UNIVERSITY OF CAPE COAST

WILLINGNESS TO PAY FOR SEWAGE TREATMENT SERVICES IN THE ASHAIMAN MUNICIPALITY

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BY

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the results of my own original research and that no part of it has been presented for another degree in this University or elsewhere.

Candidate's Signature…… Date …..……

Name: Bennett Bart Ansah

Supervisor's Declaration

We hereby declare that the preparation and presentation of this thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Supervisor's signature……..... Date …..……

Name: Dr. Joshua Sebu

Supervisor's signature……..... Date …..……

Name: ……..……...

ABSTRACT

Waste is inevitable as far as productivity, growth and development is concerned. However, the continuous increase in waste generation becomes very challenging and poses treat on sanitation, health and wellbeing of people. Following the positivist research philosophy and quantitative approach to research, the study seeks to investigate willingness to pay for sewage treatment services in the Ashaiman Municipality. The Contingent Valuation Model explains the value that individuals place on public goods, services, or environmental changes that have no market price was adopted in the study. The study used the logistic regression model in estimating the drivers of households' heads choice for the type toilet facility and willingness to pay for sewage treatment services (objectives 1 and 2). The study continued the contingent valuation model following the Newey, Lagrange and Cameron non-linear regression technique in estimating how much households' heads will in are willing to pay for sewage treatment services (objective 3). The study found that age, tenancy status, education level, gender and household dwelling unit significantly affect the drivers of households' heads choice for the type toilet facility. Whereas age, choice of toilet facility, household income, employment status and improve farming significantly affect willingness to pay for sewage treatment services. Lastly, the study concluded that majority of the people living in the Ashaiman Municipality were willing to pay an average amount of approximately GhȻ 25 on annual basis for sewage treatment services.

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DEDICATION

To my late Grandma (Martha Ansah)

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LIST OF ABBREVIATIONS

WTP - Willingness-To-Pay

STS - Sewage Treatment Services

STP - Sewage Treatment Plant

CEM - Choice Experiment Method

CV - Contingent Valuation

CVM - Contingent Valuation Model

CHAPTER ONE

INTRODUCTION

Introduction

This chapter consists of the background to the study, problem statement, research objectives, significance of the study, delimitation of the study, limitations of the study and the organisation of the study. The study explored willingness to pay for sewage treatment which is one major component of waste generation in every country. Waste generation is familiar in the Ghanaian economy however many studies focused on solid waste leaving only few works on liquid waste. Given the many negativities associated with liquid waste, this study provides insightful thought and contribute to indebt knowledge on the dynamisms of sewage management.

Background to the Study

Waste generated around the world keeps increasing at a very high rate. (World Bank, 2012; UNEP, 2015). The Sustainable Development Goal's (SDG) 3 – Good Health and Well-being, 6- Clean Water and Sanitation and 14 – Life Below Water are in line to achieve efficient waste management due to high rate of waste generation. The continuous increase in waste generation has become a very serious challenge drawing the attention of governments of many countries. The high rate of waste generation according to Omosa et al. (2012) can be attributed to population growth, increase in human's daily activities and the application of technology. Urban areas are notable for large amount of waste generation due to huge

population and many day-to-day activities. The problem of waste is greatly felt during the raining seasons. Example, flood caused by the overflow of sewage due to choke drainage systems and disposal of waste into open space. This further causes environmental pollution and health disorders.

According to Padi, Addor and Nunfam (2015) waste generation is estimated to rise to 2.2 billion tons by 2025. They further showed that cities across the world generate 1.3 billion tons of waste annually and this is expected to rise to 3.4 billion metric tons by 2050 with estimated deaths ranging between 400,000 and 1 million in developing countries on annual basis. As cited in Trang (2018), WHO (1997) found that Over 12 million people were killed in a year due to water shortages, polluted water and unsanitary living conditions and this affirms the study conducted by Padi, Addor and Nunfam in 2015.

Africa's population as of 2017 was estimated to 1.3 billion (UNDESA, 2017), with population growth rate of 2.51 percent in the periods 2000 to 2015 (UNDESA, 2019), the population of Africa is expected to be 1.7 billion by 2030 (UNDESA, 2017; 2019). Thus, 48.4 percent of the population will be living in the urban areas. Considering the fact that urbanization, increased economic activity and population growth will result in increase in consumption and thereby increase in discharge wastewater (Omosa et al., 2012), waste generation will be on a rise. According to Strande (2014), over 80 percent of the population in sub-Saharan Africa depends on septic tanks and pit latrines, these frequently fill up, and the choices are to either dig new pit latrines and abandon the current ones, or to empty and repurpose the current ones.

In the context of Ghana, Immurana et al. (2022) found that 12,710 tonnes of solid waste are generated on daily basis. Each household generated an average of 0.47 solid waste per day.

Nevertheless, countries have attached a great sense of humour to sustaining and developing an environment that can accommodate healthy living of humans, plants and animals and as well renew its natural resources, yet according to United Nation (2018) 3 out of 10 people lack good drinking water. Thus, 13% of the world's population lacks basic level services of drinking water (United Nation, 2018).

The World Bank estimates that high-income nations spend about $100 per ton on waste management services, compared to underdeveloped nations' $35 per ton cost. Decision-makers in emerging nations were primarily faced with issues related to growing urbanization and dysfunctional environmental sanitation infrastructure and services as a result of insufficient resource mobilization. Therefore, the local communities, private sector and developmental partners must be brought on board in the delivery of effective waste management services. The choice of communities to support and afford garbage management, however, varies from nation to nation.

A study conducted in Nepal showed that 61% of households supported the idea of waste management and were willing to pay USD 0.72 on monthly basis and in Nigeria, 80% of households supported the idea of residential waste management (Kaso et al., 2022). In Dar es Salaam, the capital of Tanzania, according to Reuter and Velidandla (2017) Gulper technology was introduced where faecal sludge is

transported to Sewage Treatment Plant (STP) sites using tricycles and other small vehicles. Profit of USD 14 is made on daily basis per tricycles or vehicles after operation cost, dumping cost and fuel is deducted.

In Ghana, there are established waste management policies aimed at improving environmental sanitation. These include; Environmental Assessment Regulations, 1999 (LI 1652), Criminal Code, 1960 (Act 29), Water Resources Commission Act, 1996 (Act 522) and Pesticides Control and Management Act, 1996 (Act 528). In ensuring its effectiveness, Ministry of Health, Ministry of Local Government and Rural Development, Ministry of Environment, Science and Technology and Environmental Protection Agency have established guidelines and standard for waste management at district level. These ministries and agencies through the various districts set up environmental assessment regulations, environmental education and awareness programmes as well as monitoring environmental quality so as to ensure effectiveness.

However, Ghana over the years has suffered from waste management problem and this is still a problem currently especially in Accra, as its capital town. Many lives and properties have been lost in Accra due to flooding yet no concrete solution has been put up to curb the situation. Example is the June 3rd disasters which happened in 2015 taking the life of over 150 people and also leaving hundreds of people suffering from severe burns (One Ghana Movement, 2023). According to One Ghana Movement (2023), the occurrence was attributed to blockage of water ways as an outcome of human activities.

To avert the potential dangers associated to human health and the environment, Sewage Treatment Services are generally established for such purpose. Attempting to solve waste crisis, Ghana government, private individuals and other stakeholders have come on board with ideas to curb or reduce the problem. The use of treatment plant also requires financial assistance in order to keep the plant running to produce the expected output. The rising cost of operating the plant and other related sanitation services requires that individuals in the locality pay for the services provided. But as to whether individuals will be willing to pay for the services rendered is yet to be known. Reports has shown that some truck operators in Ghana dispose of sludge directly into the or environment into manholes leading to sewage treatment plants such as the sea, to avoid the costs to be incurred at treatment plants (Murray et al., 2011, Obeng et al., 2015).

In achieving a disease free and healthy environment resulting from waste generation, individuals directly involved in the waste generation have a role to play, since they are key contributors to the escalating problem. They are the main component in the waste generation process and in the same way they are key in curbing the situation due to their impact on the environment and health. For this, individuals' perception level on waste management practices should be a priority to focus on so as to ensure a healthy environment and protection of public health.

Statement of the Problem

Waste generation is one of the causes of environmental pollution and Ashaiman in the case is not an exception. Ashaiman currently is faced with rapid

waste generation. The waste has accumulated over the years to become huge and it is still growing on daily basis. The rate of increment in waste was very alarming that it drew the attention of government and other related stakeholders to come to their rescue due to environmental pollution such as direct waste disposal into rivers, open drains and streams as well as health risks such as typhoid, dysentery and cholera. Therefore, government together with stakeholders set up a STP in the Ashaiman municipality to address the problem of inadequate sanitation and untreated wastewater. Prior to the construction of the plant, most households and businesses in the area discharged their wastewater directly into nearby streams, rivers, and open drains, causing environmental pollution and public health risks.

This untreated wastewater contained high levels of organic matter, nutrients and pathogens, which could cause waterborne diseases such as typhoid, cholera and dysentery. The discharge of untreated wastewater also contributed to the degradation of aquatic ecosystems and posed a threat to the health and livelihoods of people who depended on these ecosystems for fishing and other activities. The STP was therefore established as a solution to these problems. It provides a centralized system for the collection, treatment, and safe wastewater disposal, which helps to reduce pollution and protect environmental and public health.

Nevertheless, the continuous increase in population has affected environmental sanitation services cost and requires huge amount of money. The amount of money spent by government on sanitation services keeps rising. This expenditure has grown to the extent that government is now indebted to some private business with which they partnered. In India cities for instance, empirical

studies have shown that the government through IPAL charges IDR 100.00 per month per household and government again provides a subsidy of IDR 50.00 per household (Djayasinga, 2021). This idea of involving individual who generate waste in waste management is fantastic, but it remains unknow whether these individuals will be willing to take part.

Considering Ashaiman with about 25% and 50% its population being involved in no economic activity and self-employed activity with no employees respectively, there is uncertainty (PHC, 2021). The study aims to determine whether the people in the Ashaiman Municipality would be willing to pay for the operation cost of the STP to keep the plant running, forming the ultimate basis of this research.

Nevertheless, most studies in Ghana have looked at waste management but, they focused more on willingness to pay for solid waste whereas few works have covered willingness to pay for sewage or liquid waste treatment services at household level. For instance, Alhassan and Boateng (2017) investigated households' willingness to pay for improved solid waste management service in the Tamale Metropolitan Area and found that households were influenced by the sex, age, marital status, education as well as income and were willing to pay GH₵ 2 to GH₵ 25 per month for solid waste services.

Again, Immurana et al. (2022) investigated financial inclusion on the choice of solid waste disposal method among households in Ghana. and found that financial inclusion raises the chances of households to opt for the collection process

of solid waste disposal in relation to public dumping, burning and undiscriminating disposal of solid waste.

However, the study therefore seeks to address willing to pay for sewage treatment services (STS's) and its implications in the Ashaiman Municipality. The emanating problems in the area leads to the formulation of the following key question: What extent is the household willingness to pay for sewage treatment services in the Ashaiman Municipality?

Purpose of the Study

The purpose of the study is to investigate willingness to pay for sewage treatment services in the Ashaiman Municipality.

Research Objectives

Specifically, the study will seek to:

1. examine the drivers of household heads' choice for the type of toilet facilities in the Ashaiman Municipality.
2. examine household heads willingness to pay for sewage treatment services in the Ashaiman Municipality.
3. identify how much household heads in Ashaiman Municipality are willing to pay.

Research Questions

The objectives of the study seek to answer the following research questions:

1. What are the drivers of household heads' choice for the type of toilet facilities in the Ashaiman Municipality?

2. Are household heads willing to pay for sewage treatment services in the Ashaiman Municipality?
3. How much are household heads in Ashaiman Municipality willing to pay?

Significance of the Study

The study's findings will contribute greatly in enhancing improvement in waste management services by serving as a source of education in the implementation of effective remedial measures in solving the problems associated environmental pollution. The study's findings will also be used as a reference material to resort to in formulating environmental protection policies and programmes. Further, the study will help the improvement in public health which arose from contaminated water and again add up to existing knowledge for further studies to be conducted. Lastly, findings of the study will help in terms of employment since, the STP will need people to operate and maintain it, for it to serve it purpose.

Delimitations

The study is focused on investigating willingness to pay for sewage treatment services in the Ashaiman Municipality in Ghana. The study would reveal the perception of households on sewage treatment services and well as their stances, if there is the need to make any monetary contribution.

Limitations

The following are established limitations of the study. To begin, the study was restricted to Ashaiman municipality in Ghana. Its finding may not be applicable in other place or generalized to reflects the whole country. Moreover, the study employed a cross-sectional approach meaning any change in the perception of a respondent over time will not be catered for. Furthermore, due to data limitations, the project average amount for willingness to pay may fluctuate thus, preventing a comprehensive capture WTP.

Organisation of the Study

The study is group into five main chapters. Chapter one addresses the background story of the study, the statement of the problem, the research objectives, the significance of the study, delimitation of the study, limitations of the study and the organisation of the study. Chapter two focus on the theoretical review, an overview of willingness to pay, characterization and composition of sewage, stages of sewage treatment at the plant site, challenges of managing sewage, empirical review and conclusion. The chapter three concentrates on the research design; data sources and type; econometric specification and estimation techniques; empirical specification of logit model; empirical specification of average amount WTP; variable description and expected sign; post analytical test; data processing and analysis; and chapter summary.

CHAPTER TWO

LITERATURE REVIEW

Introduction

Theoretical literature as well as empirical literature related to the problem of the research work are reviewed in this chapter. The theoretical literature captures existing concepts, perceptions, idea and problems in relation to sewage treatment services (STS). The empirical literature on the other hand, captures studies by other institutions, departments and researchers in the field sewage treatment services. The chapter further reveals the gap that the study aims at solving.

Theoretical Review

This section focused on reviewing theories related to this study. Thus, some economics related theories implemented in STS was evaluated in this section. The theory followed in the subsection is utility theory.

Theory of Consumer Behaviour (Utility Theory)

The utility theory is a cornerstone concept in economics elucidating individuals' preferences and decision-making rationale. Utility theory, rooted in the seminal works of Bentham and further refined by von Neumann and Morgenstern, posits that individuals strive to maximize their overall satisfaction when making consumption choices (Bentham, 1789; von Neumann & Morgenstern, 1944; Varian, 2014). The von Neumann-Morgenstern utility function stands prominent, capturing individuals' ordinal preferences over different consumption bundles (Mas-Colell et al., 1995). Thus, it provided a lens through which to understand how

individuals assign subjective values to different goods and services based on their perceived utility. The crux of utility theory often materializes in utility functions, serving as mathematical representations of individuals' preferences. It is conventionally expressed as:

$$U(x_1, x_2, x_3 \dots x_n) \dots\dots\dots\dots\dots\dots (1)$$

where $x_1, x_2, x_3 \dots x_n$ delineate different goods or services consumed, and U symbolizes the utility derived from such consumption.

In the realm of WTP for STS, utility theory furnishes a robust framework that serves as a powerful analytical tool for unravelling the intricate interplay between individuals' preferences, resource allocation, and societal welfare. By conceptualizing individuals as rational agents seeking to optimize their utility, utility theory offers a framework for assessing the economic value individuals place on sewage treatment services and the factors influencing their willingness to pay for such services. Therefore, the utility function can be formulated to incorporate pertinent factors influencing individuals' utility, such as the quality and quantity of sewage treatment, income levels, and environmental concerns. This is captured through the function:

$$U(STS) = f(Q_l, Q_n, I, E) \dots\dots\dots\dots\dots\dots (2)$$

where STS represents sewage treatment services, Q_l and Q_n connote the quality and quantity of sewage treatment, I signifies income, and E denotes environmental considerations.

Deriving individuals' WTP for STS entails harnessing the concept of marginal utility, quantifying the additional utility gained from consuming an extra

unit of a good or service. Mathematically, marginal utility (MU) represented as the derivative of the utility function with respect to the quantity of sewage treatment:

$$MU = \frac{dU}{dQ_n} \dots\dots\dots\dots\dots\dots (3)$$

WTP, in turn, can be discerned from the marginal utility employing the principle of price elasticity of demand PED, gauging the responsiveness of quantity demanded to variations in price. WTP is typically computed as the price of sewage treatment services multiplied by the quantity demanded Q divided by the price elasticity of demand:

$$WTP = P * \frac{Q}{PED} \dots\dots\dots\dots\dots\dots (4)$$

However, WTP in this study would involve investigating how consumers perceive the benefits of improved sewage treatment in terms of environmental preservation, public health, and overall quality of life. By eliciting individuals' WTP, the study could uncover insights into the perceived utility of cleaner water systems and the extent to which consumers are willing to allocate their budgets for such services. Moreover, WTP considers diminishing marginal utility which is likely to reveal that early increments of improved STS might be valued more significantly than later ones (Kahneman et al., 1979). Therefore, WTP in this context was used to ascertain how much people were willing to pay for sewage collection services as well as recycling services.

Choice Experiment Method (CEM)

Given a set of hypothetical choices, the Choice Experiment Method (CEM) attempts to bring out the willingness to pay (WTP) for the use of natural resources. As a result, these resources have comparable features but at different degrees, requiring an individual to make a decision. Choice experiment according to Garrod and Willis, (1999) is contingent valuation approach anchored by the random utility theory and Lancaster's characteristic theory of value which states that, the worth of an item is decided by features that make up the whole. As a result, the CEM aims to value each of the features of a specific environmental resource or item by offering customers with various options of attributes with varying levels of satisfaction. The consumer has the choice of maintaining the status quo or selecting an option. An examination of the trade-offs between choices therefore aids in determining customers' WTP. The CEM is helpful since it provides important information about an environmental good through its qualities and also reflects real-life consumer decision making.

Overview of Willingness to Pay

Techniques of valuation based on willingness to pay (WTP) are typically used to assess the effects on the wellbeing of people and the environment. According to the argument made by Freeman, Herriges, and Kling (2014), the value of the decreases in the likelihood of mortalities or morbidities should be determined by the price that individuals are willing to pay to accomplish those decreases. WTP essentially offer monetary measures that can be added to or used in conjunction

with a benefit-cost analysis for environmental health. WTP is a measure of the "strength of preference" for or value of, a good or a service, according to Donaldson (1999). Morris, Delvin and Parkin (2012) demonstrate that the extreme ideas associated with Austrian economics, which contend that choices made in the real market have significance to economic analysis, usually conflict with the theoretical underpinning of stated preference, which is psychological.

However, the majority of economists believe that if geared toward the objectives of economic study, stated preference or willingness to pay is an acceptable strategy. Understanding an individual's WTP is crucial because the preferences they express can guide managers in determining fair rates for non-market environmental services provided. As a result, WTP becomes more appropriate for capturing such non-market advantages.

Composition and Characterisation of Sewage

Sewage is a complex blend of different pollutants which encompasses domestic, industrial, and commercial sewage, often containing organic matter, nutrients (such as nitrogen and phosphorus), heavy metals, pathogens, nutrients, small particles and emerging contaminants that poses serious threat to human health and the environment. (Okoh & Sibanda, 2013; Brown et al., 2017; Martinez et al., 2019). The characterization of these constituents' aids in assessing the potential environmental hazards associated with untreated sewage discharge, which can contaminate water bodies and soil, leading to ecosystem degradation and health risks (Chen et al., 2015; Singh et al., 2018). This understanding of sewage

composition contributes to establishing the urgency and necessity of effective sewage treatment services, thus influencing individuals' WTP for cleaner and safer environments.

In the context of WTP for sewage treatment services, studies examining sewage composition offer valuable insights. By quantifying the contaminants present in untreated sewage and highlighting the risks they pose, researchers can elucidate the direct and indirect benefits of sewage treatment (Kumar et al., 2021; Zhang & Smith, 2019). Consequently, understanding the potential positive externalities of sewage treatment, such as reduced water pollution and improved public health, can influence individuals' perceived value and willingness to pay for these services. Furthermore, information about sewage composition aids in designing efficient treatment processes that address specific contaminants, contributing to cost-effective and tailored sewage treatment solutions that resonate with consumers' preferences and justify their WTP (Jones & Green, 2022; Wang et al., 2020).

Stages of Sewage Treatment at the Plant Site

The treatment process involves a sequence of carefully designed steps aimed at reducing the environmental impact of sewage and ensuring public health. The initial stage in sewage treatment typically involves preliminary processes such as screening and grit removal, aimed at removing larger debris and particles from the sewage. This is followed by primary treatment, where settling tanks allow solid particles to settle at the bottom, forming sludge, and oils and greases rise to the

surface, which are subsequently removed. Secondary treatment involves biological processes where microorganisms break down organic matter, ensuring a substantial reduction in pollutants. Lastly, advanced treatment techniques, which include disinfection through methods like chlorination or ultraviolet irradiation, target the removal of pathogens and further reduction of contaminants.

A study by Zhang et al. (2019) exemplifies this link by demonstrating how improved sewage treatment positively correlates with decreased waterborne bacterial pathogens, thereby providing insights into the tangible benefits of enhanced treatment. As each treatment stage contributes to the overall quality of the service and its subsequent benefits, individuals' WTP is inherently linked to their understanding and perception of the effectiveness of the sewage treatment process.

Challenges of Managing Sewage

Managing sewage treatment services encompasses a myriad of challenges that have significant implications on WTP. The effective management of sewage treatment services involves addressing multifaceted technical, financial, environmental, and social hurdles that can directly influence individuals' willingness to pay for such services. One of the prominent challenges is the complexity of treatment processes required to ensure safe disposal and minimize environmental impacts. The intricate nature of sewage treatment demands advanced technologies, skilled personnel, and consistent maintenance to guarantee efficient operations. These complexities can influence perceptions of service

quality, thereby shaping individuals' willingness to pay. Adzawla and Jongare (2020) conducted a study that illustrates how perceived service effectiveness and reliability significantly impact WTP, highlighting the importance of effective management in driving consumer value perception.

Financial challenges are also paramount in sewage management. The costs associated with infrastructure development, operation, and maintenance can be substantial, influencing service pricing and ultimately affecting individuals' willingness to pay. Limited resources, competing priorities, and budget constraints at both the household and governmental levels can hinder the affordability of sewage treatment services. This financial strain might lead to lower WTP, especially among marginalized communities with limited disposable income. For instance, the research by Mazeau et al. (2014) underscores that affordability remains a crucial factor in influencing WTP for shared toilet facilities, indicating the substantial impact of financial considerations on individuals' valuation of sanitation services.

Furthermore, managing sewage treatment services necessitates effective governance and stakeholder coordination. Regulatory frameworks, policies, and institutional structures play a pivotal role in ensuring proper sewage treatment practices. However, the complexity of managing sewage treatment systems often involves various stakeholders with differing priorities and interests. Coordinating these stakeholders, including local authorities, service providers, and the community, can be challenging, potentially affecting the quality and reliability of services. In the context of WTP, a lack of perceived accountability and coordination

might undermine individuals' confidence in service delivery, subsequently impacting their willingness to pay. Understanding these challenges and their implications for service quality is vital for designing effective policies and strategies that not only enhance sewage treatment but also bolster individuals' perceived value and willingness to contribute financially.

Complex treatment processes, financial constraints, and stakeholder coordination issues can directly impact individuals' perceptions of service quality and their willingness to allocate funds for these services. Recognizing and addressing these challenges is essential for developing sustainable sewage management solutions that align with individuals' preferences and ensure the effective delivery of essential environmental services.

Empirical Review

This section the chapter highlights existing works related to households' choice of toilet facilities and willingness to pay for sewage treatment service. The chapter further review empirical literature to capture willingness to pay, the significance of willingness to pay and factors that affects willingness to pay for sewage treatment services.

Choice of Toilet Facility

Adzawla and Jongare (2020) conducted a study on socioeconomic and housing characteristics on the choice of toilet facilities among Ghanaian households using multinominal logistic regression. Their results showed that in Ghana,

majority of the households used enhanced toilet facilities (KVIP, WC and pit latrines with slab) and over one-fourth of households were involved in open defecation. They found that choice of toilet facilities was significantly influenced by age, gender, education and type of dwelling unit of the household.

Mazeau (2013) and Mazeau et al. (2014) delve into the usage, implementation and acceptability of shared toilet facilities urban Ghana specifically Ashaiman. Their study added a user-centric layer to the discourse, encapsulating the intricate blend of cultural preferences and pragmatic considerations that influence facility usage. Their findings emphasize the pivotal role of accessibility, affordability, cleanliness, and privacy in shaping household decisions. The salient impact of social norms and hygiene perceptions elucidates the complex interplay of cultural elements in determining sanitation practices.

Tiimub et al. (2009) pivot their focus towards the Bawku East District, highlighting the provisioning, patronage, quality and the management of toilet facilities. Their research accentuates the particulars associated with maintaining sanitation facilities, spotlighting concerns such as availability, maintenance and overall service quality. Their work underscores the imperative of not solely providing functional infrastructure but also fostering its consistent functionality.

The confluence of studies (Mazeau, 2013; Mazeau, Reed, Sansom, Scott, 2014; Tiimub et al.,2009; Mazeau, 2013; Adzawla & Jongare, 2020) collectively provides an encompassing panorama of the factors shaping household decisions pertaining to households' choice of toilet facility within urban areas in Ghana. The studies coalesce to enrich the understanding of the multifaceted dimensions leading

to households' sanitation preferences and practices while simultaneously offering comprehensive insights into refining sanitation infrastructure and behaviours in the country.

Willingness to Pay for Sewage Treatment Services

Munusami et al. (2016) conducted a study in Malaysia to estimate households' willingness to pay for wastewater treatment service improvement. They found that income, education, and perception of wastewater pollution significantly influenced households' willingness to pay for wastewater treatment service enhancement. They used the contingent valuation method (CVM) to estimate the WTP for the improvement of wastewater treatment services. Their result showed that the average WTP was RM 5.10 per month per household, indicating that households were willing to pay for improved services.

Similarly, Trang et al. (2018) conducted a study in Vietnam to examine households' willingness to pay for wastewater treatment in traditional agro-food processing villages. They also used the CVM method to estimate WTP for wastewater treatment services. Their results showed that income, education, and perception of wastewater pollution significantly influenced households' willingness to pay for wastewater treatment. They suggested that increasing awareness of the environmental and health impacts of wastewater pollution could increase households' willingness to pay for wastewater treatment services.

Both Munusami et al. (2016) and Trang et al. (2018) studies found that income, education, and perception of wastewater pollution were significant factors

affecting households' WTP. However, the studies were conducted in different localities, with different cultural, economic, and social contexts. Nevertheless, Whittington et al. (1993) looked at household sanitation in Kumasi focusing on attitude, practices and perception and found that only 10 percent of the waste generated (25,000 cubic meter per month) was removed out of the city. Therefore, the findings may not be directly comparable.

Moreover, Chopra and Das (2019) conducted a study in New Delhi, India, using a contingent valuation approach to estimate households' willingness to pay for wastewater treatment. The study found that income, education, and awareness of the health and environmental impacts of wastewater pollution significantly influenced households' willingness to pay for wastewater treatment services. The study by Chopra and Das (2019) affirmed the findings of Munusami et al. (2016) and Trang et al. (2018) in terms of factors persuading households' willingness to pay for wastewater treatment services. They suggested that increasing awareness of the environmental and health impacts of wastewater pollution could increase households' willingness to pay for wastewater treatment services.

On the other hand, Petcharat et al. (2022) investigated the attitudes of local residents towards water onion habitat conservation in Thailand. Their finding differ from that of Munusami et al. (2016) and Trang et al. (2018) since the residents were more willing to volunteer than to pay for conservation efforts.

Additionally, Demirbas et al. (2017), Zhang et al. (2022) and Chopra and Das (2019) concentrated on the technical and economic parts of sewage treatment, rather than households' willingness to pay for the services. Demirbas et al. (2017)

found the amount of sludge generated by STP's depends on the type of treatment process used and that sludge can be used as a source of energy to reduce greenhouse gas emissions. However, while Demirbas et al. (2017) proposed using sludge as a source of energy to reduce emissions, Zhang et al. (2022) suggested a range of measures, including energy efficiency improvements, renewable energy generation, and carbon offsetting, to achieve carbon neutrality.

Djayasinga (2021) and Jiao et al. (2022) both examined households' willingness to pay for sewage treatment services. They both discovered that households' willingness to pay was significantly impressed by their income and education levels. Djayasinga (2021) further found that public awareness campaigns and financial assistance programs could increase households' willingness to pay for wastewater management services. Jiao et al. (2022) suggested to policymakers to consider income, education, and perception of water pollution when designing policies related to rural sewage treatment. Therefore, policymakers may consider implementing financial assistance programs and awareness campaigns to encourage willingness to pay for sewage treatment services among households. They may also consider tailoring policies to the specific socioeconomic characteristics of the population they serve.

Kaso et al. (2022) and Mustapha et al. (2022) examined households' willingness to pay for better-quality waste management practices. Kaso et al. (2022) found that the majority of households were willing to pay for improved services and that income, education, and occupation were significant factors affecting households' willingness to pay. Mustapha et al. (2022) found that access to financial

services significantly influences households' choice of solid waste disposal methods. He concluded that policymakers should consider tailoring waste management policies to the specific socioeconomic characteristics of the population they serve, ensuring that financial services are widely accessible to households.

From the literature, Alhassan et al. (2017), Chopra and Das (2019), Le and Aramaki (2019), Byambadorj and Lee (2019), Djayasinga (2021), Kaso et al. (2022), and Jiao et al. (2022) all found income and education to be significant factors that affect households' willingness to pay for improved sewage treatment services. In addition, awareness of the health and environmental impacts of wastewater pollution was also found to be significant in several studies (Alhassan et al., 2017; Chopra & Das, 2019; Le & Aramaki, 2019; Byambadorj & Lee, 2019; Djayasinga, 2021).

Again, Kaso et al. (2022) and Jiao et al. (2022) found income level, education level, occupation and perception of water pollution were significant factors affecting households' willingness to pay for centralised sewage treatment in Southern Ethiopia and in North China respectively.

However, Verlicchi et al. (2018) looked at recreational benefits whereas the other studies focused on the benefits of improved sewage treatment services and their findings contradicted that of Alhassan et al. (2017), Chopra and Das (2019), Le and Aramaki (2019), Byambadorj and Lee (2019), Djayasinga (2021), Kaso et al. (2022), and Jiao et al. (2022). They found households' income, education level, and age were significant factors affecting their willingness to pay for recreational

aids in a wastewater reuse development, but did not find education and income to be significant factors affecting households' willingness to pay for sewage treatment services.

Recent studies of WTP for mangrove forest management also affirmed the argument that age was very important factor in WTP studies, as age was found to be significant in the studies conducted (Iqbal & Mozahid, 2022; Diswandi & Saptutyningsih, 2019; Ramli, Samdin & Ghani, 2017; Zaiton, Huda-Farhana & Hasan-Basri, 2019; Pham et al., 2018).

Conclusion

This chapter tend to review literature to follow the format; overview of willingness to pay, characterisation and composition of sewage, policy implementation and implementation challenges, theoretical review and empirical review. The chapter further focused on methodology and finding of empirical works in relation to the choice of toilet facility and willingness to pay. Many research across the globe (Le & Aramaki, 2019; Chopra & Das, 2019; Zaiton et al., 2019; Iqbal & Mozahid, 2022; Ramli et al., 2017; Trang et al., 2018; Demirbas et al., 2017; Zhang et al., 2022; Djayasinga, 2021; Jiao et al., 2022) found similar and different relationship between willingness to pay and sewage treatment services mostly based on the sociodemographic variables and methodology they employ.

Nevertheless, some researchers found age plays a very significant role in households' choice of toilet facility as well as willingness to pay for sewage

treatment services (Iqbal & Mozahid 2022; Adzawla, Alhassan & Jongare, 2020; Diswandi & Saptutyningsih, 2019; Palanca-Tan, 2015; Chopra & Das, 2019).

Most studies in Ghana looked at the willingness to pay for solid wate management services (Alhassan, Donkoh & Boateng, 2017; Immurana et al.;2022) but failed to look at the willingness to pay for liquid waste or wastewater management services. The study therefore focuses on liquid waste management service in bridging the knowledge gap in literature; also, to inform policy makers about the issues related to liquid waste; and establish efficient and effective initiatives to some liquid waste related issues. It is however crucial to understand willingness to pay for sewage treatment services considering the many risks it poses to human health and wellbeing.

CHAPTER THREE

RESEARCH METHODOLOGY

Introduction

The purpose of this study is to examine the drivers of household heads' choice for the type of toilet facilities using the logistic regression and also to estimate the willingness to pay (WTP) for a sewage treatment services (STS) using the Contingent Valuation Method in the Ashaiman municipality. This chapter will delineate the research methodology used in this study, including the research design, data sources and type, econometric specification and estimation techniques, empirical model specification, variable description and expected sign, post diagnostic test, data processing and analysis and chapter summary.

Research Design

The study employs positivist research philosophy which holds the view that one can observe reality (Levin 1991). The study adopted quantitative research design to establish the relationship between the dependent variables and the independent variables.

The use of research hypothesis was key and related theories were used to back the formulated hypothesis when performing the test to ensure effectiveness and efficiency. The study also followed the Contingent Valuation Method in inspiring the willingness to pay for a sewage treatment service.

Notwithstanding, the study embraced this approach given the objectives it seeks to fulfil through empirical examination that involved analytical approach and numerical measurement.

Data Sources and Type

The study used a cross-sectional and secondary data obtained from the School of Economic Studies of the University of Cape Coast. The data was obtained on the topic, "Assessing the viability of a new sewage treatment plant at Ashaiman Municipal Assembly". Data was collected from the residents' of Ashaiman in the Greater Accra region. A convenience sampling of 391 households were randomly selected for the study. The data included information on demographic characteristics, ownership of facilities and liquid waste management situation, environmental concerns, knowledge about the sewerage treatment plant, perception about the sewerage treatment plant and willingness to pay in sections.

Econometric Specification and Estimation Techniques

The logit regression model was the technique used for the study. The logistic regression model analysed the relationship between the drivers of household heads' choice for the type of toilet facilities they use and household heads willingness to pay for STS. However, the Newey, Lagrange and Cameron non-linear regression was employed in estimating the mean WTP to ascertain how much household heads are willing to pay (Lopez-Feldman, 2012).

Empirical Specification of Logit Model

The logit model was employed in the empirical model specification. The dependent variable used in the model is a dummy variable. The logit was accustomed considering the capability of the model to estimate probability that follows a rational limit of 0 and 1 and again, better handing of high correlation between the predictor variables. Since the relationship between the variables x_i and p_i is non-linear and the probability follows a logical limit (0 and 1) and this was used in estimating the drivers of household heads' choice for the type of toilet facility (as the dependent variable) in objective one.

$$y_i = \beta_0 + \beta_i x_i + \beta_k x_k + u_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

$$let\ TFChoice = \text{choice of toilet facility};\ and\ WTP = Willingness\ to\ Pay$$

$$TFChoice\ or\ WTP = \begin{cases} 1\ if\ y_i > 0 \\ 0\ if\ y_i \leq 0 \end{cases}$$

$$Pr_i(TFChoice_i\ or\ WTP_i = 1 | x_1, x_2 \ldots x_k)$$

$$= \mathrm{f}\,(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k + u_i) \ldots\ldots\ldots\ldots (6)$$

$$logit(p) = \log\left(\frac{p}{1-p}\right) \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

$$\log\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k + u_i \ldots\ldots\ldots\ldots\ldots (8)$$

$$Pr_i(TFChoice_i\ or\ WTP_i = 1 | x_1, x_2 \ldots x_k) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k + u_i)}} \quad \ldots (9)$$

$$Pr_i(TFChoice_i\ or\ WTP_i = 1 | x_1, x_2 \ldots x_k) = \frac{1}{1 + \left(\frac{1}{e^{-(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k + u_i)}}\right)} \quad \ldots (10)$$

The above model as specified in Gujarati (2006) we adopted in the WTP study.

The objective one used explanatory variables that included; Age, Household size, Employment Status, Tenancy Status, Gender, Education Level, Marital Status, and Household Dwelling unit in achieving the objective one.

The functional form is stated as:

$$f(TFChoice) = \begin{pmatrix} \text{Age, Household size, Employment Status,} \\ \text{Tenancy Status, Education level, Gender, Marital} \\ \text{Status and Household Dwelling unit} \end{pmatrix} \ldots (11)$$

The structural form of the equation is:

$$TFChoice_i = \beta_0 + \beta_1 Age_i + \beta_2 HHSize_i + \beta_3 EmpStat_i + \beta_4 TenStat_i + \beta_5 EduLvl_i + \beta_6 Gen_i + \beta_7 Mstat_i + \beta_8 HHDwell_i + e_i \ldots . (12)$$

Furthermore, explanatory variables used in achieving objective two and three were payment vehicle (bid) of WTP, Age, Gender, Household Dwelling Unit, Predicted Values of Choice of Toilet Facility, Household Heads Income, Employment Status, Tenancy Status, Level of Satisfaction and Improve Farming.

The functional form for objective two and three is stated as:

$$f(WTP) = \begin{pmatrix} \text{Bid, Age, Gender, Household Dwelling Unit, Choice of} \\ \text{Toilet Facility, Household Income, Employment Status,} \\ \text{Tenancy Status, Level of Satisfaction and Improve Farming} \end{pmatrix} \ldots (13)$$

The structural form of the equation is:

$$WTP_i = \beta_0 + \beta_1 Bid_i + \beta_2 Age_i + \beta_3 Gen_i + \beta_4 HHDwell_i + \beta_5 TFChoice_i(\Pr) + \beta_6 HInc_i + \beta_7 EmpStat_i + \beta_8 TenStat_i + \beta_9 L.Satis_i + \beta_{10} I.Farm_i + u_i \ldots \ldots \ldots \ldots . (14)$$

β is the parameter to be estimated and e and u are the error term. Age is the age of household head, Gen represents sex of the household head, HHDwell represents

Household Dwelling unit and TFChoice denotes Choice of Toilet Facility. Again, HInc denotes household income, EmpStat symbolizes Employment Status, TenStat is Tenancy Status, L.Satis denotes Level of Satisfaction and I.Farm symbolizes Improve Farming

Empirical Specification of Average Amount of WTP

We therefore use the estimated values from the logit regressions in specifying the mean or exact value for WTP following the Newey, Lagrange and Cameron non-linear regression technique.

$$WTP_i(s_i, e_i) = \tilde{s}_i\beta + \mu_i \ldots\ldots\ldots\ldots\ldots (15)$$

$$But, \hat{\beta} = -\frac{\hat{\alpha}}{\hat{\delta}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (16)$$

$$Therefore, E\left(WTP\middle|s_i, \hat{\beta}\right) = \tilde{s}_i\left[-\frac{\hat{\alpha}}{\hat{\delta}}\right] \ldots\ldots (17)$$

$\tilde{s}_i$ is the average or a vector that include the explanatory variables $\hat{\beta} = -\frac{\hat{\alpha}}{\hat{\delta}}$ is the payment vehicle (bid) and μ_i is the error term (Lopez-Feldman, 2012).

Variable Description and Expected Sign

The section looks at the two categories of variables thus, the dependent variable and the independent variable and their associated measure in accordance to the study.

Dependent Variables

Choice of Toilet Facility

This variable looks at the type of toilet facility that the household resort to ease themselves. This included; the pit-latrine, KVIP, water closet (W.C) bucket/pan, public toilet (either pit-latrine, KVIP or W.C) and no facility (bush/beach/field). The variable was recoded to take the form; "0" = Facility in the house and "1" = Public facility. The variable was dummy since is assumed the values of 0 and 1. It was a dependent variable in the estimation of the drivers of household heads' choice for the type of toilet facilities (objective one) and an independent variable in the WTP for STS by the household in objective two and three.

WTP

Willingness to Pay variable was treated as categorical and also a dependent variable. It was a dummy variable thus takes the values of 0 and 1 in its regression. The WTP variable was coded as "0" = No and "1" = Yes, that is, households unwilling to pay and households willing to pay respectively.

Independent variables

Age

This variable is a continuous variable that measures the number of completed years a household's head has lived. Age is essential in the sense that adults (people with higher ages) are naturally seen to be critical in thinking

compared to children (people with low ages). According to Torgler and Garcia-Valiñas (2005), there are two age effects, a life cycle or aging effect brought on by reaching a certain age, and a cohort impact brought on by being a member of a particular generation. They further explained that the cohort effect accounts for the changes in attitudes between age cohorts brought on by the socialization, life experiences, and economic circumstances of various generations. People of a similar age have encountered comparable historical and economic circumstances, and as a result, comparable limitations and opportunities. However, aging may also have the opposite impact, making people less risk-taking, cautious, and conservative, since they anticipate less financial gain from protecting the environment (Vlosky & Vlosky 1999).

Nevertheless, Torgler and Garcia-Valiñas (2005) expected a negative sign for age. Whereas Adzawla, Alhassan and Jongare (2020) who focused on socioeconomic and housing characteristics on the choice of toilet facilities among Ghanaian households expected a positive sign for age. However, in this research, the argument of Torgler and Garcia-Valiñas (2005), Ramli et al. (2017) and Adzawla, Alhassan and Jongare (2020) were followed, therefore, both a negative or a positive sign for age was expected.

Gender

Gender is the sex of the household head either a male or a female. The variable was dichotomous with "0" = female and "1" = male. It is frequently suggested that conventional gender socialization, cultural norms, nurturing and

caregiving duties played by women, as well as the fostering of cooperation and compassion, result in a larger concern for the preservation of life and the environment (Torgler & Garcia-Valias, 2005). Again, the "traditional" realm of working from home encourages a stronger propensity to engage in private practices aimed at environmental preservation (Hunter et al. 2004). Therefore, compared to men, women frequently show greater care for the environment.

According to some writers (Dupont 2004; Torgler & Garcia-Valiñas, 2005; Adzawla, Alhassan & Jongare, 2020), women are more worried about the risk that a poor environment point toward, hence controlling for risk aversion may result in a larger negative influence of gender. However, Adzawla, Alhassan and Jongare (2020) used female as the base category and expected a negative sign but in this study, we expected a positive sign since males was used as the base category hence, conforms to literature.

Marital Status

The variable was treated as categorical variable and focused on the state of marriage of the household head. The variable was coded as follows; “1” = Divorced, “2” = Married, “3” = Separated, “4” = Single/Never married and “5” = Widowed. People who are married are more concerned about environmental degradation than unmarried people, especially when it comes to local environmental issues, social networks, and community involvement, especially in relation to the future of their children (Torgler & Garcia-Valiñas, 2005). Torgler & Garcia-Valiñas, 2005 limited their work to married and unmarried and expected a

positive sign. However, the study expected both a negative or a positive sign for marital status due to the use of many categories other than limiting to only married and unmarried.

Household Size

The variable household size was treated as continuous variable and measures the number of people who are actively present in the household. Intuitively, huge household sizes are more likely to generate large waste relative to a small household size, ceteris paribus.

Aggrey and Douglason (2010), Afroz et al (2009) and Addai (2012) expected a negative sign while the view that large households' sizes are mostly associated with low income and vice versa. Alternatively, Alfat and Deshazo (1996) expected a positive sign and held the view that the bigger the size of the household, the more the household will be agitating for a hygienic environment. Nevertheless, the study expected both a negative or a positive sign for household size.

Household Dwelling Type

The household dwelling type was classified into different of houses the households were living in and was also treated as a categorical variable. It was grouped to follow the path where "1" = Impoverished homes, "2" = Compound house, "3" = Flat/Apartments, "4" = Semi-detached and "5" = Separate house. This category conformed to that of the Ghana Living Standard Survey (GLSS 7). Thus, households with more improved building or dwelling units have high tendency of

being wealthier than households with less improved dwelling units. The study expected both a negative or a positive sign for household dwelling type.

Education Level

This variable was treated as categorical variable. The variable looks at the educational background of household head in terms of the highest level they reached and was measured as follows; "1" = No education, "2" = Primary, "3" = JSS/JHS/Middle school, "4" = SSS/SHS/VOC and "5" = Tertiary. Intuitively, individuals with higher level of education have in-dept knowledge on health-related issues and sanitation and are more likely to encourage STS than individual with lower level of education, ceteris paribus. The study expected both a negative or a positive sign for education level. Aggrey and Douglason (2010), Afroz et al (2009) and Addai (2012), affirmed these signs based on the fact that educated people are more prospective to pay in comparison to uneducated people.

Tenancy Status

Tenancy status was perceived to be dichotomous with "0" = Not Owning and "1" = Owning. This variable looks at whether the household owns a house or does not own a house. It was also necessary in the determination of the drivers of household heads' choice for the type of toilet facilities and the WTP for STS by the household. Alhassan (2012) expected both positive and negative sign from the tenancy status in the sense that those who own house are willing to pay to in order to ensure improvement which will yield higher returns on their property in the

future. In contrast, those who do not own houses expect house owners to take responsibility since those who do not own houses will gain no returns in the future (Alhassan, 2012). In support of this valid argument, the study also expected both a negative or a positive sign for tenancy status.

Employment Status

Employment status was dichotomous with the code "0" = Unemployed and "1" = Employed. This variable focused on whether the household head is working or not working. The variable was also key the determining of the drivers of household heads' choice for the type of toilet facilities and the WTP for STS by the household. Individual who are employed higher probability of paying for STS since they more likely to pay for the services rendered than unemployed individuals. From Ghana Living Standard Survey (GLSS 7), it is clear that the more people are employed, the more they earn money to spend, hence influencing the individual's willingness to pay. The study expected both a negative or a positive sign following existing argument for employment status.

Household Income

Gross household income was used for the study. It was treated as a continuous variable and perceived to be necessary in the determination of the drivers of household heads' choice for the type of toilet facilities and the WTP for STS by the household. In this view, significant relationship was expected in relation to the dependent variables of interest. The study expected both a negative or a

positive sign for household income. Catalano, Florio and Giffoni, (2016) associated negative sign of household income to data problems than the consequences from unexpected behaviours. Also, Wang et al. (2014) and Manga et al (2019) argued that the negative sign was due to the fact that low-income earners strongly agitate for public since the rich can call for solutions for private individuals.

Improve Farming

Improve farming variable was a categorical variable and measures views of household on whether the STP will improve farming activities in the community. It was coded as "0" = No and "1" = Yes. The variable was also dichotomous or dummy since it assumes the values of 0 and 1. The study also expected both a negative or a positive sign for improve farming.

Perception and behavioural factors according to Herath (2010) as cited in Olum et al., 2020) is key to farmers, hence both positive and negative sign was expected. When cost is higher than price denoting lower returns, farming will not be willing to pay indicating negative sign (Olum et al., 2020). However, given the support of government guaranteed programs to support farmers via innovations and other means, farmer will be willing to pay even double for other raw materials needed (Olum et al., 2020).

Level of Satisfaction for Sewerage Treatment Plant

The level of satisfaction variable measures the satisfaction of the household on the sewerage treatment plant in your municipality. It followed the code; "1" =

Dissatisfied, "2" = Neutral and "3" = Satisfied. The level of satisfaction of the household is a very significant variable in relation to health and sanitation of the households. The study expected both a negative or a positive sign for level of satisfaction. Vantarakis et al. (2016) expected both positive and negative sign for level of satisfaction for sewerage treatment plant considering the clean environment and the reuse of the sludge for productivity purposes. In contrast to that, Vantarakis saw a negative sign with regards to the health of individuals due to the presence of pathogenic microorganisms.

Payment Vehicle (Bid)

This variable is a cost suggested to help in finding the exact amount households were willing to pay. The variable was categorical with the measurement; "1" = GHS 120, "2" = GHS 100, "3" = GHS 80, "4" = GHS 60, "5" = GHS 50, "6" = GHS 40 and "7" = GHS 20. The bid variable was expected to be significant in the estimation of general amount all households will be willing to pay. It played a crucial role in the estimation of objective three thus, identify how much household heads in the municipality are willing to pay. The study expected both a negative sign for bid following Lopez-Feldman (2012), as the bid increases, the amount an individual's is expected to pay decrease relatively.

Table 1: Description of Variables and the Expected Sign

Variable Name	Type of Variable	Expected Sign
Age	Discrete	Positive/Negative
Gender	**Dichotomous**	
	Female = 0	Positive
	Male = 1	
Marital Status	**Categorical**	
	Divorced = 1	
	Married = 2	Positive/Negative
	Separated = 3	
	Single/Never married = 4	
	Widowed = 5	
Household Size	Discrete	Positive/Negative
Household Dwelling Type	**Categorical**	
	Impoverished homes = 1	
	Compound house = 2	Positive/Negative
	Flat/Apartments = 3	
	Semi-detached = 4	
	Separate house = 5	
Education Level	**Categorical**	
	JSS/JHS/Middle school = 1	
	No education = 2	Positive/Negative
	Primary = 3	
	SSS/SHS/VOC = 4	
	Tertiary = 5	
Tenancy Status	**Dichotomous**	
	Not Owning = 0	Positive/Negative
	Owning = 1	
Employment Status	**Dichotomous**	
	Unemployment = 0	Positive/Negative
	Employment = 1	
Household Income	Continuous	Positive
Choice of Toilet Facility	**Dichotomous**	
	Public Facility = 0	-
	Facility in the house = 1	
Willingness to pay	**Dichotomous**	
	No = 0	-
	Yes = 1	

Table Continued		
Improve Farming	**Dichotomous**	
	No = 0	Positive/Negative
	Yes = 1	
Level of Satisfaction	**Categorical**	
	Dissatisfied = 1	Positive/Negative
	Neutral = 2	
	Satisfied = 3	
Payment Vehicle (Bid)	**Categorical**	
	GHS 120	
	GHS 100	
	GHS 80	Negative
	GHS 60	
	GHS 50	
	GHS 40	
	GHS 20	

Source: Ansah (2023)

Post Analytical Test

The goodness-of-fit test, classification test and linktest were mainly implemented to test: how best the estimated models fit the data observed; the ability to correctly classify observations into different categories; and to ensure that the relationships assumed by the model are consistent with the underlying data generating process. Also, the post analytical tests ensured that error term is normally distributed in the logistic regression model specification. Correlation matrix and sensitivity/specificity graphs were also performed.

Data Processing and Analysis

Descriptive statistics was adapted in describing the variables employed in the estimations. The use of mean and standard deviation helped in showing the

nature and kind of the variables employed. On the other hand, inferential statistics such as the logistic regression was followed in the estimations of the dependent variables. Data was computed and estimated using STATA 17 software. The study also employed CV model (single-bound dichotomous choice question) in estimating the WTP for STS using the mean values.

Chapter Summary

The study adopted a quantitative research design to achieve the maximum best results and findings. The study further used a cross-sectional and secondary data from the School of Economics. A convenience sampling of 391 households were randomly selected. The logistic regression model was the estimation techniques used to reach the objectives for the study. However, the data description and measurements of the variables were addressed in this chapter. In the chapter's final paragraph, the post analytical tests used to check the accuracy level of the results and data processing and analysis procedures were revealed.

CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

The chapter presents the results and discussion of the study. The results were presented in figures and tables to help better understand the relationships clearly. The chapter follows the following order: descriptive statistics, estimation of results and chapter summary.

Descriptive Statistics

The descriptive statistics in Table 2 shows the frequencies and percentages of the categorical variables used in the study. Females constituted the highest proportion with 56.5 percent. The proportion of household heads who were married were relative higher (66.3%) in comparison to single and never married (16.2%).

Further, majority of the household heads were employed (70%) in both the formal sector and the informal sector. In relation to willingness to pay for STS, 90.7 percent of the respondents forming the majority were willing to pay.

Table 2: Descriptive Statistics categorical variables

Variables	Categories	Frequency	Percent
Gender	Male	183	43.47
	Female	238	56.53
Marital Status	Single/Never Married	68	16.15
	Married	279	66.27
	Divorced	7	1.66
	Separated	23	5.46
	Widowed	44	10.45

Table Continued

Willingness to pay	Yes	255	90.75
	No	26	9.25
Employment Status	Employment	293	69.6
	Unemployment	126	29.93
Tenancy Status	Owning	223	52.97
	Not Owning	198	47.03
Education Level	No education	73	17.34
	Primary	51	12.11
	JSS/JHS/Middle school	169	40.14
	SSS/SHS/VOC	87	20.67
	Tertiary	40	9.5
Household Dwelling unit	Impoverished homes	34	8.08
	Compound house	267	63.42
	Flat/Apartments	90	21.38
	Semi-detached	4	0.95
	Separate house	26	6.18
Choice of Toilet Facility	Public Facility	143	33.97
	Facility in the house	278	66.03
Level of Satisfaction	Dissatisfied	15	3.56
	Neutral	119	28.27
	Satisfied	289	68.17
Improve farming	Yes	395	94.27
	No	24	5.73
Payment Vehicle (Bid)	GHS 120	39	15.98
	GHS 100	40	16.39
	GHS 80	6	2.46
	GHS 60	51	20.90
	GHS 50	1	0.41
	GHS 40	64	26.23
	GHS 20	43	17.62

Source: Ansah (2023)

The proportion of the respondents who have attained JSS/JHS/middle school certificate recorded the highest (40.1%) whereas respondents who have attained relation tertiary certificate recorded the least (9.5%). Moreover, households living in compound house recorded the highest (63.4%) while

households living in semi-detached house recorded the least (1%). 66 percent of the households had access to toilet facility in the house and constituted the majority.

From Table 2, most households were satisfied with the establishment of the STP (68.2%) leaving few households dissatisfied (3.6%). Again, 94.3 percent of the respondent were confident that farming activities will improve in the community given the existence of the STP in the community. From Table 2, a greater proportion of the respondents were willing to pay an average amount of GHS 40 which constituted 26. 2 percent of the respondents and 0.4 percent of the respondents which constituted the least were willing to pay GHS 50.

Table 3: Descriptive Statistics of Continuous and Discrete Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Age	391	48.903	14.683	17	90
Household size	391	4.796	2.726	1	20
Household Income	391	499.737	576.704	0	5000

Note: Obs represent observation while Std. Dev. represent Standard deviation.
Source: Ansah (2023)

Table 3 shows the descriptive statistics of the continuous variables showing the observation, mean, standard deviation, minimum and maximum in the study. From Table 3, out of a total observation of 391 household heads, the mean age is 49 years with a standard deviation of 14.7. The minimum age is 17 years and the maximum age is 90 years. The mean household size is about 5 people with a standard deviation of 2.7 and a minimum and maximum household size of 1 and 20 people respectively. Again, the average household head's income is approximately

Gh₵ 500 with a standard deviation of 576.7. The minimum household income is Gh₵ 0 and the maximum value is Gh₵ 5,000 annually.

Education Level and Choice of Toilet Facility

Figure 1 presents a relationship between choice of toilet facility and education level. From Figure 1, we observed that majority of households with no education makes use of public facility (50.7%) than those who have the facility in their house (49.3%). Also, 52.9 percent of primary school levers have toilet facility in their house and 47.1 percent of primary school levers make use of the public toilet facility; 69.8 percent of JSS/JHS or middle school lever have toilet facility in their house and 30.2 percent of JSS/JHS or middle school lever make use of the public toilet facility. 73.6 percent of SSS/JHS or vocational school lever have toilet facility in their house and 26.4 percent of SSS/JHS or vocational school lever make use of the public toilet facility. Lastly, 80 percent of tertiary school graduates have toilet facility in their house while 20 percent of tertiary school graduates make use of the public toilet facility.

However, from Figure 1, we noted that the higher a household climbs in the educational ladder, the more they tend to use toilet facility in the houses and vice versa.

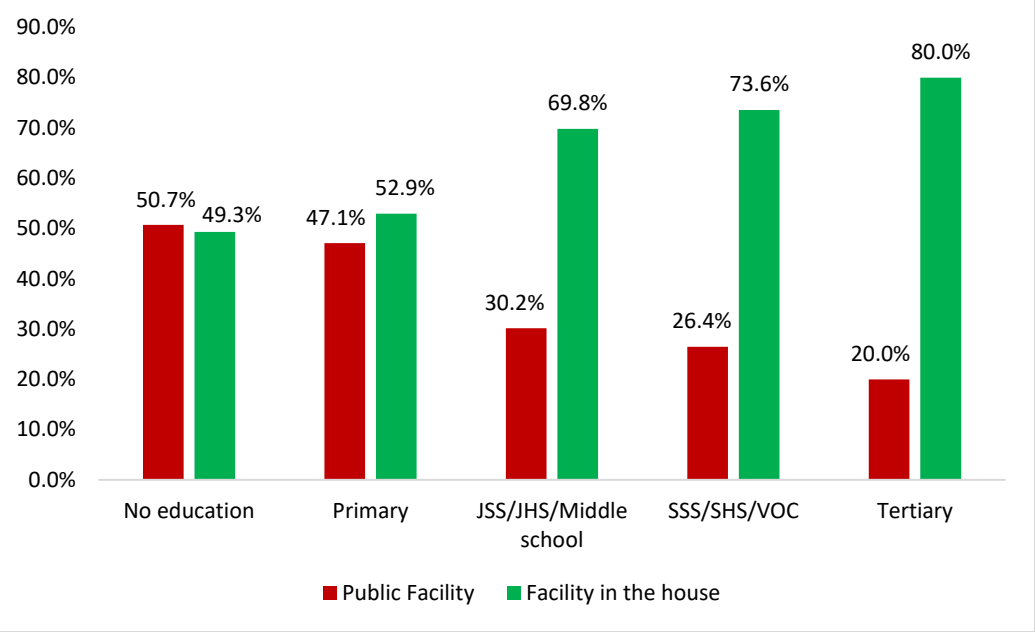

Figure 1: Distribution of Education Level on Choice of Toilet Facility
Source: Ansah (2023)

Choice of Toilet Facility and Age

From Table 4, there is a significant difference between age and Choice of toilet facility at 0.01 alpha level. The average age of households having toilet facility in the house is 52 years with standard error of 0.9 and average age of households that makes use public facility is 43 years with standard error of 1.1. Out of a total of 402 observations, the average age of households' choice of toilet facility (combined) is 49 years with a standard error of 0.7.

Table 4: T-Test Assessment of Age on Choice of Toilet Facility

Group	Obs	Mean	St. Err.	[95% conf.	interval]
Public Facility	136	43.287	1.108	41.096	45.478
Facility in the house	266	51.774	0.903	49.997	53.552
Combined	402	48.903	0.732	47.463	50.343
diff		-8.488	1.490	-11.418	-5.558

diff = mean (Public Facility) - mean (Facility in the house)		t = -5.695
H0: diff = 0		Degrees of freedom = 400
Ha: diff < 0	Ha: diff != 0	Ha: diff > 0
Pr(T < t) = 0.0000	Pr(T >t) = 0.0000	Pr(T > t) = 1.0000

Note: Obs represent observation while St. Err. represent Standard error.
Source: Ansah (2023)

Research Objective 1: Examine the drivers of household heads' choice for the type of toilet facility.

Table 5, presents the logistic regression of the drivers of household heads' choice for the type of toilet facility showing the odds ratio, the p-value and standard error respectively, of the independent variables (age, household size, employment status, tenancy status, education level, gender, marital status and household dwelling unit).

Table 5: Drivers of Household Heads' Choice for the Type of Toilet Facility

Toilet Facility	Odds Ratio	Std. Err.
Age	1.029** (0.026)	0.013
Household size	1.028 (0.582)	0.051
Employment Status		
Employment	1.043 (0.898)	0.337

Table Continued		
Tenancy Status		
Owning	2.225*** (0.008)	0.666
Education Level		
Primary	2.171 (0.102)	1.030
JSS/JHS/Middle school	3.206*** (0.002)	1.233
SSS/SHS/VOC	3.304*** (0.010)	1.526
Tertiary	6.095*** (0.004)	3.791
Gender		
Female	2.108** (0.015)	0.647
Marital Status		
Married	3.808 (0.146)	3.504
Separated	5.143 (0.130)	5.563
Single/Never Married	2.442 (0.376)	2.466
Widowed	1.938 (0.500)	1.899
Household Dwelling unit		
Compound house	10.893*** (0.007)	3.58
Flat/Apartments	37.260*** (0.000)	4.57
Separate house	16.686 (0.446)	3.30
Constant	0.04*** (0.000)	0.030

pseudo-R-square	0.232	SD dependent var	0.475
Chi-square	116.868	Mean dependent var	0.657
Prob>chi2	0.000	Akaike crit. (AIC)	419.816
N	391	Bayesian crit. (BIC)	487.284

*** *p<.01*, ** *p<.05*, * *p<.1*

Note: Std. Err. represent Standard error and p-values in parentheses.

Source: Ansah (2023)

From Table 5, the total number of observations is 391 and the pseudo-R-square shows that approximately 23.2 percent of the variation in the choice of toilet facility is been explained by the independent variables in the model (age, household size, employment status, tenancy status, education level, gender, marital status and household dwelling unit). The chi-square indicates that the model is significant at an alpha level of 0.01 since the p-value is less than 0.01. For each year increase in age of a member of the household, the odds of the choice of toilet facility increases by approximately 2.9 percent and this is statistically significant at 0.05 alpha level.

At p-value of 0.01 there is a statistical significance that a household owing a house is associated with 122.5 percent higher odds of having toilet facility in the house compared to not owing a house. Thus, a household owing a house are more likely to have toilet facility in the house compared to household who do not own a house. Households with JSS/JHS or middle school levers are associated with 220.6 percent higher odds of having toilet facility in the house compared to households with no education and this is significant at 0.01 alpha level.

Households with SSS/SHS or vocational school levers are associated with 230.4 percent higher odds of having toilet facility in the house compared to households with no education and this is significant at 0.01 alpha level. At p-value of 0.01 there is a statistical significance that households with tertiary graduates are associated with 509.5 percent higher odds of having toilet facility in the house compared to households with no education.

Females have 110.8 percent higher odds of having toilet facility in the house compared to males and this is significant at 0.05 alpha level. At p-value of 0.01

there is a statistical significance that households living in Compound houses are associated with 989.3 percent odds higher of having toilet facility in the house compared to households living in improvised homes. At p-value of 0.05 there is a statistical significance that households living in flats and apartment are associated with 3,626 percent odds higher of having toilet facility in the house compared to households living in improvised homes.

Adzawla, Alhassan and Jongare (2020) also found that age, education, gender tenancy status and household dwelling unit were significant for households' choice of toilet facility. As a person ages, the body at some point becomes weak making normal daily activities a bite challenging. Most adults in this situation tend to prefer more convenient ways of doing things and have higher probability of having toilet facility in the house compared to public toilet. Also, those who do not own a house (renting, perching and squatting) are more likely to use the public toilets since they consider that as a temporal and a kind of improvising due to the situation, they find themselves in. The more educated a household is the more he/she understands the risks of associated with sharing toilet facility with a lot of people and therefore, higher probability of having their private facility at home to minimise risks. Again, females are more likely to attract infectious disease than men and therefore females have a higher probability of having toilet facility in the house.

Moreover, household with higher income level consider toilet facility as a key component in choosing their place of resident and have higher probability of residing in flats and apartments since they have toilet facilities already installed.

Similarly, those living in separate houses and improvised homes have a high tendency of falling in the low-income class. They mostly consider sleeping place as a key component in choosing a place to reside other than the available toilet facility and have a higher probability of using the public toilet facility.

Gender and WTP

In Figure 2, 53.9 percent of female constituting the majority were not willing to pay for the sewage treatment services. This is in line with GLSS 7 data with 51.5 percent females and 48.5 percent of males out of a total population of 28.4 million household population in Ghana. Moreover, majority of females were more willing to pay for the sewage treatment services (56.1%) compared to males who were willing to pay (43.9%).

From Figure 2, we observed that irrespective of a "yes" or "no" response, females dominated males which also implies that there were more females than males in the observation.

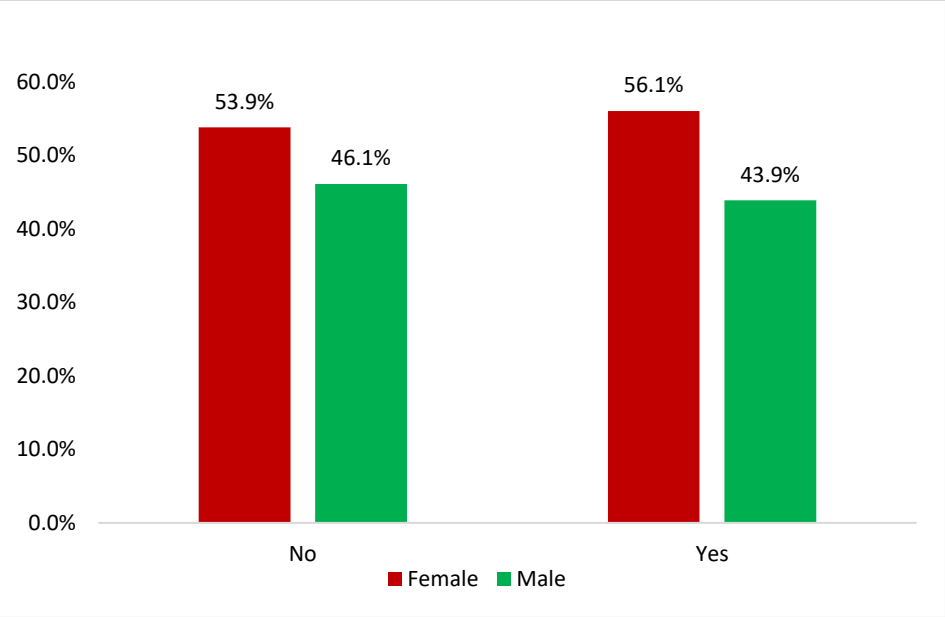

Figure 2: Distribution of Gender on WTP
Source: Ansah (2023)

Employment Status and WTP

Figure 3 shows that the employed forming the majority (57.7%) were not willing to pay for the sewage treatment services. Again, majority of the employed were more willing to pay for the sewage treatment services (70.4%).

From Figure 3, we observed that irrespective of a "yes" or "no" response, the employed dominated the unemployed which denotes that there were more the employed than unemployed in the observation. In Ghana, 70.7% of the 15years and older population are employed and this affirms higher employment in relation to unemployment (GLSS 7).

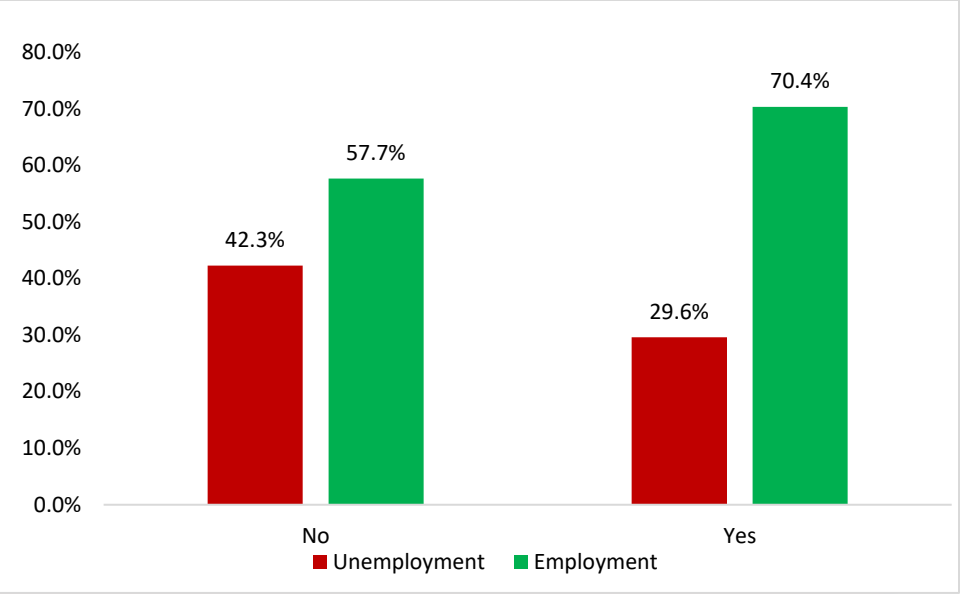

Figure 3: Distribution of Employment Status on WTP

Source: Ansah (2023)

Household Income and WTP

From Table 6, there is a significant difference between WTP and household income at 0.01 alpha level. The average household income of households that will be willing to pay is 4.94 with standard deviation of 0.16 and average household income of households that will not be willing to pay is 3.53 with standard deviation of 0.59. Out of a total of 281 observations, average household income of willing to pay (combined) is 4.81 with a standard of 0.16.

Table 6: T-Test Assessment of Household Income on WTP

Group	Obs	Mean	St. Err.	[95% conf. interval]	
No	26	3.529	0.591	2.312	4.747
Yes	255	4.939	0.160	4.624	5.254
Combined	281	4.809	0.157	4.501	5.117
diff		-1.410	0.535	-2.463	-0.357
diff = mean (No) - mean (Yes)					t = -2.636
H0: diff = 0					Degrees of freedom = 279
Ha: diff < 0		Ha: diff != 0			Ha: diff > 0
Pr(T < t) = 0.0044		Pr(T >t) = 0.0089			Pr(T > t) = 0.9956

Note: Obs represent observation while St. Err. represent Standard error.
Source: Ansah (2023)

Research Objective 2: Examine household heads willingness to pay for Sewage Treatment Services in Ashaiman Municipality

Table 7, presents the logistic regression of WTP (single-bond dichotomous choicequestion) showing the odds ratio, the p-value and standard error respectively, of the independent variables (age, gender, household dwelling unit, predicted values of the choice of toilet facility, household income, employment status, tenancy status, level of satisfaction and improve farming).

Table 7: Willingness to Pay for Sewage Treatment Services

WTP	Odds Ratio	Std. Err.
Bid	0.628** (0.046)	0.147
Age	0.874* (0.060)	0.063
Gender		
Female	0.050 (0.135)	0.100

Table Continued

Household Dwelling unit		
Compound house	0.002 (0.181)	0.011
Predicted Toilet Facility	5.94e-10** (0.048)	0.000
Household Income	3.352*** (0.001)	1.255
Employment Status		
Employment	0.002*** (0.007)	0.004
Tenancy Status		
Owning	68.149 (0.257)	253.749
Level of Satisfaction		
Neutral	12.679 (0.298)	30.971
Satisfied	13.976 (0.581)	66.832
Improve farming		
Yes	17.493** (0.012)	19.893
Constant	4.13e+12** (0.008)	0.00

pseudo-R-square	0.440	SD dependent var	0.132
Chi-square	29.746	Mean dependent var	0.982
Prob>chi2	0.002	Akaike crit. (AIC)	46.538
N	227	Bayesian crit. (BIC)	87.637

**** p<.01, ** p<.05, * p<.1*

Note: Std. Err. represent Standard error and p-values in parentheses.
Source: Ansah (2023)

From Table 7, the total number of observations is 227, thus 164 respondents were dropped since they did not response to willingness to pay question. The pseudo-R-square shows that approximately 44 percent of the variation in the WTP is been explained by the independent variables in the model (bid, age, gender,

household dwelling unit, predicted values of choice of toilet facility, household heads income, employment status, tenancy status, level of satisfaction and improve farming). The chi-square indicates that the model is significant at an alpha level of 0.01 since the p-value is less than 0.01.

For each cedi increase in the average amount of WTP, the odds of obtaining a higher WTP decreases by approximately 37.2 percent and this is statistically significant at 0.05 alpha level. For each year increase in age of a member of the household, the odds of having a higher WTP decreases by approximately 12.6 percent and this is statistically significant at 0.1 alpha level. At p-value of 0.05 there is a statistical significance that the choice of toilet facility is affects WTP but very small and close to 0. Thus, the variable is statistically significant and still contribute meaningfully to predicting WTP outcomes. A proportionate increase in households' income by 1 percent will correspond to 235.2 percent increase in the odds of the WTP and vice versa and at an alpha level of 0.01.

At p-value of 0.01 there is a statistical significance that an employed household is associated with 99.8 percent odds lesser of WTP compared to unemployed household. Households with the view of seeing improvement in the farming activity due to the existence of the STP are associated with 1649.3 percent higher odds compared to households without such view and this is significant at 0.05 alpha level. Thus, the improve farming variable has higher chances of WTP to occur.

Many WTP studies found age to be significant (Iqbal and Mozahid 2022; Diswandi and Saptutyningsih, 2019; Zaiton et al., 2019; Ramli et al., 2017; Pham

et al., 2018). Comparably, it can be established that as a person ages, he/she has a higher tendency of pay for STS. This can be attributed to higher health related risks associated to the aged compared to the young. Also, the data captures majority of the standard age range of the working population which is 15 years and older according to GLSS 7.

However, household income had a strong predictor odds ratio of 3.352 and showed a positive relationship with WTP for STS. This finding can be associated to the circumstance that higher income households are better off and do not want to be faced by water-related pollution. In brief, household income was also found to be a significant variable affecting households WTP for STS and this is in line with Le and Aramaki (2019), Palanca-Tan (2015) and Chopra and Das (2019).

Research Objective 3: Identify how much household heads are willing to pay for Sewage Treatment Services in Ashaiman Municipality.

Table 8, presents the logistic regression of WTP from objective two showing the coefficients of the independent variables (age, gender, household dwelling unit, predicted values of the choice of toilet facility, household income, employment status, tenancy status, level of satisfaction and improve farming).

Table 8: Willingness to Pay for Sewage Treatment Services Showing Coefficient Values

WTP	Coef.	Std. Err.
Bid	-0.465** (0.046)	0.233
Age	-.1343* (0.060)	0.072
Gender		
Female	-2.999 (0.135)	2.006
Household Dwelling unit		
Compound house	-6.018 (0.181)	4.494
Predicted Toilet Facility	-21.244** (0.048)	10.755
Household Income	1.210*** (0.001)	0.374
Employment Status		
Employment	-6.239*** (0.007)	2.302
Tenancy Status		
Owning	4.222 (0.257)	3.723
Level of Satisfaction		
Neutral	2.540 (0.298)	2.443
Satisfied	2.637 (0.581)	4.782
Improve farming		
Yes	2.862** (0.012)	1.137
Constant	26.049** (0.008)	11.391

pseudo-R-square	0.440	SD dependent var	0.132
Chi-square	29.746	Mean dependent var	0.982

Table Continued			
Prob>chi2	0.002	Akaike crit. (AIC)	46.538
N	227	Bayesian crit. (BIC)	87.637

*** p<.01, ** p<.05, * p<.1

Note: Coef. represent coefficient, Std. Err. represent Standard error and p-values in parentheses

Source: Ansah (2023)

From Table 8, the coefficient of the bid is negative showing that the higher the amount, the lesser the positive response to WTP. Thus, household will tend to pay less if the average amount to be paid increases.

Table 9 shows the results of the exact amount households will be willing to pay given the all the independent variables present in the WTP model following the Newey, Lagrange and Cameron non-linear regression.

Table 9: Average Amount of Households Willing to Pay for Sewage Treatment Services

WTP	Coef.	Std. Err.
WTP	24.590** (0.022)	10.712

Note: Coef. represent coefficient, Std. Err. represent Standard error and p-values in parentheses

Source: Ansah (2023)

Table 9 shows that there is statistical significance on the amount households are willing to pay for STS at 0.05 alpha level. Thus, the study found that households are willing to pay an average of approximately, Gh₵ 25 for STS on annual basis. This is in line with the study conducted on households in Tamale Metropolis of

Ghana and concluded that households were willing to pay Gh₵ 2 to Gh₵ 25 for waste management services (Alhassan, Donkoh and Boateng, 2017).

Chapter Summary

This chapter presented the descriptive statistics, cross tabulation of some variables, empirical results and analysis with the help of the research objectives. Intuitively, cross tabulations on some key variables such as, education level and choice of toilet facility; choice of toilet facility and age; gender and WTP; employment Status and WTP; and household income and WTP as performed. The results showed that the variables selected were very essential and key to the study. In addition, relevant postestimation tests were performed to ensure accuracy and reliability of the results. To achieve the stated objectives, we used the logistic regression model in estimating the drivers of household heads choice of toilet facility and also used the same model in estimating the willingness to pay for sewage treatment services. In addition to the logistic regression model, we used the contingent valuation method which enabled us estimate an average amount all households will be convenient to for sewage treatment services.

The results showed that sociodemographic factors such as age, education, gender tenancy status and household dwelling unit are significant and positively affects the drivers of households' choice of toilet facility. Again, age, choice of toilet facility, household income, employment status and improve farming variable also significantly affected WTP. The findings indicated that improving farming in

the community status highly affected WTP most while choice of toilet facility least affected WTP.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Introduction

The chapter presents the summary, conclusion and recommendations for the study. The summary captures a brief information of all the previous chapters. A significant conclusion was arrived at and relevant recommendations necessary for the study was suggested to inform policy making. The chapter finally ends with suggestion for further studies.

Summary

Water waste is a major challenge and problem that many communities and societies are facing and Ashaiman municipality cannot be left out as expressed in the previous chapters. The main purpose of this study was to investigate willingness to pay for sewage treatment services in the Ashaiman Municipality and the specific objectives were elaborated also in the previous chapters. The employed theory was the utility theory, focusing on the Contingent Valuation Model.

The first objective intended at examine the drivers of household heads' choice for the type of toilet facilities in the Ashaiman Municipality. The logistic regression model was used as the method in estimating the drivers of household heads' choice for the type of toilet facilities they select. The findings showed that education level had the strongest support followed by the type of household dwelling unit and both variables were arguably significant in the model. Again, age and tenancy status were also significant in the model. The t-test and chi-square test

results exhibited the relationship choice of toilet facilities had on age and education respectively.

The second objective examined household heads willingness to pay for sewage treatment services in the Ashaiman Municipality. The logistic regression model was again used as a methodology in estimating household heads willingness to pay for sewage treatment services. The findings also indicated; bid, age, choice of toilet facilities, household income and improve farming were significant and had strong evidence to support the argument. The T-test and Chi2 test results exhibited the relationship WTP had on household income, gender and employment status respectively.

Finally, the third objective identify how much household heads in Ashaiman Municipality are willing to pay. The Newey, Lagrange and Cameron non-linear model was used in estimating the average amount of WTP. An average amount of approximately Gh₵ 25 was obtained on annual basis for households WTP for STS.

Conclusion

The study concluded that households' choice of toilet facility was significantly influenced by age, tenancy status, education level and gender. Also, the high you go on the payment vehicle, the lesser the likelihood of household's willingness to pay and improving farming activities in the municipality was key as far as households are going to pay for STS. Again, households' choice of toilet facility was seen to be significant but has little influence on WTP. Meaning the

people of the Ashaiman municipality are very interested in farming activities to improve as far as they are going to pay for STS. Finally, majority of the people living in the Ashaiman Municipality were willing to pay approximately Gh₵ 25 as an amount average on annual basis for sewage treatment services.

Recommendation

Based on the findings, waste management policies and initiatives campaigns should highlight sanitation facilities considering age, tenancy status, education level and gender in encouraging improved toilet facility choices.

Based on the findings, we can deduce that the residents of Ashaiman municipality wants the end product of the STP to be channelled into agricultural activities to boost farm produce. Therefore, it is recommended that the sewage sludge should be used as additives in enhancing farming activities.

Further, looking at the many benefits such as environmental cleanliness; improvement in healthcare; improvement in farming activities; and many more, most of the residents in the community should be education and convinced to understand and support the STS initiative to safeguard human lives and the environment.

Based on the findings, policymakers and service providers including the government and other environmental protection agencies, can effectively put-up pricing strategies which will promote sustainable financing and enhancing public understanding of the significance of sewage treatment for societal welfare and ecological health. Thus, the CVM approach inspires the WTP by providing a more

reliable information for reaching the best appropriate amount suitable for all individuals to pay for STS. The average amount can be used to inform major policy decision on sewages treatment services.

Suggestions For Further Studies

Capitalising on the information and knowledge gained from this study, the following suggestion were arrived at to make room for further studies. Future studies should focus on WTP for STS at the national level. Alao, the study discovered improve farming as a very strong influence on the WTP for STS therefore, other economic factors and developmental factors should be considered in future studies in arriving households WTP and how much. Moreover, the future studies can focus on the double dichotomous bound question of the contingent valuation model to explore households WTP for STS decision in relation to changes in relevant factors affecting WTP.

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APPENDICES

APPENDIX A: Goodness-of-fit Test for Choice of Toilet Facility (Table 5)

Goodness-of-fit test after logistic model
Variable: Toilet Facility
Number of observations = 391
Number of groups = 10
Hosmer–Lemeshow chi2(8) = 7.80
Prob > chi2 = 0.4537

APPENDIX B: Goodness-of-fit Test for WTP (Table 7)

Goodness-of-fit test after logistic model
Variable: WTP
Number of observations = 227
Number of groups = 10
Hosmer–Lemeshow chi2(8) = 1.36
Prob > chi2 = 0.9948

APPENDIX C: Classification Test for Choice of Toilet Facility (Table 5)

Logit model for Toilet Facility

Classified	True D	True ~D	Total
+	232	75	307
-	25	59	84
Total	257	134	391

Classified + if predicted Pr(D) >= 0.5 True D defined as Toilet Facility!= 0		
Sensitivity	Pr(+| D)	90.27%
Specificity	Pr(-|~D)	44.03%
Positive predictive value	Pr(D| +)	75.57%
Negative predictive value	Pr(~D| -)	70.24%
False + rate for true ~D	Pr(+|~D)	55.97%
False - rate for true D	Pr(-| D)	9.73%
False + rate for classified +	Pr(~D| +)	24.43%
False - rate for classified -	Pr(D| -)	29.76%
Correctly classified		74.42%

APPENDIX D: Classification Test for WTP (Table 7)

Logit model for WTP

Classified	True D	~D	Total
+	222	4	226
-	1	0	1
Total	223	4	227

Classified + if predicted Pr(D) >= 0.5 True D defined as WTP != 0		
Sensitivity	Pr(+| D)	99.55%
Specificity	Pr(-|~D)	0.00%
Positive predictive value	Pr(D| +)	98.23%
Negative predictive value	Pr(~D| -)	0.00%
False + rate for true ~D	Pr(+|~D)	100.00%
False - rate for true D	Pr(-| D)	0.45%
False + rate for classified +	Pr(~D| +)	1.77%
False - rate for classified -	Pr(D| -)	100.00%
Correctly classified		97.80%

APPENDIX E: Linktest for Choice of Toilet Facility (Table 5)

Iteration 0: log likelihood = -251.34157
Iteration 1: log likelihood = -193.80244
Iteration 2: log likelihood = -192.74253
Iteration 3: log likelihood = -192.72418
Iteration 4: log likelihood = -192.72417

Logistic regression — Number of obs = 391
LR chi2(2) = 117.23
Prob > chi2 = 0.0000
Log likelihood = -192.72417 — Pseudo R2 = 0.2332

Toilet Facility	Coef.	Std. Err.	z	P>z	[95% conf.	interval]
_hat	0.975	0.125	7.800	0.000	0.730	1.219
_hatsq	0.036	0.058	0.620	0.537	-0.078	0.150
_cons	-0.035	0.154	-0.220	0.823	-0.336	0.267

Source: Ansah (2023)

APPENDIX F: Linktest Test for WTP (Table 7)

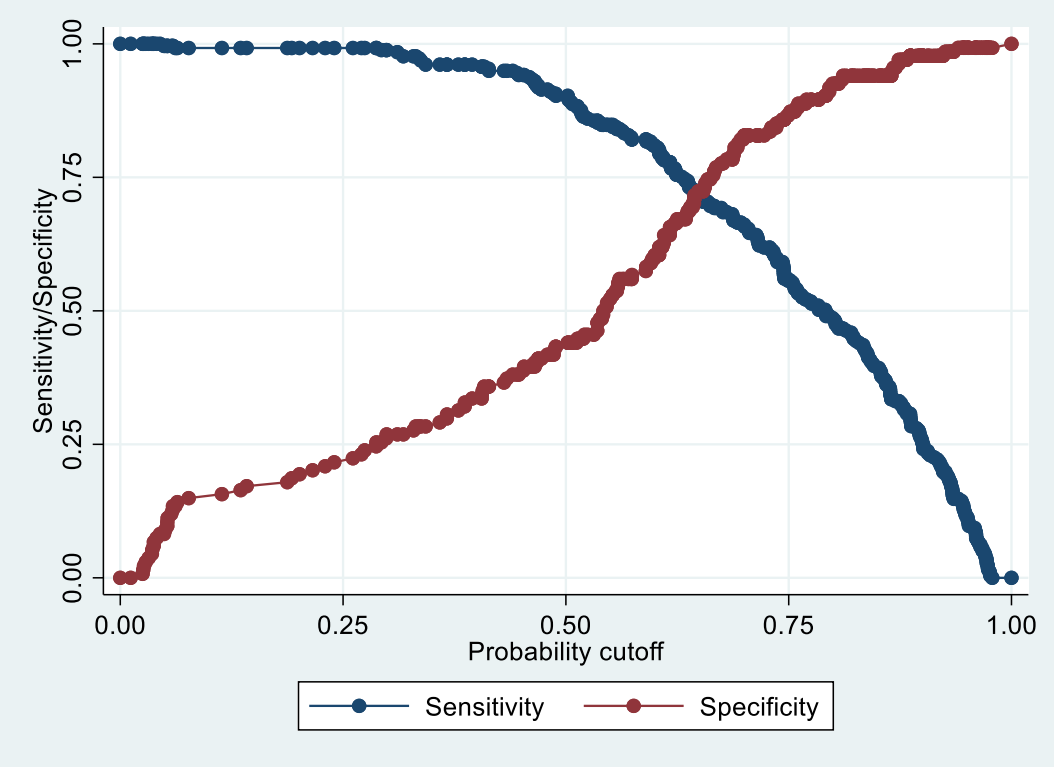
Iteration 0: log likelihood = -20.119171
Iteration 1: log likelihood = -14.554996
Iteration 2: log likelihood = -11.404578
Iteration 3: log likelihood = -11.358455
Iteration 4: log likelihood = -11.338676
Iteration 5: log likelihood = -11.222958
Iteration 6: log likelihood = -11.190505
Iteration 7: log likelihood = -11.190379
Iteration 8: log likelihood = -11.190379

Logistic regression — Number of obs = 227
LR chi2(2) = 17.86
Prob > chi2 = 0.0001
Log likelihood = -11.190379 — Pseudo R2 = 0.4438

WTP	Coef.	Std. Err.	z	P>z	[95% Conf	Interval]
_hat	0.587	1.156	0.510	0.611	-1.678	2.852
_hatsq	0.087	0.242	0.360	0.720	-0.388	0.561
_cons	0.312	1.250	0.250	0.804	-2.140	2.762

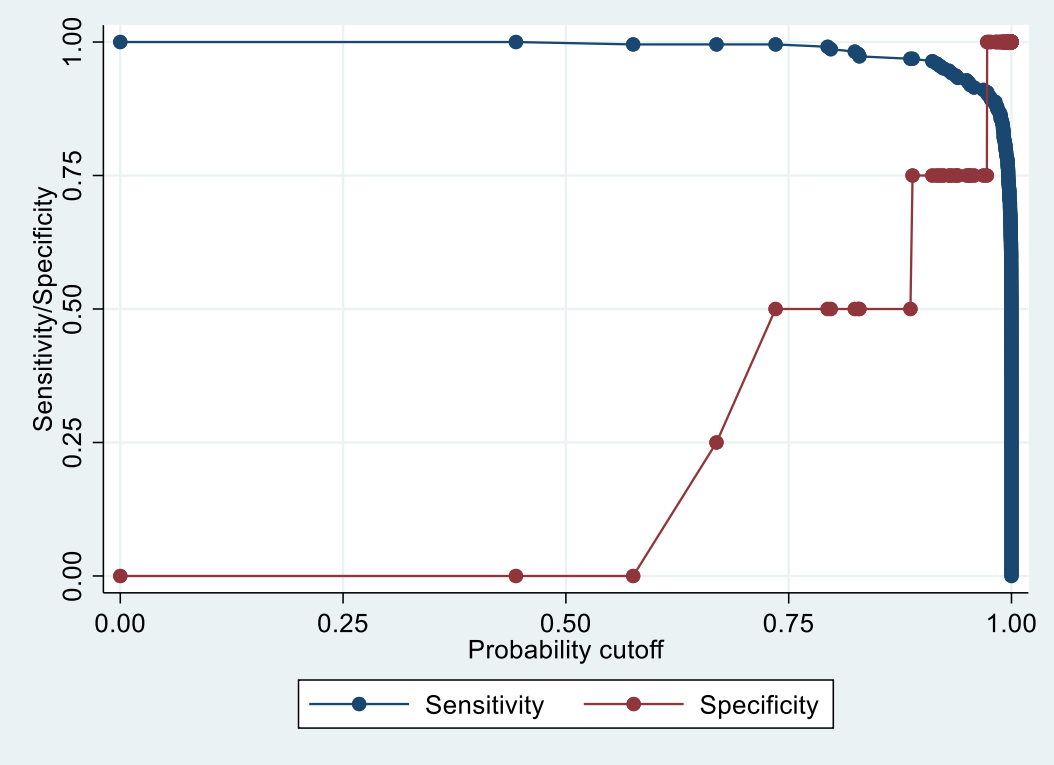
Source: Ansah (2023)

APPENDIX G: Sensitivity and Specificity Graph for Choice of Toilet Facility (Table 5)



Source: Ansah (2023)

APPENDIX H: Sensitivity and Specificity Graph for WTP (Table 7)



Source: Ansah (2023)

APPENDIX I: Pairwise Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1. Toilet Facility	1.000												
2. Age	0.274***	1.000											
3. Household size	0.176***	0.119**	1.000										
4. Employment Status	-0.151***	-0.516***	-0.069	1.000									
5. Tenancy Status	0.319***	0.487***	0.206***	-0.284***	1.000								
6. Education Level	0.207***	-0.111**	0.125**	-0.003	0.040	1.000							
7. Gender	-0.019	0.108**	0.067	-0.073	0.087*	0.378***	1.000						
8. Marital Status	-0.080	-0.023	-0.234***	-0.060	0.016	-0.051	-0.068	1.000					
9. Household Dwelling unit	0.014	0.086*	0.022	-0.055	0.209***	0.084*	0.132**	0.078	1.000				
10. Payment vehicle (Bid)	-0.014	-0.104	0.018	-0.022	0.010	0.002	0.031	0.002	-0.052	1.000			
11. Household Income	-0.074	-0.334***	-0.044	0.699***	-0.171***	0.072	0.068	-0.094*	-0.003	-0.014	1.000		
12. Level of Satisfaction	-0.161***	-0.147***	-0.172***	0.097*	-0.183***	-0.138***	-0.125**	0.014	-0.060	0.017	0.190***	1.000	
13. Improve Farming	-0.003	0.022	-0.058	-0.068	-0.026	-0.127**	-0.053	0.003	-0.154***	-0.002	-0.048	0.216***	1.000

**** p<.01, ** p<.05, * p<.1*

Source: Ansah (2023)