to describe water quality supply, and sub-section 4.3.2 will present respondents' knowledge regarding the household water treatment practices as an assessment of their recent water quality supply service in the rural populations of Lesotho.

4.3.1 Attributes used to assess the household current water quality services in the Qiloane rural communities

The purpose of this sub-section is to establish how respondents assess their present water supply quality based on the attributes used to describe the quality of water. The questions are planned to accumulate evidence concerning the water quality attributes and water treatment practices at the household level that provide indications of how the households assess the quality of the drinking water consumed in their residences. Determining households' assessments in regard to the existing quality of the water supply is important because they influence improvements to the quality of the household water supply, and thus respondents' WTP for such services.

Respondents were given the following statements to reveal their opinions concerning the quality of the prevailing household water supply among the Qiloane rural population of Lesotho: "Water from my main source is safe for consumption purposes"; "the odour of the water from my source point is acceptable to me"; "the taste of the water from my source point

has no health risk effects"; "the colour of the water from my main source of supply has no health risk effects"; "in my opinion, the water is affordable"; "there is always a flow of water from main source point whenever the household needs to use it"; "the water supply from my main water source point is consistent"; and "the water I receive from my main source point is sufficient for my household". The respondents were also requested to specify the extent of their agreement on statements which were used to assess their opinions regarding the quality of the household water supply. The preferences were presented on a five-point Likert scale, with 1 showing "strongly agree", 2 "agree", 3 "neutral/not sure", 4 "disagree". and 5 "strongly disagree". The analysis of the results is presented in Table 4.8.

Table 4.8: Attributes used to assess the household current water quality services in the Qiloane rural communities

Variable	Split sample	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
I receive safe water from my main source point for consumption purposes	HHWC	13(25%)	9(17.3%)	1(1.9%)	13(25%)	16(30.8%)
	HHWTWC	8(14.8%)	6(11.1%)	0(0.0%)	15(27.8%)	25(46.3%)
	Total:	21(19.8%)	15(14.2%)	1(0.9%)	28(26.4%)	41(38.7%)
The odour of the water from my source point is acceptable to me	HHWC	18(34.6%)	6(11.5%)	1(1.9%)	8(15.4%)	19(36.5%)
	HHWTWC	16(29.6%)	3(5.6%)	0(0.0%)	5(9.3%)	30(55.6%)
	Total	34(32.1%)	9(8.5%)	1(0.9%)	13(12.3%)	49(46.2%)
The taste of the water from my source point has no health risk effects	HHWC	8(15.4%)	5(9.6%)	3(5.8%)	8(15.4%)	28(53.8%)
	HHWTWC	14(25.9%)	4(7.4%)	1(1.9%)	5(9.3%)	30(55.6%)
	Total	22(20.8%)	9(8.5%)	4(3.8%)	13(12.3%)	58(54.7%)

The colour of the water from my main source of supply has no health risk effects	HHWC	19(36.5%)	4(7.7%)	2(3.8%)	10(19.2%)	17(32.7%)
	HHWTWC	13(24.1%)	5(9.3%)	1(1.9%)	9(16.7%)	26(48.1%)
	Total:	32(30.2%)	9(8.5%)	3(2.8%)	19(17.9%)	43(40.6%)
In my opinion, the water is affordable	HHWC	26(50%)	17(32.7%)	7(13.5%)	1(1.9%)	1(1.9%)
	HHWTWC	25(46.3%)	12(22.2%)	7(13.0%)	4(7.4%)	6(11.1%)
	Total:	51(48.1%)	29(27.4%)	14(13.2%)	5(4.7%)	7(6.6%)
There is always a flow of water from main source point whenever the household needs to use it	HHWC	20(38.5%)	8(15.4%)	0(0.0%)	9(17.3%)	15(28.8%)
	HHWTWC	11(20.4%)	6(11.1%)	0(0.0%)	9(16.7%)	28(51.9%)
	Total:	31(29.2%)	14(13.2%)	0(0.0%)	18(17.0%)	43(40.6%)
The water supply from my main water source point is consistent	HHWC	15(28.8%)	11(21.2%)	0(0.0%)	6(11.5%)	20(38.5%)
	HHWTWC	10(18.5%)	7(13.0%)	0(0.0%)	6(11.1%)	31(57.4%)
	Total:	25(23.6%)	18(17.0%)	0(0.0%)	12(11.3%)	51(48.1%)
The water I receive from my main source point is sufficient for my household	HHWC	15(28.8%)	10(19.2%)	0(0.0%)	3(5.8%)	24(46.2%)
	HHWTWC	10(18.5%)	7(13.0%)	0(0.0%)	4(7.4%)	33(61.1%)
	Total:	25(23.6%)	17(16.0%)	0(0.0%)	7(6.6%)	57(53.8%)

Source: Author’s elaboration

Note: The percentages are shown inside the brackets, while the frequencies are shown outside the brackets.

The results depicted in the table 4.8 disclose that most respondents demonstrated negative opinions in regard to the quality of their current water supply situation. However, this was expected due to the depressing circumstances of the water quality supply service within the targeted rural populations of Lesotho. As confirmed by the high corresponding figures from the results, the majority of the households revealed negative views by selecting the "strongly disagree" and "disagree" preferences from the sampled data. This implies that most respondents considered the quality of their water supply as being below standard. This was reflected in responses to the following statements: "The taste of the water from my source point has no health risk effects"; "the colour of the water from my main source of supply has no health risk effects"; "the odour of the water from my source point is acceptable to me"; and "the water I receive from my main source point is sufficient for my household". Based on the evidence observed in the field, which is also indicated by the results obtained, most households were restricted on the quantity of water they could receive per day by the amount of water released daily by their water source points. Hence, this resulted in many households not receiving sufficient water for their domestic purposes. It was further claimed that the water had a salty taste, bad smell, a dark brown colour (water discolouration) which was evident during survey implementation from the colour seen inside the water containers at most of the households' locations.

To further investigate the robustness of the results, chi-square (x^2) and ANOVA methods were employed to verify potential effects of age, income, education and gender on the attributes used to assess the quality of households' current water supply services. The analysis of the results is indicated in Table 4.9.

Table 4.9: Effect of age, gender, education and income on attributes used to assess the household current water quality services

variable	Age	Gender	Education	Income
I receive safe water from my main source point for consumption purposes	0.4903 (0.577)	0.0116 (0.914)	0.1512 (0.997)	1.0504 (0.591)
The odour of the water from my source point is acceptable to me	0.4810 (0.897)	0.0274 (0.869)	0.2152 (0.995)	0.0404 (0.980)

The taste of the water from my source point has no health risk effects	0.6808 (0.975)	0.0744 (0.785)	0.3425 (0.987)	0.2775 (0.870)
The colour of the water from my main source of supply has no health risk effects	0.7625 (0.978)	0.0078 (0.930)	0.2155 (0.995)	0.0303 (0.985)
In my opinion, the water is affordable	0.5390 (0.272)	0.4459 (0.504)	5.4388 (0.245)	4.9661 (0.083)*
There is always a flow of water from main source point whenever the household needs to use it	10.8386 (0.985)	0.0145 (0.904)	0.4204 (0.981)	0.3883 (0.824)
The water supply from my main water source point is consistent	0.5586 (0.976)	0.0024 (0.961)	0.0919 (0.999)	0.3478 (0.840)
The water I receive from my main source point is sufficient for my household	0.1156 (0.981)	0.0065 (0.936)	0.2510 (0.993)	0.6090 (0.737)

Source: Author's elaboration

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

The results in the table 4.9 indicate that almost all socio-economic variables seemed not to have had an impact on the attributes used to assess the quality of household water supply. The results reveal that only income has an influence on the respondents' opinions with regard to the attributes used to assess their present water quality supply service. The relationship was at the 10 percent level of statistical significance for the statement considered to capture how respondents assess their existing water quality supply in their locations, "In my opinion, the water is affordable". As was expected, the higher the level of respondents' incomes are, the higher the likelihood is that they are capable of financing their water service consumption. This might suggest that, owing to the prevailing cost of the water, most households expressed having higher affordability over the current low cost of the water. Hence, most of the residents are anticipated to be willing to support the new proposed project in view of the challenges they are faced with regarding their present water situation.

4.3.2 Respondents' knowledge regarding the household water treatment practices as an assessment of their recent water quality supply service.

The purpose of this sub-section is to ascertain whether the respondents have clear knowledge, based on whether the water consumed in their localities was treated and, if so, what treatment method was being applied. The questions are envisioned to accumulate evidence regarding the treatment methods used at the household level, which provides insight into how the households assess the conditions of the water consumed in their residences. Shaping households' knowledge in regard to the water treatment procedures for the quality of their existing water supply is important because these should influence an enhanced quality of the household water supply, and thus respondents' WTP for such services. Respondents were given the following statements to disclose their knowledge about water treatment procedures employed in their homesteads: "How would you rate the current water supply services in this community?"; "Do you use any purification method to purify the water in any way to make it safer before consuming it?"; "If '**NO'**, why are you not cleaning it?"; "What do you frequently do to the water to make it harmless for consumption?"; "Was there any member of your household affected by any water borne related disease due to the type of water being used in the past ***1 year?***"; and "If '**YES**', what disease?"

Respondents were also requested to state the extent to which they agree or disagree with the statements by selecting from the options as outlined: "yes" if the statement is correct or they agree with the statement, and "no" if the statement is wrong or they disagree with it. They were further requested to state the extent to which they agreed or disagreed with the statements, according to the options of "excellent", "very good", "good or average", "poor", and "very poor", regarding the existing state of the quality of water received from the main water source locations in their communities. Table 4.10 depicts the analysis of the results.

Table 4.10: Respondents' knowledge regarding the household water treatment practices as an assessment of their recent water quality supply service

variable	HHWC	HHWTWC	Total
The rate of the current water supply services in this community:			
Excellent	0(0.0%)	6(11.1%)	6(5.7%)
Very good	0(0.0%)	6(11.1%)	6(5.7%)

Average	4(7.6%)	9(16.7%)	13(12.3%)
Poor	21(40.4%)	6(11.1%)	27(25.5%)
Very poor	27(51.9%)	27(50%)	54(50.9%)
The purification method used or not to purify the water in any way to make it harmless before consuming it:			
Yes	13(25%)	11(20.4%)	24(22.6%)
No	39(75%)	43(79.6%)	82(77.4%)
The reason for not treating the water:			
Purification methods are too expensive	7(13.5%)	4(7.4%)	11(10.4%)
Water is already clean for consumption purposes	13(25%)	12(22.2%)	25(23.6%)
Although water is not clean, it does not affect my health	7(13.5%)	11(20.4%)	18(17.0%)
I am unaware that the water has to be treated before consumed	12(23.1%)	16(29.6%)	28(26.4%)
Non-applicability	13(25%)	11(20.4%)	24(22.6%)
The purification method followed to make water safer for consumption:			
The water is boiled before being consumed	6(11.5%)	8(14.8%)	14(13.2%)
Chlorine/bleach is added to the water	0(0.0%)	0(0.0%)	0(0.0%)
The water is strained through the cloth	1(1.9%)	1(1.9%)	2(1.9%)

The water is let to stand and settle before consumed	13(25%)	9(16.7%)	22(20.8%)
I am not doing anything to the water to make it safer for consumption	32(61.5%)	36(66.7%)	68(64.2%)
Whether there was any member of the household affected by any water borne related disease due to the type of water being used in the past *1 year:*			
Yes	18(34.6%)	11(20.4%)	29(27.4%)
No	34(65.4%)	43(79.6%)	77(72.6%)
The name of the disease experienced in the past one year:			
Cholera	0(0.0%)	0(0.0%)	0(0.0%)
Diarrhoea	11(21.2%)	7(13.0%)	18(17.0%)
Typhoid	0(0.0%)	0(0.0%)	0(0.0%)
Stomach-ache	7(13.5%)	4(7.4%)	11(10.4%)
Non-applicability	34(65.4%)	43(79.6%)	77(72.6%)

Source: Own construct

Note: The percentages are shown inside the brackets, while the frequencies are shown outside the brackets.

The results in Table 4.10 indicate that most respondents expressed negative views towards the questions that were posed to them regarding the household water treatment practices employed if any, and the challenges they are faced with owing to the uncleansed water in their dwellings. The majority of households described the situation regarding their water supply as being below standard for ensuring human wellbeing. This was indicated by the high corresponding figures in which most respondents chose “poor” and “very poor” preferences from the question that measured their knowledge based on how they rate the quality of the existing water supply in their dwellings. This suggests that a higher number of the rural population of Lesotho is aware

of their prevailing water supply situation, although many of them are uninformed and lack information concerning the decontamination practices needed to cleanse the water of pathogens carrying harmful organisms that cause waterborne diseases. This was indicated by a corresponding figure in which most households revealed that they do nothing to the water to make it safer before being consumed in response to the question that required them to indicate the type of purification method they followed to make water safer for consumption.

It was also ascertained that most households do not use water sanitisation methods at all for decontaminating their water, and this has further impacted on waterborne diseases for some people, more especially for children under the age of five. The majority of respondents acknowledged that they do not take into account the point that it has to be decontaminated before being consumed. However, this is not surprising because the study was conducted in the rural regions of the country where a significant number of the residents have high illiteracy rates, and have little or no information that the water has to be disinfected for consumption purposes. This was established by their relevant, high corresponding figures from the results in which most respondents noted negative opinions by selecting the "no" options for many of the questions posed to them about whether they applied any purification methods or not to treat the water in any way to make it safer before consuming it. The number of those who experienced waterborne diseases is significantly high, as shown by the "yes" preferences noted by the respondents, although it might seem small. The respondents revealed that they experienced diarrhoea and stomach-ache diseases, which was confirmed by relevant medical doctors as being attributable to the water they consume in their locations that is unsafe for human consumption.

To further investigate the robustness of the results, chi-square (x^2) and ANOVA methods were employed to verify potential effects of age, income, education, and gender on respondents' knowledge regarding the household water treatment practices in the assessment of the quality of their current water supply service. The analysis of the results is reflected in Table 4.11.

Table 4.11: Effect of age, gender, education and income on respondents' knowledge regarding the household water treatment practices as an assessment of their recent water quality supply service

Variable	Age	Gender	Education	Income
The rate of the current water supply services in this community	0.3314 (0.472)	4.1504 (0.042)**	3.1548 (0.532)	5.3332 (0.069)*

The purification method used or not to treat the water in any way to make it safer before consuming it	0.6225 (1.000)	0.0675 (0.795)	0.7859 (0.853)	0.6312 (0.729)
The reason for not treating the water	0.7547 (0.732)	0.0658 (0.797)	1.9697 (0.741)	0.8543 (0.652)
The purification method followed to make water safer for consumption:	0.6370 (0.004)***	0.3772 (0.539)	29.0196 (0.000)***	2.0296 (0.362)
Any member of your household affected by any water borne related disease due to the type of water being used in the past *1 year*	0.1869 (1.000)	0.1340 (0.714)	6.7612 (0.149)	0.0425 (0.979)
The name of the disease experienced in the past one year	0.6576 (0.750)	2.4386 (0.118)	14.7127 (0.005)***	1.3966 (0.497)

Source: Author's elaboration

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

The results in Table 4.11 indicate that education, income, gender and age seemed to have an effect on respondents' knowledge regarding the household water treatment practices as an assessment of the quality of their current water supply service. Age was statistically significant for the question that asked respondents on the purification method followed to make water safer for consumption. As projected, the older individuals become, the higher the probability is that they are aware of the risks that results follow from water that has not gone through treatment practices, and ultimately have no clear knowledge of the appropriate method to adopt to make their water safer before being consumed. The relationship has a statistical significance level of 1 percent for the variable.

It was also indicated that gender had a statistically significant relationship with the variable that assesses the knowledge of the respondents on how they rate the quality of their present water supply service within their locations. The relationship has a statistical significance level of 5 percent. It was ascertained that females are more suspicious of the kind of water they use

in their homes, as water is mostly used by females in most of the domestic household chores in the rural areas. This further implies that more females than males recognised the condition of their water supply and considered it to be of poor quality for healthy human consumption.

The positive relationship between education and the variable intended to capture respondents' knowledge based on the purification method followed to make water safer for consumption implied that the more well-educated individuals are, the higher the possibility is that they will have an understanding that consuming the water without applying proper treatment mechanisms to make it safer is unhealthy for their health and that of others. It further implies that well-educated individuals are presumed to be aware that organisms causing diseases are contained in water that is uncleansed, unlike their counterparts with little or even no awareness that water that is consumed without being purified is more likely to be carrying organisms harmful to health because they are not visible to the naked eye. This is further emphasised by Moffat *et al*. (2011) who state that the greater the number of years spent by individuals in receiving formal education, the better they would understand the concerns in consuming unsafe water and the importance of having water quality supply service in their settlements. Thus, well-educated individuals can manage to pay, as compared with unschooled individuals. This relationship is statistically significant at 1 percent level for this variable.

It is also confirmed by the results that there is a statistically significant relationship between income and the variable "The rate of the current water supply services in this community". The relationship has a statistical significance level of 10 percent for this variable. This implies that individuals receiving higher incomes are cautious regarding the vulnerable situation of the present water supply. Therefore, this reveals their affordability to finance enhanced quality water services for betterment of their health. This was confirmed by most of the households that were paying for water from alternative source points, and which they considered it excellent because it was treated.

4.4 HOUSEHOLDS' WILLINGNESS TO USE RECLAIMED OR RECYCLED WATER

This section determined the households' willingness to use reclaimed water in the rural regions of Lesotho. Therefore, this section is organised into two sub-sections. Sub-section 4.4.1 will present the respondents' views in regard to the use of reclaimed or recycled water within their locations, and sub-section 4.4.2 discusses whether the respondents would be willing to use reclaimed water or not in their residences.

4.4.1 The use of reclaimed or recycled water to settle the increased demand for water supply services in the Qiloane rural regions of Lesotho.

This section assesses respondents' opinions regarding the utilisation of reclaimed or recycled water in order to settle the increased demand for water supply services in the Qiloane rural regions of Lesotho. Respondents were given the following statements to determine their opinions towards the use of reclaimed water in rural regions of Lesotho: "In your opinion, recycled water reduces demand and stress on rivers and ground water by providing alternate for water provisions"; "In your view, recycled water provides more consumption of improved water for home purposes"; "The need for chemical fertilizers can be reduced through irrigation with reclaimed water"; "Recycled water can be used for the conservation of wetlands"; "Recycled water should be used to reduce and prevent both air and water pollution"; "Consumers of the water might complement their needs by consuming reclaimed water"; "Reclaimed water can reduce a deviation of fresh water from delicate ecosystems"; "Recycled water should be used for potable uses"; "Reclaimed water has to be applied for manufacturing and industrial purposes"; "Recycled water should be used for irrigating parks, lawn, sports fields, golf courses and farms"; and "Recycled water should be used for supporting river flows".

Respondents were then asked to select their best preferences that represented their opinions about the given statements employed to evaluate their opinions towards the use of reclaimed or recycled water. The preferences were set on a five-point Likert scale, with 1 showing "strongly agree", 2 "agree", 3 " not sure/ neutral", 4 "disagree", and 5 "strongly disagree". Table 4.12 presents the results of the analysis.

Table 4.12: The use of reclaimed or recycled water to settle the increased demand for water supply services in the Qiloane rural regions of Lesotho.

Variable	Split sample	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
Recycled water reduces demand and stress on rivers and ground water by	HHWC	20(38.5%)	24(46.2%)	3(5.8%)	1(1.9%)	4(7.7%)
	HHWTWC	31(57.4%)	12(22.2%)	0(0.0%)	4(7.4%)	7(13.0%)
	Total	51(48.1%)	36(34.0%)	3(2.8%)	5(4.7%)	11(10.4%)

providing alternate for water provisions						
Recycled water provides more consumption of improved water for home purposes	HHWC	28(53.8%)	17(32.7%)	1(1.9%)	5(9.6%)	1(1.9%)
	HHWTWC	43(79.6%)	0(0.0%)	0(0.0%)	4(7.4%)	7(13.0%)
	Total	71(67.0%)	17(16.0%)	1(0.94%)	9(8.5%)	8(7.5%)
The need for chemical fertilizers can be reduced through irrigation with reclaimed water	HHWC	16(30.8%)	19(36.5%)	10(19.2%)	5(9.6%)	2(3.8%)
	HHWTWC	31(57.4%)	8(14.8%)	4(7.4%)	5(9.3%)	6(11.1%)
	Total	47(44.3%)	27(25.5%)	14(13.2%)	10(9.4%)	8(7.5%)
Recycled water can be used for the conservation of wetlands	HHWC	15(28.8%)	20(38.5%)	11(21.2%)	3(5.8%)	3(5.8%)
	HHWTWC	14(25.9%)	24(44.4%)	5(9.3%)	3(5.6%)	8(14.8%)
	Total	29(27.4%)	44(41.5%)	16(15.1%)	6(5.7%)	11(10.4%)
Recycled Water should be used to reduce and prevent both air and water pollution	HHWC	11(21.2%)	22(42.3%)	12(23.1%)	1(1.9%)	6(11.5%)
	HHWTWC	10(18.5%)	28(51.9%)	4(7.4%)	4(7.4%)	8(14.8%)
	Total	21(19.8%)	50(47.2%)	16(15.1%)	5(4.7%)	14(13.2%)
Consumers of the water might	HHWC	17(32.7%)	19(36.5%)	10(19.2%)	5(9.6%)	1(1.9%)
	HHWTWC	13(24.1%)	26(48.1%)	5(9.3%)	1(1.9%)	9(16.7%)
	Total	30(28.3%)	45(42.5%)	15(14.2%)	6(5.7%)	10(9.4%)

complement their needs by consuming reclaimed water						
Reclaimed water can reduce a deviation of fresh water from delicate ecosystems	HHWC	23(44.2%)	13(25%)	10(19.2%)	2(3.8%)	4(7.7%)
	HHWTWC	20(37.0%)	20(37.0%)	2(3.7%)	4(7.4%)	8(14.8%)
	Total	43(40.6%)	33(31.1%)	12(11.3%)	6(5.7%)	12(11.3%)
Recycled water should be used for potable uses	HHWC	29(55.8%)	14(26.9%)	3(5.8%)	0(0.0%)	6(11.5%)
	HHWTWC	32(59.3%)	9(16.7%)	2(3.7%)	4(7.4%)	7(13.0%)
	Total	61(57.5%)	23(21.7%)	5(4.7%)	4(3.8%)	13(12.3%)
Reclaimed water has to be applied for manufacturing and industrial purposes	HHWC	19(36.5%)	14(26.9%)	10(19.2%)	6(11.5%)	3(5.8%)
	HHWTWC	18(33.3%)	18(33.3%)	7(13.0%)	7(13.0%)	4(7.4%)
	Total	37(34.9%)	32(30.2%)	17(16.0%)	13(12.3%)	7(6.6%)
Recycled water should be used for irrigating parks, lawn, sports fields, golf courses and farms	HHWC	17(32.7%)	17(32.7%)	8(15.4%)	7(13.5%)	3(5.8%)
	HHWTWC	17(31.5%)	16(29.6%)	13(24.1%)	5(9.3%)	3(5.6%)
	Total	34(32.1%)	33(61.1%)	21(19.8%)	12(11.3%)	6(5.7%)
Recycled water should be used for supporting river flows	HHWC	17(32.7%)	14(26.9%)	13(25%)	6(11.5%)	2(3.8%)
	HHWTWC	21(38.9%)	11(20.4%)	11(20.4%)	7(13.0%)	4(7.4%)
	Total	38(35.8%)	25(23.6%)	24(22.6%)	13(12.3%)	6(5.7%)

Source: Author elaboration

Note: The percentages are shown inside the brackets while the frequencies are shown outside the brackets.

The results in the table 4.12 indicate that the majority of the households exhibited positive views regarding the use of reclaimed water in the Qiloane rural settlements of Lesotho. This suggests that using reclaimed water would reduce the demand on the fresh water supply, thus allowing the fresh water to go further. Respondents were presented with positive questions that signify improved water services through the utilisation of reclaimed water as an alternative means to resolve the existing water supply shortage situation. Therefore, respondents were invited to disclose their opinions by selecting their preferences, graded on five-point Likert scale. Table 4.12 indicates that most respondents strongly agreed with the posed questions, and their positive views imply that they greatly support the use of reclaimed water to supplement the low volumes of water currently supplied to their homes for domestic purposes.

To further investigate the robustness of the results, chi-square (x^2) and ANOVA methods were employed to verify the potential impacts of age, income, education and gender on the respondents' views concerning the use of reclaimed or recycled water by the rural population of Lesotho. The analysis of the results is indicated on Table 4.13.

Table 4.13: Impact of age, gender, education and income on the use of reclaimed or recycled water to settle the increased demand for water supply services in the Qiloane rural regions of Lesotho.

Variable	Age	Gender	Education	Income
Recycled water reduces demand and stress on rivers and ground water by providing alternate for water provisions	0.5657 (0.293)	1.5085 (0.219)	14.1883 (0.007)***	4.9560 (0.084)*
Recycled water provides more consumption of improved water for home purposes	0.0639 (0.303)	2.5825 (0.108)	20.5157 (0.000)***	6.9161 (0.031)**
The need for chemical fertilizers can be reduced through irrigation with reclaimed water	0.0409 (0.678)	1.5139 (0.219)	14.7942 (0.005)***	2.5264 (0.283)
Recycled water can be used for the conservation of wetlands	0.0491 (0.505)	4.0907 (0.043)**	6.3341 (0.176)	2.1001 (0.350)

Recycled Water should be used to reduce and prevent both air and water pollution	21.4921 (0.310)	7.4323 (0.006)***	6.0469 (0.196)	4.1978 (0.123)
Consumers of the water might complement their needs by consuming reclaimed water	0.1764 (0.619)	0.5776 (0.447)	13.1571 (0.011)**	7.2459 (0.027)**
Reclaimed water can reduce a deviation of fresh water from delicate ecosystems	0.1876 (0.359)	0.7557 (0.385)	10.5941 (0.032)**	9.9227 (0.007)***
Recycled water should be used for potable uses	0.0676 (0.174)	3.4966 (0.061)*	8.2968 (0.081)*	8.3561 (0.015)**
Recycled water should be used for industrial processes and manufacturing	0.6075 (0.645)	0.0611 (0.805)	1.0923 (0.895)	2.1636 (0.339)
Recycled water should be used for irrigating parks, lawn, sports fields, golf courses and farms	0.8474 (0.357)	0.0744 (0.785)	1.2807 (0.865)	1.2168 (0.544)
Recycled water should be used for supporting river flows	0.7764 (0.784)	0.0208 (0.885)	0.8254 (0.935)	2.2762 (0.320)

Source: Author's elaboration

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

The results in Table 4.13 reveal that education, income and gender, but with age as an exception, have an impact on the respondents' opinions regarding the utilisation of reclaimed water in the Qiloane rural settlements of Lesotho. Gender was statistically significant at the 5 percent level for the question intended to capture respondents' views about the use of recycled or reclaimed water to address the situation of high water demand, "In your opinion, could recycled water be used for the conservation of wetlands". This suggests that males are more likely to think that the wetlands, as the sources of water, would be well benefited through the use of recycled water because the reclaimed water would have been purified for further reuse for domestic purposes. The wetlands are important in protecting water quality by purifying and breaking down residues, nutrients, and impurities and then gradually discharging the water to recharge the groundwater. Gender also influenced the opinions of respondents when they were asked if the recycled water should be used to reduce and prevent both air and water pollution.

This relationship has a statistical significance level of 1 percent. There was also a positive relationship between gender and the variable, "recycled water should be used for potable uses". The relationship was statistically significant at the 10 percent level for this variable. It implies that the prevailing depressing water scarcity has resulted in unsafe water being used for human consumption, and more females than males considered recycled water to be harmless for domestic purposes because it has been cleansed for further reuse.

Education positively influenced the opinions of the respondents when they were asked if the recycled water reduces demand and stress on rivers and ground water by providing alternate supplies for water provisions in the Qiloane rural locations of Lesotho. It is believed that well-educated individuals have a clear awareness of surface water such as river water and the risks associated with it, and that it carries certain organisms that are harmful for consumption. Therefore, recycled water serves as an alternative source for resolving the existing depressing water demand since it has been decontaminated for the benefit of the public wellbeing. This relationship has a statistical significance level of 1 percent for this variable.

Moreover, education has a statistical significance level of 1 percent in influencing respondents' opinions as to addressing the prevailing high demand for water on the two questions that asked the respondents whether "recycled water provides more consumption of improved water for home purposes", and "the need for chemical fertilizers can be reduced through irrigation with reclaimed water". This implies that well-educated people are associated with a greater understanding that as the water is recycled, it is appropriate for crop irrigation as it is also considered to be a fit quality for drinking by humans. Lastly, education has statistical significance levels of 10 percent for the variable: "recycled water should be used for potable uses", 5 percent for the variable: "reclaimed water can reduce a deviation of fresh water from delicate ecosystems" and 5 percent for the variable: "consumers of the water might complement their needs by consuming reclaimed water", in influencing respondents' views based on improved household demand for water. This suggests that the more-educated people considered that using the reclaimed water for consumption purposes carries no harm as it is sanitised for further domestic reuse.

Income was statistically important for the questions used to capture respondents' views regarding the use of reclaimed or recycled water to address high water demand: "Recycled water reduces demand and stress on rivers and ground water by providing alternate for water provisions"; "Recycled water provides more consumption of improved water for home

purposes"; and "consumers of the water might complement their needs by consuming reclaimed water". These relationships have statistical significance levels of 10 percent, 5 percent and 5 percent, respectively. Thus, households with higher incomes are more likely to have positive insights towards improvements to satisfy household demand for water services. As for these variables, it was believed that those respondents receiving higher incomes would better manage to pay for the use of recycled water as an alternative source to resolve the prevailing water demand excess than those households with low or zero incomes who might think that reusing water has harmful health effects and who might not even be aware that the recycled water has been made safe through decontamination.

Additionally, income positively influenced the respondents' sensitivities concerning the use of reclaimed water for supplementing household demand for water in respect of the questions that asked them about whether "reclaimed water can reduce a deviation of fresh water from delicate ecosystems"; and "recycled water should be used for potable uses". This implies that the households with higher incomes are more perceptive of the present vulnerable water supply in their locations, and the challenges they are faced with regarding the low supply that is insufficient to meet the demand for water, which resulted in occurrences of waterborne diseases. It has been emphasised by Whittington *et al*. (2009) that high water demand negatively results in poor access to convenient and good-quality water sources. Thus, many individuals receiving higher incomes are likely to support and give finance for the utilisation of recycled water for household consumption purposes. This relationship had statistical significance levels of 1 percent and 5 percent for these variables.

However, age possessed a positive sign, as was expected, even though it was statistically inconsequential in influencing respondents' views regarding the use of reclaimed or recycled water to address the high demand for water among the Qiloane rural population of Lesotho. This result accentuates the point that using reclaimed water does not depend on how old or young an individual is.

4.4.2 Determining whether the respondents will be willing to use reclaimed water for the specified activities to settle the increased demand for water at Qiloane rural locations of Lesotho.

The purpose of this sub-section is to assess whether respondents will decide to use the reclaimed water for the following activities in response to the low supply that is insufficient to meet the consumers' demand. The respondents were presented with the following water use

statements in order to derive their preferences, and were invited to indicate "yes" if the statement was correct or they agree with it, and "no" if they disagree with the statement: "For food (drinking, cooking)"; "Domestic use – Bathing"; "Domestic use – Washing clothes"; "Domestic Use – Vehicle washing"; "Fire protection; Food crop irrigation"; "Filling swimming pool"; "Toilets and urinal flushing"; "Watering gardens and filling ornamental ponds and other farming activities"; "Irrigation of parks, schoolyards, residential landscaping, nurseries"; "Will you be willing to pay 40% smaller than the amount you presently pay for water usage to use recycled water"; and "If your household is presently **not** paying for water usage, will you be willing to shift to reclaimed or recycled water". The results of the analysis are depicted in Table 4.14.

Table 4.14: Determining whether the respondents will be willing to use reclaimed water for the specified activities to settle increased demand for water at Qiloane rural locations of Lesotho

Variable	HHWC	HHWTWC	Total
For food (drinking, cooking):			
Yes	29(55.8%)	34(63.0%)	63(59.4%)
No	23(44.2%)	20(37.0%)	43(40.6%)
Domestic use – Bathing:			
Yes	28(53.8%)	34(63.0%)	62(58.5%)
No	24(46.2%)	20(37.0%)	44(41.5%)
Domestic use - Washing clothes:			
Yes	31(59.6%)	34(63.0%)	65(61.3%)
No	21(40.4%)	20(37.0%)	41(38.7%)
Domestic Use – Vehicle washing:			
Yes	44(84.6%)	42(77.8%)	86(81.1%)
No	8(15.4%)	12(22.2%)	20(18.9%)
Fire protection:			
Yes	45(86.5%)	42(77.8%)	87(82.1%)
No	7(13.5%)	12(22.2%)	19(17.9%)
Food crop irrigation:			
Yes	43(82.7%)	42(77.8%)	85(80.2%)
No	9(17.3%)	12(22.2%)	21(19.8%)
Filling swimming pool:			
Yes	43(82.7%)	41(75.9%)	84(79.2%)
No	9(17.3%)	13(24.1%)	22(20.8%)
Toilets and urinal flushing:			
Yes	45(86.5%)	42(77.8%)	87(82.1%)
No	7(13.5%)	12(22.2%)	19(17.9%)
Watering gardens and filling ornamental ponds and other farming activities:			

Yes	44(84.6%)	43(79.6%)	87(82.1%)
No	8(15.4%)	11(20.4%)	19(17.9%)
Irrigation of parks, schoolyards, residential landscaping, nurseries:			
Yes	45(86.5%)	43(79.6%)	88(83.0%)
No	7(13.5%)	11(20.4%)	18(17.0%)
WTP 40% less than the amount being presently paid for water usage to use recycled water:			
Yes	12(23.1 %%)	0(0.0%)	12(11.3%)
No	40(76.9%)	54(100%)	94(88.7%)
If a household is presently not paying for water usage, will you be willing to shift to reclaimed or recycled water:			
Yes	0(0.0%)	38(70.4%)	38(35.8%)
No	52(100%)	16(29.6%)	68(64.2%)

Source: Own construct

Note: The frequencies are shown outside the brackets while the percentages are shown inside the brackets

From the statistical results in Table 4.14, the study established that most respondents exhibited a highly positive WTU reclaimed water for the identified activities. By the same token, the study confidently establishes that the respondents do indeed have a positive WTU reclaimed water as a supplement for satisfying household demand for water due to the recent depressed water supply situation within their locations. This is confirmed by the high, significant equivalent figures in which most respondents chose the "yes" preference for almost all questions except the question that inquired if they have a WTP of 40% less than the amount being presently paid for use of the water to use recycled water, to which most respondents selected the "no" preference. This 40 percent less is based on the fact that the recycled water has been used before, therefore, the price for it has to be lower than the water that has never been use. The implication is that, most respondents are not satisfied with the conditions of the water they consume in their residences. Hence, they are willing to pay even high price in order to access improved water services.

To further investigate the robustness of the results, chi-square (x^2) and ANOVA methods were employed to verify the potential influences of age, income, education and gender on respondents' WTU reclaimed water for the specified activities so as to receive improved water

services in the Qiloane rural locations of Lesotho. The chi-square (x^2) was used where the two variables are categorical, while the ANOVA F-test was used where one variable was categorical while the other one was continuous, and in this case, income and age were considered as continuous. Table 4.15 shows the results of the x^2 and F-test

Table 4.15: Impact of age, gender, education and income on respondents' willingness to use reclaimed water for the specified activities to settle the increased demand for water at Qiloane rural community locations of Lesotho

Variable	Age	Gender	Education	Income
For food (drinking, cooking)	0.5850	0.2480	1.1639	0.3952
	(1.000)	(0.618)	(0.884)	(0.963)
Domestic use - Bathing	0.6709	0.1641	0.3384	0.2396
	(1.000)	(0.685)	(0.987)	(0.976)
Domestic use - Washing clothes	0.6095	0.3639	1.4542	0.3057
	(1.000)	(0.546)	(0.835)	(0.943)
Domestic Use – Vehicle washing	0.0037	0.4060	7.6847	0.9518
	(1.000)	(0.524)	(0.104)	(0.944)
Fire protection	0.0020	0.8880	5.9104	0.8348
	(0.999)	(0.346)	(0.116)	(0.598)
Food crop irrigation	0.0165	0.1368	4.5321	0.7256
	(1.000)	(0.711)	(0.339)	(0.458)
Filling swimming pool	0.0431	0.3757	5.0504	0.6518
	(1.000)	(0.540)	(0.282)	(0.394)
Toilets and urinal flushing	0.0020	0.8880	5.9104	0.8348
	(0.999)	(0.346)	(0.116)	(0.598)
Watering gardens and filling ornamental ponds and other farming activities	0.0023 (0.992)	0.8880 (0.346)	7.0211 (0.135)	0.8348 (0.598)
Irrigation of parks, schoolyards, residential landscaping, nurseries.	0.0007 (0.984)	1.6735 (0.196)	5.4179 (0.144)	0.8458 (0.627)
Will you be willing to pay 40% less than the amount you currently pay for water usage to use recycled water?	0.6218 (0.984)	0.0225 (0.881)	2.1484 (0.708)	0.3997 (0.119)
If your household is presently **not** paying for water usage, will you be willing to shift to reclaimed or recycled water?	0.3339 (1.000)	0.5989 (0.439)	2.4107 (0.661)	0.4799 (0.465)

Source: Author's elaboration

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

The results in the table 4.15 indicate that almost all socio-economic variables, such as education, income, and gender, do not influence respondents' willingness to use (WTU) reclaimed water for the specified activities in the Qiloane rural locations of Lesotho. Age

possessed a positive sign, although it is insignificant in determining households' WTU reclaimed water. However, this is not surprising because respondents' WTU reclaimed water does not depend on how old an individual is, but instead, the two are independent in which respondents' WTU reclaimed water is determined by the people's basic preferences and the extent of the existing water demand. It is further emphasised that children are informed about the consequences of the water shortage problem at their schools and the relevant hygienic measures to take.

Gender does not seem to have an influence in determining the households' WTU reclaimed water for the identified activities. Although it has an expected positive sign, it is statistically not important in determining the households' WTU reclaimed water for the itemised activities. These results are not surprising because WTU reclaimed water is not determined by whether a household head is a male or a female. This implies that men and women are unvarying in relation to the use of reclaimed water. However, it was expected that women in the rural areas would be more receptive and have more information regarding the water usage issues since they frequently use the water for almost all household uses on a daily basis.

The education variable seemed not to influence respondents' WTU reclaimed water. Although the variable has a positive sign, the variable is not statistically important in shaping the WTU reclaimed water by the respondents. The implication is that the WTU reclaimed water is not inspired by whether an individual is well-educated or not, but instead, by the particular prevailing demand for water resource in their homes. It is further suggested that WTU reclaimed water is influenced by life experiences concerning the present water supply situation, meaning that if individuals are directly involved in the improvements to satisfy the water demand, they are likely willing to use reclaimed water. It is further highlighted that people with basic education do not differ from those with higher education in the utilisation of reclaimed water. For an individual to have enthusiasm to something depends on his or her underlying tastes and preferences. This shows that the water availability problem is a concern for an entire family; thus, everyone in the family experiences the similar problem, regardless of educational status.

The variable of income has an anticipated positive sign, but it was insignificant in capturing the respondents' WTU the recycled water. The higher income level of some of the people does not influence their WTU reclaimed water. The implication is that the WTU reclaimed water depends greatly on the existing high demand for water in the Qiloane rural locations of Lesotho.

Indeed, it was assumed that the higher the demand for water is, the higher the probability will be that more individuals would express a higher WTU reclaimed water in their residences. Therefore, the results indicate that all the households are affected by the poor water services, irrespective of whether an individual receives a higher income or a lower income.

4.5 CONCLUDING SUMMARY

Four inferences can be developed from the results noted in this chapter. In the first instance, when the perception of the households regarding the quality of the water supply in their locations was analysed, the results revealed sufficient evidence to suggest that the households in the Qiloane rural regions prove high levels of negative perceptions in relation to the predominating situation of the quality of the water supplied within their residences. Second, there was also adequate affirmation that the households hold negative attitudes concerning the quality of the water they use in their homes. Third, the households are demonstrated to have a high level of knowledge and understanding of the current water supply service situation in the rural localities of Lesotho, and the related threats they are faced with. Education and income have an influence on all constructs, implying that both education and income play a dominating role with respect to the management of household water supply services. Fourth, the results provided adequate evidence that the households have positive views regarding the use of reclaimed or recycled water in their respective locations, which implies that the households are eager to use the reclaimed water for domestic purposes because of the prevalent high demand for water within their community settings.

5 CHAPTER FIVE

ECONOMETRIC ESTIMATION OF BINARY CHOICE MODEL

5.1 INTRODUCTION

This chapter determines the WTP of the households in order to secure improvements in the quality of their water supply services in the Qiloane rural establishments of Lesotho. In order to attain this objective, the analysis of the WTP responses was done through the use of the probit model in Stata statistical software. The survey used a single dichotomous choice approach, and respondents were also requested to justify their reasons in voting for or against the proposed project. In accord with Tapsuwan (2011), the single-bounded approach was preferred over double-bounded approach because it presents attractive features in relation to double bound format in that, it requires less information, can avoid regular bias in responses that are due to the introduction of the follow-up question, and it is easier to implement at estimation and data collection stages.

Section 5.2 presents the econometric analysis of the results for the respondents' WTP for the monthly water tariff. The econometric analysis, through the application of the probit model for the respondents' WTP for an installation of the water equipment, is presented in section 5.3

Before the Probit model could be estimated for this split sample, it is important to assess the number of responses given by the respondents to an offered improvement cost amount for both water equipment installation and monthly water charge. The results are depicted in Table 5.1.

Table 5.1: Response distribution for the water equipment installation amount and monthly water charge

Price Response	**Charge amount**	
	50 (WEI)	250 (WMC)
Yes	74 (69.81)	70 (66.04)
No	32 (30.19)	36 (33.96)
Total	106	106

Source: Own construct

Note: The numbers inside the brackets indicate the percentages, and their corresponding frequencies are outside the brackets

WEI (Water equipment installation payment)

WMC (Water monthly charge)

The results in the table 5.1 indicated that there were 106 respondents in the sample. The results further indicate that the individuals were requested to state their agreement to the payment for water equipment installation based on M50.00 monthly amount as depicted, whereas they were also asked to indicate whether they would agree or not to paying M250.00 as their on-going monthly water charge increase on top of their current water tariff. The M50 monthly payment choice was considered as payment for a new water installation equipment over a five-year period which is equivalent to a once-off payment of M3000 per household. This was preferred in order to simplify matters for the rural poor and convince them, in that it becomes easy for them to pay bit-by-bit for new water equipment over five-year period of the project. Moreover, this water installation equipment cost was determined in consideration of the fact that the government of Lesotho will meet the residents of Qiloane half way, as it is also the government's responsibility to improve on water supply services for its people because they are all tax payers in the country so that they receive better services including provision of improved water services.

The choice of this M250.00 monthly water charge was established based on the water tariff being currently paid in the urban regions of Lesotho which are the only communities receiving quality water, and also in consideration of the expenses that may be incurred during an improvement of water service delivery and financial situation of the households. It was also noted that the current cost is too small for improved water supply services, hence, an increment on the cost of the water was settled in order to improve on the water quality services. The M250 or more will be paid regardless whether it is before or after an installation of new equipment or not, meaning that it does not depend on the installation of the water equipment.

Regarding the results, the "yes" responses were higher than the "no" responses, for both water equipment installation and monthly water payments. However, most respondents expressed a higher "yes" response for the payment for the installation of the water equipment than for the payment of the monthly water charge, although the difference is not that noteworthy because the prices greatly differ, and they are not related to the same entity.

These results further confirm that more than 50% respondents responded with the "yes" preference, thus outnumbering those with the "no" preference. However, Lopez-Feldman (2012) has underlined the fact that the proportion of respondents who provide positive comebacks would decline, owing to the increment on the amount of the bid, although bid

increment is irrelevant in this study because the study employed a single-bounded dichotomous approach for eliciting individuals' WTP, by which they were offered only one improvement cost. Generally, 70% of respondents almost responded 'yes' for the amount intended to be paid for installation of their water equipment, while 66% of respondents chose the 'yes' preference for the suggested amount to be paid as the monthly water bill in order to secure future improvement to the quality of the water supply services. Thus, this permits the researcher to proceed further with analysis and an econometric valuation of eliciting individuals' WTP for an improved service for a good in return for the payment.

5.2 ESTIMATION OF RESPONDENTS' WTP THE MONTHLY WATER TARIFF FOR IMPROVED QUALITY WATER SUPPLY SERVICES

The idea behind this section was to assess whether the households will be deliberate enough to pay a monthly water tariff based on the recommended improvement cost that was established to improve and sustain the demand for water quality supply service within their community locations. The cost of the water was recommended based on the focus group discussions and pre-tests conducted before implementing a final survey. Therefore, based on the findings of these preliminary surveys regarding the existing costs of the water, it was concluded that a monthly amount of M250 will be a reasonable water fee for each household to incur in order to have access on improved water quality services. This fee was discussed with relevant policy analysts from the Department of rural water supply and other economists from the department of Agricultural Economics of the National University of Lesotho.

Table 5.2: The results from the estimated Probit model for the respondents' WTP for the monthly water tariff

Variables	Level estimates	Marginal Effects	Std. Error	z
Gender	2.579***	.6752079	.1522657	3.15
	(0.002)			
Income	2.023***	.5253	.1326457	3.50
	(0.000)			
Age	.0286	.0074206	.0064705	1.14
	(0.254)			
Education: Primary school	2.015*	.2176411	.0715808	1.81
	(0.070)			
High school	2.698**	.284946	.0785662	2.39
	(0.017)			
Vocational	2.421***	.4511208	.1401932	2.60
	(0.009)			
Tertiary	1.061	.1677168	.0822684	1.23
	(0.217)			
Marital status: Married	1.133	.3019852	.1975311	1.52
	(0.129)			
Unmarried	4.516**	.3867427	.1126674	2.18
	(0.030)			
Divorced	2.174*	.2522675	.0727334	1.70
	(0.089)			
Household size	-.649**	-.1685239	.0768867	-2.08
	(0.038)			
Relation to household head	-4.237**	-.8605993	.0599685	-2.39
	(0.017)			
Employment: S farmer	-1.032	-.3580575	.7263221	-0.56
	(0.579)			
Commercial farmer	-5.055***	.9196608	.0510619	-2.90
	(0.004)			
Government employee	-2.384	-.7607258	.3172886	-1.64
	(0.100)			
Private sector employee	3.295**	.8976766	.1401167	2.18
	(0.029)			
Self-employee	4.223***	.9586896	.0598327	2.68
	(0.007)			
Water quality from alternative source	1.592**	.5497638	.2141098	2.47
	(0.014)			
Current water supply quality from main source	2.310***	.7496943	.1547375	2.84
	(0.005)			
Constant	-5.500		2.806528	-1.96
	(0.050)			
Log likelihood	-39.933955			
No. of Observations	106			
LR Chi2 (20)	55.98			
Prob>Chi2	0.000			

Source: Own construct

Probability values are reported in parentheses

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

The table 5.2 depicts the parameter estimates for the variables intended to influence the WTP of respondents to receive improvements in water supply services. In assessing the WTP of the households for the continued provision of improved water services, other variables were dropped off because they were statistically insignificant. The results of the model shown in the table above indicate statistical significance for the included covariates. This is further confirmed by a probability value of 0.000, representing the statistical significance of the overall model. Generally, 20 covariates were used for the econometric analysis, of which fourteen decisively influenced the respondents' WTP for enhanced water services.

The gender of the household head positively influenced the WTP with a probability value of $p<0.01$: p-value=0.002. This implies that the WTP for water services in the Qiloane community locations greatly depends on whether an individual is male or female. Therefore, it can be assumed that female respondents exhibit a higher WTP for water services than male respondents do. This is conceivably attributable to the fact that females mostly perform daily family chores, and this allows them to realise the importance of paying for a sustained water supply. The result of the marginal effect indicates that where an individual is female, her WTP probability for water services will increase by M0.675 or more, as opposed to a male member of the family.

The household monthly income has a statistical significance of $p<0.01$: p-value=0.000, and with a positive sign as anticipated. This implies that people with higher levels of income can manage to settle an increased payment for water services. This is consistent with environmental economic theory that an increase in income results in improvement of environmental quality, or generally demand for a particular commodity is subject to the income of the household (Sidrat & Heman, 2015). Also, since water is a normal good, its demand is expected to increase with a rise in income. In addition to the WTP, the ability of water consumers to pay has to be taken into account in any effort to present the cost allocation for the delivery of quality water. The marginal effect value in the table 4.17 above indicates that when household monthly disposable income is raised by M1, the individual's capability to pay for water supply services would rise by more than M0.525, *ceteris paribus*.

The variable that measures a respondent's age had the expected positive sign, although statistically insignificant, signifying that the older people become, the higher the likelihood is that older people are generally aware of the consequences of the current water they consume in their residences, and this results in their WTP for enhanced water services.

The respondents' educational level was another variable recognised to have impact on the households' WTP, with probability values of $p<0.1$: p-value=0.070 for the variable: "primary education", $p<0.5$: p-value=0.017 for the variable: "high school education" and $p<0.01$: p-value=0.009 for tertiary education variable, respectively. As expected, the estimated parameters possessed positive signs, implying that educated individuals tend to express more willingness to pay than unschooled respondents do. The reason is that a well-educated respondent has a greater consciousness regarding the serious impact of the vulnerable quality of the existing water supply and the health hazards experienced by the entire community. Also, the more individuals become educated, the more they would understand the consequences of consuming the water that is not safe and the importance of having access to a quality water supply service. Hence, better-educated individuals would be more willing to pay than individuals who have not received such education would be**.** These results complement other findings that have established that education increases individuals' awareness and renders them more sympathetic to policy development and innovation (Whittington *et al*. 1989, 1990, 1991; Farolfi *et al*. 2007). The marginal effects results indicate that as an individual continues to further his or her studies, his or her WTP probability for sustained household water provision may increase by M0.218, M0.285 and M0.451 or more, *ceteris paribus*.

The coefficient for a respondent's marital status variable for the single households has a significance level $p<0.05$: p-value=0.03 and positively influenced the WTP of the households for water services. This suggests that more unmarried households are more willing to pay for water services than the married households are. The possible reason could be that married households are mostly comprised of larger numbers, and are assumed to have high water consumption that further results in incurring more costs for water. However, single households possibly have smaller household sizes, which present no problem in incurring more water costs for the improved quality and sustained supply. Conversely, this contrasts with Niringiye and Omortor (2010) who noted that people who are married have a greater likelihood of being accountable for their household water quality supply services than unmarried people are. The assumption is that married individuals may have larger family sizes and hence experience higher risks of water-related diseases than those in single households do. The marginal effect shows that a respondent who is not married has a probability of paying about M0.387 more than the married individuals for water services.

The household size variable was also recognised to have a statistically significant ($p<0.05$: p-value=0.038) impact in influencing the residents' WTP a monthly water tariff in securing an

improved quality water supply and continuous flow for sustained supply, with an anticipated negative parameter estimate. The implication is that WTP for improvements in water services declines as the size of the household rises. This is because an abundant labour source might provide alternative resources for fetching water from the alternative sources. Also, since such families are characterised by larger household sizes, there is a higher opportunity cost of spending more income for enhanced water services, food consumption and other family needs (Wondimu & Bekele, 2011). This is long-established with the findings of Yeung and Chung (2014); Moffat *et al*. (2011); Yusuf *et al*. (2007) to the effect that WTP for water supply services drops when the size of the family becomes larger because more difficulties are then encountered with correspondingly large budgetary constraints.

Nonetheless, studies conducted by Birol *et al*. (2007) and Wright (2012) indicated that the household size had a positive sign in influencing households' WTP. The implication drawn from those studies was that when a household has a large population size, water consumption becomes higher, which further compels those people to bear the burden of collecting water, and thus those households exhibit a higher WTP for sustained and improved services to avoid having to travel lengthy distances to alternative water sources. The result of the marginal effect shows that when a family size increases by one individual, the household's WTP probability for water services will decrease by about M0.685 or less, holding other factors constant.

The relationship of an individual to the household head variable also had a significant effect for the estimated parameter with a probability value of $p<0.05$: p-value=0.017 and negatively influenced the WTP of the households for water supply services as expected. This is attributed to the fact that when a respondent is not the head of a household, the lower his/her WTP would be because he/she does not face the risks that can result from water-related diseases that the head of the household does. The implication is that the majority of the relatives of the household heads, such as parents of the heads, were perceived to express a lower WTP because they were not the breadwinners of the families, and have less power over the governance of the households' finances. This is not surprising because old-aged individuals are associated with shorter planning horizon, as opposed to the younger generation, and are thus less willing to forgo their funds for water supply services, as they claim the water to be a free resource supplied by the environment from God.

The coefficient for the respondent's employment variables for the commercial and subsistence farmers section had an expected negative relationship to WTP and a statistical significant effect

for its estimated parameter, with a probability value of $p<0.01$: p-value=0.004 for commercial farmers, while the variable for the subsistence farmers was statistically insignificant in explaining the WTP of the households. Therefore, this implies that the WTP of the subsistence and commercial farmers for improved water quality supply services will be lower than that of other employees who are not farmers. This is attributed to the reasoning that agriculture is viably uncertain because of uncontrolled climatic challenges, such as drought, which are associated with high running costs. This is because commercial farmers are expected to have high water consumption for their daily farm activities, as they are producing for profit and gain purposes. Hence, there is a need for them to recognise that having adequate and consistent water for their farm activities requires them to make higher payments for improved water supply services. The outcome for the marginal effect reveals that commercial farmers in most households have a probability of paying about M0.9197 less for sustained provision than subsistence farmers who are producing only for own-consumption purposes. Accordingly, it is inferred that subsistence farmers disregard or do not recognise the payment for water services as being of paramount importance to them.

Furthermore, the employment variable had a significant effect for the private-sector employee section, with a probability value of $p<0.05$: p-value=0.029. This implies that more households with private-sector employees could manage to pay for water services than those with civil-servant employees could. This might be because the private-sector employees receive higher monthly incomes, as indicated by most respondents during survey implementation; thus, their monthly disposable incomes would not be seriously affected when paying extra for water services. Moreover, private-sector employees were established to have acquired formal educations, and therefore they are conscious that, in order to ascribe value to improved environmental resource services, they need to be supportive in attaching monetary values to those services. The marginal effect result indicates that private-sector employees in most households have a probability of paying about M0.898 more for the domestic use of their water than civil servant employees have.

The coefficient for a respondent's employment status, specifically for the self-employed variable, also had a significant effect ($p<0.01$: p-value= 0.007). This implies that most households with self-employed individuals are ready to pay for enhanced water services, as opposed to unemployed individuals. This might be because of the fact that unsafe water negatively affects the businesses of the self-employed households, such as in restaurant cooking settings. This means that if there is a low water supply, the quantity being cooked daily

would decline in consequence, and as a result their profits would also decline. Likewise, where the water they use is of poor quality for human consumption, this might cause a decline in the number of customers because water which has a bad odour and taste would consequently affect the food, which the customers would then avoid. Therefore, they highly value the payment for water services needed for the betterment of their livelihoods. The result of the marginal effect for this variable indicates a probability of paying about M0.959 more for water services than those in unemployed households would.

The existing water quality of the alternative water source variable presents a significant ($p<0.05$: p-value=0.014) impact for the estimated parameter. It is implied that when respondents are affected by the prevailing water quality supply that is vulnerable, they exhibit a higher price elasticity of demand, and a higher willingness to pay towards an improved service for the good in return. This is conceivably because travelling a lengthy distance merely in search of water from another source is wearisome and time consuming. Hence, the estimate of the variable confirms that individuals paying for water from the alternative source will have a probability of paying M0.5497 for improved water services, *ceteris paribus*.

The respondent's perception about the current quality of the water supply from the main source has a positive relationship to WTP and a statistical significance level at 1 percent ($p<0.01$: p-value=0.005). Because of the existing water supply situation, it is expected that the respondents with negative perceptions (those who answered 'very poor') regarding the prevailing situation will be highly willing to pay more for quality water supply services than those who considered otherwise. This is due to the fact that the households who observe the poor quality of their current water and its health hazards are more likely to pay for water services than those who do not recognise any problem regarding the quality of their water supply and its associated health hazards. The probability of M0.155 discloses that individuals who are aware of their current water conditions can manage to pay more for the envisioned water services than can the respondents who are unaware of the existing quality of their water. This finding contradicts with Wondimu and Bekele's (2011) view that the perception of the respondents negatively influenced their WTP for improved quality water supply service.

5.2.1 Testing for the specification error of the estimated Probit model

The linktest Stata command results shown in the below table was used to detect the model specification error. The purpose of the test was to find out if there was any misspecification of the estimated model and whether the model was correctly determined. Therefore, if the model

was precisely specified, there would be no need to find any statistically significant predictors. Once the probit model had been run, the *linktest, nolog* command from Stata was regressed immediately in order to rebuild the model if it had a specification error. In order to test and rebuild the model, the test employs predictors known as linear predicted value (_hat) and linear predicted value squared (_hatsq). Therefore, the _hat predictor has to be significant, but it is otherwise if there is a misspecification of the estimated probit model. However, if Probit is accurately estimated, the _hatsq predictor will be insignificant, because if it is significant, the linktest will be significant as well implying that there might be an omission of important variables in the model, or link function is incorrectly stated. However, as shown in the model identified in the table 5.3, the linktest is statistically insignificant (p-value=0.168), implying that the determined probit model is correctly specified, and therefore the data fits well.

Table 5.3: The results showing a test for the specification error of the estimated probit model for the respondents' WTP for monthly water tariff

Variables	**Coefficient**	**Std Errors**	**z**	**P>|z|**
Linear predicted value	1.062913	.2086419	5.09	0.000
Linear predicted value squared	-.0809076	.0586675	-1.38	0.168
Constant	.0465874	.1712279	0.27	0.786
Number of observation	**106**			
Log likelihood	**-39.700928**			
LR Chi 2(2)	**56.44**			
Prob Chi 2	**0.000**			

Source: own construct

5.3 THE ECONOMETRIC ANALYSIS OF THE RESULTS FROM THE PROBIT MODEL FOR THE RESPONDENTS' WTP FOR AN INSTALLATION OF WATER EQUIPMENT.

The intention for this section is to ascertain whether the community members would support the scheduled project or not. This was anticipated to be examined by the higher number of the respondents voting for the project if they support it, and likewise for those voting against the aforesaid project if they do not support it. This is because the number of respondents is

significant in determining whether the said project would be feasible or not, in the sense that if fewer individuals vote for the project than those who vote against it, this means that it will be impractical for the project to be implemented, and vice versa. Therefore, the higher number of respondents voting for the project indicates their WTP for the installation of the water equipment, based on the suggested improvement cost for the improvement and continued demand for a quality water supply which was reached with the help from economists and other related policy analysts. However, the opposite is true for those voting against the project.

Table 5.4: The results from probit model for the respondents' WTP for an installation of water equipment

Variables	Levels of estimates	Marginal Effects(df/dx)	Std. Error	z
Gender	2.510*** (0.000)	.6026312	.1292068	3.54
Income	1.710*** (0.001)	.3717024	.103034	3.21
Age	-.0279 (0.261)	-.0060717	.0053766	-1.12
Education: Primary	1.679* (0.065)	.176089	.0600095	1.85
High school	1.853** (0.042)	.2065222	.0646771	2.03
Tertiary	2.817*** (0.003)	.4718396	.121876	2.96
Marital status: Married	.290 (0.690)	.0639376	.1606064	0.40
Unmarried	-.403 (0.675)	-.1016121	.2770075	-0.42
Divorced	-.550 (0.556)	-.1466942	.2949107	-0.59
Household size	-.992*** (0.005)	-.215668	.0633257	-2.83
Employment: C farmer	6.068*** (0.000)	.9529794	.0350931	3.63
Government employee	-2.093** (0.043)	-.6611993	.2921831	-2.02
Private employee	3.249** (0.011)	.8951044	.1427808	2.54
Self-employee	5.206*** (0.001)	.985715	.0211709	3.48
Health and economic results due to uncleansed and water scarcity	1.441*** (0.002)	.2348493	.0737955	3.10
Accurate water description	1.634* (0.088)	.5302475	.3833574	1.45
Shortage of water due to insufficient water equipment	1.699** (0.042)	.5763118	.2753418	2.03
Constant	1.342 (0.519)		2.083722	0.64
Log likelihood	-38.436			
No. of observation	106			
LR Chi2 (18)	52.97			
Prob>chi2	0.000			

Source: Own construct

Probability values are reported in parentheses

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

The table 5.4 illustrates the parameter estimates for the variables designated to affect the WTP of the households for an installation of the water equipment systems for ensuring prolonged and enriched quality water supply services. However, some variables were discarded in determining if individuals were indeed prepared to pay for the installation of the water equipment system because they were statistically not worth mentioning. The results of the model recorded in the table above show statistical significance for the included covariates, as shown by the Likelihood ratio Chi2 (18) of 52.97. The probability value of 0.000 represents the statistical significance of the overall model. The explained variable is, furthermore, a binary variable that respondents respond to as their maximum WTP for the improved water supply services, remembering the benefits derived from those services. It is shown that 18 covariates were employed for the econometric analysis, of which 13 certainly influenced the individual willingness of the households to forgo their funds to pay for the water equipment installation needed for an improved quality water supply service.

The estimated parameter for the gender of the household head has an anticipated positive sign, and is clearly statistically significant at a p-value of 0.000. The implication is that more female-headed than male-headed households in the rural regions of Qiloane in Lesotho have a greater awareness and responsiveness to the prevailing lack of improved water infrastructure needed for the water supply. This is because women and girls are mostly responsible for daily household tasks, which from time to time compels them to travel lengthy distances in times of need to fetch water. Therefore, it is assumed that they would support the project in order to avoid long queues at the water source points which are attributable to the insufficient water equipment systems within their communities. It was also hypothesised that the existing condition of their water supply also forced them to forego carrying out some of their other important activities, as travelling to fetch water for the family consumes most of their time. As indicated by the corresponding estimated coefficient for the marginal effect result for the variable, when the household head is female, the probability that she is capable of paying for the installation of the water equipment systems would increase by about 60.3% (M0.603) or more, as compared with her male counterpart, *ceteris paribus*.

The household monthly income variable also emphatically influenced the households' WTP, as expected, and has a statistical significance level of 1 percent. It is indicated that more individuals with higher disposable incomes have a greater predisposition to pay for the installation of modern water equipment systems to secure an uninterrupted water supply. Accordingly, the result, which is characterised by its respective marginal effect estimated

coefficient, indicates that when the monthly disposable income of the household rises by about M1, such individuals have a probability of paying about M0.372 more for water equipment installations within their residences than the households' members with little or no sources of income would. This implies that the household's WTP substantially increases with a better household monthly income, as confirmed by the estimate of income, which implies that a unit increase in the monthly income of the household will influence WTP to increase by M0.372, holding everything else constant. This corresponds with the environmental economic theory that assumes that a demand for improvement in service quality, regarding environmental resources, will increase according to the increments in disposable income of an individual.

The variable that measures a respondent's age had the expected negative sign, although statistically insignificant, signifying that the older people become, the higher the likelihood is that older people generally become dim-witted, and this results in less WTP for enhanced water services. Also, the WTP of the old-aged individuals might be low because they have a tendency to develop political conservativeness.

Levels of education have positive signs as expected and with statistical significance levels of 10 percent for primary education, 5 percent for high school education, and 1 percent for tertiary education, respectively. This implies that the more an individual becomes formally educated, the higher his/her WTP will be than the individuals who hold no formal qualifications. The estimated coefficients of education of the household head from the model can thus be interpreted as: when an individual continues to further his/her studies, this will increase the probability of his/her being willing to pay for the installation of water equipment systems by about M0.176 (primary or basic education), M0.0207 (high school education) and M0.472 (tertiary education), respectively. This might be attributed to those households who stated that the establishment of a fund for the purpose of improving the water quality supply service was onerous for those unschooled individuals who simply did not express their WTP because they thought of water supply services as being a privilege due to them that must be supplied by the state. It might be because the community may equate the water service with a social service to be provided by the government. Nonetheless, it is of paramount importance that societies should value water as an economic good because of problems in the viability of its treatment and supply services. There were cases where a few individuals with PhD qualifications did not want to support the project because they strongly believed that the costs of the project should be incurred for by the government, and not by them.

The variable of marital status of the household head is not statistically significant. The variable is not important in explaining the WTP of the households for the installation of water equipment systems to provide and secure improved and sustained services. This is because many individuals were in married households; hence, most of them are assumed to have larger family sizes which are associated with higher demand for water that ultimately cause expenses of the water to also rise, and hence experience higher risks of water-related diseases than single household heads do. This is in accord with Nitringiye and Omortor (2010) who noted that people who are married have a greater likelihood of being accountable for their quality household water supply services than unmarried people are.

The household size variable also has an inverse relationship to WTP and statistical significance in shaping the willingness of the respondents to pay for the installation of improved water equipment systems in their respective community locations. This is verified by the probability value of less than 1 percent ($p<0.01$: p-value=0.005) for this relationship, albeit with a negative estimated parameter that implies an inverse relationship to WTP. This is not surprising, because as household members increase (as is the case with most rural dwellers of Lesotho), the consumption of water also rises proportionately, and this directly causes the cost of the consumed water to rise, which often cannot be afforded. Hence, the result indicated by its corresponding marginal effect indicates that households with larger family sizes have about M0.2157, or 21.6 percent, less probability of incurring more expenses in support of the envisioned project for water equipment installation at their locations.

The employment categories of individual members of the households also have positive signs, except a parameter estimate for government employee variable and statistical significance levels of 1 percent for commercial farmer, 5 percent for government employee, 5 percent for private employee, and 1 percent for self-employed individual, respectively. This implies that the higher individual commercial farmers increase in number, the higher their WTP will be. The estimated coefficient for the variable suggests that a unit increase in number of the commercial farmers by one person would give an increase in his or her probability of WTP of about M0.953, holding other factors fixed. This is attributed to the fact that most of the commercial farmers consider that the payment for water is of vital importance because its service provision would be improved and sustained for their farms' production purposes. This is hypothesised to be in contrast to the subsistence farmers' view because the latter merely produce for domestic own-consumption and not for market purposes.

The employment variable for the private-sector employees positively influenced the WTP of these households for the installation of water equipment within their community locations which would secure improved, quality water supply services. This implies that more individuals employed in the private sectors, such as private companies, have a higher WTP than those without employment do. As confirmed by the estimated coefficients from the model, a unit increase in the number of the private sector employees by one employee will also increase the probability of WTP by such employees by about M0.895. The reason might be the fact that private-sector employees receive better incentives; hence, the costs of the water will not negatively affect their monthly budgets.

On the other hand, the public-sector employees display a negative relationship regarding WTP, although this is statistically significant, at 5 percent. This suggests that more individuals who are employed as civil servants, such as in government departments, will be less willing to pay. The associated estimated parameter signifies that, as the number of public-sector employees increases by one public-sector employee, the probability of their WTP will decrease by about M0.661. This might be because more of the public-sector employees consider the establishment of a fund for the project as being pointless because they perceive it as being the government's obligation to incur the costs of supplying water to the entire society. This is a prevalent reaction exhibited by households in most contingent valuation approach surveys, globally (Hoevenagel, 1994).

Lastly, the significant relationship of the self-employed households to WTP indicates that the more of the households who are self-employed would be more willing to pay for the installation of water equipment systems in their community locations. The related estimated coefficient suggests that if the number of self-employed individuals increases by one person, the probability of their WTP will be increased by about M0.986, everything else held constant. This might be attributed to the certainty that more of the self-employed individuals regard the project as worthwhile in order to avoid travelling the long distances to fetch water, as a result of insufficient water equipment, which consumes more of their time, hence negatively affecting to attain their daily targets for profit.

The factor for health and economic consequences attributable to uncleansed and scarce water has an anticipated positive sign and a statistical significance level of 1 percent. This means that most of the community members have a higher WTP. The correlated estimated coefficient suggests that a unit increase in the communities by one member would increase the probability

of WTP by about M0.235. This is attributable to the fact that many people are indeed conscious that water scarcity, in addition to great economic loss caused by low water-based production such as in agricultural produce, can lead to uncleanliness of the house and the food consumed in the household, which has a high potential for transmitting the germs and pathogens that are the carriers of disease-causing organisms. However, these problems are only associated with a shortage of water that leads to uncleanliness. This can lead to both loss of human lives and economic loss. Hence, more individuals consider that paying out their funds is mandatory for gaining improved quality water supply provision. In addition, the households have to opt for surface water during times of water scarcity, which further results in assuming the high risks that are associated with dirty water. Thus, their WTP is expected to be higher in order to obviate such risks.

The accurate description of the status of water supply in the community has a statistical significance level of 10 percent. This indicates that many of the interviewed respondents are ready to pay the costs for installing the water infrastructure systems in their dwellings. The result from the model further discloses that an increase in the number of household members in households by one person affects the WTP probability of the respondent to increase by M0.530, *ceteris paribus*. This is because many residents are well-informed about the dangers of the water they receive, in particular when they experience a shortage. It was emphasised that the residents have to resort to using surface water in times of water supply service shortages, and this results in very high health risks that are attributable to dirty water and unprotected water abstraction areas. Therefore, considering the prevailing water supply conditions, it is expected that those respondents with higher levels of knowledge of the current situation (those who responded with the 'yes' preference) will have a higher WTP for modernised, quality water supply services than those who might think to the contrary have. Accordingly, they considered the predetermined project to be obligatory for them, to allow them avoid such incidences.

Shortages of water due to insufficient water equipment has a positive impact to WTP, and statistical significance level of 5 percent. This implies that the WTP will be higher for these respondents who are aware that the shortage of water they are experiencing is attributable to the lack of water infrastructure. This shows that more residents will be willing to pay for improved water supply services of an envisioned project. The result from the model indicates that, as more people experience the problems caused by the lack of water equipment in their

community locations, the probability of their WTP for the installation of advanced water equipment systems will increase by about M0.576, *ceteris paribus.*

5.3.1 Testing for the specification error of the estimated Probit model

The purpose of this sub-section is to ascertain whether the estimated probit model was appropriately specified. The *linktest, nolog* Stata command was run in order to detect the specification error of the stated model, or if there was a misspecification of the model. Since the linktest regression revealed that the linear predicted value is statistically significant, and the linear predicted value squared is statistically insignificant as depicted in Table 5.5, this is sufficient for concluding that the estimated Probit model is precisely quantified, and the data from the model fits well, to permit suggestions to be made on policy formulation.

Table 5.5: The results showing a test for specification error of the estimated probit model for the respondents' WTP for an installation of their water equipment

Variables	**Coefficient**	**Std errors**	**z**	**P>|z|**
Linear predicted value	.9885663	.2215193	4.46	0.000
Linear predicted value squared	.0187631	.1695516	0.11	0.912
Constant	-.0109703	.2018048	-0.05	0.957
Number of observations	**106**			
Log likelihood	**-38.429998**			
LR Chi 2 (2)	**52.98**			
Prob Chi 2	**0.000**			

Source: Author's elaboration

5.4 ASSESSMENT OF THE RESPONDENTS' EXTENT OF CERTAINTY FROM THE REFERENDUM VALUATION QUESTION

This sub-section endeavours to ascertain the degree of certainty of the households with regard to the referendum question. This was analysed in order to reduce the problem of hypothetical bias arising from the dichotomous choice question (Blumenschein *et al*. 2008; Champ *et al*. 2009; Samnaliev *et al*. 2003; Loureiro *et al*. 2009).

Table 5.6: Respondents' levels of certainty for the referendum question

Level of Certainty	**Overall Responses**
Not sure at all/very uncertain	3(2.8%)
Neutral	8(7.5%)
Least sure	10(9.4%)
Very sure/certain	85(80.2%)

Source: Own construct

Note: The percentages are indicated inside the brackets, while the frequencies are shown outside the brackets.

The results shown in the table 5.6 indicate that most households understood the referendum valuation question well. After all, the certainty question was posed to assess the legitimacy and consistency of the answers to the referendum given by the households. Therefore, the results shown in the above table confidently indicate that about 80% of the respondents reported a high level of certainty regarding the response for the valuation question, with only about 9.4% of them revealing a moderate degree of certainty. However, 10.3% of them were not certain about their responses towards the dichotomous choice question. Thus, this evidence is sufficient for accepting that the responses to the referendum question are trustworthy enough to draw on for suggesting policy formulation.

5.5 EVALUATING THE REASONS FOR, OR AGAINST, THE PROPOSED PROJECT BASED ON THE RESPONDENTS' RESPONSES AFTER THE VALUATION QUESTION

This sub-section endeavours to ascertain whether the households would support the proposed project with an indication of voting positively towards a referendum question.

Table 5.7: Reasons for, or against, the proposed project

Reasons	HHWC	HHWTWC	Total
In general, the project is not a good use of the money	4(7.7%)	4(7.4%)	8(7.55%)
In general, the project is a good use of the money	15(28.8%)	10(18.5%)	25(23.58%)
The project is not realistic or unclear	1(1.9%)	0(0.0%)	1(0.94%)
The costs of the project should be paid for by the government	4(7.7%)	10(18.5%)	14(13.21%)
No believe that water quality could be improved	8(15.4%)	5(9.3%)	13(12.26%)
The project is worth the investment	20(38.5%)	25(46.3%)	45(42.45%)

Source: Author's elaboration

Note: The percentages are indicated inside the brackets while the frequencies are shown outside the brackets.

The results reflected in the table 5.7 indicate that most respondents clearly agreed to support the proposed project for attaining a continued and improved quality water supply. The majority of respondents reasoned that the improvement costs required for the provision of the anticipated enhanced quality water services are worth the investment, and this suggests that it is feasible for the project to be executed. This is because most households chose the "yes" preference in support of the envisioned project for future sustained water supply. It was also perceived that respondents predominantly attached a noteworthy value to the water as a non-marketed environmental good because the majority of them reasoned this be a good use of their funds, and thus they considered it to be no problem for them to forgo portions of their incomes for the intended project. However, while a few respondents greatly supported the proposed development, but reasoned that the project is unclear and that its costs have to be incurred for by the government and not the public. Apart from that, many respondents responded that the government of Lesotho is unstable because it does not sustain even for over three years for the implementation of the project. Hence, these respondents do not believe that their demand for quality water services will be satisfied. However, these respondents had no information that the government would implement the policy at hand, regardless of which government is in power.

5.6 ASSESSMENT OF THE EXTENT OF AGREEMENT OF THE HOUSEHOLDS THAT THE RESULTS OF THIS STUDY WILL INFLUENCE POLICIES ALLIED TO WATER SUPPLY AFTER PROPOSED INTERVENTION

The purpose of this sub-section is to collate the respondents' views on whether the results obtained from this study would have a substantial impact on the policy regarding the depressed condition of their prevailing water supply services. It is indicated that, as reflected by the respondents' chosen preferences from the valuation questions, the households would strongly agree to the attained results in order to positively influence the policy.

Table 5.8: Households' extent of agreement concerning the survey results for the purpose of policy intervention

Options	HHWC	HHWTWC	Total
Strongly agreement	36(69.23%)	37(68.52%)	73(68.87%)
Not sure or neutral	3(5.77%)	6(11.11%)	9(8.49%)
Strongly disagreement	13(25%)	11(20.37%)	24(22.64%)
Total	52	54	106

Source: Own construct

Note: The percentages are shown inside the brackets while the frequencies are shown outside the brackets.

The results reflected in the table 5.8 indicate that the households interviewed in the study conducted have a strong, positive belief and hope for positive outcomes from this survey. This is an indication that most households are indeed in need of this water development within their locations. This is confirmed by the high corresponding value (68.9%) at which most respondents opted for the strongly agree preference, indicating their emphasis that the results of the survey would positively impact on the policy for the proposed programme. Therefore, their strong agreement, as a whole, indicates that they are extremely supportive of a project designed to offer them an improved quality water supply and regular quantities within their dwellings. Nonetheless, an insignificant number of respondents disagreed that the results of the study would have a positive effect on the policy after the proposed intervention. This might be attributable to the fact that they do not consider the government to be trustworthy enough to instigate the envisioned project, as they argued that the government had since been promising, but to no avail.

5.7 EVALUATION OF THE GENERAL HOUSEHOLDS' POVERTY

This sub-section assesses the respondents' general level of poverty as an indication that they would be able to support the proposed project, and their utility will still remain at status quo even after implementation of the envisioned project.

5.7.1 The assessment of the household's type of house

The purpose of this sub-section is to ascertain the type of house that the household resides in. This is relevant because it was assumed that households with the affordability for water service payments would reside in expensively constructed houses; hence, they would be highly capable to offer the portion of their incomes to support for the planned project.

Table 5.9: The household assessment of their type of the house

Type of the house	HHWC	HHWTWC	Total
Brick wall, tiled roof	18(34.6%)	10(18.5%)	28(26.4%)
Wall, corrugated roof	22(42.3%)	34(63.0%)	56(52.8%)
Mud wall, corrugated roof	6(11.5%)	6(11.1%)	12(11.3%)
Mud wall, thatched roof	6(11.5%)	4(7.4%)	10(9.4%)

Source: Own construct

Note: The percentages are shown inside the brackets while the frequencies are shown outside the brackets.

The results reflected in the table 5.9 disclose that most of the interviewed individuals reside in houses with walls, corrugated and brick wall, tiled roof. This is confirmed by the overall high corresponding value (52.8%), signifying that majority of them are living in houses with brick wall, tiled and wall, corrugated roof. Based on this outcome, most households would still manage to pay for their water supply services, as it was noted that their affordability to live in the wall, corrugated and brick wall, tiled roof houses reflects individuals with better means for a living as such type of the houses yield higher costs in order to own them. It was further reported that the specified improvement cost offered was not a problem for them to incur in order for them to acquire better quality and sustainable water supply services. However, it was also assumed that those residing in mud wall, corrugated and thatched roof houses would be associated with low or even no WTP for water supply services. An implication is that, since the latter respondents can only afford to live in such types of houses which is to be assumed as due to small disposable monthly incomes they have. It was also observed that most of these respondents are characterised by having large family sizes, and therefore they would be less

willing to support the intended project. Thus, their utility would be reduced upon implementation of the said project.

5.7.2 Assessment of the nature of house tenancy for the household

The purpose of this sub-section is to determine the household's ownership of their residence. This is determined in order to confirm whether the household has the capability to support the project, based on the stipulated improvement cost. The implication is that if it is impossible for them to own their residences, it is also less likely that they might be able afford to incur their contributions to funds for the project, and vice versa.

Table 5.10: The household's ownership of the premises

House ownership	**HHWC**	**HHWTWC**	**Total**
Household owns the house	40(76.92%)	45(83.33%)	85(80.19%)
Household lives in rental premises	3(5.77%)	0(0.0%)	3(2.83%)
Household lives free of charge in the house	9(17.32%)	9(16.67%)	18(16.98%)
Total	52	54	106

Source: Own construct

Note: The percentages are shown inside the brackets while the frequencies are shown outside the brackets.

The results reflected in the table 5.10 indicate that the majority of the respondents own their premises. This is indeed confirmed by their higher corresponding number, which proves that almost 80% of them own their own residences. Regarding this outcome, most households are assumed to have a capacity to forgo part of their monthly disposable incomes for the purpose of improving the quality of the current water supply services. The households that own their own houses live permanently in the locations which there is a severe problem of water scarcity and quality; hence, they consider that paying for their water services is of paramount importance in gaining sustained supplies of improved water. This is opposed to the residents who live freely in houses they do not own, and who might thus not regard the value of the water as an environmental resource. This is because most of those respondents who live freely in

residences they do not own were found to be mostly the relatives and children of the heads of the households, and therefore it was not significant for them to regard the importance of the project, although this is surprising because water is utilised by every individual. Only about 17% of the entire population of interviewed individuals reside freely in these premises, which further indicates that the expenses of providing a family's basic necessities are not directly experienced by them. There is a low likelihood that households rent premises in the rural areas of Lesotho where the study was conducted; thus it is not surprising that only a small number of them reside in rental residences, which is designated by an estimated number of 2.8%.

5.7.3 Affordability of the households for the basic needs upon implementation of the project

The study also considered an analysis of what the households' affordability of basic needs would be after the dichotomous choice question was posed to them. The reason regarding this analysis of the affordability of basic needs was to determine if the households had carefully considered their budget restraints when noting supporting for the project. Table 5.11 depicts the results of the analysis.

Table 5.11: Households' affordability of basic needs after the project has been executed

Affordability of basic needs	**HHWC**	**HHWTWC**	**Total**
Yes	35(67.3%)	40(74.1%)	75(70.7%)
No	9(17.3%)	14(25.9%)	23(21.7%)
Not sure	8(15.4%)	0(0.0%)	8(7.6%)
Total	52	54	106

Source: Author's elaboration

Note: The percentages are shown inside the brackets while the frequencies are shown outside the brackets.

Regarding the results reflected in Table 5.11, the individuals generally would afford payments for the basic needs, such as water and food, after the implementation of the project. This is confirmed by the high equivalent estimated value of about 70% of the respondents for the entire interviewed Qiloane rural communities of Lesotho. However, a small proportion of the households did reveal their unaffordability to pay for such basic needs after implementation of

the project. This might be attributable to their lower monthly disposable incomes indicated by an estimated overall value of 22%. It was also noted that an insignificant proportion of the respondents (about 7.6%) indicated as they are uncertain whether or not they would manage to pay for their basic needs after the implementation of the prospective project. This generally shows that the affordability of the households to pay for basic needs is relatively higher (those with "yes" responses) as compared to those that cannot manage to pay (those with a "no" responses).

5.7.4 The Economic situation of the household

The financial situations of the households were also considered in the analysis. This was done in order to confirm that the responses attained from the survey are sufficiently indisputable for the purpose of policy formulation. This aspect was also analysed in order to ensure that the envisioned water supply service policy would not adversely affect the households, financially. This is in accordance with Whittington's (1998) view that the communities have to realise that a contemplated change will only occur in consequence of their financial engagement. Hence, it is of paramount importance to evaluate the economic situation of the households, based on their financial obligations. Furthermore, it is imperative to assess the households' economic situation as delineated by the Hicksian welfare measure of change, to the effect that even after financial engagement, the household should still remain at the status quo or same utility as it possessed before policy intervention. Table 5.12 indicates the results for the analysis.

Table 5.12: The economic situation of the household

Economic situation	Overall Responses
We have enough money to pay for our necessities and can also manage to buy durable assets	29(27.4%)
We can afford food, public utilities and pay for school fees but cannot afford to buy durable goods like car, sofa set, TV, fridge…	31(29.3%)
We can meet the expense of food and public utilities but it is problematic to pay for transport and school fees	27(25.5%)
We have money for food but cannot manage to pay for public utilities like water and electricity	19(17.9%)

Source: Author's elaboration

Note: The frequencies are shown outside the brackets while the percentages are shown inside the brackets

The results in the table 5.12 reflect that the majority of the respondents agreed with the proposed project for the provision of enhanced quality water and sustainable supply services in the Qiloane rural regions of Lesotho, and that their financial positions would not be detrimentally altered in regard to their basic needs, such as public utilities, school fees, durable assets and food. The analysis affirms that a large portion of the households responded positively regarding their economic position, as itemised in the table above. This means that many of the people would still meet the costs of their regular basic necessities after implementation of the project. Nonetheless, there are still a few households that seemed not to be able to manage to pay for the new proposed service. It is indicated that most people can afford to pay for food, public utilities and pay for school fees, but cannot afford to buy durable goods such as a car, sofa set, TV, and fridge. This information reveals that their economic position indicates that they could manage to support the new project that is intended to offer them a sustained and enhanced quality water supply. Therefore, this information is sufficient to draw the conclusion that the households would still remain financially secure after the implementation of the new proposed policy.

5.7.5 The wealth status of the households, based on levels of their incomes.

The analysis also examined the wealth status of the household. This was done in order to ascertain if the responses from this survey are sufficiently authentic for the establishment of the policy. This is because most of the respondents expressed a higher support for the project; hence, the study investigated whether their wealth status was appropriate and practicable in voting emphatically for the dichotomous choice questions with regard to the class of their incomes. The table 5.13 shows the results for the analysis.

Table 5.13: The wealth status of the households, based on levels of their incomes

Options	Overall Responses
Well-to-do	4(3.8%)
With average income level	33(31.1%)
Below average income level	51(48.1%)
Poor	15(14.2%)
Very poor	3(2.8%)

Source: Own construct

Note: The frequencies are shown outside the brackets while the percentages are shown inside the brackets.

The results presented in the table 5.13 indicate that most of the respondents are found to be within the 'average' and 'below-average' income level categories. This analysis underpins the point that the proposed project would be feasible because most households seemed to have necessary means to support it. However, an insignificant number of the respondents fell within the 'well-to-do' income level category. This is not surprising because there is a low likelihood of rich individuals living in the rural regions of the country, as opposed to the urban areas which most of the prosperous people prefer; thus, the study was characterised by households within the 'less well-off 'category. An insignificant number of poor households was identified from the study. This implies that, since most developing countries are highly affected by extreme poverty, Lesotho is not an exception in finding poor and very poor individuals.

5.8 EVALUATING THE GENERAL ACHIEVEMENT OF THE QUESTIONNAIRE FOR THE INTERVIEWS WITH RESPONDENTS

This section assesses the specific problems within the survey instrument and seeks to ascertain the extent to which the questionnaire performed well. The questions were divided into four parts, being the questions examining the extent of understanding by the respondents; questions verifying whether or not there were any questions that were complicated; questions measuring the support of the respondents to the proposed project; and the questions examining the authenticity of the responses provided by the respondent. This part was relevant for assessing the functioning of both the enumerators and the respondents. The results for the analysis are depicted in Table 5.14.

Table 5.14: Analysis of the interview

Questions	Options	Overall responses
Did the respondent understand all the questions	Very well understood	88(83%)
	Understood	17(16%)
	Not understood	1(0.9%)
	Not well understood	0(0.0%)
Were there questions that were complicated to the respondents?	Yes	15(14.2%)
	No	91(85.8%)
How was the reaction of the respondent towards the overall survey questions	Very Supportive	90(84.9%)
	Moderately supportive	15(14.2%)
	Not supportive	1(0.9%)
	Completely unsupportive	0(0.0%)
How do you rank the reliability of the responses provided to you by the respondents	Very reliable	81(76.4%)
	Moderately reliable	20(18.9%)
	Not reliable	2(1.9%)
	Not reliable at all	3(2.8%)

Source: Author's elaboration

Note: The frequencies are shown outside the brackets while the percentages are shown inside the brackets

With reference to the results obtained from the analysis as depicted in Table 4.29, it was recognised that the overall evaluation of the respondents' interviews is sufficiently efficacious for drawing a conclusion for the purpose of policy formulation. Most of the questions in the entire interview analysis seemed to score the highest votes in all four sections. The statistical analysis for the results confirms that more than 83% of the respondents 'clearly understood' the survey questions and had a very clear understanding of the recommended policy plan, while about 16% of the respondents seemed to only 'understand' the questions and the proposed project. This is not surprising because the larger proportion of the households seemed to be more aware because they are negatively affected by the predominating, distressing situation of their water supply service; hence, they also clearly understand the planned intervention under the policy, as illustrated from the valuation scenario. However, only a smaller portion of the respondents (1.9%) expressed their misunderstanding of the questions, and more explicitly, the planned intervention of the policy.

By the same token, more than 85% of the respondents confirmed that the survey questions were not complicated for them, whereas only a few (about 14%) of them identified the survey questions as being complex for them. This is because some sought donations from the interviewers. Indeed, some respondents did not want to reveal their monthly budget and personal information. They stressed their wish not to be asked their personal information such as age because this does not correlate with water supply issues. This could be interpreted on the basis that, as more people grow older, they exhibit a susceptibility to become more politically conservative. Some self-employed respondents, specifically those selling goods on the streets, explained that they are uncertain about their actual budget and the expenditure they incur daily, because these fluctuate greatly. Nevertheless, the reliability question was posed to examine the legitimacy of the answers received through the survey. Regarding the results from the analysis, it is clear that 76.4% of the respondents provided very reliable responses, while 18.9% of them expressed moderately reliable responses, and only about 2.4% of them exhibited unreliability in their responses to the survey questions. This is because most of the respondents expressed an understanding and awareness of the importance of the study and the proposed project for their sustained livelihoods. It was also assumed that the more an individual understands the importance of the study, the higher the probability will be that he or she would exhibit a higher reliability and be more supportive of the survey questions in general. This is

confirmed by the higher number of respondents (84.9%) who reacted very supportively to the survey questions and enthusiastically supported the planned policy during the interviews. Therefore, it can be concluded that the results from this analysis provide ample evidence to confirm that the survey instrument employed for the study was comprehensive in its effect, considering the results it generated.

5.9 CONCLUDING REMARKS

As noted from the results in this chapter, four implications can also be established. In the first case, there was ample confirmation that the socio-economic characteristics of the households have impacts on the WTP of individuals for an improved quality water supply service. Second, sufficient information was derived from the households' assessments of the current quality of the water supply service to confirm that they are aware of the prevailing situation. However, most of them are uninformed and lack the applicable information pertaining to the use of decontamination practices required to cleanse the water to make it safe before being consumed.

Third, the results affirmed that the WTP of individuals for both the installation of the water infrastructure and the monthly water tariff required to satisfy the household demand for quality water supply services is clearly influenced by the intensity of the existing problems in the water supply situation. There was substantial evidence that a statistically significant discrepancy was disclosed by the responses for both installation of the water equipment and monthly water bill payments in the sample. The binary choice response model was employed to evaluate if the households would be willing to pay the offered improvement cost for the installation of the proposed water infrastructure and the monthly water tariff with the intention of acquiring and securing future improved quality and sustained water supply services. From the WTP of individuals for the installation of the water equipment, it was found that most individuals were willing to pay M50 or more. This was in accordance with expectation, as it was foreseen that the WTP of the individuals would overstate the average specified improvement cost. It was also ascertained that most individuals would be willing to pay a monthly water tariff of M250 or more, as revealed by the probit model. However, this was inconsistent with expectation, as it was anticipated that the individuals' WTP would understate the average established improvement cost.

Nevertheless, the bid coefficients were not computed in either of the probit models representing both WTP of the households for an installation of water equipment and WTP for the monthly water tariff because it does not differ. Hence, resulting in multicollinearity (Collinearity).

According to Williams (2015), multicollinearity is the problem which occurs when two or more explanatory variables in the model are nearly determined by a correlation or linear combination of other explanatory variables in the model. Collinearity can be present due to the failure to exclude one category (incorrect use of the dummy variables). When perfect collinearity occurs, meaning when one explanatory variable is a perfect linear combination of others, it is not possible to get a unique estimate of regression coefficients with all the explanatory variables in the model. Besides, the presence of multicollinearity in the model results in greater standard errors, very wide confidence intervals and very small t-statistics. Since it will be harder to reject the null during the presence of multicollinearity, the coefficients will have to be larger so as to be statistically significant. Therefore, the Stata program called *collin* was used after estimating the probit models in order to detect the multicollinearity, and it was observed that the multicollinearity was not present in the determined probit models.

6 CHAPTER SIX
CONCLUSION AND RECOMMENDATIONS OF THE STUDY

6.1 INTRODUCTION

The study employed a contingent valuation approach for ascertaining whether the surveyed households will be willing to pay to secure improved water supply services at Qiloane rural regions of Lesotho. This was achieved through the application of a single-bound dichotomous choice elicitation, in which a binary choice response probit model was applied for the econometric analysis. The data was assembled from a random sample of 106 respondents in the identified rural communities. The study also determined the willingness of the households to use reclaimed or recycled water in order to settle the increased demand for water, their assessment of the current quality of the water supply services, and the households' viewpoints, attitudes and knowledge of the existing conditions of water supply services for the purpose of securing an improvement in future water services. This chapter summarises the conclusions, recommendations, policy formulation, and boundaries of the study, and further proposes important areas for future studies.

6.2 CONCLUSION

These following conclusions can be drawn from the results reported in Chapter 4 and 5. Firstly, the households in the rural areas of Qiloane in Lesotho demonstrate high levels of knowledge regarding the consequences of improper water supply management for the environment and the welfare of the community. Secondly, the households in the fore-mentioned locations hold conceptions and attitudes that are sympathetic to a policy which will reform their *status quo*. In particular, the monthly incomes of the households and their levels of education significantly mobilise the opinions, attitudes and knowledge of the households towards enhanced quality water supply services. Thirdly, the demographic characteristics identified also significantly impacted on the individuals' WTP for securing quality water supply services. Fourthly, the WTP to satisfy the household's demand for enhanced quality water supply services was statistically important. The WTP of the households was higher for both the payment for the water infrastructure installation and the monthly water charge. This is because most households demonstrated a higher WTP an improvement cost (M250, or even more) as their monthly water

charge and M50 as the monthly instalment payment, over a period of five years, for the installation of the water infrastructure systems within their community locations. The current situation of the quality of the water supply services was perceived to be intolerable, which indicates why most households demonstrated a higher WTU recycled or reclaimed water in their dwellings.

6.3 RECOMMENDATIONS AND IMPLICATIONS FOR POLICY

Rural water supplies, delivered by public utilities, are experiencing severe failures in various developing nations. By the same token, the rural locations of Lesotho are characterised by vulnerable conditions regarding water supply facilities. Because the government has ineffectively attempted to put the water supply service system into operation, this study has endeavoured to explicitly indicate that the households in the Qiloane rural communities value a state in which sufficient and pertinent water supply services are offered higher than the *status quo*, regardless of whether such services were to be offered at a charged fee. In relation to the foregoing, the study suggests the recommendations set out below.

First, there is an obliging circumstance to establish corresponding policy regarding the water supply services in the rural settlements of Lesotho that constitute the provision of sufficient and uninterrupted water supply services of good-quality. This is due to the fact that the households rank a status in which sufficient and befitting water supply services are offered higher than the *status quo*.

Second, the government could recover some of the expenditure by charging tariffs for improvements to the water supply services in the Qiloane rural community settlements. This is because the viable provision of sufficient and quality water supply services requires a monetary involvement; therefore, such services should be offered subject to a monthly payment by consumers. This is owing to the fact that the study indicates that the households remarkably rank a state in which the sufficient and pertinent water supply services are offered higher than the status quo irrespective of whether such services were to be offered at a payment or fee basis.

The third recommendation is concerned with how much the fee should be that households would pay for the service. The analysis records that the respondents are willing to pay M250 or more for the monthly water tariff, and M50 or more per household in payment of the cost of installation of water equipment system, over a five-year period, required for improved quality

household water supply services. Therefore, the aforesaid indicates that the Qiloane rural residents in general consider water as being an economic good, and not a public good, due to their willingness to pay for its provision. Based on the awareness that some households currently pay an average of M200 to M250 in the areas (towns in the country) with improved quality water supply services, it is considered that a monthly household charge of between M250 and M300 is justifiable. However, the actual water price to be charged by the Water and Sewage Company (WASCO) for the envisioned water supply service should be settled through consultation with relevant stakeholders. This is attributed to the reasoning that in addition to economic efficiency, the said charge should be settled by taking into consideration the socio-economic status of the respondents, such as location, educational background, gender, ability of household to pay, administrative expenses, poverty status, capability and willingness of the government to subsidise, before pricing the water. Hence, training campaigns that address perceptions of water quality might be an effective strategy for addressing the demand for water supply quality improvements. Nonetheless, water pricing continues to be a challenge in the rural regions, particularly in finding an equity in access to an improved water supply and the fundamental cost recovery. Accordingly, there should be a cautious implementation of policies that are aimed at recovering revenue from water improvement measures. This is because higher prices for the water may pressurise the poor households to revert to using alternative traditional water source points with severe public health risks. Undoubtedly, wealth is an important element of both WTP and improvement preferences, which suggests that wealthier individuals would more easily afford to pay for water supply facilities than poorer individuals would.

The final recommendation relates to the issue of the subsidy by the government or other agencies. It is recommended that the households be subsidised for the upfront cost of installing the water infrastructure required for accessing water supply services. The water utility would have to determine what appropriate method should be applied to efficiently implement the subsidies.

Last, but not least, an imperative policy implication arising from this study is that consideration should be given to the demand side rather than supply side in order to assess the price instrument and to consider the WTP of the households. It is also important to recognise that an analysis of investments costs and estimation of the cost–benefits should be conducted with the application of revealed preference methods, such as the hedonic price method, instead of stated preference techniques.

6.4 LIMITATION OF THE STUDY AND AREAS FOR FURTHER STUDIES

The present study has concentrated on the demand side, examining the socio-economic circumstances, the prevailing water supply service situation, the willingness of the households to use recycled or reclaimed water, and the individual's WTP for improved water supply services. However, the study did not cater for the government's institutional inadequacies and deficits in financial management. Incremental water charges are thus considered to comprise a fundamental condition, although this is not an adequate condition for making effective water provisions. The study was restricted to the Motloheloa, Nkhata, and Mothae locations of Qiloane rural communities in Lesotho. Accordingly, the results from this study might not necessarily apply to other regions without considering further the socio-economic characteristics of the household.

This study was restricted to determining the WTP of households for improved quality water supply services. This study surveyed only the heads of the households in the Qiloane rural community area, and it is acknowledged that this area includes many individuals who are not the heads of the households, and that they might have relevant information about the water supply services. Hence, the WTP for improved quality water supply services has been examined only for the heads of households, and not the other residents. There is a need to evaluate the WTP of individuals for improvements in water supply services, irrespective of whether they are a household head or not, because it might be that their WTP for water supply services varies significantly from that of the heads of the household. Furthermore, this study did not determine the amount of household water consumed per household, which might have a significant impact on how much individuals would be able to pay for water services. Finally, this study was restricted to the quality of household water supply, whereas respondents revealed that they were also experiencing problems relating to poor water quality, unavailability water management systems, and water that is unreliable in terms of its supply capacity in the Qiloane rural community locations. Therefore, there is a requirement to examine the WTP of the households for improved water supply reliability, in terms of its capacity and position, and the provision of improved water management systems in the Qiloane rural community locations.

LIST OF REFERENCES

Abu Madi, ML, Braadbart, O., Al-Sa'-ed, R. & Alaerts, G. 2003. Willingness of Farmers to pay for reclaimed wastewater in Jordan and Tunisia. Water Supply, 4, pp. 115-122.

Agudelo, J. 2001. The Economic Valuation of Water: Principles and Methods Delft: IHE Delft.

Alam, K. 2005. Valuing the environment in developing countries: Problems and potentials. Paper presented at the 49th Australian Agricultural and Resource Economics Society (AARES) Annual Conference, February 9-11, 2005, Coffs Harbour, NSW, Australia.

Arrow, K., R. Solow, P.R, Portney, E.E. Leamer, R. Radner & Schuman, R. 1993. "Report of the NOAA Panel on contingent valuation," Federal Register, January 15, Vol.58, no.10, pp.4601-4614.

Bateman, I., Burgess, G.D., Hutchinson W.G., & Matthews, D.I. 2008. Learning design contingent valuation (LDCV): NOAA guidelines, preference learning and coherent arbitrariness. 55:127-141.

Bateman, I.J., Langford, I.H., Jones, A.P. & Geoffrey, N. K. 2001. Bound and Path effects in double and triple bounded dichotomous choice contingent valuation. 23:191-213

Baisa, B., Davis, L., Salant, S. & Wilcox, W. 2010. The welfare costs of unreliable water service. Journal of Development Economics, 92, 1-12.

Birol, E., Koundouri, P. & Kountouris, Y. 2007. *Reducing the vulnerability of Societies to Water Related Risks at the Basin Scale*. Bochum, Germany, September 2006. IAHS Publ. 317, 2007.

Bishop, R. C., Heberlein, T.A. 1979. "Measuring Values of Extra market Goods: Are Indirect Measures Biased?" American Agricultural Economics Association 61(1979): 926-930.

Bogale, A. & Urgessa, B. 2012. Households' willingness to pay for improved rural water service provision: An Application of contingent valuation method in Eastern Ethiopia. Journal of Human Ecology, 38 (2), 145-154.

Bureau of Statistics, Lesotho. 2006. Population and Housing Census, "*Volume IIIB Socio Economic Characteristics"*. Bureau of Statistics. http//www.bos.gov.ls

Blumenschein, K., Blomquist, G.C., Johannesson, M., Horn, N. & Freeman P. 2008. Eliciting willingness to pay without bias: Evidence from a field experiment. The Econ J 118 (525):114-137.

Burton, A.C., Carson, K.S, Chilton, S.M. & Hutchinson, W.G. 2003. An experimental investigation of explanation for inconsistencies in responses to second offers in double referenda. 46:472-489.

Cameron, T.A. & Quiggin, J. 1994. Estimation using contingent valuation data from a "dichotomous choice with follow-up" questionnaire. Journal of Environmental Economics and Management 27:218-234.

Carson, R.T. 2012. Contingent valuation: A Practical Alternative when Prices Aren't available. Journal of Economic Perspective, 26(4): 27-42.

Carson, R.T. & Hanemann, W.M. 2005. *Handbook of Environmental Economics, volume 2*. Edited by K.-G. Maler and J.R. Vincent, USA.

Carson, R., Mitchell, R., Hanemann, M., Kopp, R., Presser, S., & Ruud, P. 2003. Contingent valuation and lost passive use: Damages from the Exxon Valdez oil spill, Environmental and Resource Economics, 25, (2003), 257– 286.

Carson, R.T., Hanemann, M. & Mitchell, R.C .1986. Determining the Demand for Public Goods by Simulating Referendums at Different Tax Prices. Department of Economics, University of California, San Diego (1986).

Champ, P.A, Bishop, R.C., Brown, T.C. & McCollum, D.W. 1997. Using donation mechanisms to value non-use benefits from public goods. Journal of Environmental Economics & Management, 33 (2):151-162.

Champ, P.A, Moore, R., & Bishop, R.C. 2009. A Comparison of Approaches to Mitigate Hypothetical Bias. Agric Resour Econ Rev 38 (2):166–180.

Coggan, A. & Whitten, S. 2005. Market Based Instrument in Australia Background Paper presented at the Desert Knowledge CRS Workshop Alice Springs, 8-10 June, 2005, CSIRO sustainable ecosystems.

Cooper, J. Hanemann, M.W. & Signorelli, G. 2002. One and One-half Bids for Contingent Valuation. 84:742-750.

Cooper, J. & Loomis, J. 1992. Sensitivity of willingness-to-pay estimates to bid design in dichotomous choice contingent valuation models. Land Economics, 68 (1992), pp. 211-224.

Day, B.H. & Mourato, S. 1998. Willingness to pay for water quality maintenance in Chinese rivers. Centre for Social and Economic Research on Global Environment (CSERGE) Working Paper, WM 98-02.

Department of Rural Water Supply.1998. Community Management Handbook for Village Water and Health Committees. Lesotho: Ministry of Natural Resources.

Dixon, J.A., Scura, L.F., Carpenter, R A., & Sherman, P.B. 1994. Economic Analysis of Environmental Impacts. London: Earthscan Publications Ltd.

Farolfi, S., Mabugu, R. E. & Ntshingila, S. N. 2007. Domestic water use and values in Swaziland. A Contingent Valuation Analysis. Agrekon 46(1): 163-164.

Flachaire, E. & Hollard, G. 2006. "Controlling Starting-Point Bias in Double-Bounded Contingent Valuation Survey." Land Economic 82 (Feb): 103-111.

Fonta, W.M., Ichoku, H.E., Ogujiubac, K.K. & Chkwuc, J.O. 2007. Using a Contingent Valuation Approach for Improved solid waste management facility. Journal of African Economics, 2:277-304.

Freeman, A.M. 2003. The Measurement of Environmental and Resource Values, 2nd ed. Washington, DC: Resources for the Future.

Frey, B.S., Huechinger, F.S. & Stouter, A. 2004. Valuing public goods: The life satisfaction approaches, working paper series, Institute of Empirical Research in economics, university of Zurich.

Georgiou, S., Whittington, D., Pearce, D. and Moran, D. 1997. *Economic Values and the Environment in the Developing World*. Cheltenham: Edward Elgar.

Goldblatt, M. 1999. Assessing the effective demand for improved water supplies in informal settlements: A willingness to pay survey in Vlakfontein and Finetown, Johannesburg. *Geoforum* 30, 27–41.

Haab, T., & McConnell, K. 2003 .Valuing Environmental and Natural Resources: The Econometrics of Non-Market Valuation, Massachusetts: Edward Elgar.

Haab, TC, McConnell, KE. 2002. Valuing Environmental and Natural Resources: The Econometrics of Non-Market Valuation. Cheltenham, U.K.: Edward Elgar.

Hanemann, W.M, Loomis, J., & Kanninen, B. 1991 "Statistical Efficiency of Double bounded Dichotomous Choice Contingent Valuation." American Journal of Agricultural Economics 73 (Nov.):1255-63.

Hanley, W., Mourato, S., & Wright, R.E. 2001. Choice Modelling Approaches: A superior alternatives for Environmental valuation. Journal of Economic surveys, 15(3):435-462.

Hanley, N.F. Shogren, Janson & Ben. 1997. Environmental Economics in Theory and Practice. Macmillan Press Limited, London.

Hanley, N. & Splash, C. I.1993. Cost-Benefit Analysis and the Environment, Cheltenham, UK. Northampton, MA.

Haq Mirajul, Usman Mustafa, & Iftikhar Ahmad. 2007. Household's Willingness to Pay for Safe Drinking Water: A Case Study of Abbottabad District. The Pakistan Development Review, Vol. 46, No. 4, Papers and Proceedings PARTS I and II, pp. 1137-1153.

Hausman, J.A., ed. 1993. Contingent Valuation: A Critical Assessment. Amsterdam: North Holland.

Hensher, D., Shore, N. & Train, K. 2005. 'Households' willingness to pay for water service attributes'. Environmental and Resource Economics, 32, 509-31.

Hoehn, J.P., and Randall, A. 1983. "Incentives and Performance in Contingent Policy Valuation." Paper presented at the American Agricultural Economics Association summer meetings, Purdue University.

Hoevenagel, R. 1994. The Contingent Valuation Method: Scope and Validity. Amsterdam: Hoevenagel.

Herriges, JA, & Shogren, JF .1996. Starting Point Bias in dichotomous Choice Valuation with Follow-up Questioning. J Environ Econ Manag 30 (1):112-131

Hoyos, D. & Mariel, P. 2010. Contingent valuation: Past, Present and Future. Prague Economic Paper.

Johanson, Per – Olov. 1991. An Introduction to modern welfare economics, Cambridge University press.

Kahn, J.R. 1997. The Economic Approach to Environmental and Natural Resource. Orlando: The Dyden Press.

Kanayo, O., Ezebuilo, U. & Maurice, O. 2013. Estimating the willingness to pay for water services in Nsukka Area of South-Eastern Nigeria using contingent valuation method: Implications for Sustainable Development. J Hum Ecol, 41(2): 93-106(2013).

Kanninen, BJ. 1995. Bias in Discrete Response contingent valuation. 28 (1):144-125.

Kanninen, B.J. 1993. "Optimal Experimental Design for Double-bounded dichotomous choice contingent valuation" Land Economics 69:138-146.

Kingdom of Lesotho. 2013. Lesotho Millennium Development Goals Status Report.

Lebabo, R.J. 2016. Influence of water source points location on households' willingness to pay for water supply reliability in Maseru, Lesotho. MSc thesis: University of Pretoria, Pretoria.

Lema, Z. & F. Beyene. 2012. Willingness to Pay for Improved Rural Water Supply in Goro-Gutu District of Eastern Ethiopia: An Application of Contingent Valuation. *Journal of Economics and Sustainable Development* 3:14, 145–59.

Leòn, C. J**.** 1995. "El metodo dicotomico de valoraciòn contingente: una aplicaciòn a los espacios naturales en Gran Canaria", *Investigaciones Economicas,* 19.

Leshoboro, N. 2009. The Flow Variability of the Phuthi River & implications for water supply in Maseru. Ministry of natural resources, Department of Water Affairs.

Lesotho Country Proposal to the Millennium Challenge Corporation. 2006. A Programme for Improvement of Water Supply, Rehabilitation of Health Infrastructure and Promotion of Private Business Development.

Lesotho Meteorological Services. 2013. Climate of Lesotho. Ministry of Energy, meteorology and water affairs.

Lesotho Ministry of Natural Resources. 2006. Conservation and rehabilitation of wetlands in Lesotho. Ministry of Natural Resources, Department of Water Affairs, Maseru, Lesotho.

Letsie, M. 2005. Utilization of Maqalika reservoir as a source of potable water for Maseru city in Lesotho. Magister Technologiae Dissertation. Durban Institute of Technology.

Lopez-Feldman, A. 2012. Introduction to Contingent Valuation Using Stata. (MPRA Paper No. 41018). Available online at http://mpra.ub.uni-muenchen.de/41018/ . Accessed on: 10/05/2017.

Lopez-Feldman. 2013b. Introduction to contingent valuation using Stata. MPRA paper 41018.

Loureiro, M.L, Loomis, J.B, & Vázquez, M.X .2009. Economic Valuation of Environmental Damages due to the Prestige Oil Spill in Spain. 44:537–553. doi:DOI 10.1007/s10640-009-9300-x.

Markandya, A. 1992. The Value of the Environment: a state of the art survey, In: Markandya, and Richardson, J. (Eds.) Environmental Economics: A reader. New York: St. Martin's Press.

Masupha, T.M. 2007. Water Management at a textile industry: A case study in Lesotho. MSc Dissertation: University of Pretoria, Pretoria.

McFadden, D. 1994. Contingent valuation and Social choice. 76:689-708.

McLeod, D.M. & Bergland, O. 1999. "Willingness-to-Pay Estimates Using the Double-Bounded dichotomous-Choice Contingent Valuation Format: A Test for Validity and Precision in Bayesian Framework" Land Economics, 75:115-125.

Minota Temirat. 2014. Determinants of households' willingness to pay for improved water supply services in Dilla town, southern Ethiopia: An application of contingent valuation method.

Mitchell, R.C, & Carson, R.T .1989. Using surveys to value public goods: the contingent valuation method. Resource for the Future, Washington.

Mmopelwa, G., Kgathi, D.L, Masamba, W.R.L. & Thukuza, A. 2005. Household Willingness to Pay for Reliability of Water Supply and Quality in Chobe Suburb of Maun: An Application of the Contingent Valuation Method. Botswana Notes and Records, Vol. 37, Special Edition on Human Interactions and Natural Resource Dynamics in the Okavango Delta and Ngamiland (2005), pp. 97-107.

Moffat, B., Motlaleng, G.R., & Thukuza, A. 2011. Households' willingness to pay for improve water quality and reliability of supply in Chobe Ward, Maun. Botswana Journal of Economics, 8(12): 42-61.

Molapo, L. 2005. Urban water provision in Maseru, Lesotho: A Geographical analysis. MSc Dissertation: University of Free State, Bloemfontein.

Mots'oene, K.A. 2013. Urbanization and Poverty in Maseru: A comparative study of Sekameng, Motimposo, and Thibella. PhD thesis: University of Witwatersrand (WITS), Johannesburg.

Niringiye, A. & Omortor, D. 2010. Determinants of willingness to pay for solid waste management in Kampala city. Current Research Journal of Economic Theory, 2(3):

119-122.

Ntshingila, S.N. 2006. Domestic water uses and value in Swaziland: A contingent valuation approach. An MSc dissertation: University of Pretoria.

Olanrewaju, C., Omonona, E. & Titus, B. 2012. Determinants of households' willingness to pay for improved water supply service in Kosofe Local Government Area of Lagos State. Continental J. Sustainable Development, 3(3), 20-31.

Pearce, D., Whittington, D., Georgiou, S. & Moran, D. 1994. Economic values and the environment in the developing world: a report to the United Nations Environment Programme Nairobi. Environmental Economics Series, Paper No. 14, United Nations Environmental Programme, Environment and Economics Unit.

Pearce. D.W. & Turner, R.K. 1990. Economics of Natural Resources and the Environment. 1st Edition, Pearson Education Limited, Essex, London.

Perman, R., Y.Ma, J. Mc Gilvray, & Common, M. 2003. Natural Resource and Environmental Economics, person education limited, printed and bounded by Bell and Bain Ltd. 3rd edition.

Samnaliev, M., Stevens, T., & More, T. 2003. A Comparison of Cheap Talk and Alternative Certainty Calibration Techniques in Contingent Valuation. University of Massachusetts Amherst, Department of Resource Economics, Working Paper No.11.

Sidrat, A., & Heman, D. L. 2015. Households' Willingness to Pay for Improved Tap Water Services in Karachi, Pakistan. The Pakistan Development Review 54:4, Part II (Winter 2015) pp. 507–526.

Sterner, T., 2003. Policy Instrument for Environmental & Resource Management. Published by Resources for the future. Washington DC, USA.

TAMS, Consultants. 1996. Water resources management policy & strategies: Urban Water Supply. Discussion paper for the Department of Water Affairs, Ministry of natural resources Lesotho Government, Maseru.

Tapsuwan, S. 2011. Valuing the willingness to pay for environmental conservation and management: A case study of scuba diving levies in Moo Koh Similan Islands Marine National Park, Thailand. School of Economics, University of Queensland, St. Lucia, Queensland 4072, Australia.

Tietenberg, T. 2000. Environmental and Natural Resource Economics. Reading: Addison-Wesley.

Turpie, J., Smith, B., Emerton, L. & Barnes, J. 1999. Economic Value of the Zambezi Basin Wetlands. The World Conservation Union (IUCN).

UNDP/UNICEF. 2009. Improving Local Service Delivery for the MDGs in Asia: Water and Sanitation Sector in Cambodia. United Nations Development Programme, New York & United Nations Children's Fund, New York, pp. 1–62.

Varela-Ortega, C., Sumpsi, S., Garrido, María Blanco, A., & Glesias, E. 1998. Water pricing policies, public decision making and farmers' response: implications for water policy. Agricultural Economics 19(1-2), 193-202.

Vasquez, W.F., Mozumder, J.P., Hernandez-Arce, J. & Berrens, R.P. 2009. Willingness to pay for safe drinking water: Evidence from Parral, Mexico. Journal of Environmental management, (90), 3391-3400.

Verbeek, M.: A Guide to Modern Econometrics, Sussex: Wiley, third edn., 2008.

Water and Sewerage Company (WASCO). 2016. Greater Maseru Water Supply Feasibility Study & Preliminary Design. Results of Socio-Economics**.**

Whittington, D., Briscoe J. & Mu, X. 1987. Willingness to Pay for Water in Rural Areas: Methodological Approaches and an Application in Haiti. Field report 213, 93 pp.,

Water and Sanitation for Health Project, U.S. Agency for International Development, Washington, DC.

Whittington, D., Donald, T., Lauria, Daniel, A., Okun, & Zinming, Wu. 1989. "Water Vending Activities in Developing Countries: A case study of Ukunda, Kenya." *International Journal of Water Resources Development5*, no.3: 158-68.

Whittington, D., J. Briscoe, X. Mu, & Barron, W. 1990. Estimating Willingness to Pay for Water Services in Developing Countries: A Case Study of the Use of Contingent Valuation Survey in Southern "Haiti. Economic Development and Cultural Change 38, 293-311.

Whittington, D., Mu X. & Roche R. 1990: Calculating the Value of Time Spent Collecting Water: Some Estimates for Uganda, Kenya. World Development 18(2):226–280.

Whittington, D., Lauria D. T. & Mu, X. 1991: A Study of Water Vending and Willingness to Pay for Water in Onitsha, Nigeria. World Development 19 (2/3):179-198.

Whittington, D., Davis J., & McClelland E. 1998. Implementing a Demand-driven Approach to Community Water Supply Planning: A Case Study of Lugazi, Uganda. Water International 23:134-145.

Whittington, D. 2002. Improving the performance of contingent valuation studies in developing countries. Environmental and Resource Economics, 22(1): 323-67.

Whittington, D., Hanemann, W. M., Sadoff, C. & Jeuland, M. 2009. The challenge of improving water and sanitation services in less developed countries. Found. Trends Micro. 4(6), 469–607.

WHO/UNICEF. 2012. Progress on Drinking Water and Sanitation. WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation, New York.

Williams, R. 2015. Multicollinearity. University of Notre Dame. Available online at: http://www3.nd.edu/~rwilliam/. Accessed on 01/06/2018.

Willis, K.G. and G.D. Garrod .1991. Valuing Open Access Recreation on Inland

Waterways: on-site recreation surveys and selection effects. *Regional Studies* 25 (6), 511-524.

Wondimu, S. & Bekele, W. 2011. Determinants of individual willingness to pay for quality water supply: the case of Wonji Shoa Sugar Estate, Ethiopia. Industrial Projects Service, Addis Ababa, Ethiopia Dire Dawa University, Ethiopia. WIT Transactions on Ecology and The Environment, Vol 153, © 2011 WIT Press.

World Health Organization. 2004. "Domestic Water Quantity, service level and health" Geneva, Switzerland: WHO Document Production Services.

World Health Organization. 2004. The World Health Report 2002. Geneva: WHO Switzerland.

Wright, S. G. 2012. Using Contingent Valuation to Estimate Willingness to Pay for Improved Water Source in Rural Uganda.

Yeung, I.M.H. & Chung, W. 2014. Analysis of the Factors Affecting the Residents Willingness to pay for waste management in Hong Kong. Proceedings of 9th Annual London Business Research Conference. Imperial College, London, UK.

Young, Robert A. 2005. Determining the economic value of water: concepts and methods, resource for the future, Washington DC.

Yusuf, S.A., Salimonu, K.K. & Ojo, O.T. 2007. Determinants of willingness to pay for improved household solid waste management in Oyo State, Nigeria. Research Journal of Applied Sciences, 2(3): 233-239.

7 APPENDIX A: SURVEY INSTRUMENT

Department of Agricultural Economics, Extension and Rural Development

Evaluating rural household demand for improved water quality: A case of rural settlements of Qiloane community in Lesotho

Dear respondent,

You are kindly invited to participate in an academic research conducted by Elliot Tsepiso Mokhothu. The researcher undertakes this study for the partial fulfilment of MSc Agricultural Economics in the Department of Agricultural Economics, Extension and Rural development at the University of Pretoria, South Africa. The purpose of the study is to investigate the value that your household places on improved water supply service for you and your community that can contribute to dialogues on improving water supply service from this location. The information we collect in this survey will be treated as confidential and your participation should be considered voluntary. The outcomes of this study will be useful to policy makers and results will be available for academic purpose and may be published in a journal. The summary of the findings will be provided to you upon request. Please answer all questions as completely and honestly as you can. This is expected to take 30 minutes of your time.

For queries or comments concerning this study, please contact my study leader, Dr Babatunde Abidoye on tel. +1 (281) 668-5271 (Email: Babatunde@babidoye.com).

Questionnaire series #: ……

Time of interview; Starts: …….. **Ends**: ……

Date of interview……..

Village/ Community…….

Enumerator's name……..

SECTION A: RESPONDENT INFORMATION

1. Age	2. Gender	3. Marital status	4. Relation to the household head	5. Educational level	6. Employment
……years	1= Male 2= Female	1= Married 2= Never married 3= Divorced 4=Widow/widower 5= Separated 6= Polygamist	1= Head of household 2= Spouse of the head 3= Child of the head 4= Parent of the head 5= brother/sister 6=son/daughter in law 7= grandchild Other……..	1= No schooling 2= Primary education 3= High school level 4= Vocational school 5= Tertiary level	1= Peasant farmer 2= commercial farmer 3= Civil servant employee 4= Private sector employee 5= self-employed 6= Factory worker 7= Housewife 8= Pensioner 9= Unemployed Other (specify)……

SECTION B: Respondents' knowledge, perceptions, attitudes and opinions about the prevailing water circumstances

This section seeks to investigate your knowledge about your household water use, perceptions, attitudes and opinions towards water situation in your community and household.

Main water source point: The purpose of this question is to determine the main source of drinking water for members of the household (i.e. the water source that supplies most of the household drinking water needs). The type of water source or technology indicated by the household is used as an indicator for whether the drinking-water is of suitable quality.

The possible water sources to be of appropriate quality or improved, are: a piped water supply into the dwelling; piped water to a yard; a public tap/standpipe; a tube well/borehole; a protected dug well; a protected spring; and rainwater. Whereas water source points taken to be unimproved are classified as follows: an unprotected dug well; an unprotected spring; a water tanker-truck; and surface water.

7. What is your main source of water for household's domestic use?

1. Public well source point
2. Community water standpipe source point
3. Rainwater collection
4. Surface water (river, lake, pond, stream, canal, irrigation channel)
5. Other source (specify)……

Time and distance taken to collect water: The purpose of this question is to assess whether the main source of water supply for your household is sufficiently close or accessible to your household to ensure that there is an adequate daily volume of water for basic household purposes. Specifically, this question asks for the total number of minutes your household members take to fetch water from water collection point.

8. How far is the **main water source** from your household (in kilometer)? .....km

9. How long does it take to fetch water from the main water source to your household (including time taken for the round trip and queuing)? .....minutes or hours.

10. On average, how many trips do you make per day to fetch water from the water source? …….. Times.

Individual(s) collecting water: The purpose of this question is to know who usually goes to the water source point to fetch water for the household. This information gives a sense of whether there are gender and generational disparities with respect to water-hauling responsibilities.

11. How do you transport water to your home?

1=By foot **2**=By animals (by cart) **3**=By car **4**=Other (*specify*).....

12. Who usually goes to this source to fetch water for your household?

1= Men **2**= Women **3=** Girls **4**= Boys **5**=Other (Please specify) …….

13. Are people already queuing at the main water source on your arrival to fetch for water?

1=Yes, always **2**=Yes, usually **3**=Sometimes **4**=No

SECTION C: **HOUSEHOLDS' PERCEPTION ON THE USE OF UNTREATED WATER**

14. In the table below, please select the comments that best define the degree of motivation for use of untreated water for domestic purposes

Statement	**Comment** **Strongly agree [1], Agree [2], Neutral [3], Disagree [4], Strongly disagree [5]**
1.Untreated water is a good source of nutrients needed for crop production	
2.Untreated water is the most readily available water at all times whenever people need to use it	
3.Untreated water has no health risk effects	
4.Untreated water ensures high yields of the crops grown	
5. Untreated water is less costly	

15. In the table below, please select the comments that best explain the measures your household considers effective to reduce the health-risks in the untreated water consumption

Statement	**Comment** **Strongly agree [1], Agree [2], Neutral [3], Disagree [4], Strongly disagree [5]**
1. Leaving the water to settle and careful collection	
2. Promotion of health trainings for households, e.g. generating consciousness, sanitation education, etc.	
3. Protection of rural water sources for consumption purposes against pathogens (Pathogens are defined as diseases	

producing microorganisms such as bacteria, fungi, and virus found on sewerage, run-off water)	
4. Boiling the water before being consumed	
5. Filtration of the water before discharge for human consumption purposes	

SECTION D: MANAGEMENT OF PRESENT AND FUTURE WATER SUPPLY SHORTAGES

16. Has your household experienced a situation where water from the main source is not available when the household needs to use it in 2016?
1=YES 2= NO

NB: If the answer is "Yes" in 16, carry on from 17, or else go to 20.

17. If **YES,** when last did your household experience water scarcity? State the Month: .....

18. The last time your household experienced water scarcity, how long did it take? .....weeks .....days..... hours

19. Briefly explain how your household coped with the last water shortage?

1= Washing less frequently**,** 2= Bathing less frequently, 3= water recycling**,** 4= others (*specify*).....

20. Do you believe that your household will face a related problem in future? 1= **YES** 2= **NO**

SECTION E: GENERAL VALUATION OF WATER SUPPLY SERVICE QUALITY

21. How would you rate the current water supply service quality in this community?

1= Excellent, 2= very good, 3= Good/average, 4= poor, 5= very poor

Rate on a scale from 1 to 5 the degree to which you agree or disagree with the following declarations concerning the quality of existing water supply.	1= Strongly agree	2= Agree	3= Neutral	4= Disagree	5= Strongly disagree
22. I receive safe water from my main source point for consumption purposes					
23. The odour of the water from my source point is acceptable to me					
24. The taste of the water from my source point has no health risk effects					
25. The colour of the water from my main source of supply has no health risk effects					

Rate on a scale of 1 to 5 the scope to which you agree or disagree with the following declarations concerning the quantity of present water supply.	1= Strongly agree	2= Agree	3= Neutral	4= Disagree	5= Strongly disagree
26 In my opinion, the water is affordable					
27. There is always a flow of water from main source point whenever the household needs to use it					
28. The water supply from my main water source point is consistent					
29. The water I receive from my main source point is sufficient for my household					

Water treatment: The purpose of the following questions is to know whether the household drinking water is treated within the household and, if so, what type of treatment is used. The questions are intended to gather information on water treatment practices at the household level, which provides an indication of the quality of the drinking water used in the household.

30. Do you use any purification method to treat your water in any way to make it safer before consuming it? **1=YES** **2= NO**

31. If "**NO**", why are you not cleaning it?

1= Purification methods are too expensive for me

2= The water is already clean

3= Although the water is not clean, it does not affect my health

4=Other reason (specify)……

32. What do you usually do to the water to make it safer for consumption?

1= Boil before consuming 2= Add bleach/chlorine 3= Strain it through a cloth 4= Let it stand and settle 5= Other (Please Specify)……

33. Was there any member of your household affected by any water borne related disease due to the type of water being used in the past ***1 year?*** **1= YES 2= NO**

34. If "**YES**", what disease?

1= Cholera **2**= Diarrhoea **3**= Typhoid **4**= Other disease (Please Specify)…….

35. In times of water supply shortage, which alternative water source does your household opt for?

1=Vendors **2**=Well **3**= We buy water from other village **4**=Other (Please specify) ……

36. For how long does it take you to fetch water from this alternative source?..... Minutes

37. How would you rate the existing quality of water from your alternative water source?

1=Excellent **2**=Very good **3**=Good **4**=Poor **5**=Very poor

38. Do you pay for the water service from this alternative source? **1= Yes** **2= No**

39. If **YES**, how much do you pay for 20 litres you get from this source? ..... Maloti

SECTION F: HOUSEHOLD WILLINGNESS TO USE RECLAIMED OR RECYCLED WATER

NB: Reclaimed water or **recycled water** is defined as the reusing of treated wastewater (sewage) to remove solids and impurities, and used in sustainable landscaping irrigation, and for drinking.

40. In relation to the use of water, kindly rate on a scale of 1 (strongly agree) to 5 (strongly disagree) the degree to which you agree or disagree with the succeeding statements.

	Strongly agree (1)	**Agree (2)**	**Neutral (3)**	**Disagree (4)**	**Strongly disagree (5)**
1. Recycled water reduces demand and stress on freshwater resources such as the groundwater and rivers by providing alternative water supplies					

2. Recycled water provides more drinking quality water for domestic uses by substituting drinking quality water with recycled water for irrigation of agricultural crops and amenity horticulture					
3. Irrigation with recycled water can reduce the need for chemical fertilizers					
4. Recycled water may be used to create or enhance wetlands and riparian (stream) habitats					
5. Recycled Water should be used to reduce and prevent both air and water pollution					
6. Water users can supplement their demands by using recycled water, which can free considerable amounts of water for the environment and increase flows to vital ecosystems					
7. Recycled Water can decrease diversion of freshwater from sensitive ecosystems					
8. Recycled water should be used for potable uses.					
9. Recycled water should be used for industrial processes and manufacturing.					
10. Recycled water should be used for irrigating parks, lawn, sports fields, golf courses and farms.					
11. Recycled water should be used for supporting river flows.					

41. Please specify whether your household would be willing to use reclaimed or recycled water for any of these activities.

Water uses		**Yes**	**No**
For food (drinking, cooking)	[1]		
Domestic use - Bathing	[2]		
Domestic use - Washing clothes	[3]		
Domestic Use – Vehicle washing	[4]		
Fire protection	[6]		
Food crop irrigation	[7]		
Filling swimming pool	[8]		
Toilets and urinal flushing	[9]		
Watering gardens and filling ornamental ponds and other farming activities	[10]		
Irrigation of parks, schoolyards, residential landscaping, nurseries	[11]		
Other (specify)……	[12]		

42. Does your household presently pay for water usage monthly? **1=YES** **2=NO**

42. How much do you currently pay for water usage monthly? …….

43. Will you be willing to pay 40% less than the amount you currently pay for water usage to use recycled water? **1= YES** **2= NO**

44. If your household is presently **not** paying for water usage, will you be willing to shift to reclaimed or recycled water? **1= YES** **2= NO**

SECTION G: ELICITING THE WILLINGNESS–TO-PAY TO SECURE FUTURE IMPROVED WATER QUALITY SERVICES

The water systems in the rural settlements of Lesotho are consistently failing to supply enough water to these areas for quite some years now because of insufficient funds and poor maintenance. The current situation of water shortage and quality in these rural communities is depressing as the water system is failing to meet the community daily water demand. Since the current community sources can only provide less than 40% of the community people with enough and good quality water, most of the people in this community are living without enough water. This problem has been ongoing and it is further amplified by last year drought and growing population which makes other households go without water for the whole day or only get water in the late afternoon. The current possible way to get water in this community is through waking up early around 4am and queuing up for water for almost 3 hours. This seems to cause inconvenience for many people which even compels other households to use river water which is greatly contaminated as an alternative, and it is very far away from their dwellings. Other households get additional water from supermarkets which is very expensive and cutting through their limited monthly disposable income. The shortage of water, in addition to huge economic loss caused by low water based production such as agricultural produce, can lead to uncleanliness of the house and food consumed in the household which has high potential of transmitting germs or pathogens which are the carriers of disease causing organisms. However, these problems are only associated with the shortage of water leading to uncleanliness. This can lead to both human life's loss and economic loss as well.

Presently, this is how water supply service quality looks like sometimes due to water supply shortage:

As can be seen from the picture that the residents have to go for the surface water in times of water supply service shortage. However, this results in a very high health insinuations owing to dirty water and unprotected area.

1. Do you agree that this is the accurate description of the status of water supply in this community?

   1=YES 2=NO 3=NOT SURE

2. If **NO,** explain why: _____

3. Do you agree that the shortage of water you are experiencing in your household is due to poor management and maintenance of water system? **1=YES 2=NO 3=NOT SURE**

4. If N**O**, explain why? _____

5. Do you agree that the water shortage has the aforementioned health and economic consequences?

   1=YES 2=NO 3=NOT SURE

6. If **NO**, explain why? _____

In order to overcome individual's loss of life and economic losses, the **DRWS** has proposed the water regulation program to guarantee and secure sustainable water supply to this community. In this regard, I would like to describe the plan for DRWS to secure water supply. DRWS is proposing to invest in a special project that will build huge water storage tanks and pipelines. Tanks have capability to store huge quantities of water which can be purified and regulated easily to meet daily water demand for this community for a prolonged period of time. After construction of tanks

and pipelines and also making sure that they are properly functioning, adequate and good quality water would be made available during the entire day and nights. Every household including yours which will vote towards this program would have access to adequate and clean potable water every day. But each household would be expected to contribute some money for the initial investment recovery, maintenance and running costs which will be inclusive to their monthly water charge. This will help to mitigate the possible health and economic consequences caused by water shortage and poor quality water. I am therefore conducting this survey to find out whether the proposed plan means anything to you.

Here is how the new proposed program would work

Tank to be built

Water tanks are designed to store and hold huge quantities of water for multi-purposes. Contingent on the size of the tank, the tank may hold dozens or even hundreds or thousands of litres of water. The tanks can then be installed so that they supply water to be used for domestic use inside the home such as your toilets, consumption, water the lawn and more. Water used for drinking needs to be safe to prevent disease and ill health. Drinking water supplies from water tanks need to be carefully maintained to prevent contamination. The amount of money that you can save on your water bill with these tanks will be noteworthy.

Figure 1

Pipelines to be made

The purpose of water pipelines above is to transport water from one area to another without causing erosion and reducing the coincidence of evaporation. Water pipelines are large in diameter and can supply water to several communities over both short and long distances. Pipelines can be installed underground or above ground. These will be used to bring in freshwater or to transfer and dispose of wastewater. They also provide a solution to areas lacking an incessant and sustainable water source. Therefore with the incredible power of these pipelines, water can be extracted from deep within the earth through well pumping. The water will also be directly taken from a dam water source and be transported through the pipelines with pumps and the natural force of gravity.

In spite of the need for water to be diverted through pipelines to varied areas, the real construction of a main water pipeline is extremely expensive. Also, maintenance must be done daily to keep the pipeline working excellently. Pipelines need to be persistently monitored and water quality must be frequently checked. Because of the great distances that major water pipelines can cover, maintenance levies are extreme.

7. Do you agree that the **DRWS** will implement a program that enhance sustainable water supply? **1= YES** **2= NO**

8. If **NO**, explain why?

_____

If the program becomes successful and approved, the payment arrangements are as follows:

All the households in this community are expected to pay additional monthly water charge in order to supplement the **DRWS budget** in maintaining water system to secure enough water supply. Because all households in this community will be involved in sharing the burden of costs to secure reliable and sustainable water supply, I am using this survey to investigate the value your household attaches to the improvement of water supply quality for the purpose of safeguarding sustainable water supply. The water system will be managed by Department of Rural water Supply (DRWS) which is the authority accountable for the rural water supply projects in the entire country. The relevant committee approved by the DRWS authority will decide on the amount each household has to contribute to operate and maintain the daily activities of the water system. However, at present, the preliminary calculations show that it is possible to sustain this program if each household can pay the total of **M50** for installation of the water equipment on top of its monthly water bill as long as they consume **WASCO/DRWS** water from this water system. For the program to be implemented, the households' contributions must be beyond a certain threshold. In order to guarantee sustainable water supply, the collected funds will be directed to DRWS and it will be used for improvement and water system management. Remember that upon implementation of this program, your household budget will be affected as you have other financial obligations to meet like food, school fees, clothes etc. So far we have found out that some households will support the program while others will vote against it. If most people do not vote for the project, DRWS will not deliver the anticipated service. However, if most people support the project, DRWS will deliver the proposed service.

9. Would you vote "**YES**" on a referendum to improve water supply to the level described here? The proposed project will cost each household of this community a total of **M3000** for installation of water equipment as a distinct cost from monthly water tariff>> (payable in five {**M600**} instalments over a five-year period.). This is equivalent to **M50** monthly. **1= YES** **2= NO**

10. Considering the existing water supply problem in your community, suppose that specific project described will result in no water shortages and hence the water quantity and subsequently quality will be improved. It is therefore indicated that it will cost each household to pay an extra charge of **M250** Monthly water bill as an on-going progression. This amount is to be paid for by every household of this community as to secure a continuous flow of water supply shortage and quality for a prolonged life. Would your household vote for or against it? **1=YES 2= NO**

11. How certain are you of this answer?

1= Not sure at all 2 =Least sure 3 =Very sure 4 =Neutral 5= Certain

12. To help us better understand your answer, please indicate the single most important reason for your response to the preceding question:

1= In general, the project is not a good use of my money

2= In general, the project is a good use of my money

3= The project is not realistic or unclear

4= The costs of the project should be paid for by the government, not by me

5= I do not believe that water quality could be improved even if we have a continuous flow

6= The project is worth the investment

7= Other (Please specify) …….

13. Assume you have a total of 100 important points to assign to the following factors in voting yes for the referendum. Please indicate the importance of each factor by allocating your 100 points among the items on this list. To indicate one item is more important to you than

another, you should allocate more points to it. You do not need to give points to all the items, but remember that the total needs to equal 100.

Current cost of major water source				pts.
Current cost of the alternative water source when there is a shortage				pts.
Quality of the water from the project				pts.
Reliability of water supply				pts.
Potential for agricultural and other commercial use				pts.
Others (Please specify) _____				pts.
TOTAL	1	0	0	pts.

14. To what degree do you come to an agreement that the results of this study will influence policies allied to water supply at this area?

    1= Strongly agree, 2= Agree, 3= Neutral, 4= Disagree, 5= Strongly disagree

SECTION H: HOUSEHOLD FINANCIAL INFORMATION

15. What is the monthly expense for your household on each of the following items? *(Tick those applicable)*:

    1= Electricity…… Maloti (M)

    2= Food…….M

    3= School fees……. M

4= Housing (rent)…….. M

5= Transport……..M

6= Water ……..M

7= Other (specify)…… M

Household Monthly income in maloti (M): Lesotho currency is equivalent to South African rand (ZAR).

16. . What is your household monthly average income?

1= <M500

2= M500…….M2000

3= M2000……..M5000

4= >M5000

SOCIO ECONOMIC STATUS OF THE HOUSEHOLD

17. Type of house

1= Brick wall, tiled roof, 2=Wall, corrugated roof, 3=Mud wall, corrugated roof, 4=Mud wall, thatched roof, 5=Other (*specify*).....

18. Number of people in this household

>18 years …….

5-18 years ……..

< 5 years …….

19. What is the nature of house tenancy?

1=Household possesses this house

2=Household lives in rental premises

3=Household lives free of charge in the house

4=Other (*specify*).....

20. Since you voted for this program, considering your income and expenditure, do you think your household would be able to afford to pay for basic needs like food, clothes and water upon implementation of this program? **1=YES 2=NO 3=NOT SURE**

21. Which of the following statements can best define economic situation of your household?

1= We have enough money to pay for our necessities and can also manage to buy durable assets.

2= We can afford food, public utilities and pay for school fees but cannot afford to buy durable goods like car, sofa set, TV, fridge,…

3= We can meet the expense of food and public utilities but it is problematic to pay for transport and school fees

4= We have money for food but cannot manage to pay for public utilities like water and electricity

5= We have no money even for food

22. Based on the following statements, how do you consider yourself?

1= Well-to-do 2= With average income level 3= Below average level of income 4= Poor 5= Very Poor

SECTION I: DEBRIEFING QUESTIONS

This part assesses specific problems in the questionnaire and seeks to what extend the questionnaire performed well.

23. In your own opinion did the respondent understand all the questions? Rank the following level of understanding by putting numbers

a) Very well understood ( ) b) Well understood ( ) c) Understood ( ) d) Not understood ( ) e) Not well under stood ( )

24. Were there questions that were complicated to the respondents?

a) Yes ( ) b) NO ( )

What was the problem?
Specify_____

_____

_____

25. How was the reaction of the respondent towards questions and survey in general?

a) Very Supportive ( ) b) Moderately supportive ( ) c) Supportive ( ) d) Not supportive ( ) e) completely not supportive ( )

26. How do you rank the reliability of the responses given to you by the respondents? Please put numbers on the following for ranking starting with 1 for high rank

a) Very reliable ( ) b) Moderately reliable ( ) c) Reliable ( ) d) Not reliable ( ) e) Not reliable at all ( )

27. What are the reasons for not being reliable? Specify

_____

_____