EVALUATING THE WILLINGNESS TO PAY FOR IMPROVED WATER SUPPLY BY POULTRY AND NON-POULTRY FARMERS IN WAKISO DISTRICT, UGANDA

By

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DECLARATION OF ORIGINALITY

I, Moses Ssebaggala, affirm that this dissertation, which I hereby submit for the degree of MPhil. (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.

Moses Ssebaggala

Signature: 

Date: August 2021……

Approved by:

Dr Selma Karuaihe

Signature: ……

Date: September 2021……

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DEDICATION

This dissertation is dedicated to my beloved family, for all their spiritual, financial and moral support. It is further dedicated to the almighty God, for His unwavering provision.

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YUNIBESITHI YA PRETORIA

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ABSTRACT

Evaluating the willingness to pay for improved water supply by poultry and non-poultry farmers in Wakiso district, Uganda

By

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Department: Agricultural Economics, Extension & Rural Development

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Access to improved water supply services remains a global challenge despite progress made towards the water Sustainable Development Goals (SDGs) globally. Wakiso district in Uganda is no exception, as access to safe water services is limited, leading to welfare losses, which affect the livelihoods of several households. The study uses double bounded elicitation format to determine the value which households in Wakiso District are willing to pay for improved water supply services. The study also examines whether poultry farming significantly influences households' willingness to pay (WTP). Wakiso District was purposively selected for this study due to its documented poor water supply services, which result in welfare losses to poultry and non-poultry farming households. The study uses data collected from 243 households, split in two samples of 110 poultry farmers and 133 non-poultry farmers. Results indicate that households are aware of the risks and threats associated with fetching water from distant sources. Households portrayed positive attitudes, perceptions and opinions towards a policy that improves the *status quo*. The mean WTP was estimated at UGX 197.1068 (USD 0.0591) per 20litres (L) for poultry farmers, compared to UGX 204.3567[1] (USD 0.0613) per 20L for non-poultry farmers. The null hypothesis for the equality of WTP means is rejected at 1% level ($p = 0.000$, $t = 6.2673$), implying that poultry farming significantly influences households' WTP. Results from the double bounded models indicate that WTP is positively influenced by the following variables: gender, education, the number of chicken reared by a farmer, whether the current quality of water is problematic, the price of water charged by water vendors at alternative sources, household's monthly expenditure, and whether the respondent

[1] UGX 1.0000 is equivalent to USD 0.0003 based on the average exchange rate in the month of October, 2018.

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YUNIBESITHI YA PRETORIA

pays for water at alternative sources. Conversely, WTP is negatively related to the age of the respondent, household size and whether the respondent receives enough quantity of water from the main source. Based on the results, the study recommends that economic values of water uses and socioeconomic factors should be incorporated in the water use, pricing and management policies. The study also recommends that the government of Uganda through the National Water and Sewerage Corporation (NWSC) should consider improving water access to the communities and implement a water supply policy that improves household's access to water supply services in Wakiso District to meet their demand.

Key words: water, double bounded models, willingness to pay (WTP), households, poultry farmers, Wakiso District.

UNIVERSITEIT VAN PRETORIA
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TABLE OF CONTENT

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

LIST OF TABLES

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

LIST OF FIGURES

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

LIST OF ACRONYMS

CBA–Cost Benefit Analysis

CE–Choice Experiment

CMM–Choice Modelling Method

CV–Contingent Valuation

CVM–Contingent Valuation Method

DWD–Directorate of Water Development

FAO–Food and Agriculture Organisation

GDP–Gross Domestic Product

GOU–Government of Uganda

HPM–Hedonic Pricing Method

LB–Lower Bound

MAAIF–Ministry of Agriculture, Animal Industry and Fisheries

MoFPED–Ministry of Finance Planning and Economic Development

MWE–Ministry of Water and Environment

NDP11–The Second National Development Plan

NGOs–Non-Governmental Organisations

NPF–Non-Poultry Farmers

NWSC–National Water and Sewerage Corporation

OLS–Ordinary Least Squares

PF–Poultry Farmers

PPI–Potential Pareto Improvement

SDGs–Sustainable Development Goals

SS–Sample Size

SSA–Sub-Saharan Africa

TCM–Travel Cost Method

UB–Upper Bound

UBOS–Uganda Bureau of Statistics

UGX–Uganda Shillings

UN–United Nations

UNICEF–United Nations Children's Fund

USD–United States Dollars

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YUNIBESITHI YA PRETORIA

WDLG–Wakiso District Local Government

WHO–World Health Organisation

WTA–Willingness to Accept

WTP–Willingness to Pay

WUCs–Water Users Committees

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UNIVERSITY OF PRETORIA
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CHAPTER 1: INTRODUCTION

1.1 Background

Access to improved water supply services is a serious global challenge that calls for urgent responses at local, national and global levels. Nearly 844 million people globally have no access to improved water supply services despite modest improvement over the years (UN Water, 2018). Most of these people live in the rural areas of Sub-Saharan Africa (SSA) and Asia (WHO and UNICEF, 2015). This is attributed to inadequate investments in water supply infrastructure, insufficient water sources, water system non-functionality (which adversely affect water supply sustainability) and poor water quality. Limited access to improved water supply services is also attributed to climate change (increasing temperatures and variability in rainfall), and high rate of population growth rate, which accelerate demand for domestic and agricultural water(Lee & Schwab, 2005; van der Bruggen et al., 2010). Water supply is associated with substantial challenges in developing countries such as water shortages, insufficient water treatment facilities, serious water losses, and health-related risks. Moreover, most of the people in developing countries travel long distances to fetch water, especially in rural areas and a few buy water expensively from vendors (Lee & Schwab, 2005; Lehmann, 2010).

Uganda is not an exception as far as water supply challenges are concerned. Only 77% of households in urban areas access safe water, compared to 70% in rural areas (MWE, 2018), where 79% of the total population lives (UBOS, 2016a). Due to the limited access to improved water services especially in rural areas in Uganda, waterborne diseases such as cholera, diarrhoea, typhoid and stomach problems, have been affecting a large proportion of the population. It is estimated that 15% of the children below five years die due to waterborne diseases (Naiga et al., 2015; Naiga & Penker, 2014; WHO and UNICEF, 2001; Wright et al., 2014). Therefore, accessing improved water supply services is important in Uganda, especially in rural areas where people resort to unclean and contaminated water sources for survival.

In Uganda, the main water supply sources in rural areas include boreholes, shallow wells, protected springs, tap stands of piped schemes and rainwater harvesting (MWE, 2018). In the urban areas, households mainly use piped water supplied by National Water and Sewerage Corporation-NWSC(MWE, 2018). Water in the rural areas is owned and managed by the

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YUNIBESITHI YA PRETORIA

Directorate of Water Development (DWD), under the Ministry of Water and Environment (MWE), with the local governments operating at district levels and Water Users' Committees (WUC) at village level. On the other hand, piped water in urban areas is managed and supplied at a given tariff by the NWSC. Rural water is mainly free of charge especially at village water collection points, which are collectively used by households (Mwebaza, 2010; Naiga et al., 2015; Naiga & Penker, 2014).

Piped water supplied by NWSC is characterized by good quality, long hours of water supply service, efficiency in revenue collection for operation and management cost coverage and acceptable non-revenue water standards (MWE, 2017). By contrast, water sources collectively managed by the DWD, local councils and WUCs are associated with non-functionality of water systems especially boreholes, and distant locations of water sources particularly in rural areas, where women and children travel long distances to fetch water. Additionally, water resources are overexploited and mismanaged due to open-access management, ineffective and poorly operating WUCs, and poor-quality water supply due to pollution especially from pesticides (Alabaster & Kručková, 2015; Naiga et al., 2015).

Agriculture is the dominant sector in Uganda's economy. About 80% of the households are engaged in agriculture (UBOS, 2016a). Poultry farming is fastest-growing segment of the agricultural sector, mainly due to the high demand for poultry products (Byarugaba, 2007; Ekesa et al., 2015; Tumwebaze, 2016). Additionally, Wakiso District is the leading producer of poultry products in Uganda, accounting for 7.4% of the national chicken population (MAAIF and UBOS, 2009).

Poultry farms are mainly located in the backyards of homesteads, with a few large commercial farms located in separate places. Birds, such as ducks, turkeys, guinea fowls, pigeons, geese, ostriches, and chicken are reared. This study partially focuses on water use pertaining to chicken farming because it is the dominant type of poultry farming in Uganda. The sector employs a considerable number of people, especially women and the youth. Similarly, several people are employed in the chicken products supply chain, such as traders and workers in slaughterhouses as indicated in literature (Byarugaba, 2007; Ekesa et al., 2015).

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YUNIBESITHI YA PRETORIA

Accessing improved water supply services is a real challenge affecting households in Wakiso District. According to (MWE, 2019) 39% of Wakiso population access clean and good quality water, while the majority collect water from distant unprotected water sources, due to lack of reliable water sources. Although the government of Uganda increased access to safe water from 67 % in 2016 to 70% in 2017 through the construction of new water systems (MWE, 2017), a lot still needs to be done.

An estimated number of 734 water points (mostly boreholes) in Wakiso District are not functioning. This is attributed to poor management and operation of water infrastructure (MWE, 2018). Limited access to water in rural areas in Uganda, is worsened by the increasing population, which accelerates the demand for water (Naiga & Penker, 2014). Despite the numerous challenges associated with the current water supply in rural and urban communities in Uganda, water plays a major role in the welfare of households. It is used for agricultural and domestic purposes (Chanie, 2014).

Poultry farming heavily relies on water to feed the birds, clean troughs and drinkers (Folorunso et al., 2013; Tumwebaze, 2016). In addition, households use water for cooking, drinking, washing utensils, laundry, bathing and sanitation activities. Furthermore, water is also used for industrial, recreational, hydropower generation and cultural activities. Therefore, water is an indispensable resource for sustainable development and determines key aspects of social, economic and environmental development (Akeju et al., 2018; Alabaster & Kručková, 2015; Asim & Lohano, 2015).

However, limited water supply in some areas in Uganda, results in welfare losses due to water collection from distant sources, high water prices and poor water quality (Baguma et al., 2013; Musoke et al., 2017; Naiga et al., 2015). All these challenges affect households engaged in poultry farming and those for domestic water use. Resource economists use the concept of Potential Pareto-Improvement (PPI), which stresses that the allocation of resources should result in a situation whereby all individuals are collectively better-off (welfare improvement) without making any individual worse off (Tisdell, 2010).

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YUNIBESITHI YA PRETORIA

Improving water supply services in Uganda is critical in addressing the challenges associated with limited water supply and ultimately improves peoples' welfare. However, this requires the extension of water supply systems to areas where they are non-existent, and this requires financial resources for investments in water infrastructure (MWE, 2018). Therefore, understanding the water users' willingness to pay (WTP) for the improved water supply services is imperative before investing in the extension of water supply systems. This would assist in determining the possibility of recovering funds for the extension of water systems, assessing whether maintenance and operation costs of water systems will be generated in long run and determining the appropriate water tariff for all water users (the poor and rich) (Whittington et al., 1998; Wright et al., 2014).

In a view of the above, this study adopted a Contingent Valuation Method (CVM) to elicit WTP values for improved water supply by households (poultry farmers and non-poultry farmers) in Wakiso District. Water is treated as a non-market good associated with open access property rights regime and the characteristics of a public good, hence making CVM an appropriate tool for determining the value people attach to improved water supply. Although other non-market valuation methods are equally applicable, the CVM was considered the best approach after a review of all other methods as shown in chapter two.

A number of studies looked at water related issues in Uganda and these include: gender and the burden of water collection (see study by Asaba et al., 2017);households' willingness to contribute towards rural water management and operation (see study by Naiga & Penker, 2014);challenges associated with accessing rural water (see study by Naiga et al., 2015); rice farmers' WTP for irrigation water (see study by Namyenya et al., 2014);and households' WTP to pay for improved water supply services for domestic purposes (see studies by Whittington et al., 1998; Wright et al., 2014).

Based on the reviewed literature, none of the studies looked at water use, differentiated by the type of households, like in our case of differentiating poultry and non-poultry farming households. For that reason, this study is attempting to address that gap by evaluating the economic value poultry and non-poultry farmers attach to improved water supply service in Wakiso District.

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1.2 Poultry farming in Uganda

Poultry is defined as domesticated birds reared for either their meat, eggs or feathers (Vaarst et al., 2015). Poultry species include chicken, ducks, turkeys, guinea fowls, pigeons, ostriches, and geese. Chicken farming is the main type of poultry farming in Uganda due to its great economic significance (Byarugaba, 2007; Ekesa et al., 2015). Chicken farming is categorized into commercial and free-range farming. Commercial farming relates to rearing exotic(improved hybrid) and local breeds, under intensively confined shelters for commercial purposes (Byarugaba, 2007).

Exotic chicken farming is concentrated in urban and peri-urban areas in Uganda, particularly in Kampala, Wakiso, and Mukono due to high demand for eggs and chicken meat in those areas (Ekesa et al., 2015; Tumwebaze, 2016). By contrast, free-range poultry farming refers to rearing local indigenous breeds, which scavenge for their food and seek shelter in the natural environment such as trees and bushes around homesteads, especially in rural areas (Byarugaba, 2007). The chicken population in Uganda increased from 23.5 million in 2005 to 37.4 million birds in 2008. Indigenous chicken account for 80% of the total chicken population compared to 20% exotic breeds. Wakiso district is the leading producer of poultry products in Uganda and accounts for 7.4% of the national chicken population (MAAIF and UBOS, 2009).

The poultry farming is not only important to individual households, but also to the general economy in Uganda. Poultry farming contributes to food security and people's livelihoods (Byarugaba, 2007; Vaarst et al., 2015). Moreover, poultry products provide proteins and micronutrient properties, which are essential for the health of pregnant women and children (FAO, 2009; Prabakaran, 2003). In addition, poultry farming provides income and employment to farmers, traders, market operators, and slaughterhouse owners and workers. Lastly, indigenous chicken are used for socio-cultural ceremonies in many cultures in Uganda especially traditional marriages, as they are valuable for paying the bride price (Byarugaba, 2007; FAO, 2009, 2011; Vaarst et al., 2015).

Water is an indispensable resource in chicken farming (Koelkebeck et al., 1999; Mohammed, 2011). The constant supply of water in chicken farming is crucial for feeding, drinking,

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cleaning drinkers and chicken houses (Folorunso et al., 2013). Water is also used by chicken in physiological functions namely; thermoregulation, digestion, elimination of waste, enzymatic functions, nutrient transportation, absorption, lubrication of joints and organs, and nervous system cushioning (Ravindran, 2013; Schlink et al., 2010).

It is estimated that chicken consume between 1.6 to 2 times much water than feeds depending on their weight and age. Limiting the chicken flock from accessing water even for a short time, impact irreversibly on their performance (in terms of weight and eggs), and welfare(Koelkebeck et al., 1999; Morris, 2000; Ravindran, 2013). Additionally, chicken water intake increases more than twice the amount of feed intake during periods of higher temperatures (>30^{o} C) (Pym, 2013).For better performance in chicken farming, water must be made available at all times. Therefore, limited access to water supply mainly due to distant water sources affects chicken health and performance, which leads to increased welfare losses to farmers.

To meet the high demand for water in chicken farming, farmers resort to buying water from vendors. However, water vendors charge relatively higher water prices to maximise profits (Pangare & Pangare, 2008). This increases the cost burden for chicken farmers. Alternatively, farmers collect water from distant water sources such as springs, public wells, boreholes and ponds. Since water from such sources is usually not treated, it transmits waterborne diseases (such as Avian cholera, Fowl typhoid, Newcastle and Coccidiosis) to the chicken flock (Amaral, 2005). This results in increased water treatment costs, which lead to great economic losses. Additionally, households (chicken farmers inclusive) also incur welfare losses in terms of spending a considerable amount time and labour in collecting water from distant sources, at the expense of other productive activities (Baguma et al., 2013).

Welfare losses incurred by poultry farmers due to limited water supply affect both the demand (consumption) and supply (production) sides of poultry farming households since they are semi-commercial farmers that partly buy some inputs and sell some outputs. The implication is that the demand and supply decisions could be determined jointly using a single model when the profit effect is significant or independently when the profit effect is insignificant. However,

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YUNIBESITHI YA PRETORIA

estimating the demand and supply decisions jointly calls for much data and a complicated theoretical background (Singh et al., 1986).

This study focused on the demand side of poultry farmers which requires relatively less data (based on the time and budget constraints) and a simple theoretical foundation for empirical estimation. In this case, poultry farmers' profits were assumed to be insignificant and the study opted for their preferences since they partly consume eggs and chicken, and they also use chicken droppings as fertilizers for their crops. Related empirical studies (Baidoo et al., 2013; Kassahun et al., 2016; Namyenya et al., 2014), also applied a similar approach to determine farmers' WTP for irrigation water.

The government of Uganda has to extend potable water supply services closer to the poultry farms (homes) to improve the welfare of this type of households from the status quo to the new proposed level. This study applies the double bounded CVM to elicit poultry farmers' WTP preferences for water supply improvement, since it is the most frequently applied approach for estimating changes in welfare (Philcox, 2007).

Fresh water resources are stressed due to the ever-increasing population and water consumption levels. This is worsened by the competition for water amongst users especially between domestic, agricultural, and industrial users (Naiga et al., 2015; Postel, 2000).Therefore, the stressed water resources further limit households' access to water supply. Since households (poultry and non-poultry farmers) access water from similar sources, they face similar challenges with reference to distant water sources. However, households use water for different purposes (poultry farming and domestic household activities). In a view of that, it is logical to address water supply challenges for poultry farming concurrently with those for domestic consumption. Therefore, this study examines water use between different households who access similar water sources, but use water for different purposes.

1.3 Problem statement

Despite the significance of water in domestic (non-poultry) and poultry farming activities in Uganda, there is a scarcity of water in many areas of the country. Accessing improved water

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UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

supply services remains a great challenge in Uganda in general (Naiga et al., 2015) and in Wakiso District in particular. Most of the water sources are in distant locations, far away from the homesteads (Baguma et al., 2013; Wright et al., 2014). Women and children are burdened with walking long distances on hilly roads and paths carrying water on their heads, which results in health-related complications, such as chest pain, prolonged fatigue, and headache. Moreover, nearby water sources are associated with long queues and the loss of productive time for other domestic and developmental activities (Asaba et al., 2017).

The shortage of water is aggravated by the fact that a large proportion of water sources in rural areas in Uganda are not functioning. For instance,734 out of 4275 water points in Wakiso District, are not functioning (MWE, 2019), particularly boreholes due to poor management and operation of water infrastructure resulting from sinking pipes, missing repairs, leaking, corrosion and salinity of water (MWE, 2019; Naiga et al., 2015). Such challenges limit access to water supply in rural areas. This is worsened by insufficient funds to buy spare parts, equipment, and paying for preventive maintenance of rural water infrastructure as well as inactive and non-existent WUCs in some areas (Naiga et al., 2015). Furthermore, rural households are forced to access water from unprotected water sources, such as wells and ponds. This has increased the spread of waterborne diseases, such as typhoid, diarrhoea, and cholera, which led to increased infant mortality rate (WHO and UNICEF, 2001, 2015). Accordingly, this has resulted in welfare losses in the form of increased water treatment and medical costs (Alabaster & Kručková, 2015; Naiga et al., 2015; Naiga & Penker, 2014; Wright et al., 2014).

Water is also an indispensable resource in poultry farming. Therefore, limited access to water supply affects poultry health, livelihood and production, which in turn results in increased economic losses to poultry farmers (Amaral, 2005; ElSaidy et al., 2015; Folorunso et al., 2013; Mohammed, 2011). This implies additional costs to the poultry farmers, who already incur costs of collecting water from distant sources. Additionally, water from unprotected sources transmits bacterial, protozoan and viral poultry diseases, which result in increased financial losses to poultry farmers (Amaral, 2005).

Therefore, limited access to water supply due to distant untreated and non-functioning water sources results in welfare losses to non-poultry and poultry farmers. To address the challenges

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

associated with poor water supply services in Wakiso District the government of Uganda needs to extend potable water supply systems closer to households and ultimately improve their welfare. This would increase water accessibility and relieve households from the burden of travelling long distances for water collection and save time for other productive activities (Amaral, 2005; Asim & Lohano, 2015).

However, the extension of potable water supply services requires large financial investments in water infrastructure, which have cost implications not only for the government, but also for the affected communities. Therefore, establishing whether beneficiaries of improved water supply services are willing to pay for the services in question, is important. This is what the current study investigates, building on previous studies that employed CVM technique (Whittington et al., 1991, 1998; Wright et al., 2014). Based on the reviewed literature, previous studies did not examine the economic value of water use differentiated by poultry and non-poultry farming households, which created a gap in the current WTP literature.

To address the gap in the literature, the current study determines the value poultry and non-poultry farmers attach to improved water supply services and evaluates households' knowledge, perceptions, and attitudes regarding water supply challenges in Wakiso District. The value households attach to improved water supply services in Wakiso would provide evidence-based information to policymakers to determine policy alternatives concerning the efficient use and management of water resources. The CVM is one of the most frequently employed methods to estimate the value households attach to improved water supply services due to the absence of markets for improved water supply services. Therefore, this study applied CVM as a tool to determine the value households in Nsangi Sub-county attach to improved water supply services in order to answer the following questions:

1. Do households' perceptions, knowledge, attitudes, and opinion show their concern about water supply improvement?
2. What value do non-poultry farmers place on water supply improvement?
3. What value do poultry farmers place on water supply improvement?
4. Does poultry farming significantly influence households' WTP for water supply improvement?
5. What are the main factors that determine households' WTP water supply improvement?

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1.4 Objectives

The main objective of this study is to investigate households' WTP for improved water supply in Nsangi Sub-county using CVM. The specific objectives are to:

1. Analyse households' knowledge, perceptions, attitudes and opinions regarding the current water quantity, fetching water from distant sources and water supply improvement.
2. Determine non-poultry farmer's mean WTP for water supply improvement.
3. Determine poultry farmer's mean WTP for water supply improvement
4. Determine whether poultry farming significantly influences households' WTP for water supply improvement.
5. Determine the main factors that determine household's WTP for water supply improvement.

1.5 Hypotheses

The study tests the following hypotheses:

i. The mean WTP for poultry farmers is more than the mean WTP for non-poultry farmers' sub-sample.
ii. WTP for improved water supply services is statistically dependent on poultry farming.
iii. WTP for improved water supply is significantly influenced by households' socioeconomic characteristics.

1.6 Significance of the study

The justification for conducting this study is to highlight the importance of water supply improvement to households. This is consistent with the Sustainable Development Goal Six (SDG6) (UN Water, 2018) and Uganda's second National Development Plan (NDP11) (GOU, 2015). The aim of the SDGs is to achieve universal and equitable access to safe and affordable drinking water for all by 2030 (UN Water, 2018). On the other hand, Uganda's NDP11 aims at increasing access to safe water in urban areas to 95% and 100% in towns served by National Water and Sewerage Corporation (NWSC) (GOU, 2015). The study also intended to establish whether poultry farming significantly influences households' WTP for water supply improvement.

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Furthermore, the results of this study will assist policymakers at NWSC in designing and formulating water supply policies regarding investing in water supply systems, management and sustainability of water resources. This could help NWSC to determine the feasibility of investing in improved water supply systems and ascertain whether maintenance and operation costs could be generated in the long run to sustain improved water supply services. Furthermore, findings from this study could be useful to Non-governmental organisations (NGOs) for advocacy and decision-making purposes. Lastly, this study will also contribute to the current debate on improved water supply services.

1.7. The structure of the thesis

The rest of the thesis is organized into four chapters. Chapter two provides the methodological and empirical review of the WTP literature for water supply improvement. Chapter three presents the study area, survey development, and data collection methods, and describes the models employed in the study. Chapter four presents the results and the discussion of findings. Finally, the study conclusions and recommendations are presented in chapter five.

UNIVERSITEIT VAN PRETORIA
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CHAPTER 2: LITERATURE REVIEW

2.1 Valuation of environmental goods and services

This section evaluates non-market valuation methods and explains the rationale for applying the CVM. The section presents the theoretical and empirical evaluation of the WTP literature to find the practical methods to apply in the study and identify the research gap to justify the study. Additionally, the section evaluates CVM studies on water supply enhancement to examine factors which explain the demand for water supply improvement. The section also presents the theory of welfare economics. It is arranged into the following sections. Section 2.2 presents the valuation of environmental goods and services, section 2.3 presents the elicitation formats, section 2.4 illustrates the theory of welfare economics, and section 2.5 reviews the methodological and empirical literature.

The economic valuation of environmental goods and services involves assessing households' preferences for the environmental good or service investigated. It is an approach used to assign monetary value to choices made regarding policies, projects, and programmes (Haab & McConnell, 2002). Valuation of environmental goods (such as water) is essential for policymakers to make evidence-based decisions regarding pricing, conservation, and allocation of resources that are in harmony with economic efficiency, equity, and sustainability. Therefore, the economic valuation of environmental goods is a tool used for improving their sustainable use (Whittington et al., 1998). Conservational and sustainable policies for environmental goods (or services) and government projects are correctly designed when their economic values are known (Pearce et al., 2006). However, the economic values of environmental goods are not known because they are public goods with missing markets and externalities (Hanemann, 1994). This implies that the value of environmental goods and services cannot be estimated directly through market prices. Therefore, non-market valuation methods are deemed suitable for estimating households' WTP for water supply improvement.

The values of environmental goods and services are determined by non-market valuation methods, namely revealed preference and stated preference methods (Pearce et al., 2006; Tietenberg & Lewis, 2012). The RP methods derive preference values indirectly based on the observed human behaviours with respect to an environmental good or service. These methods

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include; travel cost method (TCM), hedonic pricing method (HPM), averting expenditure technique and the market pricing method (Pearce et al., 2006). In this study, the TCM and the HPM are reviewed as the most common demand approach methods in the literature.

The TCM generates the value of an environmental good from the travel time and recreational expenditure. It is normally employed in the non-market valuation of recreational sites (Baker & Ruting, 2014) and measure only use values. The method is criticised for basing on unrealistic assumptions to convert the market behaviour into values for a change in environmental quality (Carson et al., 1987). For instance, in the case of an individual TCM, the method assumes that a trip is for a single recreational site. However, this is not always the case since an individual can visit more than one recreational site in a single trip. Therefore, assigning the travel cost of the whole trip to one recreational site overstates its value (Louvierè & Timmermans, 1990). Further, the TCM is associated with complications in estimating the travel time especially for short trips, which complicates the valuation process.

On the other hand, the HPM derives the price of a good from to its internal and external characteristics, known as attributes, to measure use values. For instance, the value of a house could be determined by a attributes such as the number of rooms, bed rooms and the floor area, the age of the house, the structural design of the house, proximity to the social services (shopping centres, schools, and roads), crime rate and pollution level (Chin & Chau, 2003). The technique is mainly applied in the non-market valuation of labour and property markets. It has been applied in the non-market valuation of water quality, air pollution, proximity to the landfill and air traffic noise. The HPM has also been applied to determine wage differences in jobs with different risks (Pearce et al., 2006).

The main advantage of HPM is that, it generates the equilibrium market value of an environmental good, *ceteris paribas*. However, the method is associated with the problem of multicollinearity, since the variables normally considered in the HP models tend to be highly correlated (Haab & McConnell, 2002). For instance, properties near highways have higher concentrations of noise and air pollution, and such variables are highly correlated. Therefore, considering highly correlated variables in the hedonic analysis biases the results. With regards to hedonic wage applications, respondents may have imperfect information about the injury

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and accident risks they face at their places of work. This curtails wage-risk analysis (Pearce et al., 2006). Further, the HPM requires huge datasets to be implemented. Yet, such datasets are limited, especially for developing countries. This curtails the valuation of environmental goods using the HPM (Chin & Chau, 2003).

In general, revealed preference methods are applied to generate reliable values of environmental goods, since they are based on the actual market behaviour rather than the hypothetical market, like the SP methods. However, revealed preference methods are incapable of estimating the non-use values of environmental goods, which implies that such methods cannot be used to generate the total economic value (use and non-use value) of environmental goods (Carson et al., 1987). Since revealed preference methods focus on what has happened in the real market, they cannot be used to estimate values attached to changes in environmental quality *ex-ante* (before such changes are implemented). Therefore, this curtails informing policy before the implementation of projects (Baker & Ruting, 2014).

To address the limitations of revealed preference methods, stated preference methods use surveys based on the hypothetical market to directly elicit households' WTP for changes in environmental quality. The contingent valuation method (CVM) and choice experiment (CE) method are the most commonly applied SP methods (Haab & McConnell, 2002; Tietenberg & Lewis, 2012). The CE approach is a survey-based method that is applied to estimate the value of goods and services depending on their attributes (characteristics) and the levels of attributes in question. It is mainly employed to estimate the value of a good with multiple attributes. In this case, respondents are presented with different descriptions of a good, distinguished by its attributes and levels, and are asked to rate the various alternatives or select their most preferred choices. The WTP estimate is then derived from the individual's rankings or choices (Pearce et al., 2006).

The CE method has become popular owing to the advantages it offers relative to other valuation methods. The method provides more information than CV, as it facilitates measuring the marginal WTP for multiple attributes and the mean WTP. Additionally, CE provides a natural internal scope test due to the use multiple responses. With CE, it is possible to compare different attributes generated, which enables respondents and policymakers to consider a wider

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variety of options. The CE approach also facilitates the use of a smaller sample to generate efficient statistical results, especially when the experimental design theory is applied. This reduces the implementation costs (Adamowicz et al., 1998).

However, the CE approach is associated with some challenges as well. The approach places a higher cognitive burden on the respondents, especially when they are faced with numerous choice sets to choose from. Additionally, CE studies assessing complex environmental changes are difficult to design and to analyse (Pearce et al., 2006). However, this could be mitigated by statistical software, such as NGENE for experimental design and NLOGIT for econometric analysis (Mahieu et al., 2014). Nevertheless, the CV technique is of great interest in this study.

2.2. The Contingent Valuation Method (CVM)

The CVM is a non-market valuation technique used in the estimation of public and environmental goods. It involves asking directly individuals under investigation for their WTP or willingness to accept (WTA) for a change in environmental quality (Pearce et al., 2006; Tietenberg & Lewis, 2012). The CVM elicits WTP for an improvement in environmental quality, contingent on the hypothetical scenario. The proposed improvement in environmental quality is typically non-existent at the time of conducting the study (Whittington, 1998). The CVM scenario uses the approach of asking valuation questions using a structured survey instrument.

The CVM is established on stated behaviour and uses the WTP survey instrument to get information concerning the value that people place on an improved environmental good (Carson, 2000; Perman et al., 2003). The survey instrument presents an individual with a specified improvement cost to elicit his or her response to such cost (Hanemann, 1994). The survey instrument comprises of a hypothetical scenario with questions regarding respondent's monetary values for a non-market good (Carson, 2000). The second aspect of a scenario is the payment vehicle applied for paying for the proposed improvement in the environmental quality, which relates the payment with receipt of the service in the sense that there would be no service without the payment for it (Johnston et al., 2017; Wedgwood & Sansom, 2003).

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The CVM stems from a study by Bowen (1943), which examined the application of voting in the allocation of economic resources. The study recognized that public goods are associated with a political (collective) demand, which requires consumers of such goods to be allowed to participate in determining the optimum quantity preffered and its value. The study proposed that methods involving questionnaires and polls could be used as techniques for determining the optimum output of a public good preferred by a given community. Additonally, such methods could also be applied to value an increase or decrease in the quantity of a public good already supplied. Similarly, a study by Ciriacy-Wantrup (1947), investigated the economic effects of soil erosion. The study revealed that some effects of interest, such as reduced siltation of water bodies, are public goods. Therefore, it recommended that estimating the demand for such effects would be through asking respondents for their WTP.

However, no practical valuation study was conducted until the 1960's. Davis (1963) conducted the first practical application of the CVM in his investigation about the economic value of outdoor recreation. The study employed the CVM to estimate the value tourists and hunters attach to Maine woods. Nevertheless, the CVM was applied to estimate only use values, before the theory for non-use values was developed by Krutilla (1967), who acknowledged the importance of considering existence value in policy evaluations. A study by Haab & McConnell, (2002) suggests that existence value entails non-use value, bequest value and option value. The recognition of existence value in policy evaluations enabled the estimation of use and non-use values of environmental goods.

Randall et al., (1974), estimated the existence value in a study for the very first time. This study was important based on its theoretical thoroughness and the use of photographs to display visibility level. Since 1970's the CVM has grown in significance and popularity. It has been widely applied to estimate the value of different environmental goods including forests, recreational sites, scenery, amenity value, wetlands, wildlife, and air and water quality. The CVM has also been applied in the agricultural, marketing and health economics fields. Literature (Mitchell & Carson, 1989), indicates that the US Water Resources Council endorsed the CVM as one of the techniques for project evaluations in 1979. This indicated the growing acceptability of the CVM. In 1989, the *Exxon Valdez* oil spill in Alaska became a significant event in the development of the CVM. This event raised the debate about the application of

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CVM in assessing environmental damage values. Following that event, the US National Oceanic and Atmospheric Administration (NOAA) panel of economics experts (Arrow et al., 1993), authorised the use of CVM results in litigations about environmental damage losses. This further increased the acceptance and application of the CVM in the valuation of non-market goods and services.

2.2.1 Advantages of contingent valuation method (CVM)

The CVM is one the most popular valuation technique applied in the valuation of environmental goods (Mitchell & Carson, 1989) and it has been used widely to estimate the value households attach to improved water supply services *ex-ante* (Bogale & Urgessa, 2012; Moffat et al., 2011; Namyenya et al., 2014; Vásquez et al., 2009; Whittington, 1998; Wondimu & Bekele, 2011; Wright et al., 2014). This facilitates informing policy decisions before such projects are implemented. The CVM can also be applied to assess the value of environmental damage *ex-post* (after the damage has occurred) to facilitate compensating the affected individuals. Moreover, the CVM is suitable for estimating the non-use value of water supply services compared to other non-market valuation methods, such as the revealed preference methods covered earlier (Hanemann, 1994). Furthermore, the CVM hypothetical scenario is cognitively easier for respondents to understand compared to the classifications of CE numerous choice sets (Mahieu et al., 2014). The CVM also provides for an opportunity to determine values when the change being valued cannot be easily be explained in terms of attributes and levels (Johnston et al., 2017). Therefore, the advantages of the CVM over other non-market valuation methods formed the basis for its application in the current study.

2.2.2 Limitations of Contingent Valuation Method

Empirical evidence (Desvousges et al., 1993; Eberle & Hayden, 1991) indicates that several criticism have been imposed against the CVM, especially concerning its ability to generate reliable and valid results, and the effect of several biases. These include hypothetical, information, starting point, and payment vehicle biases presented in detail below.

2.2.2.1 Hypothetical bias

CVM studies are based on hypothetical scenarios and therefore generate hypothetical results. Respondents do not make actual payments for the improvement in the provision of an

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environmental good or service and therefore may not recognize the impact of the hypothetical scenario. Additionally, respondents may not reveal true preferences about WTP for an improvement in water supply, if the hypothetical scenario is not clearly explained and understood. However, the hypothetical bias can be mitigated by the presentation of a convincing and familiar environmental good in the hypothetical scenario to the respondents (Johnston et al., 2017; Piper & Martin, 1997; Tietenberg & Lewis, 2012).

2.2.2.2 Strategic bias

Respondents may deliberately underestimate or overestimate their true WTP for improved water supply service to influence policy decisions (Wedgwood & Sansom, 2003). The possible explanation for respondents' under estimation of their true WTP preferences is that respondents deliberately opt to free ride in anticipation that payments by other community members will be enough to cater for the costs for water supply improvement (Pearce et al., 2006; Wedgwood & Sansom, 2003; Whittington, et al., 1990).

Similarly, respondents may deliberately overstate their true WTP while knowing that they cannot afford to pay the stated prices, based on their desire to change the *status quo* of water supply services (Wedgwood & Sansom, 2003). To mitigate the strategic bias problem, CV studies should be carefully designed in such a way that respondents are notified in advance about the objectives of the study and possibility of policymakers to use their responses to determine decisions (Asim & Lohano, 2015; Piper & Martin, 1997; Wedgwood & Sansom, 2003).

2.2.2.3 Starting point bias

Valuation formats based on starting bids (such as dichotomous choice format) influence respondents regarding answering WTP questions, as presented bids are used as clues to determine the right price. However, the starting point bias could be mitigated by using different starting bids and asking respondents an open-ended maximum WTP question after the dichotomous choice questions (Pearce et al., 2006; Piper & Martin, 1997; Wedgwood & Sansom, 2003; Whittington et al., 1990).

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2.2.2.4 Information bias

Framed questions for eliciting WTP for improvement in environmental good or service influence the answers (Piper & Martin, 1997), hence information bias. However, giving respondents more accurate, reliable and clear information about the *status quo* of environmental good and proposed benefits of the improvement in the environmental good before asking them WTP questions can reduce the information bias (Wedgwood & Sansom, 2003).

2.2.2.5 Interview bias

Interviewers may influence respondents in revealing true WTP preferences, especially when they are not trained well. Interviewers may influence respondents to consistently state lower or higher WTP preferences by deviating from the script, which biases generated results. However, this can be minimized by training interviewers well and stressing the importance of objectivity before collecting data from the respondents (Asim & Lohano, 2015).

2.2.2.6 Payment vehicle bias

According to literature (Mitchell & Carson, 1989), respondents may refuse to participate in the survey when they are presented with an unclear and unfamiliar payment vehicle (method) for the environmental good under investigation. Therefore, presenting a realistic, well defined and familiar payment vehicle, with clearly explained periods of payments (such as daily, weekly or monthly) (Wedgwood & Sansom, 2003). This is essential in reducing the payment vehicle bias. For example, a daily payment per 20L drawn from the improved water source is appropriate for water supply studies (Wright et al., 2014).

2.3 Guidelines for conducting a contingent valuation (CV) study

Despite all the criticisms against the CV, there is a growing body of literature (Arrow et al., 1993; Johnston et al., 2017; Mitchell & Carson, 1989; Wedgwood & Sansom, 2003), which indicates that correctly designed and implemented CV studies can generate reliable and valid results. Additionally, several guidelines have been developed to facilitate designing and implementing credible CV studies. These range from the NOAA panel CV procedures proposed by Arrow et al., (1993), to the more recently published stated preference guidelines

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suggested by Johnston et al., (2017), to facilitate generating reliable and valid CV results. The main guidelines reported by the NOAA panel include the following. The CVM should:

i) Elicit WTP for future events rather than WTA for previous events. Following that guideline, this study applied WTP as a welfare measure for the proposed improved water supply project in the hypothetical scenario.

ii) Rely on face-to-face interviews as opposed to telephone interviews. However, telephone interviews were given preference to mail surveys, in case the researcher fails to conduct face-to-face interviews. The current study used face-to-face interviews with a structured questionnaire to reduce non-response cases and generate reliable results.

iii) Apply a single dichotomous choice referendum elicitation format. However, a single dichotomous choice format was not applied in this study. We opted for a double bounded elicitation format with a follow up question, which is statistically more efficient and it mitigates the problems of starting point bias and yea-sayings compared to the single bounded dichotomous choice referendum elicitation format.

iv) Describe clearly and accurately the policy under consideration in the hypothetical scenario, highlighting the difference between the *status quo* and the proposed policy improvement. Based on that guideline, this study clearly explained the *status quo* of the current water supply services and the proposed potable water supply services in the hypothetical scenario, for the respondents to make informed choices.

v) Remind respondents about substitutes for the good under consideration and their budget constraint. This study followed this guideline, as we put questions in the questionnaire which reminded respondents about alternative goods and their budget constraints. These are question 67 and 85, respectively.

vi) Include a follow-up section at the end of the questionnaire to assess whether respondents understood the questions they were presented with. Following that guideline, we incorporated a section (Section O) in the questionnaire to determine whether respondents understood the survey questions.

Similarly, Johnston et al., (2017), made several recommendations to guide stated preference studies including the application of CVM. These guidelines include clearly presenting the *status quo* and the change to be valued in the hypothetical market, developing an incentive compatible hypothetical scenario, pre-testing the survey questionnaire, data collection methods

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and the rationale for employing them. Additionally, the CV guidelines also relate to the rationale for using CV or CE in the study design, the basis for applying WTP or WTA in the study design, the basis for using debriefing questions in questionnaire, validity assessments, and reporting study results (Johnston et al., (2017). These guidelines also informed the development and implementation of this study, pretesting, data collection and analysis, as well as reporting study results.

2.4 Elicitation formats

The following elicitation formats are used to elicit WTP or WTA preferences from respondents under investigation using CVM and these include; Open-ended elicitation method, bidding game, payment card approach, single bounded dichotomous choice or referendum formats and double-bounded dichotomous choice formats (Johnston et al., 2017;Hanemann et al., 1991; Pearce et al., 2006).

2.4.1 Open-ended elicitation format

The open-ended elicitation format uses straight forward questions to reveal values respondents place on a certain environmental or public good under investigation. In this case, the respondents are not given clues regarding the value of the good under investigation and hence no starting point bias. However, open-ended elicitation format is associated with high non-response rates, outliers, protest answers, zero answers, and unreliable responses (Pearce et al., 2006).

2.4.2 Bidding game

Under the bidding game format, respondents are faced with several discrete choice questions about WTP for the good or service under investigation, with an open-ended question as the final question. This format uses iterative questions to elicit WTP values from the respondents, who choose preferences carefully. However, bidding game format is positively related to the starting point bias, high numbers of outliers and yea-saying, as some respondents accept to pay to avoid being socially embarrassed (Pearce et al., 2006; Johnston et al., 2017)).

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2.4.3 Payment card approach

The payment card approach presents respondents with visual aid containing different monetary amounts to facilitate the valuation task, which provides a context to their bids. This approach avoids the starting point bias and minimizes the number of outliers. Nevertheless, it is associated with biases related to the figures used and the location of benchmarks (Pearce et al., 2006).

2.4.4 Single bounded dichotomous choice

Under the single bounded dichotomous choice method, respondents make judgments regarding a given price of an environmental good or service, as they decide whether to buy a good or service in question or not. This method is incentive-compatible as it provides incentives for the truthful revelation of preferences under certain circumstances and minimizes outliers and non-responses (Pearce et al., 2006). It is against this background, that it was recognised by the NOAA panel, as the best elicitation format in CV studies (Johnston et al., 2017). However, a single bounded dichotomous choice method is associated with the generation of less information from respondents, numerous yea-sayings as respondents try to please the interviewer by avoiding being socially embarrassed. It also requires a big sample size and therefore very expensive to conduct (León & León, 2003).

2.4.5 Double bounded dichotomous choice format

The double bounded dichotomous choice format was initially suggested by Hanemann(1985) and first applied by Carson et al., (1987). The format presents respondents with a simple ‘yes’ or ‘no’ questions in a formalized format. This study used the double-bounded dichotomous choice CVM to elicit WTP for improved water supply in Wakiso District. To illustrate the approach, we asked the following questions: Are you willing to pay Uganda Shillings (UGX) 250 for a 20 litres (L) Jerry-can of water? A follow-up question is then asked depending on the answer to the first question. If the answer to the first question is ‘yes’, then the bid amount is increased in the second question, and the reverse is true if the answer to the first question is ‘no’ (Hanemann et al., 1991). The double bounded dichotomous choice has been extensively applied in CV studies owing to its advantages compared to other elicitation formats. It is statistically more efficient relative to a single bounded format. Moreover, the double bounded

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elicitation format permits for the correction of a poor choice of the initial bid. This enables the respondent to recover from either too low or too high initial bid responses, which minimizes the strategic bias problem. The double bounded dichotomous choice format also mitigates the problems of the starting point bias and yea-sayings (Hanemann et al., 1991). The starting point bias is unlikely due to the difference in design between the first and the second bid. Similarly, yea-sayings with respect to the second bid are ruled out, since the responses to the second bid are not necessarily influenced by the responses to the first bid. This could be indicated by testing the proportion of "yes" responses with respect to the second bid (Hanemann et al., 1991).

Nevertheless, the double-bounded dichotomous choice is associated with the loss of incentive compatibility as the second question may be perceived by respondents to be external to the choice situation. Despite the weakness of the dichotomous choice format, it has been extensively adopted in contingent valuation studies (Haab & McConnell, 2002). Therefore, the double-bounded dichotomous choice format was selected for this study, based on its advantages over other elicitation formats. These range from statistical efficiency to the mitigation of the yea-sayings, starting point and strategic biases.

2.5 The theory of Welfare Economics

2.5.1 Overview

The foundation of welfare economics for non-market goods and services is mainly based on the concept of Potential Pareto Improvement (PPI), which relates to the increase in the wellbeing of individuals to level whereby everyone is well off, without making anyone worse off. In other words, PPI is synonymous with the concept of welfare improvement. Welfare improvement relates to improved provision of public or environmental goods such as water, which translates into improved welfare of all individuals in a given society (Haab & McConnell, 2002; Tisdell, 2010).

The Kaldor-Hicks principle suggests that for policies to be welfare improving, beneficiaries from policy interventions should compensate losers and still obtain net-gains (Pearce et al., 2006). It is important to note that a policy is considered to be welfare improving whether the

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actual compensation takes place or not. The actual compensation of losses by winners is left to the political process (Gowdy, 2004). Nevertheless, the Kaldor-Hicks principle is prone to preference reversals, which complicate the compensation criterion concerning the changes in welfare (Scitovszky, 1941). The preference reversal suggests that a change in welfare from the new utility level back to the original position may also be Pareto improving (Gowdy, 2004). Additionally, preference reversal is popularly known as the Scitovszky paradox (Schmitz & Zerbe, 2008).

Accordingly, Scitovszky (1941) proposed a double criterion for the fulfilment of the Kaldor-Hicks principle, which implies that households that gain from the change in welfare can compensate the losers. In this case, the gainers from the change in welfare should be able to agree to the change and simultaneously losers from the change in welfare are unable to compensate the gainers such that they remain at the original position. However, empirical evidence (Schmitz & Zerbe, 2008) indicates that Scitovsky paradox is essentially ignored due to the limited cases in which it occurs. Furthermore, Boadway, (1974), demonstrates that in comparing alternative policies or projects, the one with the largest net gains is not necessarily the best, from the compensation point of view. Therefore, choosing gainers and losers from the change in welfare may be tricky. Nevertheless, Gowdy, (2004) postulates that Broadway's observation is considered to be a theoretical anomaly that has little relevance in the application of PPI (Gowdy, 2004).

It is important to note that such improvements in the provision of environmental goods (such as water) are done by the relevant government agencies at a given cost. The PPI, therefore, provides a rationale for public intervention in the allocation of environmental goods and services to increase the efficiency in resource allocation. The change in welfare is determined by the total benefits derived by individuals from the improvements in the environmental good. Therefore, assessing individual preferences about WTP for the changes in the provision of environmental goods and services is essential for a cost-benefit analysis (CBA) before the real changes are effected (Haab & McConnell, 2002).

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2.5.2 Individual preference function

Individuals' preferences for water supply services are represented through utility functions (Haab & McConnell, 2002; Haq et al., 2007). An individual's initial welfare level before the intervention of improved water supply services is represented by the following equation (Pearce et al., 2006).

$$U_0 = u_0(y_0, e_0) \quad (1)$$

Where: U_0=Utility before the intervention

y_0= Income

e_0= Environmental quality before the intervention

Based on the proposal to improve water supply services, environmental quality would improve from e_0 to e_1. The improvement in environmental quality would result in an increase in the individual's welfare from u_0 to u_1.

Thus, $U_1 = u_1(y_0, e_1)$ (2)

Where: U_1= Utility after the intervention

y_0 =Income

e_1 = Environmental quality after the intervention

Therefore, the difference between equation (1) and (2) illustrates the change in welfare due to water supply improvement. It is also equivalent to WTP for the improvement.

$$WTP = U_1 - U_0 \quad (3)$$

However, the individual's utility derived from the consumption of water is unobservable and cannot be measured directly. Therefore, WTP for improved water supply services is considered the most appropriate indirect welfare measure (Pearce et al., 2006).

2.5.3 Measures of welfare estimation

Welfare estimation is defined in two ways namely, compensating variation and equivalent variation (Baker & Ruting, 2014; Haab & McConnell, 2002). Compensating variation relates to the sum of money received or paid that leaves the person at the initial level of well-being,

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while equivalent variation relates to the sum of money paid or received that leaves an individual at the final level of well-being. These two concepts are derived from welfare economics concepts of consumer's surplus and producer's surplus. Consumer's surplus refers to the difference between the maximum sum of money a customer is willing to pay for a certain good or service and the actual amount she pays (Philcox, 2007). On the other hand, the producer's surplus relates to the difference between the minimum sum of money a producer is willing to accept for a given good or service and the actual amount she accepts. Therefore, the concepts of WTP and WTA are directly related to the measures of economic surplus (Pearce et al., 2006).

Further, WTP and WTA are appropriate measures of welfare estimation for non-market goods and services (Philcox, 2007). These welfare measures determine the changes in households' welfare, derived from changes in environmental quality (Haab & McConnell, 2002; Pearce et al., 2006). Examples of changes in environmental quality include water supply and air quality improvements. By definition, WTP refers to the maximum amount of money an individual is willing to pay for an improvement in the provision of an environmental good (Haab & McConnell, 2002; Pearce et al., 2006). On the other hand, WTA refers to the minimum amount of income an individual is willing to accept for a decline in the provision of an environmental good (Haab & McConnell, 2002; Philcox, 2007).

2.5.4 Willingness to pay (WTP) versus Willingness to accept (WTA)

Following the endorsement of WTP as the best welfare measure by the NOAA panel (Arrow et al., 1993), it has been widely adopted in non-market valuation studies (Banda et al., 2006; Genius et al., 2008; Mezgebo & Ewnetu, 2015; Moffat et al., 2011; Namyenya et al., 2014; Philcox, 2007; Whittington et al., 1998; Wondimu & Bekele, 2011; Wright et al., 2014). However, adopting either WTP or WTA depends on the change in the environmental quality being investigated. Explicitly, WTP is deemed to be an appropriate welfare measure for evaluating improvements in the environmental quality. By contrast, WTA is considered to be a suitable welfare measure for assessing reductions in the environmental quality (Philcox, 2007).

Theoretically, WTA is supposed to be equal to WTP. However, empirical evidence indicates that there is a lot of divergences between WTA and WTP (Carson, 2000; Haab & McConnell,

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2002; Mitchell & Carson, 1989; Philcox, 2007). The divergences between WTA and WTP could be attributed to the endowment effect, which suggests that households tend to report relatively more WTA values for the reductions in environmental quality than the WTP values they report for the proposed improvements in environmental quality (Gowdy, 2004; Tietenberg & Lewis, 2012).

Nevertheless, WTA is associated with difficulties in framing incentive-compatible questionnaires and increased rates of scenario rejections relative to WTP (Johnston et al., 2017). Furthermore, the NOAA panel (Arrow et al., 1993), recommended the application of WTP as opposed to WTA in contingent valuation studies. This consequently increased the application of WTP in valuation studies. In this study, we adopted WTP as a welfare measure to determine the change in household's welfare concerning their initial welfare level (*status quo*), which would be derived from improved water supply services.

2.6 Previous studies about WTP for improved water supply

2.6.1 Methodological literature review

This sub-section focused on the methods adopted by previous WTP studies, with a view of identifying appropriate methods for the current study. Most studies (Kanyoka et al., 2008; Mezgebo & Ewnetu, 2015; Whittington, 1998; Wondimu & Bekele, 2011), on WTP for water services employed limited dependent variable models such as conditional logit, probit and Tobit, to estimate the WTP function, with a few exceptions that used ordinary least squares (OLS) (Namyenya et al., 2014).

Previous WTP studies (Mezgebo & Ewnetu, 2015; Whittington et al., 1991), applied a t-test to determine the significance of socioeconomic factors in explaining WTP for improved water supply. It is against this background, that the current study applied the t-test technique to determine the significance of socioeconomic factors in explaining WTP. Several referendum format CV surveys have been administered, adopting purposive and random sampling techniques and the double bounded elicitation format (Mezgebo & Ewnetu, 2015; Whittington et al., 1998).

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2.6.2 Review of Empirical Literature

Empirical literature review focuses on areas emphasized by previous WTP studies, factors considered, and the results generated, with a view of considering similar factors in the current study and identifying the study gap. Previous studies include among others: the assessment of WTP for improved water supply in Onitsha, Nigeria (Whittington et al., 1991). Socioeconomic factors (such as age, number of people in the household, income, education, and gender) and water use practices were considered. Results revealed that households were willing to pay for improved piped water supply. This is consistent with results from other studies (Akeju et al., 2018; Asim & Lohano, 2015; Mezgebo & Ewnetu, 2015; Piper & Martin, 1997). The study further revealed that social welfare would be increased if the water supply system is provided at lower prices below the water vendor's price. It is against this background, that the current study selected bids based on water vendor's prices, the water tariff charged by NWSC for domestic water users and the pre-test.

Furthermore, similar studies considered socioeconomic factors (such as, education, age, distance to the water source, time spent in water collection, connection charges, price charged by water vendors, experience in farming and attitudinal factors (such as, water quality, water reliability) (Farolfi et al., 2007; Margarita Genius & Tsagarakis, 2006; Kanyoka et al., 2009; Kwak et al., 2013; Moffat et al., 2011; Namyenya et al., 2014; Wondimu & Bekele, 2011).

Although households have substantial knowledge regarding the challenges related to limited water supply and display positive attitudes and perceptions towards a policy formulated to address the problem (Mezgebo & Ewnetu, 2015), a few studies have considered households' knowledge, perceptions, and attitudes in their analysis. Accordingly, the present study considers socioeconomic factors (such as household size, age, gender, education, and expenditure) and attitudinal factors (such as, water quantity and quality). Households' knowledge, perceptions, and attitudes regarding the *status quo* of water supply in Nsangi and the proposed improvement in water supply are also investigated.

An investigation of households' WTP for improved tap water services in Karachi, Pakistan revealed that income is positively related to WTP for improved water supply services (Asim & Lohano, 2015). This is consistent with economic theory and other studies conducted about

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YUNIBESITHI YA PRETORIA

WTP for improved water supply (Mezgebo & Ewnetu, 2015; Moffat et al., 2011; Piper & Martin, 1997; Whittington et al., 1990; Wondimu & Bekele, 2011). Following that background, expenditure is expected to be positively related to WTP in this study.

2.6.3 Previous studies on Uganda

This section examines previous studies related to household's WTP for water supply improvement and the challenges associated with water collection from distant water collection sources in Uganda.

The study of rice farmers' WTP for irrigation water supply services was conducted at Doha Rice Irrigation Scheme, in Eastern Uganda (Namyenya et al., 2014). Results from the double-log ordinary least squares (OLS) indicated that education, experience in farming, distance to the market, training in soil conservation and access to credit facilities were significant in influencing rice farmers' WTP. However, access to the extension worker, household size, involvement in non-farm income activities, positive attitude towards payment of user fees and proximity to the irrigation water source had no explanatory power on WTP. Based on the results, the study recommended that farmers should be charged USD 6 per hectare per season below the mean WTP of USD 8 per hectare per season, to generate revenue to cover the maintenance costs (Namyenya et al., 2014).

A study of 802 households looking at the assessment of local water users' willingness to finance the operation and management of rural water system in the villages of Isingiro District, Western Uganda (Naiga & Penker, 2014), revealed that collective action in the context of rural water management is associated with several challenges. These include limited participation of water users, mistrust regarding the use of collected money, limited information about roles and responsibilities of members on WUCs and water users in general.
The chi-square results indicated that the actual contribution is correlated to willingness to contribute towards the operation and management of rural water system. On the other hand, results from a binary logit model indicated that trust, distance to water source, household income, and gender were significantly influencing water users' willingness to contribute

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towards the maintenance and operation of rural water system. However, age, water quality, the existence of clear rules and training of Water User Committees (WUCs) were not significant (Naiga & Penker, 2014).

The analysis of the challenges associated with accessing safe water in rural areas in Isingiro District (Naiga et al., 2015), identified several rural water sources. These include boreholes, protected wells, shallow wells, and gravity flow systems. Accessing water from such sources is associated with the burden on women and children who walk long distances to collect from distant isolated areas such as valleys. Therefore, collecting water from such sources results in losing valuable productive time for other household activities. Additionally, the non-functionality of the water sources in rural areas, particularly boreholes due to poor management and operation of water infrastructure. This results in sinking pipes, missing repairs, corrosion and salinity of the water, which limits access to safe water in rural areas. This is worsened by insufficient funds to buy spare parts, equipment, and paying for preventive maintenance of rural water infrastructure as well as ineffective and non-existent WUCs in some areas. Additionally, water users' unwillingness to contribute funds towards the operation and maintenance of rural water sources impact negatively on water supply and functionality of rural water sources (Naiga et al., 2015).

Another study on gender and water collection analysis in the rural areas of Makondo Parish, Lwengo District, South-central Uganda (Asaba et al., 2017), revealed that children and women are the most burdened with collecting water from distant water sources. Additionally, the study indicated that children and women walk long distances on hilly paths and roads to collect water and waste a lot of time standing in lines at water sources. This is consistent with other studies (Lee & Schwab, 2005; Lehmann, 2010), which confirm that households travel long distances to access to water in developing countries. Consequently, many children and women suffer from health-related problems, such as chest pains, fatigue, headaches, and nasal bleeding. Besides, children and women are also affected by the dangers of physical and verbal assault as well as rape at water sources (Asaba et al., 2017). However, such problems associated with collecting water from communal water sources could be prevented by improving water supply services, by bringing water access closer to the affected households (MWE, 2018).

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Another study applied three hypothetical scenarios to determine households' preferred payment vehicle, and WTP for improved water and sanitation systems among tenants and landlords in Lugazi, Uganda (Whittington et al., 1998). The study discovered that 60% of the households preferred to pay monthly water payments compared to 37% who preferred to pay per Jerry-can. The study further discovered that most of the households were willing to pay for improved water services. Additionally, tenants' demand for private water connections exceeded expectation and most households could afford the water from public taps as opposed to private metered connections. Based on the results, the study recommended that households who could afford to connect to metered private connections should connect and sell water to neighbours (Whittington et al., 1998).

The CV study conducted in the villages of Kigisu and Rubona, Mubende district (Wright et al., 2014) estimated WTP for improved rural water supply services. A survey sample of 122 households was interviewed using an iterative bidding process to determine WTP per 20L of water from a public tap. Results from the ordered probit model indicated that the mean WTP was equivalent to UGX 356 ($ 0.83) per 20L. Results also indicated that distance to the water source and the number of children was significantly influencing households' WTP for improved water supply. By contrast, income, age, and gender had no explanatory power on WTP. Nevertheless, previous WTP studies (Akeju et al., 2018; Mezgebo & Ewnetu, 2015), revealed that income and gender significantly influence WTP for improved water supply services.

The current study builds on the previous studies reviewed to formulate an appropriate model for the WTP for improved water supply services in Wakiso District. In summary, previous studies concentrated on determining the factors that influence households' willingness to finance the maintenance and operation of rural water system (Naiga & Penker, 2014), challenges associated with accessing rural water (Naiga et al., 2015), gender and the burden of water collection (Asaba et al., 2017), rice farmers' WTP for irrigation water (Namyenya et al., 2014), and households' WTP for improved water supply for domestic purposes (Whittington et al., 1998; Wright et al., 2014).

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Based on that background, previous studies did not address the economic value of water use, differentiated by type of use, with reference to poultry and non-poultry farming households, which created a gap in literature. In an attempt to address the literature gap and contribute to the issue of accessing water in Wakiso District, this study investigates poultry and non-poultry farmers' WTP for potable water supply services. Further, the study examines households' knowledge, attitudes, and perceptions concerning the current water supply challenges and the proposed water supply improvement in Nsangi Sub-county. The study also evaluates important factors in explaining WTP.

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CHAPTER 3: STUDY AREA AND METHODOLOGY

3.1 Study area

Uganda is located in East Africa, approximately 800 kilometres inland from the Indian Ocean with a total area of 241,551 square kilometres. The country is landlocked, boarded by South-Sudan in the North, Tanzania in the South, Kenya in the East, Democratic Republic of Congo in the West, and Rwanda in South West (UBOS, 2017), as indicated in Figure 3.1.

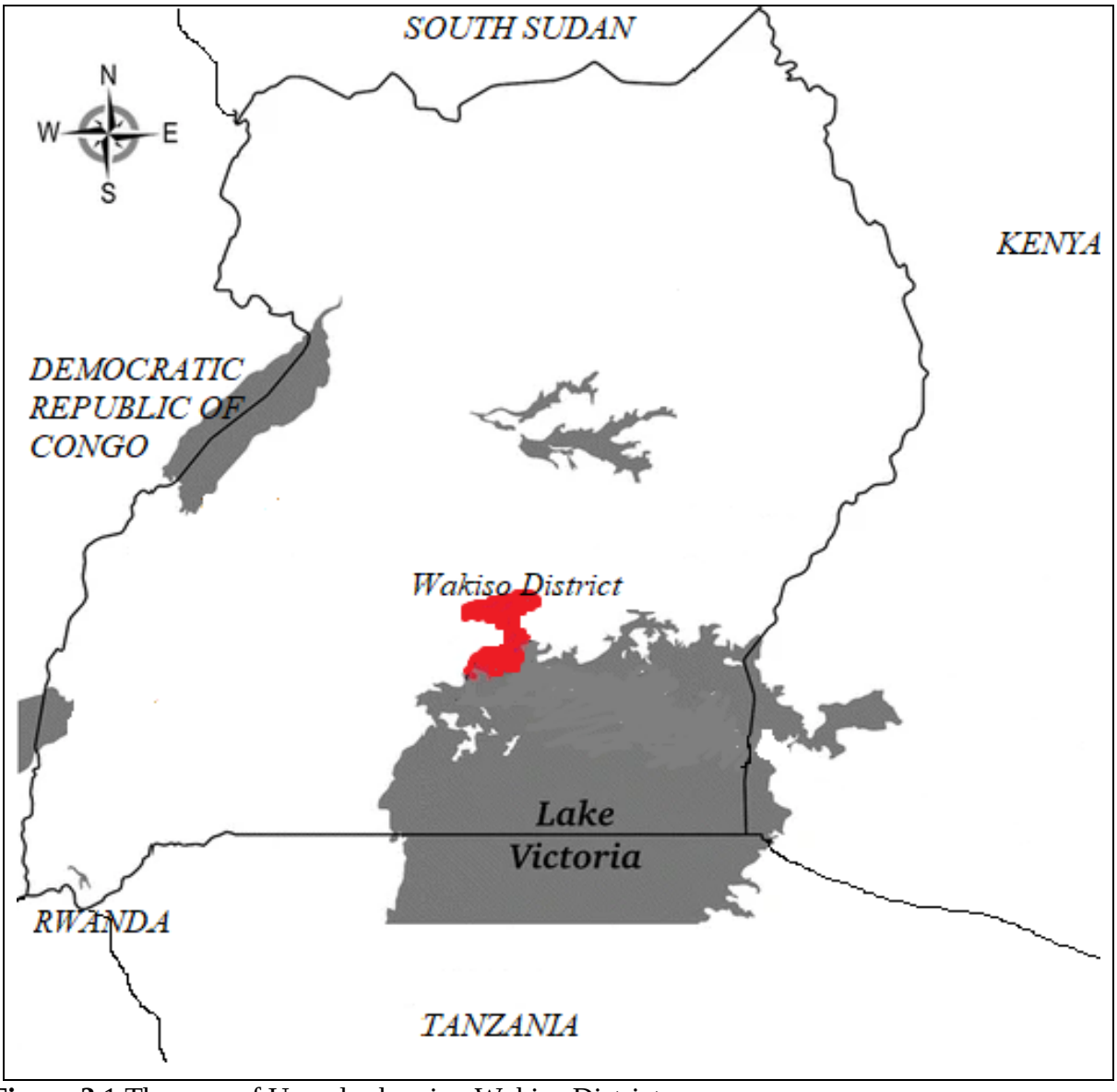

Figure 3.1 The map of Uganda showing Wakiso District
Source: UBOS, (2017)

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Uganda has an equatorial climate with adequate rainfall and sunshine regulated by relatively high altitude. The Central, Western, and Eastern regions have two rainy seasons per annum, with relatively heavy rains from March through May and light rains from September through December. The average rainfall in Uganda ranges between 750 mm and 2100 mm annually and the mean annual temperature ranges from 16^0 C to 30^0 C in most parts of the country. The country has freshwater resources, which cover 11% of the total surface area, and these include Lakes such as Victoria, George, Edward, Kyoga and Albert, and Rivers, such as the Nile. The Southern region of Uganda has a tropical rainforest vegetation compared with the savannah woodlands and semi-arid vegetation in the Northern region (Alabaster & Kručková, 2015; UBOS, 2014).According to UBOS (2014), the population of Uganda is estimated at 34.6 million people, with females accounting for 51% of the total population compared to 49% males.

Uganda is divided into 116 local government administrative districts (as at September 2014), which are further sub-divided into Counties, Sub-counties, parishes, and villages. These local administrative units are responsible for the implementation and monitoring of government programmes at different levels. Wakiso District is of one the local government administrative districts in Uganda, with several Sub-counties, such as Bussi, Wakiso, Kasanje, Nsangi Sub-county (Kyengera Town Council) and Kakiri. It is represented by the red shaded area in figure 3.1(UBOS, 2017; WDLG, 2009).

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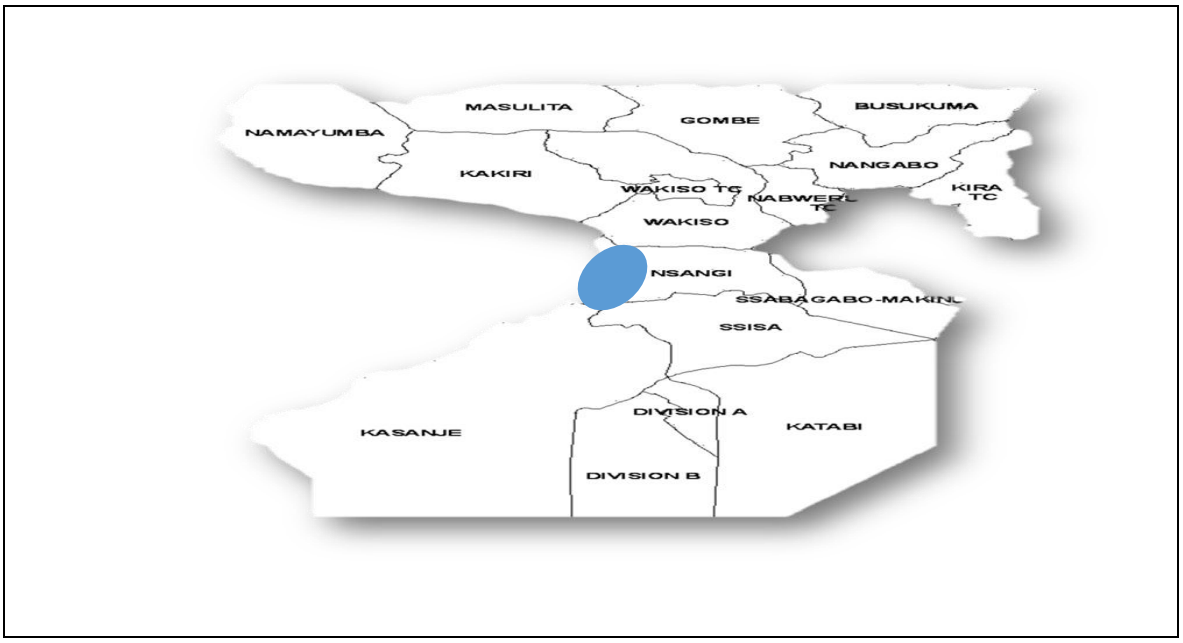

Figure 3.2 The map showing Wakiso Sub-counties
Source: Wakiso District Local Government (WDLG, 2009)

This study was conducted in Nsangi Sub-county, Wakiso District, focusing on the following villages: Kikajjo, Kasenge, Nakirama, and Kazinga (represented by the blue circle in figure 3.2). Wakiso was chosen due to its documented poor water quality and supply services (Baguma et al., 2013; Musoke et al., 2017), and the presence of numerous poultry farmers (MAAIF and UBOS, 2009). Nsangi Sub-county has a population of 195,531 people, of which 52.8% are females compared to 47.2% males and a total of 48,421 households (UBOS, 2016b).

Agriculture is one of the main critical sectors of Uganda's economy, employing over 72% of the total population particularly women and the youth (MoFPED, 2018). According to the national statistics (UBOS, 2017), the agricultural sector contributes 23.5% to Gross Domestic Product (GDP)and 46% to Uganda's total export earnings. Households are engaged in crop farming (coffee, maize, tea, tobacco, and beans) and animal farming (livestock, fish, and poultry) (MoFPED, 2018; UBOS, 2014, 2017).

Poultry farming is the fastest-growing segment of the agricultural sector in Uganda due to the high demand for poultry products, particularly chicken meat and eggs (Byarugaba, 2007; Ekesa et al., 2015; FAO, 2009; Tumwebaze, 2016). As indicated earlier, Wakiso District is the leading

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producer of poultry products in Uganda, accounting for 7.4% of the national chicken population (MAAIF and UBOS, 2009). Poultry farming is widely practiced in Nsangi sub-county maily in the villages of Kikajjo, Kasenge, Nakirama and Kazinga. Most households have small scale poultry farms in the backyard of their homesteads associated with low input and output, and a few with large scale poultry farms, which heavily rely on water use.

3.2 Water access in Wakiso

According to the statistics from Uganda's Ministry of Water and Environment (MWE), only 39% of the Wakiso population has access to safe water, where 51.2% of the population have access to potable tap water supply (MWE, 2018), leaving 48.8% of the population with limited access to reliable water sources. The current study focuses on the 48% of Wakiso households who don't have access to potable tap water, but rely on external sources for water supply. Furthermore, a large proportion of the population accounting for 48% access water from shallow wells, 23% from protected springs, and 15% from piped water supply system operated by NWSC, while 13% access water from deep boreholes and 1% harvest rainwater (MWE, 2019). This implies that a large proportion of the households in Wakiso District access water from distant sources, with a few households that access potable piped water supply at their premises.

For that reason, households in Wakiso spend a considerable amount of time and labour collecting water from distant water sources at the expense of other productive activities (Baguma et al., 2013), yet the quality of water from such sources is wanting (Musoke et al., 2017).Therefore, this affects the health and welfare of households and livestock (including poultry) that heavily rely on water use in Wakiso District. It is important to note that households also buy water at relatively higher prices from vendors mainly during the dry season (Pangare & Pangare, 2008), which impacts negatively on their well-being.

A large proportion of households in Wakiso is engaged in agriculture. About 37.5% of the total number of households in Wakiso are either engaged in crop or livestock farming, 25% are engaged in livestock stock farming and 27% are involved in crop farming (UBOS, 2017).This is consistent with the latest national agricultural statistics (MAAIF and UBOS, 2009), which revealed Wakiso District as the leading poultry farming District in Uganda. To mitigate the

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problems of distant water sources and their related health and economic risks, the government of Uganda has to extend potable water supply services to the affected households (MWE, 2018).

However, investing in extending potable water supply services to the affected households requires huge sums of money to cater for procuring and installing potable water supply machinery and to cover maintaince and operational costs. Therefore, investigating whether the affected households are willing to pay for the potable water supply services is critical before investing in that expensive venture (Wondimu & Bekele, 2011).

3.3 Methods

3.3.1 Sampling design and methods

The study employed purposive and random sampling techniques in data collection. The sample is divided into poultry and non-poultry farming households in Kasenge, Nakirama, Kikajjo and Kazinga villages. Purposive sampling technique was used to identify poultry and non-poultry farming households without potable piped water supply at their premises or poultry farms in the study area. Subsequently, a random sampling technique was applied to select households to engage in the study and ensure that different categories of respondents are represented. The villages in question were selected due to the presence of many poultry farmers and severe water supply challenges faced by residents. The study used primary data from a survey sample of 243 households in the study area. The sample size (SS) for this study was determined by the following formulations (Kothari & Gaurav, 2015), denoted by equation (4) and (5).

$$ss = \frac{(z\text{-}score)^2 * p\ (1-p)}{(Margin\ of\ error)^2} \quad (4)$$

Where:

ss = sample size

z-score = 1.96 for 95% population representation

p = probability of a selecting a given respondent in the population (0.5)

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The probability value of 0.5 implies that every respondent in the population has an equal chance of being selected to participate in the study.

$$ss_{Adjusted} = \left(\frac{ss}{1+\frac{ss-1}{population}}\right) \quad (5)$$

According to national statistics (UBOS, 2016b), Nsangi sub-county has 48,421 households. Using equation (4), ss = 384 and using equation (5), the adjusted ss = 383. Based on time and financial limitations, the study considered a sample size of 243 to be fairly representative. The sample was split into two sub-samples of 110 or poultry farmers and 133 for non-poultry farmers. The aim was to compare the WTP for improved water supply services among the two sub-samples and determine whether poultry farming significantly influences households' WTP.

3.3.2 Survey instrument development

The pre-tested questionnaire for poultry and non-poultry farming households was designed to attain the specific objectives of the study and address the research gap. About fifteen households were interviewed in the pilot study and a survey questionnaire pre-test was conducted. Thereafter, a few adjustments were made in the questionnaire as respondents demonstrated that they understood the questions and the hypothetical scenario. According to (Johnston et al., 2017) pretesting is critical in designing clear and reliable contingent valuation questionnaires through a well-adjusted presentation of information. Additionally, key informant questionnaires and focus group guides were also developed to get more information concerning water supply challenges from a diverse audience. Two enumerators were trained to assist with the data collection process.

3.3.3 Bid design

The bids for the study were informed by a pilot study of fifteen respondents, which was conducted between 10 and 12 August 2018. We presented the hypothetical scenario clearly explaining the *status quo* of the current water supply services and the improved potable water supply services. Based on the hypothetical scenario presented, we asked respondents for their maximum WTP pay for potable water supply services. Using the maximum WTP data, we

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generated summary statistics regarding households' mean, maximum and minimum WTP. These figures were used to generate the first bids for the study. The study used three starting bids, namely: UGX 150 (USD 0.05), UGX 200 (USD 0.06) and UGX 250 (USD 0.08), which were administered randomly. The study also considered the following second bids based on the responses from the first bid: UGX 100 (USD 0.03), UGX150 (USD 0.05), UGX 200 (USD 0.06), UGX 250 (USD 0.08) and UGX 300 (USD 0.09). The difference between the first and the second bid was UGX 50. The lowest bid for the study (UGX 100) was slightly higher than the current price (UGX 66 per 20L) charged by NWSC (MWE, 2018) and the highest bid (UGX 300 per 20L) was marginally lower than the average price (UGX 330 per 20L) charged by water vendors. Additionally, the study adopted a 20L Jerry-can as the common unit of measurement, since most households are familiar with it and it is also commonly used by the water vendors.

3.3.4 Survey implementation

The study used structured questionnaire to conduct interviews with households in selected villages in Wakiso District. One-on-one interviews were conducted in Nsangi sub-county at Nakirama, Kasenge, Kikajjo and Kazinga villages. Each respondent was presented with a consent form to sign before the interview was conducted. Enumerators interviewed poultry and non-poultry farming households considered to participate in the study, per village at a time, with the supervision of the researcher. On average, interviews took 35-50 minutes per interview apart from a few interviews that took relatively longer time per interview. Some respondents were not comfortable revealing their income information at first. However, the researcher had to re-emphasize the confidentiality of the study based on their anonymous participation and they responded positively. Due to water supply challenges in Nsangi sub-county, especially regarding high water prices charged by water vendors and distant water sources, respondents were more cooperative in the study. Ultimately, respondents dedicated their invaluable time to engage in the study and revealed reliable information.

Questions were asked regarding the socioeconomic characteristics of the respondent and the knowledge, perceptions, attitudes, and opinions regarding the current water quantity, fetching water from distant sources and the improved water supply services before the hypothetical scenario was presented. The validity and reliability of the responses were determined by

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affordability and financial questions after the WTP section, as well as the respondent assessment questions at the end of the interview. A double bounded valuation format was adopted to determine the WTP for improved water supply services, where respondents were asked to vote for or against the proposed policy improvement in the water supply. Six key informant interviews were conducted with government officials, water user committee members and local leaders. Three focus group discussions (FGDs) were conducted with the youth association (group), women association (group), and a group representing all community members in the study area.

3.3.5 Data analysis

The study used Excel and STATA for data entry and analysis. Frequencies and percentages for all the variables were analysed during the data cleaning process to ensure that data was entered correctly and the outliers were removed to generate accurate and reliable results. Accordingly, the necessary adjustments were made. Different analyses were conducted to achieve different study objectives as follows: (i) the first objective of this study was to examine respondents' perceptions, knowledge, attitudes, and opinions about the current water quantity, fetching water from distant areas and improved water supply services. This was achieved by the one-way analysis of the variance (ANOVA) using the chi-square and the related p-values; (ii) the second objective of this study was to determine the mean WTP for non-poultry farmers and this was achieved by the estimation of a double bounded model for non-poultry farmers; (iii) the third objective of this study was to determine the mean WTP for poultry farmers and this was achieved by the estimation of a double bounded model for poultry farmers;(iv) the fourth objective of this study was to determine whether the household's WTP is significantly influenced by poultry farming. This was achieved by the paired t-test analysis of equal variances for the two sub-samples.

Finally, (v) the fifth objective of this study was to determine the main factors that determine poultry and non-poultry farmers' WTP for improved water supply services and it was determined by the double bounded dichotomous model and the related p-values of explanatory variables considered in the model.

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3.3.6 Variable description

This sub-section explains the variables employed in the study. The mean WTP was determined by socioeconomic variables and the knowledge, perceptions, attitudes, and opinions variables. These variables were informed by previous WTP studies. These variables were analysed by descriptive statistics such as means, confidence intervals, and standard errors. The double bounded model was applied to determine households' mean WTP, which is the ultimate goal of the study. The WTP variable is a binary variable with a yes or no option. This implies that respondents are either willing to pay for water supply improvement or not. The WTP variable represented the dependent variable as the households' mean WTP for improved water supply for non-poultry or poultry farmers in the model and it was explained by several explanatory variables. The variables applied in the models and their expected signs are presented in Table 3.1.

Table 3. 1 The description of variables used in the models and their expected signs

Variable Name	Definition	Expected Sign (+/-)
Gender	Sex of the household head (1= Female, 0 = Male)	+
Age	Age of the household head (1= Age ≤ 34, 0 if Age = ≥35)	+/-
Price	The current price of water per 20L charged by water vendors at alternative sources	+
Education level	Household's Education level Level 1 (Graduate=1, 0= otherwise) Level 2 (High school =1, 0 otherwise), Level 3 (Secondary = 1, 0 otherwise) & Level 4 (Primary & below) (The base variable)	+
Household size	The number of people in the household	+/-
Number of Chicken	Number of chicken reared by a poultry farmer	+
Quality	Respondent's perception on whether the current water quality is problematic (1 = Yes, 0 = Otherwise)	+

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Quantity	Whether the respondent receives enough quantity of water from the main source (1 = Yes, 0 =Otherwise)	–
Expenditure	Households' monthly expenditure	+
Water payment	Whether the respondent pays for water at alternative sources (1 = Yes, 0 = Otherwise)	+
Rhead	Whether the respondent is the head of the household (1= Yes, 0 = Otherwise)	+
Bid1	The first bid amount presented to the respondent	–
Tenancy type	Whether the respondent owns a house (1 = Yes, 0 = Otherwise)	+
Queues	Whether the respondent finds queues at water collection points (1 = Yes, 0 = Otherwise)	+
Willingness to shift	Whether the respondent is willing to shift to the new water supply network. (1 = Yes, 0 = Otherwise)	+

Based on the theoretical and empirical literature established earlier, independent variables and their expected signs are briefly explained.

Gender: This variable is likely to influence the WTP decision positively when the respondent is female since women are more affected with the burden of collecting water from distant sources.

Age: This variable is expected to be with either a positive or negative impact on the WTP for water supply improvement. On one hand, the young people are more engaged in collecting water far from their homes and therefore more willing to pay than older people. On the other hand, the older people could be more willing to invest in improved water supply services for the future of their children.

Price: This variable is expected to be positively related to WTP based on the economic theory which predicts a positive cross elasticity of demand for a substitute good or service.

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Education level: A positive relationship is expected between the WTP decision and education level. Educated households are more informed about the benefits of water supply improvement than less educated households. Thus, the educated households will be willing to pay more than less educated.

Household size: The WTP is expected to be either positively or negatively related to household size. Households with several members are expected to be less willing to pay for water supply improvement due to the budget constraint, compared to households with fewer members. Alternatively, households with more members are likely to demand for more water for domestic household activities and make several trips to distant water collection points than households with fewer members and therefore expected to be more willing to pay.

Number of chicken: The study expects a positive relationship between WTP and the number of chicken since farmers with larger numbers of chicken generate more profit and can afford to pay compared to farmers with less numbers of chicken.

Quality: The WTP decision is expected to be positively related to the respondent's perception on whether the current water quality is problematic. Respondents who perceive poor water quality and its associated economic costs are likely to be willing to pay for good water quality services to avoid such costs.

Quantity: It is expected that this variable will influence WTP negatively, since economic theory regarding the law of demand predicts that price for a normal good is negatively related to the quantity demanded.

Expenditure: This variable is expected to impact WTP positively since expenditure represents the respondent's income and capacity to invest in improved water supply services. Therefore, respondents with more income are expected to be willing to spend more on water supply improvement compared with respondents with less income based on economic theory.

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Water payment: A positive relationship is expected between WTP and the water payment variable when the respondent is currently paying for water at alternative sources. Since water from alternative sources is relatively expensive compared with the water from the NWSC, respondents are likely to be willing to pay for an improved water supply service.

Rhead: This variable is expected to influence positively the probability of being selected in survey when the respondent is the head of the household. However, it does not influence the magnitude of WTP. For this reason, it is assumed that the influence of this variable would only be on the selection stage, i.e., on the selection equation. Ultimately, it is used as an exclusion restriction in the Heckman probit model.

Bid1: The Bid variable is expected to be negatively related to WTP based on economic theory, which potrays a negative relationship between the price and the quantity demanded.

Tenancy type: Just like the Rhead variable, the tenancy type of the respondent is used only in the selection equation as an exclusion restriction. It is expected to influence positively the probability of being selected in the survey but doesnot impact on the magnitude of WTP.

Queues: This variable is also used as an exclusion restriction. It is expected that queues at water collection points will influence positively the respondent's probability of being selected in survey.

Willingness to shift: This variable is expected to influence the probability of being selected in the survey positively and it was also applied as an exclusion restriction.

Table 3.2Household Characteristics of the Sample: Descriptive Statistics

Variable	Poultry farmers	Non-poultry farmers	Total
Gender			
Male	46 (42.73%)	47 (35.34%)	93 (39.03%)
Female	57 (57.27%)	86 (64.66%)	143 (60.97%)
Average household size	5	5	5
Age in years			
18-34	55 (50.00%)	72 (54.14 %)	127 (52.07%)
≥ 35	55 (50.00%)	61 (45.86%)	116 (47.93%)

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Relation to the head			
Head	42 (38.18%)	65 (48.87%)	107 (43.52%)
Spouse	34 (30.91%)	50 (37.59%)	84 (34.25%)
Son/daughter	10 (9.09%)	14 (10.53%)	24 (9.81%)
Relative	2 (1.82%)	1 (0.75%)	3 (0.94 %)
Worker	22 (20.00%)	3 (2.26%)	25 (11.13%)
Marital status			
Married	60 (54.55%)	80 (60.15%)	140 (57.35%)
Never married	33 (30.00%)	29 (37.59%)	62 (33.80%)
Divorced	4 (3.64%)	3 (2.26%)	7 (2.95%)
Widow/widower	8(7.27%)	7 (5.26%)	15 (6.27%)
Separated	5 (4.55%)	14 (10.53%)	19 (7.54%)
Period at the present location for the past year (12 months)			
Whole year	107 (97.27%)	123 (92.48%)	230 (94.88%)
Otherwise	13 (2.73%)	10 (7.52%)	23 (5.12%)
Highest level of education			
Graduate (Tertiary education)	38(34.55%)	32(24.06%)	70(29.30%)
High school	23(20.91%)	34(25.26%)	57(23.09%)
Secondary school	27(24.55%)	33(24.81%)	60(24.68%)
Primary and below	22(20.00%)	34(25.56%)	56(22.78%)
Monthly income (in Uganda Shillings)			
0- 0.5M	8 (7.27%)	61(45.86%)	69 (26.07%)
0.5 -1.2M	35 (31.82%)	46(34.59%)	81 (33.21%)
> 1.2M	67 (60.91%)	26 (19.55%)	93 (40.23%)
Employment status			
Formal employment	13 (11.82%)	17 (12.78%)	30 (12.3%)
Informal employment	9 (8.18%)	28 (21.05%)	37 (14.61%)
Poultry farmer(Own business)	55 (50.00%)	61(45.86%)	100 (47.93%)
Poultry farm worker	23 (20.91%)	0(0.00%)	23 (10.46%)
Farmer	10 (9.09%)	0(0.00%)	10 (4.54%)
Unemployed	0 (0.00%)	27(20.30%)	27 (10.15%

From Table 3.2, results indicate that many of the respondents interviewed were females accounting for 61% for both sub-samples. The young respondents were more than their older counterparts above 35 years. Respondents aged between 18 and 34 are about 52 %, while those above 35 years are represented by 48%. The average family size for both sub-samples is five (5) family members per household. Most of the respondents interviewed were household heads accounting for about 44% for both sub-samples. These are followed by spouses to the household head represented by approximately 34% in total for both sub-samples. Spouses were

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interviewed in the absence of household heads, the main focus of the study. Other family members were also interviewed in the absence of both the household head and the spouse.

Further, most of the respondents interviewed were married accounting for about 57% in total for both sub-samples. About 95% of the respondents had lived at the present location for one year, which implies that they were knowledgeable about water supply challenges in the study area. Results from Table 3.2; also indicate that most of the respondents have tertiary level qualifications accounting for about 29%. These are followed by respondents with secondary school qualifications, high school certificates, and primary school and below, in that order. Most of the respondents are engaged in either poultry farming or personal businesses accounting for 47% for both sub-samples earning above UGX 1,200,000/- per month. These are followed by respondents earning between UGX 500,000/- and 1,200,000/- monthly. About 26% of the total number of respondents for both sub-samples are earning below UGX 500,000/- per month.

3.4 Empirical models used in the study

3.4.1 Chi-square model

The chi-square model was applied in this study to determine the relationship between categorical variables (such as gender, age and education) and households' knowledge, perceptions and attitudes regarding improved water supply in the study area. The chi-square with a p-value less than 0.05 signifies that a variable under investigation, influences households' knowledge, perceptions and attitudes concerning improved water supply and the reverse is true for a chi-square with a p-value above 0.05. The chi-square model is given in equation below.

$$x^2 = \frac{(observed - expected)^2}{expected} \quad (6)$$

Where: x^2= Chi-square, which measures the relationship between variables.

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3.4.2 T-test model for regression coefficients

The t-test model was adopted in this study to establish the key factors that determine households' WTP for water supply improvement. The t-test analysis determines the significance level of the regression coefficients in relation to the mean WTP for water supply improvement. This implies that the regression coefficients with p-values less than 0.05significantly explain the mean WTP for water supply improvement at a 5% confidence interval. The t-test can be expressed as follows.

$$t_k = \frac{\beta_k - \beta_k^0}{se * \beta_k} \quad (7)$$

Where:

t_k = test statistic

β_k = estimated value

β_k^0 = specific value chosen by the respondent

se = standard error

Under the null hypothesis, this statistic has n-k-1degrees of freedom with a t-distribution.

Where n = Sample size and k = number of explanatory variables.

3.4.3 Two-sample t-test for the mean WTP

The study adopted the two-sample t-test to examine the statistical significance of the two mean WTP for the split samples (the mean WTP for poultry and non-poultry farmers). This test assists in determining whether the null hypothesis which states that the mean WTP for the two sub-samples is equal. The null hypothesis could be rejected or accepted based on the t-statistics produced by the data. The two-sample t-test is denoted by equations (8) and (9).

$$t = \frac{(\widetilde{\beta_2} - \beta_2)}{Se\beta_2} \quad (8)$$

$$= \frac{\widetilde{\beta_2} - \beta_2 \sqrt{X_i^2}}{\tilde{\sigma}} \quad (9)$$

Where:

$\widetilde{\beta_2}$ = Estimated beta value

β_2 = The true beta value

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Se = Standard error

X_i = Explanatory variables

Under the null hypothesis, this statistic has n-2 degrees of freedom and follows a t-distribution. The confidence interval determined under this statistic follows a t-distribution as well (Gujarati, 2004).

3.4.4 The sample mean

The sample mean model was applied in this study to estimate the upper and lower bounds for the WTP means for the split sample. The sample mean is determined by the summation of all the observations divided by the total number of observations (Manikandan, 2011).The maximum WTP values for the 'yes-yes' answers were employed to estimate the upper bound for the mean WTP. While the lower bound for the mean WTP was estimated using maximum WTP values for the 'no-yes' responses. The sample mean technique was adopted in this study because it was suitable for the data collected. The sample mean model is given by the following equation.

$$\bar{X} = \frac{\sum X_i}{n} \tag{10}$$

Where:

$\bar{X}$= The sample mean

$\sum x_i$= The summation of all the observations

n = The total number of observations

3.4.5 The double bounded dichotomous probit model

The double bounded dichotomous probit model is applied based on the following assumptions. The error term is normally distributed, independent and identically distributed (IID) with a zero mean value. In this case, each respondent is offered two bids. The first bid is indicated by B_i, while the second bid is denoted by B_i^u. The second bid is dependent on the answer to the first bid. If the respondent answers 'yes' to the first bid, the second bid is increased above the first bid ($B_i < B_i^u$) and if the respondent answers 'no' to the first bid, the second bid is reduced

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below the first bid ($B_i^v < B_i$). This generates four responses namely: yes-yes (yy), yes-no (yn), no-yes (ny) and no-no (nn).

The likelihoods of these responses are $\pi^{yy}, \pi^{yn}, \pi^{ny}$ *and* π^{nn}, respectively. The log-likelihoods of the responses in are calculated by the Maximum likelihood method to generate the WTP for water supply improvement for the split sample. For a utility maximising water user, the formulas for these likelihoods are given in the following equations (Hanemann et al., 1991).

For the yes-yes responses, $B_i^u > B_i$ and

$$\pi^{yy}(B_i, B_i^u) = \Pr\{B_i \leq max\ MTP\ and\ B_i^u \leq max\ WTP\} \quad (11)$$

$$= \Pr\{B_i \leq max\ WTP \mid B_i^u \leq max\ WTP\} \Pr\{B_i^u \leq max\ WTP\}$$

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

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

$$\pi^{nn}(B_i^v, B_i) = \Pr\{B_i \leq max\ MTP\ and\ B_i^v \leq max\ WTP\} = G(B_i^v, \theta) \quad (12)$$

For the yes-no responses, we have $B_i^u > B_i$, and

$$\pi^{yn}(B_i, B_i^u) = \Pr\{B_i \leq max\ MTP \leq B_i^u\} = G(B_i^u; \theta) - G(B_i; \theta) \quad (13)$$

For the no-yes responses, we have $B_i^v < B_i$, and

$$\pi^{ny}(B_i, B_i^v) = \Pr\{B_i \geq max\ MTP \geq B_i^v\} = G(B_i; \theta) - G(B_i^v; \theta) \quad (14)$$

Using equation (13) and (14), the second bid permits the researcher to determine the respondent's lower and upper bound for the unobserved true WTP. However, with equation (11) and (12), the second bid reduces the lower bound or increases the upper bound for WTP. Given a sample of N respondents, with B_i, B_i^u and B_i^v bids for the ith respondent, the log-likelihood function is transformed in the following equation.

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$$\text{In}L^D(\theta) = \Sigma_{i=1}^{N}\{d_i^{yy}\text{In}\pi^{yy}\left(B_{i,}B_i^u\right) + d_i^{yy}\text{In}\pi^{nn}\left(B_{i,}B_i^v\right) + d_i^{yn}\text{In}\pi^{yn}\left(B_{i,}B_i^u\right) + d_i^{ny}\text{In}\pi^{ny}\left(B_{i,}B_i^v\right)\} \quad (15)$$

Where $d_i^{yy}, d_i^{nn}, d_i^{yn}$ *and* d_i^{ny} represent the binary variables generated from the respondent's bid responses. The formulas for the related response probabilities are given in equations (11) to (14). The Maximum likelihood estimator for the double bounded model , $\tilde{\theta}^D$, is derived from solving the subsequent equation:

$\partial\ \text{In}L^D(\tilde{\theta}^D)/\ \partial\theta = 0$

The asymptotic variance-covariance matrix for $\tilde{\theta}^D$ is represented by:

$$V^D(\tilde{\theta}^D) = \left[-E\frac{(\partial^2 In\, L^D\,(\tilde{\theta}^D)}{\partial\,\theta\,\partial\,\theta'}\right]^{-1} \equiv I^D\left(\tilde{\theta}^D\right)^{-1}$$

The double bounded dichotomous model is statistically more efficient than a single bounded dichotomous model. This is reflected in its relatively higher t-statistics for the model coefficients, comparatively greater chi-square statistics (goodness of fit), and a smaller gap between WTP confidence intervals. It is suggested that the double bounded dichotomous model mitigates the strategic bias problem, as it permits for the correction of a poor choice of the first bid. The double bounded model also mitigates the problems of yea-sayings and starting point bias (Hanemann et al., 1991). Additionally, the double bounded model requires a small sample size to generate efficient results compared to the single bounded dichotomous model. Nevertheless, the main weakness of a double bounded dichotomous model is that the second bid response may be influenced by the first bid, which induces the starting point bias.

This study applied the double bounded dichotomous model based on its advantages over other models and the application of a double bounded elicitation format in the survey design. The model determined factors which influence poultry and non-poultry farmer's WTP for potable water supply. The best models for the split sample were determined by the likelihood-ratio test, which evaluates the goodness of fit of two competing models using the ratio of their likelihoods. The unrestricted model is preferred when the likelihood ratio is significant. By contrast, the restricted model is selected when likelihood ratio is insignificant (Greene, 2012). The double-bounded probit model for WTP is expressed as here below.

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$$WTP_{ij} = \mu_i + \epsilon_{ij} \quad (16)$$

Where:

WTP_{ij} = represents the j[th] respondent's WTP

i=1, 2 represents the first and second question

μ_1= mean of the first response

μ_2 = mean of the second response

ϵ_{ij}= error term for the j[th] respondent's WTP for questions 1 and 2 (Based on the assumption of the standard normal distribution, its zero).

Thus $\mu_{ij} = X_{ij}\beta_1$. This implies that the mean WTP is dependent on the characteristics of the respondent, as indicated in equation (17) and (18).

$$WTP = \beta_0 + \beta_1 Gender + \beta_2 Age + \beta_3 Householdsize + \beta_4 Quality + \beta_5 Quantity + \\ + \beta_6 Expenditure + \beta_7 Water\ payment + \epsilon \quad (17)$$

After several attempts, the final WTP model for non-poultry farmers is given by equation (17). It differs slightly from the model for poultry farmers in terms of explanatory variables due to the correlation problem (which resulted in dropping some variables) and the best fit of the two models. This explains why the two models have different explanatory variables. Equation (18) presents the WTP model for poultry farmers.

$$WTP = \beta_0 + \beta_1 Gender + \beta_2 Age + \beta_3 Number\ of\ chicken + \beta_4 Education1 + \\ \beta_5 Education2 + \beta_6 Education3 + \beta_7 Price + \epsilon \quad (18)$$

Following the two models estimated in equations (17) and (18), we can estimate the mean WTP with the double bounded model, which is calculated after determining the coefficients of the models with the maximum likelihood method. This is represented by equation (19).

$$E(WTP) = \overline{X'\widetilde{\beta}} \quad (19)$$

Where:

E(WTP) = The mean WTP value.

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$\overline{X'}$ is the vector of mean values of explanatory variables.

$\tilde{\beta}$ is the vector of maximum likelihood coefficients.

All the models were tested for heteroskedasticity and multicollinearity to ensure that credible results are generated. Heteroskedasticity relates to different variations across explanatory variables and the error term in a model (Greene, 2012). Biased WTP results may be obtained when these aspects are not considered within the models. The Breusch-Pagan test was applied to test for heteroskedasticity, based on the test statistic generated. When the test statistic is significant, the null hypothesis of homoskedasticity is rejected. Otherwise, we fail to reject the null when the test statistic is insignificant. On the other hand, multicollinearity relates to a strong linear relationship between two or more explanatory variables in the model. It generates large standard errors for the model coefficients, which implies unsatisfactory model estimates. Multicollinearity was tested using the variable inflation factor (VIF) test. Additionally, multicollinearity is ruled out when all the variable applied in the model have VIFs less than 10 (Wooldridge, 2012).

3.4.6 Summary

This section presents the methodology applied in the study. Several households in Wakiso District keep poultry at a small scale in their backyards. Poultry farming households compete for water with their non-poultry farming counterparts. Purposive and random sampling techniques were used to select 243 households to participate in the study. Split sampling technique was adopted to divide the sample into poultry and non-poultry farmers. The rationale behind split sampling was to determine whether poultry farming significantly influences the household's WTP for water supply improvement. A double bounded dichotomous elicitation choice format was adopted using contingent valuation method and data was analysed with STATA 14 software. The variables applied in the models and their expected signs are summarized in Table 3.1.

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CHAPTER 4: RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the assessment and interpretation of the study findings in relation with the study objectives and hypotheses. The chapter relates the study findings to empirical literature and economic theory. The justifications and implications of the study findings are also presented in this chapter. It is divided into three main sub-sections. Section 4.2 presents results for water sources, respondent's knowledge, perceptions, attitudes, and opinions about the quantity of water. Section 4.3 presents the economic valuation techniques used to analyse the WTP for water in Wakiso District, by both poultry and non-poultry farmers. The results presented in section 4.3 are for the models given in equations (17) and (18) in chapter 3. This section also covers all the necessary econometric tests required for the analyses. Section 4.4 discusses households' financial status after the proposed intervention.

4.2 Water sources

This sub-section presents results for the current households' water sources in Nsangi sub-county. Statistical results are summarised in Table 4.1.

Table 4. 1 Water sources by type

Water sources	Non-poultry farmers	Poultry farmers	Total
Spring wells	88 (66.17 %)	71 (64.55 %)	159 (65.36 %)
Public wells	17 (12.78%)	19 (17.27 %)	36 (15.02 %)
Boreholes	5 (3.78%)	5 (4.55 %)	10 (4.15 %)
Public/communal taps	20 (15.04%)	8 (7.27%)	28 (11.15 %)
Rainwater tanks	3 (2.26%)	7 (6.36 %)	10 (4.31 %)

Note: Frequencies are indicated outside brackets, while percentages are shown inside brackets.

The study considered respondents without potable piped water at their premises or poultry farms. This covers the 48.8% of the population without access to potable water in Wakiso District (MWE, 2018). In this case, public taps are not located at the premises of respondents considered in the study. Results from Table 4.1, indicate that poultry and non-poultry farmers access water from similar sources. Results also show that the majority of households in the selected villages in Nsangi sub-county access water from spring wells. This is indicated by over 65% of the total number of respondent's that access water from spring wells, while 15% of the total number of respondents access water from public wells, free of charge. This is

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followed by 11% of the total number of respondents that access water from neighbours with public taps provided by NWSC at a low price compared to the price charged by water vendors. However, a few respondents access water from boreholes, and rainwater tanks. It is important to note that spring wells, public wells and boreholes are located in distant places and households are burdened with collecting water from such sources, as revealed through discussions with communities. It is also consistent with previous studies (Asaba et al., 2017; Baguma et al., 2013; Wright et al., 2014), which indicate that households spend a substantial amount of time and labour collecting water from distant sources.

4.3 Knowledge, perceptions, attitudes and opinions

Respondents were asked questions concerning their knowledge, perceptions, attitudes, and opinions to analyse their understanding about the current water quantity and collecting water from distant sources. This section intended to establish whether the respondents have knowledge about the current water supply challenges faced in selected areas in Nsangi sub-county. The analysis on perceptions is to test if the socioeconomic variables affect households' perceptions about water availability through the quantity they receive. Furthermore, respondents were asked questions about their knowledge, perceptions, attitudes, and opinions towards the improvement of water supply in Nakirama, Kasenge, Kikajjo and Kazinga villages of Nsangi sub-county. This section is divided into the following sub-sections.

4.3.1 Respondent's knowledge about the current water quantity

This sub-section analysed respondents' knowledge about the quantity of water received from the selected villages in Nsangi sub-county to assess the availability of water in their localities. To achieve this objective, respondents were presented with statements given in Table 4.2. A five-point Likert scale was presented to respondents to assess their level of agreement with the statements, using the following options: strongly agree, agree, neutral, disagree and strongly disagree.

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Table 4. 2 Respondents' knowledge, perceptions, attitudes, and opinions about the current water quantity

Statement	Split sample	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
he quantity of water meets my household's and /or poultry farm's needs	Non-poultry farmers	68 (51.13%)	51(38.35%)	0 (0.00%)	9 (6.77%)	5 (3.76%)
	Poultry farmers	63(40.91%)	45(40.91%)	0(0.00%)	1(0.91%)	1(0.91%)
	Total	131(46.02%)	96(39.63%)	0(0.00%)	10(3.84%)	6(2.34%)
The quantity of water is too much, but some water is wasted	Non-poultry farmers	12 (9.02%)	14(10.53%)	16(12.03%)	45(33.83%)	46(34.59%)
	Poultry farmer	2(1.82%)	12(12.73%)	7(6.36%)	44(40.00%)	43(39.09%)
	Total	14(5.42%)	26(23.26%)	23(9.20%)	89(36.92%)	89(36.84%)
The quantity of water is too little due to water shortages	Non-poultry farmers	5 (3.76%)	6(4.51%)	8(6.02%)	47(35.34%)	67(50.38%)
	Poultry farmers	1(0.91%)	0(0.00%)	9(8.18%)	35(31.82%)	65(59.09%)
	Total	6(2.34%)	6(2.26%)	17(7.10%)	82(33.58%)	132(54.74%)
The quantity of water does not meet my household's needs	Non-poultry farmers	4(3.01%)	10(7.52%)	4(3.01%)	45(33.83%)	70(52.63%)
	Poultry farmers	2(1.82%)	0 (0.00%)	5(4.55%)	42(38.18%)	61(55.45%)
	Total	6(2.42%)	10(3.76%)	9(3.78%)	87(36.00%)	131(54.04%)

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Water quantity is not a problem but the price	Non-poultry farmers	51(38.35%)	52(39.10%)	4(3.01%)	17(12.78%)	9(6.77%)
	Poultry farmers	36(32.72%)	61(55.45%)	5(4.55%)	7(6.36%)	1(0.91%)
	Total	87(35.53%)	113(47.28%)	9(3.78%)	24(9.57%)	10(3.84%)

Frequencies are indicated outside brackets, while percentages are shown inside brackets

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In terms of water quantity, statistical results indicate that respondents receive sufficient water quantities for domestic household and poultry farming activities from their current sources. This is indicated by over 89% of respondents' agreement or strong agreement with the statement that the quantity of water meets my household's and or my poultry farm's needs. Nevertheless, households receive sufficient water quantities from distant water sources and suffer welfare losses in terms of walking long distances to collect water, queuing at water sources and buying water expensively from water vendors.

In terms of wasting water, results show that respondents use water sparingly. This could be attributed to distant water sources and their related economic and health implications (in terms of high-water prices, increased medical costs, and health problems such as, headaches and chest pains). Over 68% of the total number of respondents disagreed or strongly disagreed with the statement that the quantity of water is too much, but some water is wasted. This suggests that respondents are not wasting the water they either collect from distant sources or buy from vendors, due to its economic and health implications, as expected.

In terms of water prices, results indicate that the current water prices charged by water vendors is another problem facing households. This is shown by over 83% of the total number of respondent's agreement or strong agreement with the statement that water quantity is not a problem, but the price is. However, results from FGDs indicate that respondents mainly buy water from vendors during periods of water scarcity, with a few respondents who buy water from vendors daily. This finding suggests that respondents are more concerned with the problem of high-water prices charged by water vendors during periods of water scarcity than the problem of water availability. To further explore the robustness of the results, the chi-square (X^2) method was employed to determine the effect of socioeconomic variables (gender, age, education level, and income) on respondent's perceptions about the current water quantity. Table 4.3 presents the results of the chi-square test and the p-values for non-poultry farmers.

Table 4. 3 The effect of selected variables of interest on the five-point Likert scale presented to respondents for non-poultry farmers

Variable	Gender	Age	Education	Income
The quantity of water meets my household's needs	6.3713	0.1457	18.9383	3.9176
	(0.012) **	(0.703)	(0.000) ***	(0.141)
The quantity of water is too much, but some water is wasted	0.4851	0.0597	6.3242	1.7805
	(0.486)	(0.807)	(0.097) *	(0.411)
The quantity of water is too little due to water shortages	4.5275	0.0001	6.9500	5.2696
	(0.033) **	(0.991)	(0.074) *	(0.072) *
The quantity of water does not meet my household's needs	0.0245	0.0322	14.3772	3.6852
	(0.876)	(0.858)	(0.002) ***	(0.158)
Water quantity is not a problem but the price	1.5150	0.3907	0.3860	0.6192
	(0.218)	(0.532)	(0.943)	(0.734)

*The chi-square statistic is denoted by an upper figure without brackets, while the p-value is denoted by lower figure inside brackets. *, **, and *** Indicate significance levels at 10%, 5% and 1% respectively.*

Results in Table 4.3 show that education has a dominant effect on non-poultry farmers' perceptions about the quantity of water received in Nsangi. Education positively influences non-poultry farmer's perceptions about water availability for household's needs, at 1% significance level. It is interesting to note that the level of education affects the perception of both households' groups; those who said that water is enough to meet their needs, as well as those who indicated that water is insufficient to meet household needs. This finding suggests that educated households are more knowledgeable about the benefits of water household activities, such as cooking and washing, compared to the less educated households.

Furthermore, education is positively related to non-poultry farmers' perceptions about water availability with respect to wasting water. The relationship is significant at 10% significant level. This implies that educated households are more aware of the impact of wasting water on water costs and water-intensive household activities, compared to less educated households. Similarly, education has a positive effect on non-poultry farmers' perception about water availability with respect to water shortages, at 10% significance level. This means that educated

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households are more knowledgeable about the impact of water shortages on water availability than less educated households.

Gender is statistically significant at 5% level in influencing non-poultry farmers' perceptions concerning water availability with respect to meeting household's needs. This finding suggests that women are well informed about the conditions pertaining water availability than men at household level, given that water is mostly used by women in doing water intensive household activities, such as cooking and washing. Furthermore, gender is also significant at 5% level in influencing non-poultry farmers' perception about less water availability due to water shortages. This finding implies that women are relatively more knowledgeable about the impact of water shortages than men. This could be attributed to the fact that women mainly engage in collecting water from distant sources compared to men.

Income has a positive effect on non-poultry farmer's perception about less water availability due to water shortages. The relationship is significant at 10% level. This indicates that households earning more income are more knowledgeable concerning water availability, which normally decreases during periods of water scarcity, than households earning less income. However, age is insignificant in influencing non-poultry farmer's perceptions about water availability. This suggests that non-poultry farmers' perceptions regarding water availability are not determined by age but rather by other socioeconomic factors, such as income and gender.

Table 4. 4 The effect of selected variables of interest on the five-point Likert scale presented to respondents for poultry farmers

Variable	Gender	Age	Education	Income
The quantity of water meets my poultry farm's needs	1.8113 (0.178)	9.6611 (0.002)***	7.1428 (0.067)*	15.1285 (0.001)***
The quantity of water is too much, but some water is wasted	0.7385 (0.390)	0.0623 (0.803)	1.3878 (0.708)	1.1880 (0.552)
The quantity of water is too little due to water shortages	3.2885 (0.070)*	1.6138 (0.204)	15.2163 (0.002)***	4.3449 (0.114)
The quantity of water does not meet my poultry farm's needs	0.3652 (0.546)	7.2637 (0.007)***	4.4350 (0.218)	15.9075 (0.000)***
Water quantity is not a problem but the price	2.8592 (0.091)*	0.4526 (0.501)	7.4422 (0.059)*	3.0753 (0.215)

*The chi-square statistic is denoted by an upper figure without brackets, while the p-value is denoted by lower figure inside brackets. *,**, and *** indicate significance levels at 10%, 5% and 1% respectively.*

Statistical results in Table 4.4 indicate that gender positively influences poultry farmers' perceptions when they were asked whether the quantity of water is too little due to water shortages and the relationship is significant at 10% level. This implies that female poultry farmers are more concerned about the risks posed by water shortages to their poultry farms. Additionally, gender also influences poultry farmers' perceptions when they were asked whether water quantity is not a problem, but price. The relationship is significant at the 10% level. This finding suggests that female poultry farmers are more affected by the problem of water prices relative to the problem of water shortages. The possible justification for this finding is that water vendors, especially bicycle water vendors collect water from distant sources and charge poultry farmers relatively higher water prices based on distance.

Age is statistically significant at 1%in influencing poultry farmers' perceptions about water reliability for the variable that examined whether the quantity of water meets their poultry farm's needs. This suggests that younger poultry farmers (between 18 and 34 years) are well-informed about the benefits of water availability in poultry farming than older poultry farmers

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(above 34 years). Age is also significant at 1% level in influencing poultry farmers' perceptions about water availability when they were asked whether the quantity of water does not meet their poultry farm's needs. This finding suggests that younger poultry farmers are more concerned about the risks and threats posed by water shortages in poultry farming compared to older poultry farmers.

Education positively influences poultry farmers' perceptions about water quantity to meet their poultry farm's needs, at 10% significant level. This implies that more educated households are aware of the benefits of enough water supply concerning poultry performance and health than less educated households. Furthermore, education influences poultry farmers' perceptions about water availability due to water shortages. The relationship was found to be at 1% level of significance. This suggests that highly educated poultry farmers are aware of the risks and threats posed by water shortages in poultry farming than the less educated poultry farmers, as expected. Education also has a significant effect at the 10% level, on the knowledge of respondents for the variable "Water quantity is not a problem but the price". This indicates that educated households are more conscious about the problem of water prices, as compared to the problem of water availability.

Income has a statistically significant relationship with the variable that assessed respondents' knowledge about how they rated the quantity of water with respect to meeting their poultry farms' needs. The relationship is significant at 1% level. This implies that poultry farmers earning higher income are more concerned about the benefits of enough water supply in their poultry farms than poultry farmers earning less income. Additionally, the income also influences respondents' knowledge about the quantity of water with respect to failing to meet their poultry farms' needs. This finding implies that poultry farmers earning more income are more cautious about the risks and threats posed by the current water supply services in their localities than poultry farmers earning less income.

4.3.2 Respondent's knowledge about distant water sources

This sub-section analysed respondent's knowledge regarding the challenges associated with fetching water from distant water sources in selected villages of Nsangi sub-county. In this case, respondents were presented with statements indicated in Table 4.5. A five-point Likert scale was presented to respondents to indicate their level of agreement to statements in

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YUNIBESITHI YA PRETORIA

question, using the following options: strongly agree, agree, neutral, disagree and strongly disagree. In this case, respondents were presented with these statements and the results are indicated in Table 4.5.

Table 4. 5 Respondents' knowledge, perceptions, attitudes, and opinions about fetching water from distant sources

Statement	Split sample	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Fetching water from distant sources results in increased water prices	Non-poultry farmers	66(49.62%)	45(33.83%)	4(3.01%)	6(4.51%)	12(9.02%)
	Poultry farmers	71(46.36%)	38(34.55%)	1(0.91%)	0(0.00%)	0(0.00%)
	Total	137(47.99%)	83(34.19%)	5(1.96%)	6(2.26%)	12(4.51%)
Fetching water from distant sources is associated with health-related problems such as headache, fatigue and chest pain	Non-poultry farmers	57(42.86%)	58(43.61%)	4(3.01%)	7(5.26%)	7(5.26%)
	Poultry farmers	51(46.36%)	53(48.18%)	4(3.64%)	1(0.91%)	1(0.91%)
	Total	108(44.61%)	111(45.90%)	8(3.32%)	8(3.09%)	8(3.09%)
Fetching water away from homesteads is not time-consuming	Non-poultry farmers	11(8.27%)	13(9.77%)	9(6.77%)	42(31.58%)	58(43.61%)
	Poultry farmers	2(1.82%)	10(9.09%)	9(8.18%)	43(39.09%)	46(41.82%)
	Total	13(5.05%)	23(9.43%)	18(7.48%)	85(35.33%)	104(42.72%)
Fetching water away from homesteads inconveniences household individuals responsible for water collection, such as children and women	Non-poultry farmers	49(36.84%)	58(43.61%)	6(4.51%)	14(10.53%)	6(4.51%)
	Poultry farmers	33(30.00%)	60(54.55%)	7(6.36%)	8(7.27%)	2(1.82%)
	Total	82(33.42%)	118(49.08%)	13(5.44%)	22(8.90%)	8(3.17%)

Fetching water away from homesteads is associated with long queues at water sources	Non-poultry farmers	36(27.07%)	47(35.34%)	13(9.77%)	23(17.29%)	14(10.53%)
	Poultry farmers	21(19.09%)	52(47.27%)	11(10.00%)	20(18.18%)	6(5.45%)
	Total	57(23.08%)	99(41.30%)	24(9.89%)	43(17.73%)	20(7.99%)
Walking to collect water is a serious a problem	Non-poultry farmers	38(28.57%)	47(35.34%)	4(3.01%)	30(22.56%)	14(10.53%)
	Poultry farmers	28(25.45%)	60(54.55%)	7(6.36%)	14(12.73%)	1(0.91%)
	Total	66(27.01%)	107(44.95%)	11(4.69%)	44(35.29%)	15(5.72%)
Walking to collect water is not a problem but the queues at water points	Non-poultry farmers	19(14.29%)	30(22.56%)	11(8.27%)	31(23.31%)	42(31.58%)
	Poultry farmers	4(3.64%)	16(14.55%)	16(14.55%)	33(30.00%)	41(37.27%)
	Total	23(8.97%)	46(18.56%)	27(11.41%)	64(26.66%)	83(34.43%)

Frequencies are indicated outside brackets, while percentages are shown inside bracket

Statistical results from Table 4.5 indicate that respondents are aware of the numerous challenges associated with fetching water from distant sources. In terms of cumulative water prices, the results show that respondents are concerned about higher water prices motivated by fetching water away from homesteads, which affect poultry and non-poultry farmers. This is shown by 82% of the total number of respondents that agree or strongly agree that fetching water from distant sources results in increased water prices. One-point worth noting is that households collect water from different sources, some of which are closer, and others are far. Usually water vendors use the farther sources during dry seasons, since they use other transport means like bicycles to fetch the water. It is during such seasons that households pay for water, since they must buy from vendors. Therefore, households who collect their own water do not pay (in terms of money, although they incur non-monetary costs of walking and queuing), for water under normal circumstances.

In terms of health-related problems, results show that respondents are aware of the health-related problems, such as headache, fatigue and chest pain, that are associated with fetching water. This is shown by more than 90% of the total number of respondents that agree or strongly agree that fetching water from distant sources is associated with health-related problems such as headache, fatigue, and chest pain, associated with fetching water from distant sources. This is consistent with empirical literature (Asaba et al., 2017; Naiga et al., 2015), which indicate that households that engage in collecting water suffer health-related problems and hence increased medical costs.

In terms of time spent on fetching water, results indicate that respondents recognise the fact that fetching water is time-consuming. This is indicated by 82% of the total number of respondents that disagree or strongly disagree that collecting water from distant sources is not time-consuming. This implies that respondents invest a substantial amount of time and labour collecting water from distant sources, at the expense of other productive activities (Asaba et al., 2017; Baguma et al., 2013). Furthermore, the challenge of losing time in collecting water from distant water sources is worsened by long queues at water sources (Asaba et al., 2017).This is because households lose productive time that they could spend on other economic activities. Results further indicate that the burden of walking to collect water from distant sources is a serious problem that affects poultry and non-poultry farmers. This is indicated by nearly 74% of the total respondents that agree or strongly agree that walking to collect water

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YUNIBESITHI YA PRETORIA

is a serious problem. Therefore, the burden of walking to collect water far away from homesteads and its related health and economic risks is the main challenge affecting poultry and non-poultry farmers in Nsangi, relative to the problem water scarcity.

Based on the results, respondents have enough knowledge concerning the main challenges and welfare losses associated with fetching water and are likely to be receptive towards a policy that attempts to change the status quo. To further investigate the robustness of the results, the chi-square technique was employed to determine the effect of socioeconomic factors (namely: gender, age, education level and income) on respondent's perceptions concerning distant water sources. Results of the chi-square technique and p-values for non-poultry farmers are presented in Table 4.6.

Table 4. 6The effect of selected variables of interest on the five-point Likert scale presented to respondents for non-poultry farmers

Variable	Gender	Age	Education	Income
Fetching water from distant sources results in increased water prices	9.1363 (0.003)***	0.3097 (0.578)	5.7629 (0.124)	7.2293 (0.027)**
Fetching water from distant sources is associated with health-related problems such as headache, fatigue and chest pain	3.5552 (0.059)*	0.0938 (0.759)	7.8794 (0.049)**	9.6955 (0.008)***
Fetching water away from homesteads is not time consuming	1.7735 (0.183)	0.2751 (0.600)	0.9344 (0.817)	1.0035 (0.605)
Fetching water away from homesteads inconveniences household individuals responsible for water collection, such as children and women	1.6215 (0.203)	0.0681 (0.794)	5.8489 (0.119)	12.0224 (0.002)***
Fetching water away from homesteads is associated with long queues at water sources	0.2117 (0.645)	0.2011 (0.654)	2.0467 (0.563)	3.7320 (0.155)
Walking to collect water is a serious problem	3.2229 (0.073)*	0.3339 (0.563)	0.3202 (0.956)	1.1822 (0.554)
Walking to collect water is not a problem but the queues at water points	0.0462 (0.830)	0.0037 (0.951)	0.6164 (0.893)	0.6615 (0.718)

The chi-square statistic is denoted by an upper figure without brackets, while the p-value is denoted by lower figure inside brackets. ***, ****, and ***** *indicate significance levels at 10%, 5% and 1% respectively.*

From Table 4.6, statistical results indicated that gender, education level, and income significantly influence non-poultry farmer's (domestic water user's) perceptions about fetching water. Gender was statistically significant at 1%and 10% respectively, in influencing non-poultry farmer's perceptions about fetching water. This is because women in general are more engaged in fetching water in several households, compared to men. Therefore, women are well-informed about the challenges and financial implications associated with fetching water way from home.

Education positively influences non-poultry farmers' perceptions about fetching water. This is shown by the variable that assessed their knowledge about health-related problems, which was significant at 5%. This implies that the more educated an individual is, the more the possibility of that individual to have more knowledge about health-related risks associated with fetching water.

Income is statistically significant in influencing non-poultry farmer's perceptions about fetching water, as it corresponds to their knowledge about increased water prices, health-related risks and other inconveniences. The relationships are significant at 5%, and 1% respectively. This implies that households earning more income are cautious about the challenges associated with fetching water away from home. However, age was not statistically significant in influencing non-poultry farmer's perceptions about fetching water from distant sources.

Table 4. 7 The effect of selected variables of interest on the five-point Likert scale presented to respondents for poultry farmers

Variable	Gender	Age	Education	Income
Fetching water from distant sources results in increased water prices	1.7369 (0.188)	0.6898 (0.406)	1.7661 (0.622)	0.9012 (0.637)
Fetching water from distant sources is associated with health-related problems such as headache, fatigue and chest pain	0.7982 (0.372)	5.5359 (0.019)**	10.4994 (0.015)**	9.2700 (0.010)**
Fetching water away from homesteads is not time-consuming	3.4112 (0.065)*	1.8232 (0.177)	5.3374 (0.149)	0.5197 (0.771)
Fetching water away from homesteads inconveniences household individuals responsible for water collection, such as children and women	2.7217 (0.099)*	0.3233 (0.570)	5.7150 (0.126)	0.2634 (0.877)
Fetching water away from homesteads is associated with long queues at water sources	0.5444 (0.461)	0.4658 (0.495)	5.1323 (0.162)	0.2722 (0.873)
Walking to collect water is a serious problem	0.4804 (0.488)	0.3431 (0.558)	5.9856 (0.112)	2.6253 (0.269)

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YUNIBESITHI YA PRETORIA

Walking to collect water is not a problem but the queues at water points	0.5449 (0.460)	3.3324 (0.068)*	1.9979 (0.573)	0.9200 (0.631)

*The chi-square statistic is denoted by an upper figure without brackets, while the p-value is denoted by lower figure inside brackets. * and ** indicate significance levels at 10% and 5% respectively.*

Results in Table 4.7 revealed that gender significantly influences poultry farmers' perception about fetching water based on the time spent collecting water and the inconveniences associated with fetching water far from poultry farms. The relationships are significant at 10% for both variables. The implication is that female poultry farmers are more affected by the challenges and risks posed by fetching water than male poultry farmers. Therefore, female poultry farmers are more aware of the challenges and risks associated with fetching water away from poultry farms than male poultry farmers.

Age was statistically significant in influencing poultry farmer's perceptions about fetching water especially for the variables that assessed their knowledge about health-related problems and queues associated with fetching water. The relationships are statistically significant at 5% and 10% respectively. Therefore, it is logical to conclude that the younger the individual (between 18 and 34 years), the higher the possibility of that individual to have more knowledge concerning distant water sources and their related challenges such as health-related problems and queues, than older individuals (above 34 years).This could be attributed to the fact that young individuals are more affected with the burden of collecting water from distant sources (Kaliba et al., 2003), compared to older individuals.

Education is positively related to poultry farmers' perceptions about fetching water as shown by their knowledge about health-related problems and inconveniences associated with fetching water away from their poultry farms. This implies that highly educated poultry farmers are more concerned about the burden of collecting water far from their poultry farms, than the less educated people.

Results also indicate that income significantly influences poultry farmers' perceptions about distant water sources. This is shown by the 5% significant relationship between income and farmers' knowledge about health-related problems associated with fetching water. This shows

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YUNIBESITHI YA PRETORIA

that shows that income plays a significant role among poultry farmers regarding health-related problems associated with fetching water away from poultry farms.

4.3.3 Respondent's knowledge about improved water supply services

This sub-section evaluated respondent's knowledge about improved water supply (potable tap water) services in selected villages of Nsangi sub-county. The households (not part of the study) who receive water from the water authority, the NWSC through private connections, pay around UGX 56 per 20L (MWE, 2018). In this case, some households with private water connections sell water to a few neighbours, who also collect water from the open sources. However, the majority of the households in this study still collect water from distant sources free of charge, and also buy from vendors at a price ranging from UGX 200 to UGX 500 per 20L, especially during periods of water scarcity (Pangare & Pangare, 2008). In view of the above, this study attempted to get the views of respondents on their knowledge about improved water supply. This was done through the presentation of the statements in Table 4.8 to respondents, which presents the results. A five-point Likert scale was presented to respondents to indicate their level of agreement to statements in question, using the following options: strongly agree, agree, neutral, disagree and strongly disagree.

Table 4. 8 Respondents' knowledge, perceptions, attitudes, and opinions about improved water supply (potable tap water) services

Statement	Split sample	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Tap water supplied NWSC is always readily available at all times when people need to use it	Non-poultry farmers	67(50.38%)	50(37.59%)	3(2.26%)	7(5.26%)	6(4.51%)
	Poultry farmers	65(59.09%)	29(26.36%)	4(3.64%)	8(7.27%)	4(3.64%)
	Total	132(54.73%)	79(31.98%)	7(2.95%)	15(6.27%)	10(4.08%)
Tap water supplied by NWSC is relatively less costly	Non-poultry farmers	125(93.98%)	0 (0.00%)	0 (0.00%)	8(6.02)	0(0.00%)
	Poultry farmers	67(60.91%)	37(33.64%)	2(1.82%)	4(3.64%)	0(0.00%)
	Total	192(77.45%)	37(16.82%)	2(0.91%)	12(4.83%)	0(0.00%)
Tap water supplied by NWSC has no health-related risks	Non-poultry farmers	49(36.84%)	59(44.36%)	7(5.26%)	9(6.77%)	9(6.77%)
	Poultry farmers	36(32.72%)	50(45.45%)	13(11.82%)	10(9.09%)	1(0.91%)
	Total	85(34.78%)	109(44.90%)	20(8.54%)	19(7.93%)	10(3.84%)
Tap water supplied by NWSC relieves people from the burden of water collection far away from homesteads	Non-poultry farmers	86(64.66%)	38(28.57%)	4(3.01%)	4(3.01%)	1(0.75%)
	Poultry farmers	59(53.64%)	46(41.82%)	1(0.91%)	4(3.64%)	0(0.00%)
	Total	145(59.15%)	84(35.20%)	5(1.96%)	8(3.32%)	1(0.38%)
NWSC can mitigate water supply challenges	Non-poultry farmers	53(39.85%)	49(36.84%)	8(6.02%)	9(6.77%)	14(10.53%)
	Poultry farmers	37(33.64%)	53(48.18%)	6(5.45%)	9(8.18%)	5(4.55%)
	Total	90(36.75%)	102(42.51%)	14(5.74%)	18(7.48%)	19(7.54%)

Note: Frequencies are indicated outside brackets, while percentages are shown inside brackets.

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Statistical results presented in Table 4.8 show that respondents are well-informed about the benefits of improved water supply services provided by NWSC. In terms of tap water reliability, results indicate that respondents are well informed about the reliability of tap water supplied by NWSC. This is indicated by a large percentage (86%) of the total number of respondents that agree or strongly agree that tap water provided by NWSC is always readily available when people need to use it. Furthermore, for the case of tap water prices, results show that respondents are well informed about the cheap tap water provided by NWSC, relative to the expensive water sold by water vendors. This is shown by over 94% of the total number of respondents that agree or strongly agree that tap water supplied by NWSC is relatively less costly. This finding is consistent with literature (MWE, 2018), which confirms that NWSC charges domestic water users only UGX 56 per 20L, far lower than water vendors' prices that range from UGX 200 to UGX 500 per 20L (Pangare & Pangare, 2008).

In terms of health related-risks, results indicate that respondents are aware that water provided by NWSC does not pose health related-risks to the people and poultry flocks. This is indicated by 80% of the total number of respondents that agree or strongly agree that tap water supplied by NWSC has no health-related risks. This implies that people are well-informed that water supplied by NWSC is free from contamination, since NWSC treats its water before it is supplied to the water users.

Additionally, for the case of relieving households from the burden of collecting water from distant sources, results indicate that respondents are aware that tap water provided by NWSC can relieve households from the burden of collecting water. This is indicated by over 94% of the total number of respondents that agree or strongly agree that tap water supplied by NWSC relieves people from the burden of collecting water far away from their homesteads.

Despite the benefits of potable tap water supply services, only 51.2% of the total number of households access potable tap water at their premises in Wakiso District (UBOS, 2017). Therefore, the burden of collecting water from distant sources and its related health and economic implications is a serious problem affecting household in Wakiso district and Nsangi sub-county. To further investigate the robustness of the results, the chi-square (X^2) technique was employed to determine the effect of socioeconomic factors (namely: gender, age, education level, and income) on respondents' perceptions about improved water supply

services. Statistical results of the chi-square test and p-values for non-poultry farmers are denoted by Table 4.9.

Table 4.9 The effect of selected variables of interest on the five-point Likert scale presented to respondents for non-poultry farmers

Variable	Gender	Age	Education	Income
Tap water supplied by NWSC is always readily available at all times when people need to use it	0.5891 (0.443)	3.6979 (0.054)*	21.1243 (0.000)***	6.7031 (0.035)**
Tap water supplied by NWSC is relatively less costly	5.0728 (0.024)**	22.3633 (0.000)***	14.9234 (0.002)***	2.0972 (0.350)
Tap water supplied by NWSC has no health-related risks	4.8447 (0.028)**	1.8298 (0.176)	4.8353 (0.184)	1.7868 (0.409)
Tap water supplied by NWSC relieves people from the burden of water collection far away from homesteads	0.0146 (0.904)	0.5984 (0.439)	5.2301 (0.156)	20.6599 (0.000)***
NWSC can mitigate water supply challenges	0.9405 (0.332)	0.0300 (0.862)	1.2577 (0.739)	1.3467 (0.510)

Note: The chi-square statistic is denoted by an upper figure without brackets, while the p-value is denoted by lower figure inside brackets. ***, ****and* ***** ****indicate significance levels at 10%, 5% and 1% respectively.*

From Table 4.9, statistical results revealed that gender, age, education, and income influence non-poultry farmers' perceptions about improved water supply. Gender positively influenced non-poultry farmers' perceptions about improved water supply services for the variables that assessed their knowledge about the price of tap water and health-related risks associated with tap water. The relationship is statistically significant at 5% level, for both variables. This could be attributed to the fact that women mainly engage in collecting water from distant sources and they suffer health-related problems, such as headache, chest pain, and fatigue, compared to men (Asaba et al., 2017; Farolfi et al., 2007). Furthermore, women are more engaged in water-intensive household activities, such as cooking and washing than men (Kanayo et al., 2013).Therefore, women are more knowledgeable about the benefits of improved water supply services than men.

Age is significant in influencing non-poultry farmer's perceptions about improved water supply services. This was indicated by the variables that evaluated non-poultry farmers' knowledge about the availability and the price of tap water at 5% and 1% significant levels, respectively. Since the burden of water collection falls more on the younger members of the households (between 18 and 34 years), they are more conscious about water availability and water prices, compared to older individuals (above 34 years). Furthermore, education was found to be statistically significant at 1% level, for the variables that assessed non-poultry farmers' knowledge about the availability and relatively lower price of tap water. This implies that educated people are more knowledgeable about the benefits of improved water supply services, especially concerning the availability and the relatively cheap tap water. The reverse is true for less educated people.

Income positively effects non-poultry farmer's perceptions about improved water supply services. This is shown by a statistically significant income at both 5% and 1% levels, for non-poultry farmers' knowledge about the availability of tap water and alleviating households' burden of collecting water far away from homesteads. It is, therefore, reasonable to conclude that households earning more income are more concerned with the availability and the convenience of accessing water at their premises than their counterparts earning less income.

Table 4. 10 The effect of selected variables of interest on the five-point Likert Scale presented to respondents for poultry farmers

Variable	Gender	Age	Education	Income
Tap water supplied by NWSC is always readily available at all times when people need to use it	0.0031 (0.956)	0.1545 (0.694)	15.2566 (0.002)***	6.2474 (0.044)**
Tap water supplied by NWSC is relatively less costly	14.0781 (0.000)***	2.5071 (0.113)	24.5962 (0.000)***	3.7426 (0.154)
Tap water supplied by NWSC has no health-related risks	1.8749 (0.171)	0.2064 (0.650)	14.4990 (0.002)***	0.9919 (0.609)
Tap water supplied by NWSC relieves people from the burden of water collection far away from homesteads	17.0801 (0.000)***	0.1060 (0.745)	6.3781 (0.095)*	2.4512 (0.294)
NWSC can mitigate water supply challenges	0.3818 (0.537)	0.4881 (0.485)	5.7149 (0.126)	0.4917 (0.782)

*Note: The chi-square statistic is denoted by an upper figure without brackets, while the p-value is denoted by lower figure inside brackets. *, ** and ***indicate significance levels at 10%, 5% and 1% respectively.*

From Table 4.10, results indicate that gender is statistically significant at1% level, regarding poultry farmers' knowledge about the low cost of tap water relative to cost of water from alternative sources and in relieving households from the burden of collecting water. Therefore, this implies that female poultry farmers are more conscious about the negative consequences of poor water supply, such as high-water prices and the burden of collecting water from distant sources than male poultry farmers.

Education has a significant impact on farmers' perceptions about improved water supply services, for all the variables, except for mitigation. Results indicate that education is significant at 1% level for tap water availability, cost, and quality. Education is also significant at 10% level regarding tap water in relieving the burden of collecting water far from homesteads. The implication is that educated people are more knowledgeable about the benefits of improved water supply services than less-educated people, as expected.

The results also indicate that income is statistically significant at 5% level, in influencing poultry farmer's perceptions about improved water supply services. This shows that poultry

farmers earning more income are more concerned about water reliability than poultry farmers earning less income. However, age was insignificant in influencing poultry farmers' perceptions concerning improved water supply services. This implies that poultry farmer's perceptions about improved water supply services are not determined by how old a poultry farmer is, but by other socioeconomic factors.

4.4 Economic valuation of water in Wakiso District

The purpose of this section is to determine the welfare change from the status quo of the prevailing water supply services at selected villages in Wakiso District. This is given by the results of the mean WTP for improved potable water supply service for the split sample using double bounded models. Since the mean WTP value is in line with Potential Pareto criteria, which enables winners to compensate losers, this study uses the mean WTP value. The mean WTP evaluation is based on the hypothetical scenario.

4.4.1 The hypothetical scenario for the study

Based on the analysis of the respondents' knowledge, perceptions, attitudes, and opinions on the *status quo* of the current water supply services, respondents unanimously agree that accessing water supply services from distant sources is problematic and unreliable. This supports the presentation of the following environmental change scenario, which highlights the *status quo* of the current water supply and the proposed scenario of improved water supply service. The *status quo* of the current water supply in Wakiso as summarised in the following paragraph.

Households accessing distant water sources face numerous challenges in Wakiso District. Such households spend a significant amount of time and labour collecting water from distant sources at the expense of other productive activities. Additionally, water vendors charge relatively high prices for water. This prompts some individuals to collect water from unprotected sources, such as wells and springs, yet water from such sources is unsafe and limited in supply. Poultry farming, the main agricultural activity in Wakiso District, which heavily relies on water use, is adversely affected due to limited water supply.

The proposed scenario of improved water supply service is based on the status quo where secondary sources (MWE, 2018) showed that about 51.2% of the population in Wakiso access

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YUNIBESITHI YA PRETORIA

water from reliable sources, leaving 48.8% who collect water from unreliable sources, which is the focus of this study.

The proposed scenario is as follows: To address challenges associated with poor water supply services in Wakiso, the government through the National Water and Sewerage Corporation (NWSC) has proposed a program to extend potable tap water supply coverage from the current 51.2% to 100%. It is important to note that the 51.2% is based on secondary data from government, (MWE, 2018), which was presented in the literature review section 3.2 (also see section 4.4.1). This program will ensure that households access a sustainable water supply service at their homesteads or poultry farms. This will mitigate the challenges associated with collecting water from distant water sources. NWSC will ensure that households (poultry and non-poultry farmers) receive improved and sustainable water supply services, without interruptions. Any potential water interruptions would be fixed within one to two days of reporting. The project will involve the improvement in the existing water supply system and the extension of the water supply system to new areas. NWSC will recover the project cost by charging users per 20 Litres (L) of water drawn from the tap.

4.4.2 The payment vehicle

The payment vehicle employed in this study is the charge per 20L of water drawn from the potable water source, based on the pilot study conducted prior to the main data collection process. It is the same method currently used by water vendors. Therefore, respondents are familiar with it, as they pay water vendors using the same method (Pangare & Pangare, 2008). It is also consistent with the payment vehicle applied in the WTP investigation conducted by Wright et al., (2014), in the rural villages of Mubende district, Uganda. The payment vehicle in question is non-voluntary to prevent free riding and promote generating credible preferences from respondents. This is in line with the latest WTP guidelines by Johnston et al., (2017), which suggest that the payment vehicle should be familiar, realistic and non-voluntary to all respondents.

4.5 WTP for improved water supply for non-poultry farmers

4.5.1 Determining true and protest zeros for non-poultry farmers

Protesters are defined as respondents who do not reveal their true preferences towards the value of the good under investigation (Meyerhoff et al., 2012). Such respondents refuse to pay any amount for the good under investigation. These are identified by a debriefing question, which determines whether they are protesting or stating their true WTP of zero (Meyerhoff et al., 2012; Strazzera et al., 2003). The debriefing question is presented to respondents after the 'no-no' response to the bid questions (Strazzera et al., 2003).

The study targeted 143 respondents for the non-poultry farmers' subsample. About 15% of the total number of non-poultry farmers that stated zero WTP responses was presented with four alternative reasons in a closed format to determine the true and protest zeros. These alternative reasons include: (i) It is not worth the money; (ii) I cannot afford to pay; (iii) I do not trust the government; (iv) I prefer the existing water sources. Following literature (Strazzera et al., 2003), the first (i) and second (ii) reasons, are considered as true zeros. While the third (iii) and the fourth (iv) reasons are considered as protest zeros. This is based on the fact that the first two reasons (i and ii) focussed on the value aspect of improved water supply, while the last two reasons (iii and iv) referred to other aspects of water supply with the exception of its value (Strazzera et al., 2003). The responses to the debriefing question, (in this case are represented by the reasons given by respondents for voting against the bill for improved water supply) are summarized in Table 4.11.

Table 4. 11 Respondents' reasons for voting against improved water supply service

Reason	Frequency	Percentage
(i) It is not worth the money	14	53.85
(ii) I can not afford to pay	5	19.23
(iii) I do not trust the government	3	11.54
(iv) I prefer the existing water sources	4	15.58
Total	**26**	**100.00**

Results in Table 4.11 show that the main reason given by respondents for voting against improved water supply service is that it is not worth the money, which accounts for approximately 54%. This is followed by respondents' unaffordability to pay, preference of the existing water sources and government distrust, respectively. True and protest zeros were identified following Strazzera et al., (2003). Accordingly, 19 (73%) respondents who voted against improved water supply services for reasons:(i) and (ii),were categorized as true zeros, while 7 (27%) respondents who voted against improved water supply services for reasons:(iii)

and (iv),were categorised as protest zeros. Ultimately, nineteen (19) true zeros were maintained in the non-poultry farmer's subsample, while seven (7) protest zeros were dropped following Piper & Martin, (1997). This reduced the number of observations from 133 to 126, for the non-poultry farmers' subsample.

However, dropping protest zeros would result in a sample selection bias if there is a significant difference between protest zeros and the positive responses in terms of the explanatory variables applied in the model (Halstead et al., 1992; Strazzera et al., 2003). Following (Fonta & Omoke, 2008), the T-statistics were applied to compare protest zeros with the positive responses in terms of the explanatory variables applied in the model, as an initial test for the sample selection bias. Results are presented in Table 4.12.

Table 4. 12 Comparing positive responses and protest zeros for non-poultry farmers

	Positive responses			**Protest zeros**				
Variable	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.	T-Stats.	P-value
Gender	126	.6587302	.4760285	7	.5714286	.5345225	0.4695	0.6395
Age	126	.5555556	.4988877	7	.2857143	.48795	1.3943	0.1656
Household size	126	4.5	1.883614	7	5.285714	1.603567	-1.0810	0.2817
Quality	126	.484127	.501743	7	.4285714	.5345225	0.2843	0.7767
Quantity	126	.8492063	.3592762	7	.8571429	.3779645	-0.0567	0.9548
Expenditure	114	561127.2	261874.8	7	492571.4	337961.5	0.6613	0.5097
Water payment	87	.5862069	.4953675	3	.3333333	.5773503	0.8658	0.3890

The analysis considered a confidence interval of 95% and the following hypotheses. The null hypothesis (H0): There is no significant difference between positive responses and protest zeros. The alternative hypothesis (H1): There is a significant difference between positive responses and protest zeros. The null hypothesis can be rejected in favour of the alternative hypothesis if the absolute T-statistics are significant based on their respective p-values below 5% significance level. Otherwise, we fail to reject the null hypothesis, if the absolute T-values are not significant at 5% level.

Since the analysis intended to determine whether the two groups (positive responses and protest zeros) are significantly different or not, the two tailed test was deemed suitable. As indicated in Table 4.12, the T-statistics are insignificant based on their respective p-values, which are

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greater than 0.05. Based on the results, we fail to reject the null hypothesis, which states that there is no significant difference between positive responses and protest zeros. This means that positive responses and protest zeros are similar in terms of the explanatory variables applied in the model. Accordingly, this finding suggests that dropping protest zeros from the analysis cannot result in a sample selection bias.

Nevertheless, the analysis applied the Heckman sample selection technique, as a robust test for sample selection bias in the subsample for non-poultry farmers. The Heckman model estimates the selection equation in the first stage considering the whole sample. Additionally, the WTP equation in the second stage applies only to respondents who are willing to pay. In this case, respondents in the survey with zero WTP values are dropped from the analysis. Summary statistics for respondents who are willing and not willing to pay are presented in Table 4.13.

Table 4. 13 Distribution of willing to pay and not willing to pay by respondents

Selection	Frequency	Percentage (%)
Willing to pay	107	80.45
Not willing to pay	26	19.55
Total	133	100

Approximately 80% of the respondents agreed to pay for water supply improvement presented in the valuation scenario. However, about 20% of the respondents did not accept to pay for the improvement in water supply and responded with a ‘no-no’ response to the valuation question (Table 4.13).

4.5.2 The Heckman sample selection model for non-poultry farmers

In the estimated Heckman model, all the explanatory variables indicating sample characteristics are applied in the selection equation. However, the variables which captured the relationship to the household head (Rhead) and household’s willingness to shift are excluded in the WTP equation (Table 4.14). This is because the Heckman model should include at least one explanatory variable (exclusion restriction) in the first stage, which should be excluded in the second stage (Heckman, 1977). In the second stage the WTP equation involves only respondents selected to participate in the study. It is important to note that exclusion restrictions

considered in the sample selection bias analysis influence the probability of being selected in the survey but do not influence the magnitude of WTP.

Table 4. 14 The Heckman sample selection model for non-poultry farmers

	Equation 1	*Equation 2*
Variables	*Selection*	*WTP*
Bid1		-.0240481***
		(.0070956)
Gender	.4683167	.085496
	(.4086818)	(.4578486)
Age	.0614131	-.1861275
	(.2893832)	(.2558829)
Household size	-.2768499 **	.0573006
	(.1072167)	(.1397758)
Quality	-.0144075	-.2523034
	(.5322418)	(.4781485)
Quantity	-.1160681	-.2197017
	(.2814908)	(.2168273)
Expenditure	-5.32e-08	-1.79e-07
	(3.63e-07)	(3.93e-07)
Water payment	.7145689*	-.2122271
	(.3697115)	(.52764)
Willingness to shift	.2808165	
	(.7977071)	
Rhead	-.7788431*	
	(.4304401)	
Constant	2.382578	5.439051
	(1.380814)	(1.771511)
Rho (ρ)	.8646289	
	(.8250399)	
N	133	107

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LR test of indep. eqns. (rho = 0): chi2 (1) = 0.3 Prob > chi2 = 0.5766

Note: Figures without brackets are coefficients and in brackets are standard errors. Asterisks ***, ** and *, indicate significance levels at 1%, 5% and 10% respectively.

Results from Table 4.14, indicate that there is insufficient evidence to reject the null hypothesis for independence of the selection and WTP equations, based on the insignificant probability coefficient generated from the Likelihood ratio test (Prob > chi2 = 0.5766). This finding implies that dropping respondents who are not willing to pay for water supply improvement cannot induce sample selection bias in the subsample for non-poultry farmers and the two equations can be estimated separately. Therefore, a double bounded probit model considering positive WTP responses, can be applied to generate unbiased WTP estimates for the non-poultry farmers. For the WTP equation, the first bid variable was found to be significant at 1% level and it is negatively related to WTP.This implies that household's WTP reduces with the increase in the bid price as expected from demand theory. On the other hand, the probability of being selected in the sample for non-poultry farmers is negatively related to the variable that captured household size at 5% significant level. It is also negatively related to the relationship to the household head and positively related to whether the respondent pays for water at alternative sources at 10% significant level, respectively.

Based on the fact that sample selection bias is not a problem and the two equations can be estimated separately, we continued our estimation with the positive WTP group using the double bounded probit model employed for this study.

4.5.3 Distribution of the first bid amounts for non-poultry farmers

This section determines whether contingent valuation data reveal that individuals are rational to bid amount, which is indicated by the lower proportion of the 'yes' response as bid amounts increase (Lopez-Feldman, 2012). This section also ascertains whether the demand for the environmental good under investigation conforms to the economic theory regarding the law of demand, which portrays a negative relationship between the price and quantity demanded, ceteris paribus.

Table 4. 15 Proportion of bid1 responses

Response	Bid1			
	150	**200**	**250**	**Total**
No	9	22	36	67
	(20.45)	(56.41)	(83.72)	(53.17)
Yes	35	17	7	59
	(79.55)	(43.59)	(16.28)	(46.83)
Total	**44**	**39**	**43**	**126**

Note: Numbers without brackets are frequencies, while numbers in brackets are percentages.

Results for the different options of bid1 are presented in Table 4.15 and they include: UGX 150; UGX 200; UGX 250, which were randomly presented to respondents. The first bid options are subsequently increased or reduced depending on the response to the first bid option presented to the respondents, to generate the second bid amount. For instance, if the respondent answers 'yes' to the first bid amount presented, then the subsequent bid amount is increased, and the reverse is true if the respondent answers 'no' to the first bid option.

Results indicate that approximately 47% of the total number of respondents answered 'yes' to bid1 options, while53% of the total number of respondents answered 'no' to bid1 options presented to them. Results also reveal that, as bid amounts increase, the probability of respondents answering 'yes' to the first bid question reduces, which implies that respondents are logical to the bid amounts. This is consistent with economic theory based on the law of demand, which depicts a negative relationship between the price and quantity demanded, ceteris paribus. These results are also consistent with the results achieved by López-Feldman (2012), which confirm that respondents are rational in choosing bid amounts presented to them.

4.5.4 Distribution of the second bid responses for non-poultry farmers

Given that the present study employed a double bounded elicitation format, it is also imperative to analyse the second bid responses given by respondents. The second bid responses given by non-poultry farmers are presented in Table 4.16.

Table 4. 16 Proportion of bid2 responses

Response	**Bid2**					
	100	**150**	**200**	**250**	**300**	**Total**
No	0	9	18	15	6	48
	(0.00)	(40.9)	(25.35)	(88.24)	(85.71)	(38.10)

Yes	9 (100.00)	13 (59.03)	53 (74.65)	2 (11.76)	1 (14.29)	78 (61.90)
Total	**9**	**22**	**71**	**17**	**7**	**126**

Numbers without brackets are frequencies, while numbers in brackets are percentages.

From Table 4.16, the second bid options (UGX 100; 150; 200; 250; 300) are derived from the responses to the first bid options (amounts) presented to respondents. This implies that the second bid option is dependent on whether the respondent answers 'yes' or 'no' to the first bid option presented. Results indicate that about 62% of the total respondents answered 'yes' to the second bid amount, while 38% of the total respondents answered 'no' to the second bid amount.

Furthermore, when comparing responses to the first bid amounts (UGX 150;200;250), to the responses to the second bid amounts (UGX 100;150;200;250;300), results indicate that respondents that answered 'no'(53%) to the first bid amounts did not reject the project for water supply improvement, but rather reacted to the high bid amounts presented to them. This explains why the 'yes' responses (62%) to the subsequent second bid amounts are more than the 'no' responses (38%) to the second bid amounts.

4.6 Econometric estimation of a double bounded model with explanatory variables

This section presents the results of WTP by non-poultry farmers with explanatory variables. Table 4.17 presents the results of the double-bounded model for non-poultry farmers.

Table 4.17 The estimation of WTP with explanatory variables for non-poultry farmers

Variable	Coef.	Std.Err.	z	P>z	95%Conf.	Interval
Gender	31.74708	11.88261	2.67	0.008***	8.457598	55.03657
Age	25.11222	10.52825	2.39	0.017**	4.477217	45.74722
Household size	-5.554543	3.07834	-1.80	0.071*	-11.58798	.4788916
Quality	27.36805	10.28808	2.66	0.008***	7.203787	47.53232
Quantity	-40.74548	16.51805	-2.47	0.014**	-73.12026	-8.370702
Expenditure	8.95e-07	.0000201	0.04	0.964	-.0000384	.0000402
Water payment	26.33037	10.95305	2.40	0.016**	4.862785	47.79796
Constant	200.2332	25.76465	7.77	0.000	149.7354	250.7309
Sigma	38.36638	4.416559	8.69	0.000	149.7354	250.7309

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Log likelihood = -76.619968 Number of obs = 79 Prob > chi2 = 0.0002 Wald chi2(7) = 28.14

*Asterisks (***, ** & *****) indicate significance levels at 10%, 5% and 1% respectively.*

To further explore the significance of socioeconomic variables, knowledge, perceptions and other factors that capture the attitudes and opinions of respondents, the mean WTP is estimated with socioeconomic factors. Table 4.17 presents statistical results for the non-poultry farmers' subsample. The statistical significance of explanatory variables used in the model is shown by the Wald Chi2 (7) statistic of 28.14. The probability value of 0.0002 shows the overall significance of the model at 1% level. The model used seven explanatory variables, of which six are statistically significant in influencing individual household's WTP for improved water supply services. Following Gunatilake & Tachiiri, (2012) the study applied households' expenditure, which is relatively more reliable compared to income. However, this variable is insignificant in explaining non-poultry households' WTP for improved water services. It is important to note that the coefficients for the explanatory variables were used to estimate the mean WTP.

Gender is positive and statistically significant at 1% in explaining the WTP. This means that female respondents are more willing to pay for improved water supply services than their male counterparts. This is consistent with the fact that the majority of women endure the burden of collecting water from distant water points compared to men (Asaba et al., 2017; Farolfi et al., 2007). Therefore, women are more affected with the burden of collecting water relative to their male counterparts, hence higher WTP. Additionally, more women and girls participate in domestic water-intensive activities, such as washing and cooking, compared to their male counterparts. Therefore, women are more affected during periods of water scarcity and hence more willing to pay than men (Kanayo et al., 2013). The coefficient on gender implies that the Z-score in favour of WTP is 31.7471 higher for women than men.

The age of the respondent between 18 and 34 years is significant at 5% and positively related to WTP, relative to the age above 34 years. This implies that young respondents are more willing to pay for improved water supply services compared to older respondents (above the age of 34 years).The justification for this finding is that young people are more engaged in collecting water far from their homes (Kaliba et al., 2003), compared to older people. As expected, younger people are more affected with the burden of collecting water and, are more

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willing to pay for convenient water supply services compared to their older counterparts. This finding is consistent with empirical literature (Fujita et al., 2005; Mezgebo & Ewnetu, 2015; Wondimu & Bekele, 2011), which confirms that age is negatively related to WTP. On the contrary, Moffat et al., (2011), reported that age is positively related to WTP. The Z-score in favour of WTP is 25.1122 higher for young respondents (aged between 18 and 34 years) relative to older respondents (aged above 34).

Furthermore, there is a negative and statistically significant (at 10%) relationship, between household size and WTP. This implies that households with many members are less willing to pay for improved water supply services due to the budget constraint, compared to households with fewer members. This is consistent with empirical literature (Moffat et al., 2011; Wondimu & Bekele, 2011), which confirms that household size is negatively related to WTP. However, other WTP studies (Akeju et al., 2018; Kaliba et al., 2003), indicate that household size is positively related to WTP. The coefficient on household size suggests that a unit increase in household size will lead to a decrease in the Z-score in favour WTP by 5.5545.

The next variable analyses whether the households perceive the current water quality to be problematic, and it shows that there is a positive relationship between water quality perception and WTP. This shows that households that recognize the low water quality and health hazards posed by the current water supplied, are more likely to be willing to pay for improved water supply services relative to their counterparts who do not recognize the problem with the current water quality. It is consistent with literature (Bogale & Urgessa, 2012; Wondimu & Bekele, 2011), which confirms that households' perception regarding poor water quality and its related health hazards, is positively related to WTP. Results also indicate that the Z-score in favour of WTP increases by 27.3681 for respondents who perceive poor water quality than those who perceive otherwise. Additionally, quality perception is significant at 1% level in influencing WTP.

Additionally, the quantity of water received by the respondent is negatively related to WTP and it is statistically significant at 5% in explaining WTP, as expected. This implies that households who receive enough quantity of water from current water sources are less willing to pay for improved water supply services (in terms of availability) compared to their counterparts that receive less quantity of water from the current water sources. This is in line

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with economic theory regarding the law of demand, which depicts a negative relationship between the price and quantity demanded. It is also consistent with literature (Banda et al., 2006; Farolfi et al., 2007)**,** which portrays a negative relationship between WTP and the quantity of water consumed by households. Further, the Z-score in favour of WTP decreases by 40.7455 for households receiving enough quantities of water than those receiving insufficient water quantities.

Household's expenditure is positively related to WTP, as anticipated. This implies that the higher the household's expenditure, the higher the WTP for improved water supply services. This finding is consistent with empirical literature (Gunatilake & Tachiiri, 2012), which confirms that there is a positive relationship between household's expenditure and WTP. However, expenditure is insignificant in explaining WTP.

Paying for water from alternative sources is positively related to WTP and it is significant at 5% level in explaining WTP. The implication is that respondents that are already paying for water from alternative sources are more willing to pay for improved water supply services compared to their counterparts that are currently not paying for water from alternative sources. This confirms the fact that water vendors charge households relatively higher water prices, which has a positive effect on WTP as shown by others (Kanayo et al., 2013; Whittington et al., 1991; World Bank, 1993). Further, the Z-score in favour of WTP is 26.3304 higher for respondents that are already paying for water at alternative sources than those who are not currently paying.

4.7 Econometric estimation of the mean WTP for non-poultry farmers

The mean WTP for non-poultry farmers was estimated using the explanatory variables (socioeconomic and attitudinal factors) presented in Table 4.17. The coefficients on explanatory variables were multiplied by their respective means and these were added to generate the mean WTP. The study applied the sample mean method to determine the upper and the lower bound for the mean WTP, because it was suitable for the data. All the estimations were done using STATA 14. Theoretically, the mean WTP (or the expected value of WTP) is given by $E(WTP) = \overline{X'}\tilde{\beta}$. Where $\overline{X'}$ represents the means of explanatory variables, while $\tilde{\beta}$ is the vector of coefficients. For the case of the WTP model without explanatory variables,

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$\widetilde{\beta}$ predicts the value of WTP directly. This implies that the WTP without explanatory variables is equivalent tothe constant $(\widetilde{\beta})$.

Following Lopez-Feldman, (2012), the analysis compared WTP with and without explanatory variables to validate the results. For the precise mean WTP estimates, the WTP with explanatory variables should not change much from the WTP without explanatory. The subsequent step is to estimate WTP without and with explanatory variables. Results are presented in Table 4.18.

Table 4.18 The mean WTP for non-poultry farmers

Coefficient		Std. Error	z	P>z	95% Conf.	Interval
WTP1	204.6827	4.631998	44.19	0.0000	195.6042	213.7613
WTP2	204.3567	5.155162	39.64	0.0000	194.2528	214.4607

Lower bound UGX 173 Upper bound UGX 227

Where:

WTP1= WTP without explanatory variables.

WTP2= WTP with explanatory variables

Results from Table 4.18 indicate that WTP1 for non-poultry farmers is UGX 204.6827 per 20L per household and it is statistically significant at 1%. Additionally, the WTP1 at the lower bound (LB) is approximately UGX 196 and UGX 214 at the upper bound (UB). The mean WTP with explanatory variables for non-poultry farmers from a double bounded model is equivalent to UGX 204.3567 per 20L per household. This represents the domestic water user's welfare measure with explanatory variables. Based on the results, the mean WTP with explanatory variables is slightly lower than the WTP without explanatory variables, which implies that the mean WTP for non-poultry farmers was precisely estimated. Additionally, the mean WTP of UGX 204.3567 lies between the two arithmetic WTP means of the lower bound and upper bound, namely: UGX 173 and UGX 227, respectively.

However, the range between the two values appears to be broader than confidence interval values (UGX 194.2528 and UGX 214.4607) generated by STATA inbuilt maximum likelihood technique at 95% confidence level, which is considered to be more reliable than the former.

The arithmetic mean is generated from the no-yes and yes-yes maximum WTP responses, while the STATA inbuilt maximum likelihood technique generates confidence intervals from the socioeconomic, attitudinal and knowledge factors. Wright *et al.*(2014), adopted the STATA inbuilt maximum likelihood method to determine the lower and upper bound of WTP values at 95% confidence level. Based on that background, the confidence intervals generated by the STATA inbuilt maximum likelihood technique are preferred.

4.7.1 Testing for the heteroskedasticity in the model for non-poultry farmers

The analysis used the Breussch-Pagean technique to test for heteroskedasticity in the model for non-poultry farmers. Results are presented in Table 4.19.

Table 4.19 Testing for heteroskedasticity in the model for non-poultry farmers

Variables	Coefficients
chi2(1)	0.04
Prob > chi2	0.8353

The test considers a significance level of 5%.

Note: The null hypothesis (H_0)= There is no *heteroskedasticity*

The alternative hypothesis (H_1) = There is *heteroskedasticity*

The null hypothesis can be rejected in favour of the alternative hypothesis if the test generates a probability below the 5% significance level. Based on the results in Table 4.19, the test follows a chi-square distribution with one degree of freedom. Since the generated probability (p=0.8353) is above the significance level of 5%, we fail to reject the null hypothesis for the absence of heteroskedasticity in the model for non-poultry farmers. This implies that the model estimates are unbiased.

4.7.2 Testing for the multicollinearity in the model for non-poultry farmers

The study applied the variable inflation factor (VIF) analysis to test for multicollinearity in the model for non-poultry farmers. Results are presented in the following Table.

Table 4.20 Testing for multicollinearity in the model for non-poultry farmers

Variable	VIF	1/ VIF
Gender	1.17	0.857124
Household size	1.10	0.909136
Quality	1.10	0.911349

Expenditure	1.08	0.929004
Age	1.07	0.937171
Water payment	1.07	0.937209
Quantity	1.07	0.941389
Mean VIF	**1.09**	**-**

Based on the results in Table 4.20, all the variable inflation factors (VIFs) are below 5 with an average VIF of 1.09. Since all the VIFs are below 10, the model for non-poultry farmers does not suffer from the problem of multicollinearity. Therefore, standard errors for the model are incontestable and the model was correctly estimated.

4.8 WTP for improved water supply for poultry farmers

This section presents results for the poultry farmer's model estimations. Before estimating the mean WTP for improved water supply services for poultry farmers, it is important to determine true zeros and protests zeros.

4.8.1 Determination of true and protest zeros for poultry farmers

This first step in ensuring that responses are correct is to determine the true zeros and protest zeros, based on literature (Strazzera et al., 2003). Using the same approach used for the non-poultry sub-sample, respondents were presented with the following reasons in the debriefing question after voting against improved water supply services, namely: (i) It is not worth the money; (ii) I cannot afford to pay;(iii) I do not trust the government;(iv) I prefer the existing water sources. The results are displayed in Table 4.21. Consequently, protest zeros were categorized as respondents who rejected improved water supply services based on reason (iii) and (iv). However, reason (iii) was dropped from the analysis because no respondent selected it. By contrast, true zeros comprised of the respondents who voted against improved water supply services based on reasons: (i) and (ii).

Table 4. 21 Reasons for voting against improved water supply services

Reason	Frequency	Percentage
(i) It is not worth the money	11	68.75
(ii) I can not afford to pay	2	12.50
(iv) I prefer the existing water sources	3	18.75

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Total	**16**	**100.00**

Results presented in Table 4.21 show that 3 (19%) protest zeros were identified and dropped from the analysis to avoid generating biased results (Mitchell & Carson, 1989; Piper & Martin, 1997), while13 (81%) true zeros were retained. Accordingly, after dropping three protest zeros, the number of observations reduced from 110 to 107, for the poultry farmers subsample. To test for the sample selection bias, a preliminary test comparing the positive responses for the remaining sample and protest zeros using t-statistics was conducted, based on the explanatory variables applied in the model. Results are presented in Table 4.22.

Table 4. 22 Comparing positive responses and protest zeros for poultry farmers

		Positive responses		Protest zeros				
Variable	**Obs.**	**Mean**	**Std.Dev.**	**Obs.**	**Mean**	**Std.Dev**	**T-stats.**	**P-value**
Gender	107	.5700935	.4973922	3	.6666667	.5773503	-0.3306	0.7416
Age	107	.5046729	.502331	3	.3333333	.5773503	0.5809	0.5625
Number of chicken	105	446.9143	259.4607	3	366.6667	115.4701	0.5322	0.5957
Graduate level	107	.3364486	.4747179	3	.6666667	.5773503	-1.1831	0.2394
Primary and below	107	.1962617	.3990378	3	.3333333	.5773503	-0.5809	0.5625
Price	76	272.3684	32.03616	2	300	0	-1.2120	0.2293

Note: The analysis considered a confidence interval of 95%.

The null hypothesis (H0): There is no significant difference between positive responses and protest zeros. The alternative hypothesis (H1): There is a significant difference between positive responses and protest zeros. The null can be rejected in favour of the alternative hypothesis if the absolute T-statistics are significant based on their respective p-values below 5% significance level. Otherwise, we fail to reject the null hypothesis if the absolute T-statistics are insignificant based on their respective p-values above 5% significant level.

The variables that captured high school and secondary school levels of education were not considered in the analysis due to missing data for the protest zeros. Results in Table 4.22, indicate that there is no significant difference between positive responses and protest zeros for the poultry farmers sub-sample. This is based on the insignificant T-statistics indicated by their respective p-values (which are greater than 0.05). Therefore, this is an indication that the sample selection bias is not serious problem.

The Heckman sample selection test was subsequently applied as a robust test for sample selection bias. The Heckman model estimates the selection equation in the first stage considering the whole sample and the WTP equation in the second stage considering only respondents who are willing to pay. In this analysis, respondents in the survey with zero WTP values are dropped. Summary statistics for respondents who are willing and not willing to pay are presented in the following Table.

Table 4. 23 Distribution of willing to pay and not willing to pay by respondents

Selection	Frequency	Percentage (%)
Willing to pay	96	85.45
Not willing to pay	14	14.55
Total	110	100

About 85% of the total number of poultry farmers agreed to pay for water supply improvement presented in the valuation scenario. However, nearly 15 % of the total number of poultry farmers did not accept to pay for the improvement in water supply and responded with a 'no-no' response to the valuation question (Table 4.23).

4.8.2 The Heckman sample selection model for poultry farmers

In this analysis, all the explanatory variables indicating sample characteristics are applied in the selection equation, considering the whole sample for poultry farmers. However, the WTP equation captures a few variables since exclusion restrictions are not captured in the second stage. The variables that captured the relationship to the household head (Rhead), tenancy type and queues at water collection points were considered as the exclusion restrictions, which influence respondent's probability of being selected in the survey but do not influence the magnitude of WTP.

Table 4. 24 The Heckman sample selection model for poultry farmers

	Equation 1	Equation 2
Variables	Selection	WTP
Bid1		-.0111772 **

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		(.0049387)
Gender	.0521602	-.2843635
	(.6194853)	(.3912518)
Age	-.0102748	.4993834
	(.4399787)	(.4385678)
Number of chicken	.0014296	-.000888
	(.0009401)	(.0008658)
Graduate	.1664613	.9529265
	(.5354854)	(.589881)
High school	.3273167	.7010764
	(.7171915)	(.6567309)
Secondary school	1.022052	.2853647
	(.809335)	(.6453742)
Price at alternative source	-.010768	.0162731**
	(.0099456)	(.0069835)
Rhead	1.423499**	
	(.715009)	
Tenancy	-1.40504**	
	(.6386787)	
Queues	-.8562681	
	(.6022229)	
Constant	4.234638	-2.265383
	(3.100073)	(1.877387)
Rho (ρ)	-.427118	
	(1.082594)	
N	110	96

LR test of indep. eqns. (rho = 0): chi2 (1) = 0.11 Prob > chi2 = 0.7411

Figures without brackets are coefficients and in brackets are standard errors. Asterisks ** indicate significance level at 1% and 5% respectively.

Results from Table 4.24, indicate that we have insufficient evidence to reject the null hypothesis for independence of equations (selection and WTP equations), based on the insignificant probability coefficient generated from the Likelihood ratio test (Prob > chi2 = 0.7411). This finding suggests that dropping respondents who are not willing to pay for water supply improvement cannot generate sample selection bias in the subsample for poultry farmers and the two equations can be estimated separately. Accordingly, a double bounded probit model considering positive WTP responses can be applied to generate unbiased WTP estimates for the poultry farmers.

For the WTP equation, the first bid variable was found to be significant at 5% level and it is negatively related to WTP. This implies that household's WTP reduces with the increase in the bid price, which is consistent with economic theory regarding the negative relationship between the price and the quantity demanded. Additionally, WTP is also positively influenced by whether the respondent pays for water at alternative sources at 5% significant level. This is in conformity with economic theory regarding the positive cross elasticity of demand for substitute goods. By contrast, the probability of being selected in the sample for poultry farmers is positively related to whether the respondent is the head of the household at 5% significant level. The variable that captured whether the respondent owns a house is also significant at 5% level and negatively influences the probability of being selected in the sample for poultry farmers.

Since sample selection bias is not a problem and the two equations can be estimated separately, we continued our estimation with the positive WTP group using the double bounded probit model employed for this study. The next step is to analyse the distribution of bids for the poultry farmer's sub-sample. Results for the distributions of bid1 are presented in Table 4.25.

Table 4. 25 Distribution of bid1 responses

Response1	**Bid1**			
	150	**200**	**250**	**Total**
No	14	18	28	60
	(40.00)	(50.00)	(77.78)	(56.07)
Yes	21	18	8	47
	(60.00)	(50.00)	(22.22)	(43.93)
Total	**35**	**36**	**36**	**107**

Note: Numbers without brackets are frequencies, while numbers in brackets are percentages

Results in Table 4.25 indicate that about 56% of the respondents answered 'no' to the first bid amount, compared to 44% of respondents that answered 'yes' to the initial bid amount. Additionally, results also indicate that respondents were sensitive to bid amounts presented them, as the probability of saying yes reduced with increasing bid amounts (Asim & Lohano, 2015), as expected. It is logical to analyse the distribution of the second bids presented to poultry farmers, based on the use of a double bounded elicitation format.

Table 4. 26 Distribution of bid2 responses

Response2	Bid2					
	100	**150**	**200**	**250**	**300**	**Total**
No	0 (0.00)	6 (33.3)	19 (38.78)	14 (77.78)	8 (100.00)	47 (43.93)
Yes	14 (100.00)	12 (66.67)	30 (61.22)	4 (22.22)	0 (0.00)	60 (56.07)
Total	**14**	**18**	**49**	**18**	**8**	**107**

Note: Numbers without brackets are frequencies, while numbers in brackets are percentages

Results from Table 4.26 indicate that approximately 44% of the respondents answered 'no' to the second bid question, relative to 56% of the respondents that answered 'yes' to the second bid. While comparing responses to the first bid amounts (UGX 150;200;250), to the responses to the second bid amounts (UGX 100;150;200;250;300), results indicate that respondents that answered 'no' (56%) to the first bid amounts did not reject the project for water supply improvement, but rather reacted to the high bid amounts presented to them. This explains why the 'yes' responses (56%) to the subsequent second bid amounts are more than the 'no' responses (44%) to the second bid amounts. After analysing the distribution of the bids presented to poultry farmers, the next step is to estimate the mean WTP for poultry farmers from the double bounded probit model with explanatory variables using the maximum likelihood method.

4.8.3 Econometric estimation of a double bounded model with explanatory variables for poultry farmers

Table 4.27 The estimation of WTP with explanatory variables for poultry farmers

Variable	Coef.	Std.Err.	z	P>z	95% Conf.	Interval
Gender	14.0896	10.79982	1.30	0.192	-7.07766	35.25685
Age	5.647247	10.42832	0.54	0.588	-14.79188	26.08637
Number of chicken	.0369571	.0220722	1.67	0.094*	-.0063037	.0802179
Graduate	28.56681	14.22196	2.01	0.045**	.6922746	56.44135
High school	49.16092	16.04349	3.06	0.002***	17.71626	80.60558
Secondary school	26.12256	15.28683	1.71	0.087*	-3.839078	56.08419
Price	.1810314	.160859	1.13	0.260	-.1342464	.4963093
Constant	98.09045	45.05973	2.18	0.029	9.774998	186.4059
Sigma	39.99138	4.263027	9.38	0.000	31.636	48.34676

Log likelihood = -83.377687 Number of obs = 74 Wald chi2 (7) = 19.03 Prob > chi2 = 0.0081

Note: Asterisks (*, ** & ***), indicate significance levels at 10%, 5% and 1% respectively

Statistical results from Table 4.27 present the complete model, which is statistically significant at 1% level based on the probability Chi-square of 0.0081. The expenditure variable was dropped from the analysis for poultry farmers, since it was correlated with the number of chicken reared by a poultry farmer. Similarly, the variable on quality perception was dropped from the model for poultry farmers based on its correlation with high school and secondary school levels of education. Further, the variable which captured whether the respondent pays for water at alternative sources was also dropped from the analysis for poultry farmers since it was correlated with the price of water at alternative sources. The model employed seven explanatory variables, of which four are statistically significant in explaining households' WTP. These include the number of chicken reared by the household, education levels of graduate, high school and secondary school. However, the following variables, gender, age and the price of water at alternative sources have no explanatory power on WTP for poultry farmers.

The gender of the respondent is positively related to WTP, which implies that female poultry farmers are more willing to pay for pay for improved water supply services than their male counterparts. This is attributed to the fact that most of the poultry farmers are women (accounting to about 57% to the total number of poultry farmers) and therefore are more affected with the problem of collecting water from distant sources than men. Nevertheless, the variable which captured gender is not significant in explaining WTP for poultry farmers.

The age variable used as a proxy for experience in poultry farming is positively related to WTP. This suggests that respondents with less years of experience in poultry farming are more willing to pay than their counterparts with more years of experience. This is rather unusual since experienced farmers are associated with a better understanding of the benefits of improved water supply services than less experienced farmers.The possible justication for this finding is that less experienced farmers could be with a broader planning perspective than more experienced farmers. By contrast, empirical evidence (Namyenya et al., 2014) indicates that more experienced farmers are more willing to pay than less experienced farmers. However, the variable that captured the age of the respondent has no explanatory power on WTP at all significance levels.

The number of chicken reared by the poultry farmer positively influences WTP and it is significant at 10%. This suggests that the more chicken reared by a poultry farmer, the more

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the WTP for improved water supply services. This could be attributed to the fact that poultry farmers with more chicken are more likely to earn higher income from poultry farming when the reliable water supply service is brought closer to their poultry farms, compared to others with less chicken. Therefore, they are more willing to pay for improved water supply services. Empirical evidence (Mohammed, 2011; Morris, 2000) indicates that water is necessary for chicken production, as it affects their performance (in terms of weight and eggs) and health. Therefore, the risks and challenges posed by poor water supply services affect poultry farmers with more chicken compared to poultry farmers with less chicken. Therefore, households with more chicken are more willing to pay improved water supply services to curb the risks and challenges posed by the current unreliable water supply services. Further, the coefficient on the number of chicken suggests that a percentage increase in the number of chicken increases the Z-score in favour of WTP by 0.0370.

Education level is positively related to WTP, with significance levels of 5% for graduate education, 1% for high school education and 10% for secondary school education. Households with graduate level of education are more willing to pay compared to households without graduate education level. Similarly, households with high school education level are more willing to pay compared with other households without high school education level. Further, households with secondary school education level are more willing to pay compared to their counterparts with primary education and below. The possible justification for this finding is that educated households tend to be aware of the benefits of improved water supply in poultry farming and the risks posed by poor water supply services to the poultry farms than households with less education. This is supported by other studies (Kanayo et al., 2013; Namyenya et al., 2014; Wondimu & Bekele, 2011), which show that household's education level is positively related to WTP. Results also indicate that the Z-score in favour of WTP is 28.5668 more for respondents with graduate level of education than respondents with other levels of education. Similarly, the Z-score in favour of WTP is 49.1609 more for respondents with high school level of education compared to respondents without high school level of education. Further, the Z-score in favour of WTP increases by 26.1226 for respondents with secondary school level of education relative to respondents without it.

The price of water per 20L at alternative water sources is positively related to WTP. This implies that, the higher the price of water charged at alternative water sources, the higher the WTP by poultry farmers. This is in line with the priori expectation and economic theory

regarding the cross elasticity of demand for substitute goods or services, which portrays a positive relationship between quantity demanded and the price of a substitute good or service. Empirical evidence (Kanayo et al., 2013; Whittington et al., 1991; World Bank, 1993) indicates that water vending is associated with high demand for improved water supply services, due to high prices of vended water. Nevertheless, the price of water per 20L at alternative sources has no explanatory power on WTP at all significance levels.

4.8.4 Econometric estimation of WTP for poultry farmers

The mean WTP value for poultry farmers was derived from the socioeconomic, knowledge and attitudinal factors explained above. The lower bound and upper bound of the mean WTP were estimated by the arithmetic mean method because it was suitable for the data. The analysis compared the WTP value without explanatory variables with the mean WTP with explanatory variables to validate the results, following the procedure by Lopez-Feldman, (2012). Results of the mean WTP for poultry with and without explanatory variables are presented in Table 4.28.

Table 4.28 Estimation of the mean WTP for poultry farmers

Coefficient		Std. Error	z	P>z	95% Conf.	Interval
WTP1	197.4676	4.998177	39.51	0.000	187.6714	207.2639
WTP2	197.1068	5.989506	32.91	0.000	185.3676	208.8461
Lower bound UGX 159		Upper bound UGX 231				

Where: WTP1= WTP without explanatory variables

WTP2= WTP with explanatory variables

As shown in Table 4.28, the mean WTP for poultry farmers was estimated to be UGX 197.1068 per 20L per household. The estimated mean WTP for poultry farmers is within the lower bound and upper bound values of UGX 159 and UGX 231, respectively. However, the WTP without explanatory variables is equivalent to UGX 197.4676 per 20L per household, which is slightly lower than the mean WTP with explanatory variables. This indicates that the mean WTP does not change much when explanatory variables are evaluated at their mean values. Furthermore, it implies that the mean WTP for poultry farmers was accurately estimated.

Following literature (Wright et al., 2014), the STATA in-built intervals at 95% (UGX 185.3676 and UGX 208.8461), was adopted based on the relatively narrower gap between them. The estimated mean WTP value for poultry farmers is approximately UGX 197 per 20L, which is lower than that of the non-poultry farmers (UGX 204). It is important to note that the estimated mean WTP values for the split sample are far above the current water tariff of UGX 56 per 20L, charged by NWSC for domestic water purposes (MWE, 2018),but still below the average price charged by water vendors (UGX 300 per 20L) (Pangare & Pangare, 2008).Therefore, implementing a policy for improving water supply services in Wakiso at a higher water price will result in Pareto improvement.

4.8.5 Testing for the heteroskedasticity in the model for poultry farmers

The analysis used the Breussch-Pagean technique to test for heteroskedasticity in the model for poultry farmers. Results are presented in Table 4.29.

Table 4. 29 Testing for heteroskedasticity in the model for poultry farmers

Variables	Coefficients
chi2(1)	0.22
Prob > chi2	0.6392

The test assumes a 5% significance level

Note: The null hypothesis (H_0):= There is no heteroskedasticity.

The alternative hypothesis (H_1):= There is heteroskedasticity.

Results in Table 4.29 clearly indicate that the probability (p=0.6392) generated from the test is not significant at 5% significant level. Therefore, we fail to reject the null hypothesis for the absence of heteroskedasticity in the model for poultry farmers. The implication is that the model estimates are unbiased.

4.8.6 Testing for the multicollinearity in the model for poultry farmers

The study applied the variable inflation factor (VIF) analysis to test for multicollinearity in the model for poultry farmers. Results are presented in the following table.

Table 4.30 Testing for multicollinearity in the model for poultry farmers

Variable	VIF	1/ VIF
Graduate level	1.72	0.581923
Secondary school level	1.67	0.597817

High school	1.57	0.638134
Gender	1.07	0.930614
Number of children	1.05	0.954870
Age	1.04	0.961557
Price at alternative sources	1.03	0.966471
Mean VIF	1.31	-

Based on the results in Table 4.30, all the variable inflation factors (VIFs) are below of 10 with an average VIF of 1.50. Since all the VIFs are below 10, multicollinearity is ruled out in the poultry farmer's model. This implies that standard errors for the poultry farmer's model are not questionable and the model was correctly estimated.

4.9 Testing hypotheses

4.9.1 Testing for the statistical difference between the two sub-samples

Based on the WTP equations (17 and 18 as indicated in Chapter 3), the WTP model for non-poultry farmers applied the following explanatory variables; gender, age, expenditure, quality perception, household size, whether the respondent receives enough quantity of water from the main source and whether the respondent pays for water at alternative sources. On the other hand, the WTP model for poultry farmers adopted the following explanatory variables; gender, age, the number of chicken reared by the respondent, education levels of graduate, high school and secondary school, and the price of water at alternative sources. The variables which captured expenditure, quality perception and whether the respondent pays for water at alternative sources were dropped from the model for poultry farmers due to the correlation problem. This partly explains why the WTP models applied slightly different variables. The WTP models for the split sample also applied slightly different explanatory variables, based on the best fit of the two models. Further, the mean WTP values for poultry and non-poultry farmers are different in size. The study employed the unpaired t-test to determine whether the two mean WTP values are statistically different. The test assumes equal variance of the mean WTP values for the sub-samples under investigation. The results are presented in table 4.30.

Table 4. 31 Statistical difference of the mean WTP values using the unpaired t-test

Variables	Observations	Mean	Std. Err	Std. Dev.	95% Conf.	Interval
NPF WTP	133	210.9291	2.35002	27.10175	206.2805	215.5777

PF WTP	110	186.7328	3.154546	33.08515	180.4806	192.985
Combined	243	199.9761	2.068107	32.23859	195.9023	204.0499
Difference		24.19627	3.860732		16.59119	31.80136
t-value = 6.2673		Degrees of freedom = 241				
H_o: diff = 0 H_{a1}:		H_a: diff != 0			H_a: diff > 0	
Pr (T < t) = 1.0000		Pr (|T| > |t|) = 0.0000			Pr (T > t) = 0.0000	

Where: diff = difference, PF = Poultry Farmers, NPF = Non-Poultry Farmers, and the Difference = mean (NPF WTP) – mean (PF).

The null hypothesis (H_o: diff = 0) is that the difference between the mean WTP for non-poultry and poultry farmers is zero. Additionally, the two-sided alternative hypothesis (H_{a2}: diff ≠ 0) is that the difference between the mean WTP for non-poultry and for poultry farmers is not equal to zero. The two-sided test statistic was deemed appropriate for this analysis based on testing the divergence from the null. The null hypothesis (H_o: diff = 0), can be rejected if the two-sided p-value is significant ($p \leq 0.05$). Otherwise, the null hypothesis cannot be rejected if the two-sided p-value is not significant ($p > 0.05$).

Statistical results from Table 4.31 reveal that there is a significant difference between the WTP means for the split sample. This is indicated by a significant two-sided p-value (p = 0.000). Based on the results, there is sufficient evidence to reject the null hypothesis that the difference between the mean WTP for non-poultry and for poultry farmers is equal to zero (mean WTP_{NPF}–mean WTP_{PF}= 0), at 1% level of significance. This implies that poultry farming significantly influences households' WTP for improved water supply services in Wakiso District. This could be attributed to the fact that poultry farming heavily relies on water use, which impact on poultry health and performance. Alternatively, water use differentiated by poultry and non-poultry farming activities, significantly influences households' WTP for improved water supply services.

4.9.2 Testing whether the mean WTP for poultry farmers is greater than that of non-poultry farmers

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The study also tests the null hypothesis that the mean WTP for poultry farmers is greater than the mean WTP for non-poultry farmers (mean WTP_{PF}> mean WTP_{NFP}). The alternative hypothesis for this test is that the mean WTP for poultry farmers is less than that of the non-poultry farmers (mean WTP_{PF} < mean WTP_{NFP}). Based on testing whether the mean WTP for poultry farmers is greater than or less than that of non-poultry farmers, we deemed the two-sided t-test suitable for this analysis. The null hypothesis can be rejected in favour of the alternative if the two-sided p-value is significant. By contrast, the null cannot be rejected if the two-sided p-value is insignificant.

Results in Table 4.31, indicate that the two-sided p-value (p = 0.0000) is significant. Therefore, there is sufficient evidence to reject the null hypothesis in favour of the alternative at 1% significance level. This finding implies that poultry farmers are willing to pay less than non-poultry farmers for an improved water supply service. However, this finding is unusual because poultry farmers use relatively more water compared to non-poultry farmers. The possible justification for this finding is that data for this study was collected in October 2018, during the second rainy season (which is mainly from September to December in Uganda) and most of the poultry farmers (99%) were found to be with water harvesting tanks (water storage facilities) relative to non-poultry farmers (78%). This suggests that poultry farmers harvest more rainwater during the rainy season and are less affected with challenge of limited water supply compared to non-poultry farmers. Based on that background, poultry farmers are less willing to pay for improved water supply services compared to non-poultry farmers. Another explanation could be that poultry farmers treat water as an input that adds to their production costs. Thus preferring to pay less or rely on their existing water sources.

4.10. Evaluating respondents' understanding of the contingent valuation (CV) survey scenario

The purpose of this section is to assess respondents' understanding of the CV scenario, and their knowledge regarding the current water supply challenges. The contingent valuation scenario must be drafted well to generate credible results (Whittington, 1998). To ensure proper designing of the CV scenario for this study, the CV scenario was separated into sections, which explained the current water supply challenges in the study area, the main effects on the economic and health aspects, government's ability to deliver on water supply improvement

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project and eventually presented payment logistics. The analysis evaluated respondents' understanding of the CV scenario and the current water supply challenges.

Table 4. 32 Statistics of contingent valuation (CV) scenario responses

Question	Option	Non-poultry farmers	Poultry farmers	Total
Do you agree that this is an accurate description of the status of water supply in this community?	Yes	125 (94.98%)	110 (100%)	235 (97.49%)
	No	8 (6.02%)	0 (0.00%)	8 (3.03%)
Do you agree that accessing water from distant water sources has health and economic consequences?	Yes	133 (100%)	110 (100%)	243 (100%)
	No	0 (0.00%)	0 (0.00%)	0 (0.00%)
In your view, can the government deliver on this program to improve water supply accessibility for Nsangi residents?	Yes	125 (94.98%)	107 (97.27%)	232 (96.12%)
	No	8(6.02%)	3 (2.97%)	11 (4.50%)
In your view, would the introduction of this program be a good idea?	Yes	132 (99.25%)	107 (97.27%)	239 (98.26%)
	No	1 (0.75%)	3 (2.97%)	4 (1.86%)

Note: Frequencies are indicated outside brackets, while percentages are shown inside brackets.

Results from Table 4.32 indicate a big percentage of 'yes' responses to all the questions asked in the CV scenario, including water supply challenges namely, distant water sources, high water prices charged by water vendors and long queues at nearby water sources. This implies that the CV scenario clearly presented the prevailing water supply challenges in selected areas in Wakiso District. Over 97% of the total number of respondents agreed that the CV scenario accurately described the status of the water supply situation in Wakiso District. Additionally, 100% of the total number of respondents acknowledged that accessing water from distant sources has adverse effects on the economic and health aspects of their respective households. This is because untreated water from springs and wells results in increased water-borne diseases in both human beings and poultry birds, and hence increased medical costs and water treatment costs. Besides, water vendors charge relatively high prices during periods of water scarcities due to distant alternative water sources, which results in increased water costs for poultry and non-poultry farmers.

Furthermore, over 96% of the total number of respondents recognizes that the government can deliver improved water supply services in Wakiso District. This is attributed to the fact that the government has resources and capacity to implement improved water supply projects, water pipes have already been installed in some areas in Wakiso District, and the effectiveness of NWSC in supplying water in urban and semi-urban areas. However, only 4% of the total number of respondents disagreed that the government could deliver improved water supply services due to the high level of corruption associated with government projects.

Lastly, 98% of the total number of respondents acknowledged that the introduction of improved water supply services would be a good idea due to the following reasons: it will improve water supply services; it will bring water closer to users; it will reduce water prices. Nevertheless, 2% of the total number of respondents believes that improved water supply services will only benefit households who can afford to pay for it and therefore, it is not a good idea.

4.11 Assessment of households' financial status after the proposed intervention

This section evaluates households' general financial status to ascertain whether they will be able to fund the envisioned project, and whether their utility will remain at the same level after the implementation of the proposed project. It is divided into the following sub-sections namely; assessment of households' house type, assessment of households' tenancy type,

evaluation of households' affordability of basic needs and the general economic situation of the household.

4.11.1 Assessment of households' house type

This sub-section determines the house type in which the household resides. It is important because it is hypothesized that households residing in expensively constructed houses are more likely to pay a reasonable percentage of their income to support the proposed improved water supply project than their counterparts staying in cheaply constructed houses.

Table 4. 33 Assessment of households' house type

House type	Non-poultry farmers	Poultry farmers	Total
Brick wall, tiled roof	5 (3.76%)	7 (6.36%)	12 (5.06%)
Brick wall, corrugated roof	124 (93.23%)	103 (93.64%)	227(93.43%)
Mud wall, corrugated roof	4 (3.01%)	0 (0.00%)	4(1.50%)
Mud wall, thatched roof	0 (0.00%)	0 (0.00%)	0 (0.00%)

Note: Frequencies are shown outside brackets, while percentages are shown inside brackets.

Results from Table 4.33 indicate that the majority of households reside in houses with brick walls and corrugated roofs. This is shown by over 93% of the total number of households staying in houses with brick walls and corrugated roofs. Based on the results, most households would be able to pay for improved water supply services, as indicated by their affordability to reside in houses with brick walls and corrugated roofs. This implies that households residing in houses with brick walls and corrugated roofs earn relatively more income and hence more likely to finance the proposed project than their counterparts residing in houses with mud walls and corrugated roofs. It also implies that the utility for households residing in houses with brick walls and corrugated roofs would increase due to their higher disposable income relative to the utility of households residing in houses with mud walls and corrugated roofs, after the implementation of the project.

4.11.2 Assessment of households' tenancy type

This sub-section assesses the ownership of the households' premises to determine whether they can support the proposed project. It is assumed that households owning their premises are more likely to finance the proposed project compared to their counterparts in rented or free premises. The results are summarized in Table 4.34.

Table 4.34 Assessment of households' tenancy type

Tenancy type	NP	FPF	Total
Household owns the house	78 (58.65%)	72 (65.45%)	150 (62.05%)
Household lives in rented premises	37 (27.82%)	10 (9.09%)	47 (18.46%)
Household lives free of charge in the house	18 (13.53%)	28 (25.45%)	46 (19.49%)

Note: Frequencies are shown outside brackets, while percentages are shown inside brackets.

Results displayed by Table 4.34 indicate that most of the households reside in their own houses. This is shown by over 62% of the total number of households that own their residences. Households that own their premises stay permanently in such localities with severe challenges of water scarcity, long queues at water sources and poor water quality. This implies that most households can finance the proposed project to improve the current water supply in their localities. By contrast, about 19% of the total number of households live free of charge in houses they do not own. These were mainly relatives, children and workers of household heads, who do not directly contribute towards water payments and therefore attach less value to water, yet they are also affected by the challenges of accessing water in their localities. Lastly, over 18% of the total number of households reside in rented premises and therefore less likely to finance the proposed project for improved water supply in their localities because they don't own residences where they stay and can easily shift to other areas with improved water supply services.

4.11.3 Households' affordability of basic needs after the implementation of the project

The purpose of this sub-section is to determine whether respondents carefully considered their budget constraints before supporting the project for improved water supply services. This was done by asking respondents whether they could be able to afford to pay for basic needs or poultry farm production cost after the implementation of the project. Respondents were presented with a simple 'yes' or 'no' options. Results are denoted in table 4.35.

Table 4.35 Households' affordability of basic needs after the implementation of the project

Affordability of basic needs	Non-poultry farmers	Poultry farmers	Total

Yes	125 (93.98%)	110 (100%)	235 (96.99%)
No	8 (6.02%)	0 (0.00%)	8 (3.01%)

Note: Frequencies are shown outside brackets, while percentages are shown inside brackets.

Results from Table 4.35 indicate that households can afford to pay for basic needs (such as water and food) or poultry production costs (such as, water and feeds), after the implementation of the proposed water improvement project. This is confirmed by 97% of the total number of respondents that agreed that they can afford to pay for basic needs or poultry production cost after the implementation of the project. However, only 3% of the total number of respondents revealed that they cannot afford to pay for basic needs or poultry production costs after the implementation of the project. This could be attributed to their lower disposable income. Conclusively, respondents that can afford to pay for basic needs after the implementation of the project are significantly more than those that cannot to pay. Therefore, the implementation of the project will result in Pareto improvement.

4.11.4 Households' economic situation

This sub-section analyses the economic position of households. The purpose of this sub-section is to determine whether the proposed water improvement project will not adversely affect households' financial situation. Whittington (1998), argues that the proposed change in water supply can be achieved with the financial contribution of the beneficiaries. It is therefore important to analyse the economic situation of households, based on their financial responsibility. Lastly, it is also logical to assess whether households will remain at the same level of utility after financing the proposed water improvement project. Table 4.36 presents the results for the analysis.

Table 4.36 Households' economic situation

Economic situation	Non-poultry farmers	Poultry farmers	Total
We have enough money to pay our necessities and can also manage to buy durable goods	21 (15.79%)	35 (32.11%)	56 (23.95%)
We can afford food, public utilities and pay for school fees but cannot afford to buy durable goods like fridge, TV, sofa set, a car, etc.	73 (54.89%)	72 (66.06%)	145 (60.48%)
We can meet the expense of food and public utilities, but it is problematic to pay for transport and school fees.	32 (24.06%)	2 (1.66%)	34 (12.86%)
We have money for food but cannot manage to pay for public utilities, transport and school fees.	7 (5.26%)	0 (0.00%)	7 (2.63%)
We have no money even for food	0 (0.00%)	0 (0.00%)	0 (0.00%)

Note: Frequencies are shown outside brackets, while percentages are shown inside brackets.

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UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Results from Table 4.36 reveal that most households in Wakiso District are willing to support the proposed project for improved water supply services and their financial situation will not be curtailed in regard to basic needs. This is indicated by over 60% of the total number of households that revealed that they can afford basic needs and school fees but cannot afford durables. It implies that most households can still afford to meet the costs for basic needs even after the implementation of the project. It is also important to note that approximately 24% of the total number of households has enough money to pay for their daily necessities and durable goods such as cars, furniture and fridges. Therefore, they are financially stable to finance the water improvement project and ultimately improve their welfare. By contrast, a small percentage of households were not able to pay for the proposed improved water supply service. This is indicated by almost 3% of the total number of households that indicated that they have money for food but cannot manage to pay for public utilities, transport and school fees. Households in Wakiso Districts can support the proposed project for improved water supply services based on their good financial position. With that background, it is also logical to conclude that households would remain financially stable after the implementation of the project.

4.12 Assessment of the overall performance of the survey instrument by the interviewers

Following the latest SP guidelines by Johnston et al., (2017), the overall performance of the survey instrument was analysed by questions directed to the interviewers after each round of the interview to ensure reliability and validity of the results. These questions evaluated the responses of the respondents and were divided into four parts namely: questions which analysed the respondents' level of understanding with respect to the survey questions, questions which established whether there were complicated questions in the survey, questions which assessed respondents' reaction towards the questions and the survey in general, and questions which assessed the reliability of respondents' answers. Results are indicated in Table 4.37.

Table 4.37Results for the assessment of the respondents' responses

Questions	Options	Non-poultry farmers	Poultry farmers	Total
Did the respondent understand all the questions	Very well understood	113 (84. 96%)	100 (90.91%)	213 (87.93%)
	Well understood	17 (12.78%)	5 (4.55%)	22 (8.67%)
	Understood	3 (2.26%)	5 (4.55%)	8 (3.40%)
	Did not understand	0 (0.00%)	0 (0.00%)	0 (0.00%)
Where the questions complicated	No	111 (83.46%)	97 (88.18%)	208 (85.82%)
	Yes	22 (16.54%)	13 (11.82%)	35 (14.18%)
How was the reaction of the respondent towards questions and the survey in general	Very supportive	110 (82.71%)	95 (86.36%)	205 (84.53%)
	Moderately supportive	20 (15.04%)	13 (11.82%)	33 (13.43%)
	Supportive	3 (2.26%)	2 (1.82%)	5 (2.04%)
	Not supportive	0 (0.00%)	0 (0.00%)	0 (0.00%)
How do you rank the reliability of the responses given to you by the respondents	Very reliable	110 (82.71%)	95(86.36%)	205 (84.53%)
	Moderately reliable	20(15.04%)	13(11.82%)	33 (13.43%)
	Reliable	3 (2.26%)	2(1.82%)	5 (2.04%)
	Not reliable	0 (0.00%)	0 (0.00%)	0 (0.00%)

Note: Frequencies are shown outside brackets, while percentages are shown inside brackets.

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From Table 4.37, results are highly suitable for policy formulation. All the questions that assessed respondents' responses to the survey questions recorded high percentages under the four categories. Statistical results show that almost 88% of the total number of respondents understood the survey questions very well, while 9% understood the survey questions well and 3% understood the survey questions. This implies that 100% of the respondents understood the survey questions due to the severe challenges associated with accessing water in Wakiso District and a clearly explained intervention in the hypothetical scenario. Furthermore, more than 85% of the respondents indicated that there were no complicated questions in the survey, compared to 14.18% that acknowledged that there were a few complicated questions.

The reasons given for complicated questions include: A few respondents were not comfortable in revealing their personal information especially age and income at first. However, the researcher and enumerators assured them that they were participating anonymously in the survey and they ultimately cooperated. Additionally, some respondents misunderstood some questions at first, for example the bidding game questions, and the research team had to repeat the explanation for such questions until respondents understood and responded accordingly.

Statistical results also indicate that respondents positively reacted to the questions and the survey in general. This is indicated by over 84% of the respondents that proved to be very supportive during the interview and willingly supported the proposed policy intervention. It could be attributed to the desire by most residents in Wakiso to change the status quo of the prevailing water supply conditions due to their negative consequences on people's welfare.

Lastly, more than 84% of the respondents gave very reliable responses to the survey questions, while 13.48% gave moderately reliable responses and 2.04% gave reliable responses. This implies that respondents provided valid and credible responses, which were used to generate reliable results suitable for policy formulation. Based on the results from this analysis, the questionnaire design had far-reaching effects, as it generated the anticipated results.

4.13 Concluding summary of results

Based on the analysis presented, there is substantial evidence to show that households in Wakiso District have more knowledge about the challenges associated with poor water supply services, which affect poultry and non-poultry farmers. Households are knowledgeable regarding water availability and the problem of accessing water from distant sources in Wakiso District.

The models included socio-economic and demographic variables. Education level, gender, income and age are statistically significant in influencing household's knowledge regarding the availability of water in their localities. Results suggest that this knowledge is activated by education, which shows that educated households are more likely to be aware of the challenges associated with poor water supply services in their localities, relative to their counterparts with less or no education.

The gender of the household plays a fundamental role regarding the knowledge of households concerning fetching water from distant sources. This implies that women have more knowledge regarding the burden of collecting water in their households (or poultry farms), as they involve in water intensive household or poultry farming activities and bear the burden of collecting water from distant sources, relative to men. Additionally, this is attributed to the fact that the majority of respondents interviewed were women accounting for about 61% for the split sample.

The key factors that influence household's knowledge about improved water supply services are education, to a large extent, and to a lesser extent, gender and income. Education appears to be playing a central role in this construct, as households with higher levels of education seem to have more knowledge relating to the benefits of improved supply services, relative to their counterparts with less or no education.

The water from Nsangi sub-county plays a significant role in the welfare of several households, as they recorded high WTP for the split samples. The mean WTP was estimated at UGX 197.1068 per 20L Jerry-can per household for poultry farmers and 204.3567 per 20L Jerry-can per household for non-poultry farmers, far above the current water tariff of UGX 56 per 20L,

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UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

charged by NWSC, but below the water price charged by vendors. This suggests that water supply improvement in Nsangi sub-county at a higher price will result in Pareto improvement.

The difference of 24.1963 between the two WTP means of the split sample is statistically significant at 1% level (t = 6.2673, p =0.000), which means that poultry farming significantly influences households' WTP for improved water supply services. This is attributed to the fact poultry farming heavily relies on water use, which affects poultry health and performance. However, the WTP for poultry farmers seems to be lower than that of non-poultry farmers. The possible justification for this finding is that data collection was conducted during the rainy season, in which most of the poultry farmers harvest rainwater compared to non-poultry farmers. Another explanation is that water charges contribute to production costs for poultry farmers and that is why they are willing to pay less.

The analysis of household's financial situation and debriefing questions also give justifiable evidence that households support the proposed project of extending potable water supply services closer to their homesteads (or poultry farms) in Wakiso District and they are willing to pay for it. Another interesting conclusion that can be drawn from the analysis is that respondents reacted negatively towards high starting bids. High starting bids presented to respondents were negatively related to the 'yes' responses to purchase improved water supply service. This is consistent with the law of demand, which portrays a negative relationship between the price and quantity demanded. Nevertheless, respondents reacted positively towards reduced subsequent bid amounts presented to them.

Following empirical literature (Dormann et al., 2013; Mezgebo & Ewnetu, 2015) and theoretical literature (Gujarati, 2004; Wooldridge, 2012), explanatory variables were tested for multicollinearity using the simple pair-wise correlation and variance inflation factor (VIF) analyses, before estimating probit models. Accordingly, correlated variables were dropped from the models to avoid generating biased results (Mezgebo & Ewnetu, 2015). Similarly, explanatory variables used in the models were also tested for heteroskedasticity. Results indicate that all the variables employed in the models have no problems of collinearity and heteroskedasticity. Similarly, the Heckman sample selection models were applied to the split sample to check for sample selection bias due to dropping protest zeros from the analysis.

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Results indicate that sample selection bias was not a problem and the double bounded probit models were applied to generate unbiased results.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 Overview

Based on the findings of this study, there is sufficient evidence that highlight the challenge of distant water sources and its related economic and health implications, as a serious problem affecting poultry and non-poultry farmers in Nsangi sub-county, Wakiso District. The objectives of this study are to: (1) determine the value households are willing to pay to access improved water supply services at their premises or poultry farms; (2) establish whether poultry farming significantly influence household's WTP for improved water supply services; (3) analyse respondent's knowledge, opinions, perceptions and attitudes about water availability, the problem of collecting water from distant sources, and the benefits of improved water supply services.

Several statistical analyses were performed to achieve the study objectives. The robustness of statistical results on households' knowledge, opinions, perceptions and attitudes, was analysed by the chi-square and the one-way analysis of the variance (ANOVA) to establish the possible influence of socioeconomic factors, namely gender, education, age and income, on the formerly specified concepts of knowledge, opinions, perceptions and attitudes. Data was collected from 243 randomly selected households using a pre-tested questionnaire, and split into two, based on poultry and non-poultry farming households. The study employed the double bounded dichotomous CVM to determine the mean WTP for the split samples. Additional statistical tests were performed using the t-test to determine the statistical difference between WTP means for the split sample. This chapter presents the summary of the most important conclusions, recommendations and policy implications, based on the findings of the study. This chapter also examines the limitations of the study and the proposed areas for further research.

5.2 Conclusions

Based on the findings presented in the text, this study draws conclusions presented in this section. Households in Wakiso District, Nsangi sub-county have high levels of factual knowledge about water availability, the problem of collecting water from distant sources, and the benefits of improved water supply services, as indicated by the five-point Likert scale analyses. Certainly, households in Nsangi sub-county have positive attitudes towards a policy that improves the *status-quo* of water supply services in their localities.

Results show that socio-economic factors such as, gender, education, age and income, have a statistically significant influence on their knowledge, opinions, perceptions and attitudes towards water availability, the problem of water collection and the benefits of improved water supply services. These results were generated by the one-way ANOVA approach. Furthermore, households with higher levels of education have more knowledge relating to water availability and the benefits of improved supply services, relative to their less educated counterparts.

Gender of the household plays a big role in all the constructs of knowledge, opinions, perceptions and attitudes concerning the problem of collecting water from distant sources. Women are more knowledgeable regarding the problem of collecting water from distant sources as they bear the burden of collecting water from distant sources and involve in water intensive household and poultry farming activities, relative to men.

Household's income is also statistically significant in influencing household's knowledge, opinions, perceptions and attitudes concerning water availability, the problem of collecting water and the benefits of improved water supply services. Households earning more income in Nsangi sub-county are more concerned with water availability, the problem of collecting water from distant sources and displayed positive attitudes towards improved water supply services.

Age is significant for poultry farmers' perceptions concerning water quantity and distant sources. However, the reverse is true for the case of same perceptions for non-poultry farmers. Furthermore, age is also significant for non-poultry farmers' perceptions regarding water supply improvement and the reverse is true for the case of poultry farmers. Therefore, household's socioeconomic factors influence their knowledge, opinions, perceptions and attitudes about water availability, collecting water from distant sources and improved water supply services.

The mean WTP was estimated at UGX 197.1068 per 20L Jerry-can per household for poultry farmers, and 204.3567 per 20L Jerry-can per household for non-poultry farmers. These figures are above the current water tariff of UGX 56 per 20L for domestic water users, charged by NWSC, but below the charges by water vendors. Therefore, a policy that improves household's access to water supply services will result in Pareto improvement. The WTP means for the split

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sample were positive and statistically significant. This is attributed to the positive attitudes and perceptions displayed by respondents.

The t-test analysis applied to determine the statistical significance between the WTP means for the split sample revealed that, the difference between the two WTP means is statistically significant at 1% level ($t = 6.2673$, $p = 0.000$). This suggests that poultry farming significantly influences household's WTP for improved water supply services. This is because poultry farming heavily relies on water use, which impact on poultry health and performance. In other words, water use differentiated by poultry and non-poultry farming activities, significantly influence households' WTP for improved water supply service.

Double bounded Dichotomous CVM was employed to determine factors that influence household's WTP for the split sample. Household's socioeconomic factors that explain WTP seem to have the appropriate signs based on empirical literature, and most of them are statistically significant in explaining WTP. Findings for the poultry farmers sub-sample indicate that WTP was positively related to the education levels (graduate, high school and secondary school); the number of chicken reared by a poultry farmer (the greater the number of chickens reared, the greater the WTP); the water price charged by water vendors per 20L at alternative water sources (the higher the price charged by water vendors, the higher the WTP); and the gender of the respondent (females were more willing to pay). However, WTP was negatively related to the age of the respondent (the younger the respondent, the higher the WTP).

By contrast, the findings for the non-poultry farmers indicate that WTP was positively related to gender (females were more willing to pay); whether the current water quality is problematic; whether the respondent pays for water at alternative sources; and household's monthly expenditure (the more the household spends, the higher the WTP). Nevertheless, WTP was negatively related to age (the younger respondent, the higher the WTP), household size (the bigger the number of household members, the lower the WTP), and whether the respondent receives enough quantity of water from the main source (respondents that receive enough quantity of water were less willing to pay). It can therefore be concluded that, household's socioeconomic factors have a substantial effect in explaining the household's WTP.

The main conclusion that can be drawn from this study is that households were willing to pay for improved water supply services to change the status quo of water supply services in their localities. Results of this study also make a new contribution to the contingent valuation literature concerning the verification that water uses differentiated by poultry and non-poultry farming activities significantly influence household's WTP for improved water supply services. This is based on the statistically significant difference between the WTP means of the split sample.

5.3 Recommendations and implications for the study

This study has generated sufficient evidence that indicates that the *status quo* of water supply services in Wakiso District is associated with welfare losses which affect poultry and non-poultry farming households. Households portrayed positive attitudes towards a policy that improves the *status quo* of accessing water supply services in Wakiso. Based on the findings, this study makes the following recommendations relevant in designing evidence-based water supply and management policies in Uganda.

The economic values attached to water uses (by poultry and non-poultry farming households) and socioeconomic factors which influence households' WTP for improved water supply services should be incorporated in policies for sustainable use and management of water resources for domestic and agricultural purposes.

The Ugandan government through the NWSC should invest in water infrastructure that improves household's access to water supply services in Wakiso District to meet their demand. This is supported by the positive and significant mean WTP values for the split sample, which are above the current water tariff for domestic water users. The new water supply system should provide uninterrupted good quality water supply service considering the health and economic risks associated with accessing water from distant sources.

Furthermore, NWSC can recover the expenditure for the implementation, maintenance and operation of improved water supply system by charging beneficiaries for water drawn from the system. The study suggests that rates should consider issues of affordability and be guided by WTP value found by this study through consultations with all the relevant stakeholders. Furthermore, charging beneficiaries of improved water supply services to recover costs could

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also be partly motivated by fact that households displayed positive attitudes and perceptions towards improved water supply services. Households also demonstrated their willingness to pay for improved water supply services, above the current water tariff charged by NWSC for domestic water purposes.

Policies geared towards improving households' education level in Wakiso District would shift the demand for improved water supply service to the right, since education level was positively related to WTP. Additionally, households should also be educated to reduce their family size since the smaller the household size the higher the WTP.

5.4 Limitations of the study and areas for further research

The survey considered poultry farming and non poultry farming households from four villages in Nsangi sub-county namely: Nakirama, Kasenge, Kikajjo and Kazinga. The study did not incorporate residents from nearby areas, who might be facing severe welfare losses due to poor water supply services. Therefore, comprehensive studies covering the majority of residents in Wakiso District should be conducted to further understand the benefits households derive from improved water supply services.

This study applied CVM to elicit household's WTP for improved water supply services. Applying Choice Experiment (CE) to generate comparable findings can be considered for future research. Additionally, this study used a double bounded dichotomous probit model to determine household's mean WTP for improved water supply services. Other models, such as the single bounded dichotomous probit model, bivariate probit model and the spike model, to determine household's mean WTP for improved water supply services can be considered for future research.

The WTP values of this study were not compared with estimates from other studies due to lack of studies conducted in a similar context.

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APPENDIX: QUESTIONNAIRE

Department of Agricultural Economics, Extension and rural development

Title of the research: Evaluating the willingness to pay for improved water supply by poultry and non-poultry farmers in Wakiso District, Uganda

Research conducted by	Student number	Contact Numbers
Moses Ssebaggala	17288152	+27812415970 / +256781490224

You are kindly invited to take part in this academic research study to be submitted as a partial fulfilment of the master's Degree Program which is conducted by Moses Ssebaggala from the University of Pretoria, South Africa. The main purpose of this study is to investigate the value each household attaches to the improved water provision in Nsangi sub-county for a sustainable water supply service.

Please note the following:

- Confidentiality is highly respected in this study; therefore, this study is meant to be anonymous survey on which the name of the participant will not appear on the questionnaire and answers will be treated as confidential.
- Your sincere responses are highly appreciated and honoured in this survey. However, you may choose not to participate or stop participating at any time without any frustrations.
- The outcomes of this study will be used for academic purposes and policy formulation and may be published in a journal. The summary of the findings will be provided to you upon request.
- Answer all questions as completely and honestly as you can. This is expected to take few minutes of your time.
- Sign below to indicate that you have read and understood information provided above. This will also indicate your consent in participating in this study voluntarily.

Participant's signature ……...

Date …….

For any questions / clarifications regarding this study, please contact my supervisor,
Dr Selma Karuiahe on email (selma.karuaihe@up.ac.za).

SECTION A: INTERVIWER'S SECTION

This section is to be filled in by the interviewer.

Questionnaire number	
Number of the respondent	
Place of Interview	
Date of Interview	
Starting time of the interview	
End time of the interview	

1.Can we proceed with the interview?

Yes	1	No	0

If NO, proceed to the next HOUSEHOLD as per sample selection.

SECTION B: DEMOGRAPHICS OF THE RESPONDENT

The following questions are requesting for information regarding your household's characteristics, such as gender, age, educational level and marital status.

2. Gender of the respondent?[Please tick what applies]

Male	1	Female	0

3. Age of the respondent?[**in years**]

18-34	1
35-54	2
55 Plus	3

4. Number of people in the household? [Please write the number]

Household size	**Number of people**
Children below 5	
Children below 18	
Adults above 18	

5.What is your relationship with the household head? [Please select what applies].

Relationship to the HH Head	**Code**
Head	1
Spouse	2
Son/ Daughter	3
Relative	4
Worker	5
Others (Specify) ……	6

6. What is your marital status?

Marital status	**Code**
Married	1
Never married	2
Divorced	3
Widow or Widower	4
Separated	5

7. How long have you been living at this present location in the last one year? Please state the number of months…….Months

8. What is your highest level of education?

Education level	**Code**
Graduate degree	1
College diploma/Certificate	2
Advanced level (Senior 5-6)	3
Ordinary / Secondary school level (Senior 1-4)	4
Primary school level (Primary 1-7)	5
None	6

9. What is your economic status in form of employment?

Employment status	Code
Formal employment	1
Informal employment	2
Own business (Specify)……	3
Unemployed	4
Others (specify)……	5

SECTION C:RESPONDENTS' KNOWLEDGE, PERCEPTIONS, ATTITUDES AND OPINIONS ABOUT THE CURRENT WATER QUANTITY

These questions are requesting for your views, opinions, perceptions, knowledge, and attitudes regarding the quantity of water you get from current sources.

Before we ask your views regarding water availability and reliability, we need to know your main use of water, i.e. household consumption, farming, business, etc.

10. Do you use water mainly for household needs or for other business activities, like poultry farming?

Yes (household only)	1
No (other: Specify)	2

11. In the table below, please select the comments that best explain your understanding of the quantity of water you get from the current water sources. Please indicate your level of agreement based on the following statements relating. *Fill in the table below using the following comment codes.*

Statement	**Comment** Strongly agree [1], Agree [2], Neutral [3], Disagree [4], Strongly disagree [5]
a) The quantity of water meets my household's and /or poultry farm's needs	
b) The quantity of water is too much but some water is wasted	
c) The quantity of water is too little due to water shortages	
d) The quantity of water does not meet my household's and / or poultry farm's needs	
e) Water quantity is not a problem but the price	

SECTION D:RESPONDENTS' KNOWLEDGE, PERCEPTIONS, ATTITUDES AND OPINIONS ABOUT FETCHING WATER FROM DISTANT SOURCES

These questions are requesting for your views, opinions, perceptions, knowledge, and attitudes regarding collecting water from distant sources.

12.In the table below, please select the comments that best explain your understanding of the current challenges associated with fetching water away from households or poultry farm. *Fill in the table below using the following comment codes*:

Statement	**Comment** Strongly agree [1], Agree [2], Neutral [3], Disagree [4], Strongly disagree [5]

a) Fetching water from distant sources results in increased water prices	
b) Fetching water from distant sources is associated with health-related problems such as headache, fatigue and chest pain	
c) Fetching water away from homesteads is not time consuming	
d) Fetching water away from homesteads inconveniences household individuals responsible for water collection, such as children and women	
e) Fetching water away from homesteads is associated with long queues at water sources	
f) Walking to collect water is a serious problem	
g) Walking to collect water is not a problem but the queues at water points	

SECTION E:RESPONDENTS' KNOWLEDGE, PERCEPTIONS, ATTITUDES AND OPINIONS ABOUT THE IMPROVED SUPPLY SERVICES

These questions are requesting for your views, opinions, perceptions, knowledge, and attitudes regarding improved tap water supply services.

13. In the table below, please select the comments that best explain your understanding of water supply services by National Water and Sewerage Corporation (NWSC). Please indicate your level of agreement based on the following statements relating. *Fill in the table below using the following comment codes*:

Statement	**Comment** Strongly agree [1], Agree [2], Neutral [3], Disagree [4], Strongly disagree [5]
a) Tap water supplied NWSC is always readily available at all times when people need to use it	
b) Tap water supplied by NWSC is relatively less costly	
c) Tap water supplied by NWSC has no healthy-related risks	
d) Tap water supplied by NWSC relieves people from the burden of water collection far away from homesteads	
e) NWSC can mitigate water supply challenges	

SECTION F: ELICITING THE WILLINGNESS–TO-PAY TO SECURE FUTURE IMPROVED WATER SERVICE

The following section presents a scenario in which water supply accessibility in Nsangi sub-county would be improved, which we believe would lessen the burden on water collection and related health issues.

Currently, accessing distant water sources is associated with numerous challenges. Women and children are burdened with the responsibility of fetching water, travel long distances especially on hilly paths to collect water and normally suffer from health-related illnesses (such as, fatigue and headaches) due to carrying water Jerry-cans on their heads.

Furthermore, where water points are located nearby, queues for water collection are long and unreliable. Ultimately, valuable time for other domestic activities is lost. In addition to this, water vendors charge relatively high-water prices and those who opt for unprotected water sources, such as wells and springs, water is unsafe and limited in supply. Poultry farming, the main agricultural activity in Nsangi sub-county, is adversely affected due to limited water supply. This leads to increased water prices and hence increased poultry production costs, thereby reducing the profits of poultry farmers.

The picture shows that residents queue at water sources and valuable time for other activities is lost

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

Options	Household	Poultry farmer
Yes	1	1
No	0	0

15. Elaborate your answer in (14) above;

……
……

16. Do you agree that accessing water from distant water sources has health and economic consequences?

Options	Household	Poultry farmer

Yes	1	1
No	0	0

17. Elaborate your answer in (16) above?
……
……
……

Following the elevation of Nsangi Sub-county to a Town Council status, the government through the National Water and Sewerage Corporation (NWSC) has proposed a program to extend tap water supply system in Nsangi Sub-county. This program will ensure that a sustainable water supply service is brought closer to the people to mitigate the challenges associated with collecting water from distant water sources. The government is considering passing a bill that will ensure that each household will receive improved and sustainable water supply services. If the bill passes, NWSC will ensure that water is available without interruptions. Any potential water interruptions would be fixed with in I-2 days of reporting. We are conducting this survey to establish if this project means anything to your household and/ or poultry farm. The project will involve improvement in the existing water supply system and the extension of water supply system to new areas; such improvements have been done in other developing countries.

18. In your view, can the government deliver on this program to improve water supply accessibility for Nsangi residents?

Options	**Household**	**Poultry farmer**
Yes	1	1
No	0	0

19. Elaborate your answer given in (18) above?
.....
.....
.....

20. In your view, would the introduction of this program be a good idea?

Options	**Household**	**Poultry farmer**
Yes	1	1
No	0	0

21. Elaborate your answer given in (20) above?
.....
.....

If the project is approved, all the households in Nsangi will be required to pay a specific amount for water used, to ensure that water supply is improved and sustained for a long time to serve all people in Nsangi. The collected money will go to NWSC and it will be used to buy project equipments, payment of contractors and the on-going operation and maintenance of the water supply system. The implementation of this project will affect your household and / or poultry farm budget obligations such as food, transport, school fees, poultry feeds and alike, will be affected. We are conducting a survey to ask how households would respond given an opportunity to improve water supply in Nsangi. We have discovered that some households and/

or poultry farmers will vote for the project while others will vote against it. Those who will vote for it state that the project is worth the money, to guarantee access to potable water supply service and improve the welfare of Nsangi residents. On the other hand, those who vote against it, state that they prefer the existing service and the project is not worth the money. Others state that they cannot afford water charges due to financial challenges.

A

22. Suppose the NWSC officials have estimated that the project will cost each household and / or a poultry farm **Shs.200/- per 20L** Jerry-can of water to implement. Given that all other households will pay the same amount, would your household and or poultry farm vote for the project?

Options	**Household**	**Poultry farm**
Yes	1	1
No	0	0

[If YES to question 22, proceed to question 23, 24 and 25, If NO, proceed to question 26, 27, and 28 or 29].

23. Suppose it turned out that that the true cost is **Shs.250/- per 20L.** Would your household vote for project?

Options	**Household**	**Poultry farm**
Yes	1	1
No	0	0

24. What is the maximum amount your household and or poultry farm would be willing to pay for a Jerry-can of 20L of water collected for the project to be implemented?

	Household	**Poultry farm**

Amount	Shs……	Shs…….

25. What encouraged you to vote for the bill?(**YES VOTE**)

Reason	**Household**	**Poultry farmer**
It will reduce on the distance I travel to fetch water	1	1
I will have enough time for other household and development activities	2	2
I will use water for other income generating activities, such as selling it neighbours, vegetable farming, etc	3	3
I will reduce on the water cost	4	4
Others (Specify)……..	5	5

26. **If NO to question 22**, Suppose it turned out that the true total cost is **Shs. 150/- for a Jerry-can of 20L**, would your household and / or poultry farm vote for the project?

Options	**Household**	**Poultry farm**
Yes	1	1
No	0	0

27. What is the maximum amount your household and or poultry farm would be willing to pay per **20L** of water collected for the program to be implemented?

	Household	**Poultry farm**
Amount	Shs……	Shs……

28.What encouraged you to vote for the bill?(**YES VOTE**)

Reason	**Household**	**Poultry farmer**
It will reduce on the distance I travel to fetch water	1	1
I will have enough time for other household and development activities	2	2
I will use water for other income generating activities, such as selling it to neighbours, vegetable farming, etc	3	3
I will reduce on the water cost	4	4
Others (Specify)…….	5	5

29. Why did you vote against the bill?(**NO VOTE**)

Reason	**Household**	**Poultry farmer**
It is not worth the money	1	1
I cannot afford to pay	2	2
Do not trust the government	3	3
I prefer the existing water sources	4	4
Other reasons (Specify)……..	5	5

SECTION G:HOUSEHOLD POULTRY FARMING INFORMATION

The following questions are about poultry farming and water use, and the general importance of water in farming compared to domestic household purposes.

30. Are you a poultry farmer? Please tick the appropriate box

Yes	1	No	0

If YES, proceed to question 31-39, If NO, proceed to question 40

31.What is the total number of chicken on your poultry farm?

……. Chicken

1. Which type of chicken do you rear?

Type of chicken reared	**Select what applies**
Broilers	1
Layers	2
Both broilers and layers	3
Local chicken	4
Kuroilers	5
Others (Specify)…….....	6

2. How long have been doing poultry farming (in years)?

Between 1-3 years	1
Between 3-7 years	2
Between 7- 12 years	3
Above 12 years	4

3. In your view, does poultry farming require a lot of water?

Yes	1	No	0

4. Do you separate the amount and type of water you use for household needs and poultry farming?

Yes	1	No	0

5. Do you access the same source of water for household and poultry farming?

Yes	1	No	0

6. Do you use different amounts (in litres) for poultry farming compared to domestic household uses?

Yes	1	No	0

7. On average, how many litres of water do use for household and poultry farming per day? Please select one option for each use.

Options	**Household**	**Poultry farming**
0-60 litres	1	1
60- 100 litres	2	2
100- 200 litres	3	3
200- 400 litres	4	4
400- 600 litres	5	5
Over 600 litres	6	6

8. Which one of the following farming activities use more water? Select the best option

Poultry farming	1
Miraa farming	2
Livestock farming	3
Vegetable farming	4
Others (Specify)……	5

SECTION H:ACCESSING WATER AT YOUR HOUSEHOLD AND OR POULTRY FARM

The following questions are asking for your views regarding the way you access water, the distance to the water source, trips you make to the water source and the time you spend in water collection.

9. What is your main source of water for household's domestic activities and or poultry farming?

Water source	**Household**	**Poultry farmer**
Spring	1	1
Public well	2	2
Borehole	3	3
Communal/public tap	4	4
Rainwater collection	5	5
Tap water	6	6
Others (Specify)…….....	7	7

41. In case you fetch water from a source point, what is the size of the Jerry-can / bucket / container you use for fetching water?

Size in Litres (L)	Household	Poultry farm
20 L	1	1
10L and 20L	2	2
5L, 10L and 20L	3	3
Others (Specify)…….	4	4

42.In case you fetch water from a source point, how many Jerry-cans do you carry per round trip on average?

Jerry-cans	
……	Household
……	Poultry farm

43.In the case where you have to walk to collect water for your household and or poultry farm, how far do you walk?

Distance to the water source	**Household**	**Poultry farm**
0-0.5 km	1	1
0.5 – 1 km	2	2
1- 2 km	3	3
Above 2 km	4	4

44. In the case where you have to walk to collect water away from your household and or poultry farm, how long does it take to fetch water from the main water source to your household and or poultry farm?

Time spent in water collection	Household	Poultry farm
Time for queuing	……. Minutes	……. Minutes
Time for walking to and fro	……. Minutes	……...Minutes
Total time	……. Minutes	…….Minutes

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

Trips	
……..	Household
……..	Poultry farm

46. How do you transport water to your home and or poultry farm? **[Mode of transport]**

Mode of transport	Household	Poultry farm
By foot	1	1
By bicycle	2	2
By motorcycle	3	3
By car	4	4
Others (Specify)…….	5	5

47. Who is responsible for fetching water for your household and or poultry farm?

Water collection responsibility by gender	Household	Poultry farm
Mostly men	1	1
Mostly women	2	2
Mostly girls	3	3
Mostly boys	4	4
Others (Specify) ……	5	5

48. In the event that you personally collect water from the source point, do you have a fixed time for collecting water per day?

Options	Household	Poultry farm
Yes	1	1
No	0	0

49. If so, what time do you normally leave your house for water collection and or poultry farm?

Time for water collection	Household	Poultry farm
Morning	1	1
Day time	2	2
Evening	3	3
Morning and evening	4	4

50. What season of the year do you use most water?

Season	Household	Poultry farm
Dry season	1	1
Wet season	2	2
Others (Specify)……..	3	3

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

Queuing at water collection points	Household	Poultry farm
Yes, always	1	1
Yes, usually	2	2
Sometimes	3	3
No	4	4

52. Is the water path / road easy to walk / drive? Please tick what applies

Options	Walk	Drive
Yes	1	1
No	0	0

53. If **NO**, specify why the path is not easy to walk or drive?

Reasons	Easy to walk	Easy to drive
Dark in the evening	1	1
Too uneven	2	2
Too dirty	3	3
Others (Specify)……	4	4

SECTION I: WATER USES

This section has questions regarding water uses for domestic household purposes and poultry farming uses.

54. What domestic household activity and or poultry farming activity uses most water in a typical day? Please select one option.

Household	Options	Poultry farming	options
Bathing / washing	1	Feeding	1
Cooking	2	Cleaning troughs	2
Laundry	3	Cleaning the poultry house	3
Watering the garden/ lawn	4	Ingredient in poultry drugs	4
All the above	5	All the above	5
Others (Specify)……	6	Others (Specify) …….	6

55. What is the most critical water use in your household and / or poultry farm, which would cause most hardships if water were not available? Please select one option

Household	Options	Poultry farm	options
Bathing / washing	1	Feeding	1
Cooking	2	Cleaning troughs	2
Laundry	3	Cleaning the poultry house	3
Watering garden/ lawn	4	Ingredient in poultry drugs	4
All the above	5	All the above	5
Others (Specify)……	6	Others (Specify) …….	6

SECTION J: WATER PAYMENT

The following questions relate to the current price you pay for water.

56. In addition to personal water collection, do you currently pay for the water service?

Options	Household	Poultry farm
Yes	1	1
No	0	0

[If YES, go to 57-58 and if NO, go to 59]

57. If YES, how much do you spend on water service per 20L Jerry-can?

	Household	Poultry farm
Amount	Shs……	Shs……

58. If **YES**, how often do you pay for the water service?

Options	Household	Poultry farm
Daily	1	1
Weekly	2	2
Monthly	3	3

59. If **NO**, why are you not paying for the water service?

……
……
……

60. Do you consider this payment acceptable for the level of the existing service provided?

Options	Household	Poultry farm
Yes	1	1
No	0	0

61. Will you be willing to pay 5% more than the current amount you pay for water usage given improved tap water supply?

Options	Household	Poultry farm
Yes	1	1
No	0	0

62. If you are presently not paying for water usage, will you be willing to shift to improved tap water?

Options	Household	Poultry farm
Yes	1	1
No	0	0

SECTION K: WATER SHORTAGE EXPRIENCE AND MANAGEMENT

The following questions are about your water shortage experience and management

63. Has your household and/ or poultry farm experienced water supply shortage at your current water source point in 2018?

Options	Household	Poultry farm

Yes	1	1
No	0	0

64. If YES**,** which month did the most recent water supply shortage take place? Please state the Month.

	Household	**Poultry farm**
Month	…….	…….

65. The last time your household and/ or poultry farm experienced water scarcity, how long did it take? Please fill in and tick the appropriate option.

Options	**Household**	**Poultry farm**
Weeks …….	1	1
Days ……	0	0

66. Do you believe that your household and/ or poultry farm will face a similar problem in future?

Options	**Household**	**Poultry farm**
Yes	1	1
No	0	0

67. In times of water supply shortage, which alternative water source does your household and or poultry farm opt for? Please select the best option that applies

Alternative water sources	**Household**	**Poultry farm**
Water vendors (Bicycle / public tap vendors)	1	1
Wells/ Springs	2	2
We buy from water trucks	3	3
Others (Specify)……	4	4

68. How much time does it take you to make one round trip to f etch water from the alternative source? Please fill in either minutes or hours

Options	**Household**	**Poultry farm**
Minutes ……...	1	1
Hours …….	0	0

69. Do you pay for water access from these alternative sources? Please select what applies.

Options	**Household**	**Poultry farm**
Yes	1	1
No	0	0

70. If **YES**, how much do you pay per 20 litres (L) of water from this source?

	Household	**Poultry farm**
Amount	Shs……	Shs……

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

Water quality	**Household**	**Poultry farm**
Very good	1	1

Good	2	2
Poor	3	3
Very poor	4	4
Not sure	5	5

72. Would you be willing to use piped tap water for your domestic household and/ or poultry farming activities?

Options	**Household**	**Poultry farm**
Yes	1	1
No	0	0

SECTION L: WATER CONSERVATION AND MANAGEMENT

These questions request for information regarding water management and conservation in your households and/ or poultry farm.

73. As a principle of water management, do you store water at your household and/or poultry farm?

Options	**Household**	**Poultry farm**
Yes	1	1
No	0	0

If „YES" proceed to 74 and 75, if „ NO" proceed to 75.

74. What is your household's and or poultry farm's water storage capacity?

Water storage capacity	**Household**	**Poultry farm**
20L Jerry-can (s) …….	1	1
Water Tank ……(L)	0	0

75. What is the reason for not having a private water connection?

Reasons	**Household**	**Poultry farm**
Not wanting the service	1	1
Inability to pay connection charges	2	2
The service is expensive	3	3
The service is not available	4	4
Other reasons (specify)……	5	5

SECTION M: QUALITY OF WATER USED BY HOUSEHOLDS AND OR POULTRY FARMERS

These questions relate to the quality of water used by the household and or poultry farms and the problems encountered by water users.

76. Do you have a problem with the quality of water you get from your main water source?

Yes	1	No	0

77. What do you think is the problem?

The problem	**Household**	**Poultry farm**
Long distance to the water sources	1	1
Cost implications	2	2
Health complications	3	3

Taste	4	4
Colour	5	5
Others (Specify) ……	6	6

78. If the quality of water is very poor to the extent that it's not safe for drinking, what do you do to make it drinkable for people living in your household and / or chicken?

Options for making water drinkable	**Household**	**Poultry farm**
Boiling the water before using it	1	1
Leaving the water to settle before drinking it or giving it to chicken	2	2
Purifying the water	3	3
Others (Specify)……..	4	4

79. If water quality is not a problem, do you get the right quantity of water? Please select one option.

Always	1	Sometimes	2	Most of the time	3

80. How do you rank the quality of water you receive from the main water source? Please select one option

Poor	1	Fair	2	Good	3	Excellent	4

SECTION N: HOUSEHOLD FINANCIAL INFORMATION

These questions relate to your household financial status.

81. What is your household average monthly income?

Average monthly income (Shs.)	**Select what applies**
0-500,000	1
500,000 – 1, 200, 000	2
1,200,000- 2,500, 000	3
2, 500, 000- 5,000, 000	4
Above 5, 000,000	5

82. Type of your house?

House type	**Select what applies**
Brick wall, tiled roof	1
Brick wall, corrugated roof	2
Mud wall, corrugated roof	3
Mud wall, thatched roof	4
Others (Specify)……	5

83.What is the monthly expenditure for your household on each of the following items? Please fill in the amount.

H/H Monthly expenditure	**Amount (Shs.)**	**Selected options**
Electricity		1
Food		2
Housing		3

Transport		4
Water		5
Airtime		6
School fees		7
Others (Specify)……		8
Total (Shs.)		

84. What is the nature of your house tenancy?

Own	1
Rental	2
Free	3
Others (Specify) ……	4

85. If you voted for this program, considering your income and expenditure, do you think your household and/ or poultry farm would be able to afford to pay for household basic needs and /or poultry farm production costs, such as food, clothes, water and/ or poultry feeds upon implementation of this program?

Yes	1	No	0

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

Economic Situation	Select what applies
We have enough money to pay our necessities and can also manage to buy durables	1
We can afford food, public utilities and pay for school fees but cannot afford to buy durable goods like fridge, tv, sofa set, a car, etc	2
We can meet the expense of food and public utilities, but it is problematic to pay for transport and school fees	3
We have money for food but cannot manage to pay for public utilities to pay for transport and school fees	4
We have no money even for food	5

87. Do you think your household affords basic needs like food and water?

Yes, always	1
It is sometimes difficult	2
No	3

END OF THE INTERVIEW, THANK YOU FOR PARTICIPATION

SECTION O: ASSESSMENT OF RESPONDENTS (INTERVIWER'S SECTION 11)

(This section is to be filled in by the interviewer).

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

88. In your own opinion did the respondent understand all the questions? Rank the following level of understanding by putting numbers (5, 4, 3,2,1). Understanding is ranked in descending order. 5 means that the respondent understood the questions very well and 1 means that questions were not well understood.

a) Very well understood []b) well understood []c) understood []
d) did not understand []e) not well understood []

89. Where there questions that were complicated to the respondents?

a) Yes [] b) No []

What was the problem? (Please specify)

……
……

90. 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 []

91. How do you rank the reliability of the responses given to you by the respondents? Please put numbers on the following for ranking respondents starting with 5 for high rank

a) Very reliable []b) moderately reliable []c) reliable []d) not reliable []e) not reliable at all []

92. What are the reasons for not being reliable? Specify……
…….....
……..

DECLARATION BY INTERVIEWER TO BE DONE AFTER THE INTERVIEW

I declare that I have checked my work regarding the above module and that I am confident that it truly reflects the information given by representatives of this household and that the quality of my work is the best possible.

Date	D	D	M	M

Interviewer's Name | | Signature | |

Time ending:

……THE END …….