



UNIVERSITY of
RWANDA

**HOUSEHOLDS WILLINGNESS TO PAY FOR SOLID WASTE
COLLECTION SERVICES IN SECONDARY CITIES OF
RWANDA.**

**Thesis submitted in partial fulfilment of the requirements for the degree of
Master of Science in Regulatory Economics and Competition Policy.
College of Business and Economics, University of Rwanda**

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DECLARATION

I declare that this thesis is the result of my own work and has not been submitted for any other degree at the University of Rwanda or any other institution.

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NAHIMANA Elisabeth Marie Constance.

ABSTRACT

Solid waste management is one of the most challenging developmental issues faced by authorities around the world but mostly in developing countries. Rapid urbanisation, population growth and improved living conditions have led to increased volume of solid waste that requires proper management in order to preserve public health and environment. Though the services of solid waste management draw significant portion of municipal budget, municipalities are not yet able to fully cover the required costs of these services due to financial constraints. In most cases, government funding in solid waste management is meant for capital cost of treatment and disposal facilities while costs for collection and operation are generally the responsibilities of local authorities.

This study aimed at determining the households' willingness to pay for solid waste collection services in secondary cities of Rwanda. Using Contingent Valuation Method, a total of 422 households were interviewed to gather information on their willingness to pay. Logistic regression model was used to determine the influence of different factors on households' willingness to pay.

Socioeconomic information showed that 53% of the respondents were male, 69.7% married and 79.9% attained a certain level of education. The majority of respondents (51.95%) fall under the age group of 26-45 years, 279 are employed and the average monthly expenditure was found to be 136,287 FRw. Residents of secondary cities of Rwanda have basic knowledge about solid waste management, they understand the problems associated with uncollected waste and 34% inform that they separate biodegradable from non-biodegradable waste. Two hundred eighty-three respondents showed interest of having professional service provider for solid waste collection and 64.5% of the total respondents suggested a weekly waste collection frequency.

As of the willingness to pay for solid waste collection services, 327 respondents corresponding to 77.49% answered yes and 95 respondents said "no". The average amount that the household would pay per month was found to be one thousand five hundred ninety-six Rwandan Francs (1,596 FRw, almost \$1.5).

The regression analysis revealed that at 5% significant level, age, education level, employment status of household's head, and monthly expenditure of the household have positive and significant influence on the households' willingness to pay for solid waste collection services.

Household's size variable exhibited a negative relationship and significant influence on the households' willingness to pay. On the other hand, gender, marital status and ownership of the house did not have any significant impact.

The study showed that the main reason for not willing to pay for waste collection services is the lack of financial capacity, implying that households need to be financially empowered. Further studies are recommended to determine whether the expressed amount of willingness to pay if scaled to the entire urban population can cover the costs associated with solid waste collection services. Furthermore, cross subsidisation among the rich and poor households should be explored to ensure full coverage of the service.

Key words: Contingent Valuation Method, households, logistic regression, municipalities, secondary cities, solid waste collection, solid waste management, willingness to pay

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CHAPTER ONE: INTRODUCTION

1.1 Background on solid waste management

Solid waste management refers to the collection, transportation, processing or treatment and disposal of waste generated in urban areas (Ashish et al., 2014; Schübeler, 1996). It has four main objectives: to protect the urban public health, to promote environmental conditions and sustainability of urban ecosystems, to support economic development through efficient waste management and to generate employment and income (Hemkendreis and Gudel 2008). To achieve these goals, an integrated approach is being employed for a more sustainable solid waste management. The following figure presents different stages of this approach, which are ranked according to their levels of preference.

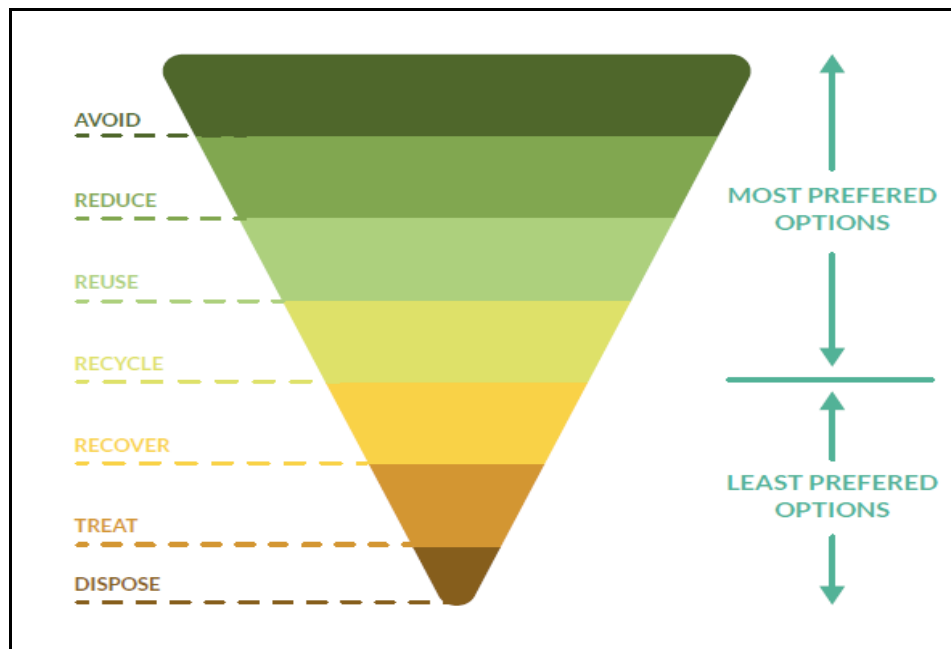


Figure 1: Waste Management Hierarchy. Source: Government of Rwanda and GGGI, 2015

From the figure above, waste management hierarchy gives top priority to waste prevention and minimisation in the first place. As it is inevitable to hundred per cent avoid generating waste, the hierarchy recommends the re-use option as the next step, then recycle waste into new products and energy recovery. The least desired option is waste disposal such as landfill and controlled dumping (DEFRA, 2011; Hoonwerg and Bhada-Tata, 2012).

Solid waste management is one of the most challenging issues faced by many cities in developing countries mainly due to limited resources, generally financial resources, which do not match with ever-increasing volume of waste (Rajesh et al., 2019). This service draws a significant portion of municipalities’ overall budget estimated at 20% in low-income countries, still 90% of generated waste is dumped in open spaces or burned (Silpa et al., 2018). Despite this substantial share of solid waste management, still municipalities are not able to cover the total costs. Their financial capacities are limited and the available funding is generally shared among other essential services (GIZ, 2018; Silpa et al., 2018 and Lohli et al., 2013).

Rapid urbanization, population growth, improved households living conditions and increased consumption of goods and services are directly associated with increased generation of municipal solid waste. (World Bank, 2014). It is estimated that 2.01 billion tonnes of municipal solid waste were generated in 2016 globally and this volume is expected to increase to 3.40 billion tonnes by 2050. Significant increase will be observed in Sub-Saharan Africa and South Asian region.

As presented by the figure 2 below, waste generation is projected to nearly triple from 176 to 516 million tonnes of waste per year in Sub-Saharan Africa if business remains as usual (Silpa et al., 2018). The reason is that cities in this region are urbanising fast and the availability of infrastructure, public utilities and services attract people from rural areas and other cities and countries thus increasing urban population. As the cities become more developed and prosperous, citizens’ welfare improves thus increasing the level of consumption. Consequently, the volume of waste generated also increases.

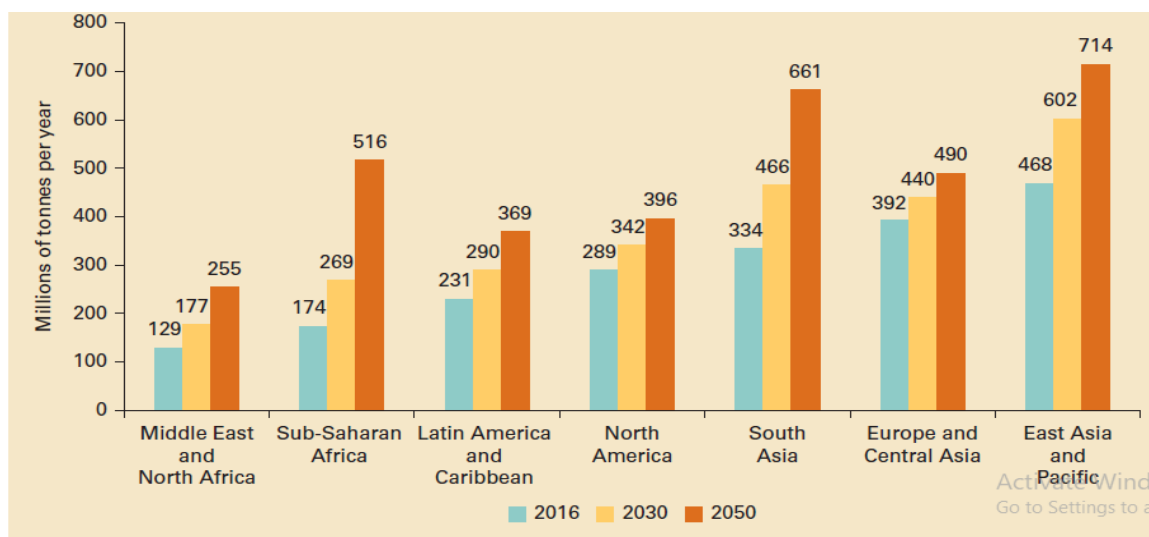


Figure 2: Trend in global solid waste generation. Source: Silpa et al., 2018

In East African urban centres, waste generation rates vary on average from 0.26 kg to 0.78 kg per capita per day in low income and high income areas respectively (Luis, 2012). The difference in waste generation between low and high income is linked to the fact that urban poor communities have little income and are less wasteful in consumption compared to rich families with disposable income and high level of consumption leading to larger volume of waste (Eawag/Sandec, 2008).

Solid waste if not properly managed, has adverse impacts on health, environment and economy of individuals and countries at large. Uncollected waste constitutes a breeding environment of rodents, mosquitoes and other diseases vectors and produces unpleasant odour. Poor disposal of waste such as burning and open dumping generates greenhouse gas emissions that pollute the air and leachate that contaminates both surface and underground water sources. In addition, due to low level of waste recycling and resource recovery, resources are wasted and large space of land is required for waste disposal.

Waste collection is a key component among the functional elements of municipal solid waste management and is the costliest component, typically accounting for 60-70% of total operational costs (UNEP, 2005). The financial constraints make it difficult for all generated waste to be collected and the situation is more problematic in developing countries. The World Bank reports show that collection rates varies from 39% in low-income country, 51% in lower-middle-income countries to nearly 100% in high income countries (Hoornweg and Bhada-Tata, 2012). In Rwanda, access to waste collection service by households is at 42.1% and 0.2% in urban and rural areas respectively (NISR, 2018).

While Government investment through subsidies, donors funding or through partnership with private companies is mainly for capital costs of treatment and disposal facilities, waste collection service costs and other operational costs are borne by municipalities. One of the financing mechanisms being explored by municipalities is through the user fee, which is charged to waste generators to cover waste collection and transportation services cost. The user fee is an important component and has a potential “to reducing the financial burden of solid waste management on municipalities in developing countries” (Oduro-Appiah et al., 2013). This is however, possible if the fee is well studied, applied and administered effectively.

There is no best approach for designing the user fee for waste collection; the ideal principle is to employ approaches that can be easily implemented and controlled by responsible entities.

The study by GIZ (2015) on economic instruments in solid waste management discusses three main approaches by which the user fee is designed.

In industrialized countries, especially where “polluter pays” principle has been adopted, user fee is set based on the quantity of waste generated. This approach is commonly referred to “Pay as you throw” whereby the fee is proportional to the volume of waste generated. Therefore, big waste generators pay more than those who generate less waste.

Cities in low and middle-income countries where systems of constantly weighing waste are not readily available generally use a flat rate tariff; the users are charged the same fee for waste collection services. In other places like Maputo, Mozambique, user fee is set based on social economic categories or utility charges such as water, electricity that are directly linked to income (GIZ, 2015). Some other countries may decide to ensure that all citizens get the waste collection service and this requires that the poorest segment of the society gets the service free of charge. This is the case of South Africa. Other municipalities adopt the approach that everyone pays but with cross-subsidizing pattern where the rich pays more and the poor pays less regardless of the quantity generated (Reka, 2017).

In Rwanda especially the City of Kigali where waste collection is more advanced than in other parts of the country, the user fee for waste collection service is set based on combination of approaches. According to the Regulatory Board Decision, waste collection fee setting considered universal service provision and social economic categories of population with subsidizing pattern: the high income households pay more to subsidise low income households that pay less and the poorest households get the service free of charge. In terms of quantity and frequency wise, the monthly fee is for the collection of two sacs of waste once a week, an extra sac is charged half of the monthly collection fee. The distance from a particular Sector to the dumpsite was also considered. (RURA, 2012).

In other urban centres especially those identified as secondary cities, waste collection services have started but are still at early stage and the Regulatory Authority has not yet established service fee. In cities like Huye and Muhanga, the District Councils issued temporary waste collection charges however, they are not applied in most cases. Generally, the service fee is negotiated between the user and service provider (Global Green Growth Institute [GGGI], 2019) and this practice affects the service provision in terms of quality, coverage and sustainability of service.

Despite the existence of user fees, collection of waste from households in the majority of municipalities in developing countries continues to be challenging, the collection coverage is low and the quality of service is still poor. One of the reasons of underperforming service is the little attention given to public participation in solid waste management (Rajesh et al, 2019). Most of the time, the service fee is set out of good faith without involving service beneficiaries to reflect their preferences.

As per Vision 2020, the Government of Rwanda had set a target of increasing the urban population from 12% in 2000 to 35% by 2020. For this purpose, the second Economic Development and Poverty Reduction Strategy (EDPRS 2) identified Muhanga, Huye, Musanze, Rusizi, Rubavu and Nyagatare as secondary cities to be developed as “*poles of growth and centres of non agricultural economic activities*” (GoR, 2012 & 2013) to promote urban development outside Kigali, the capital city of Rwanda.

The urbanisation of these cities will not only transform the economic geography of the country but also will reduce the pressure on urban and peri-urban land of the Capital City, Kigali. This goes hand in hand with socio economic development of the area and the uplifting of social conditions and wellness of households including access to essential services like solid waste management services. As secondary cities get urbanised and living standards are improved, domestic solid waste generation will increase substantially.

To ensure cleanliness, citizen’s welfare, protection of environment and even making the cities more attractive for business investments, collection and proper handling of generated waste become a requisite not an option. The success of this however, depends on the level of involvement of all actors: waste generators, service providers and local authorities.

The interest of this study is to know how households as major waste generators, are ready to participate in proper solid waste management that requires in first place the removal of waste from the generation point. It is in line with National Sanitation Policy, which emphasizes on service beneficiaries’ involvement in planning and decision making with the aim of choosing the level of service that responds to their needs and capacities (Ministry of Infrastructure, 2016).

Determining households’ willingness to pay for solid waste collection and the factors influencing it is an important aspect to consider while planning for sustainable solid waste management and ultimately urbanisation and economic development of secondary cities of Rwanda. It helps to understand what would be their responses vis-a-vis a new or increased

service fee, their views and expectations in terms of quality of service, collection frequency and timing of collection and all these are useful for organising solid waste collection service. In addition, identifying determinants of willingness to pay provides information about socioeconomic characteristics that need to be empowered in order to increase financial participation of households in improved solid waste management.

The study employed Contingent Valuation Method to depict households' willingness to pay for solid waste collection services while logit model helped in determining how different factors influence this willingness to pay.

1.2 Research problem

Urbanisation, population growth and economic development are associated with increased waste generation. The projections indicate that volume of solid waste generated in Sub-Saharan Africa will triple from 176 in 2016 to 516 million tonnes of waste by 2050 (Silpa et al., 2018). This increase is attributed to the fact that an urbanised area attracts people from rural areas as it offers job opportunities and conducive environment for trade and other income generating activities. Because of increased wealth, the living conditions improve and the level of consumption increases resulting in rise of solid waste generated. This situation obliges Governments and municipalities to put in place a proper solid waste management system in a bid to preserve the environment and public health and promote development.

To achieve this requires a significant investment and the current practice in most developing countries including Rwanda is that the central government funding is mainly for big infrastructure such as treatment and disposal facilities whereas waste collection and other operational costs are borne by municipalities. It is reported that waste collection is the costliest component of the entire solid waste management accounting for 60-70% of the total operational costs (UNEP, 2005).

With limited financial resources generally shared among other basic services such as health and education, municipalities are not able to fully cover the costs of solid waste collection. One of other financing mechanism being explored by a number of countries is the "user fee" where waste generators pay for collection of their waste.

The successful implementation of user fee requires the involvement of service beneficiaries even before the fee setting stage in order to ensure that their expectations are reflected in the organisation of waste management services. Waste collection system cannot sustain itself if the citizens are not interested or not willing to pay. In other words, if the system is designed and imposed without discussing and negotiating with users to consider their needs, it will not perform well (Scheinberg et al., 2010).

One way of capturing users' perception of the service and understanding what would be their reaction towards a particular tariff is to assess their willingness to pay. Without this knowledge, the service cost may either be overestimated and users are charged higher than they can afford or underestimated by setting low user fee that cannot cover the cost of the service. In other cases, users may refuse to pay the fee because there are other unknown or ignored factors that influence their willingness to pay.

The reviewed literatures indicate that households' willingness to pay for solid waste management services was widely explored in a number of countries but with controversy in their findings especially on the determinants of willingness to pay. This shows that the topic is not yet exhausted to conclude that one factor will definitely have similar influence on willingness to pay for solid waste management in different countries or regions.

In Rwanda, studies were carried out in solid waste management field but little is known about households' willingness to pay for solid waste management services. Some of the available works from different researchers provide limited descriptive information about the willingness to pay without deeper analysis of it. They however highlighted that the non-willingness to pay affected negatively solid waste collection in terms of coverage, quality and sustainability of service (GGGI, 2019; Nishimwe, 2016).

If solid waste collection should be full cost recovery using user charges without subsidies and some users do not pay for the service, it will be difficult for the private service provider to ensure hundred per cent collection coverage (serving even those who do not pay). Either the service provider will collect waste for those who pay or try to serve all users but at substandard terms (collection frequency not respected). In either case, the quality, reliability and sustainability of service will be compromised.

The purpose of this research is to determine the households' willingness to pay for solid waste collection services in secondary cities of Rwanda. Knowing the households' willingness to pay and its determinants can help the governments to not only set appropriate fee for waste collection services but also identify socio economic areas that need attention in order to improve solid waste management.

1.3 Research objectives

1.3.1 General Objective

The overall objective of this research project is to determine the households' willingness to pay for solid waste collection service in secondary cities of Rwanda.

1.3.2 Specific Objectives

1. To assess the households' willingness to pay for solid waste collection services;
2. To determine the average amount that the households are willing to pay for solid waste collection services
3. To identify factors that influences the households' willingness to pay for solid waste collection at household level.

1.4 Theoretical and conceptual framework

The assessment of household's willingness to pay for solid waste collection service in secondary cities was based on economic consumer theory that the consumer demand of good is a function of the price of that good and the consumer income. In other words, the consumer choice of a good that gives the highest satisfaction is constrained by his/her disposable income (Hamidiyah et al, 2017; Liebe et al, 2011). For non-market good such as solid waste collection, the price can be predicted from the monetary value that consumer places on that good which is revealed through his/her willingness to pay for that good. Accordingly, the income should be correlated with this expressed monetary value, reason why it is generally considered as determinant of willingness to pay. Assuming that solid waste collection is a normal good, the likelihood that a household is willing to pay for that service will increase as the household's income increases. In this study, household's monthly expenditure was used as a proxy for household's income.

The household's willingness to pay for solid waste collection services can also be affected by the household's knowledge about the importance of having those services and living in a clean environment. Other socio-economic characteristics such as age, education, gender, marital status, employment and household's size are expected to influence the household's willingness to pay. Some characteristics can also influence each other, this is the case where having a certain level of education is assumed to increase the chance of getting employed and having an income.

The below conceptual framework was built to elicit the household's willingness to pay for solid waste collection services in secondary cities of Rwanda and how different factors affect this willingness to pay. Willingness to pay is the dependent variable while socio-economic characteristics are the independent variables.

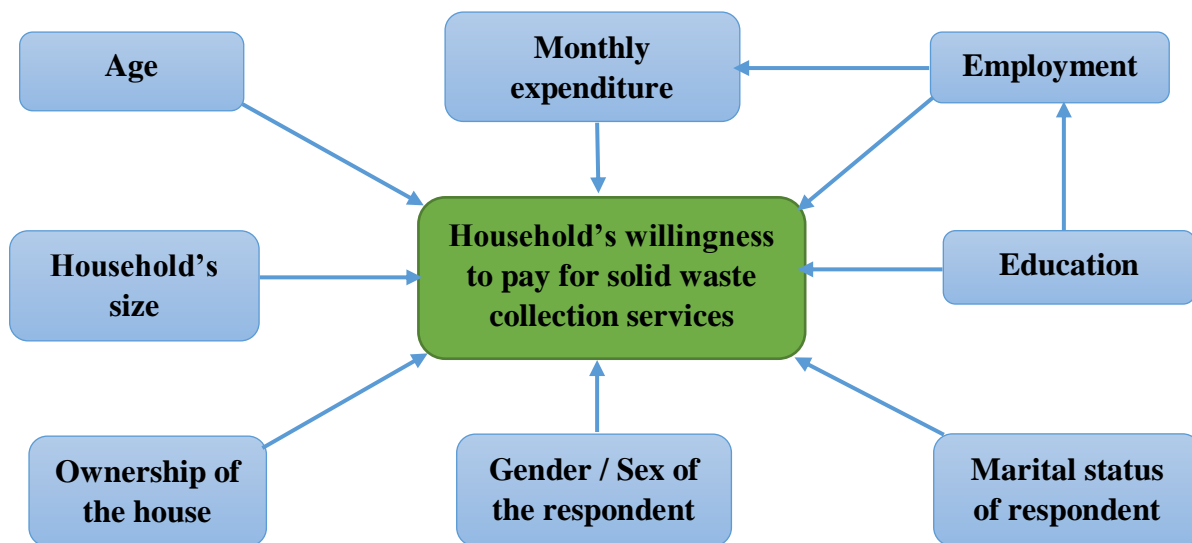


Figure 3: Conceptual framework Source: Adapted from Kassahum & Birara, 2020

1.5 Thesis organization

This thesis is organized into five chapters:

Chapter 1 introduces the study by providing the general overview about solid waste management. Trends in solid waste generation, necessity of proper solid waste management and challenges in financing this sector are briefly highlighted which open the discussion about the need for assessing households' willingness to pay for solid waste collection in secondary cities of Rwanda. The study objectives are also part of this chapter.

Chapter 2 reviews the findings of previous studies on determinants of willingness to pay for solid waste management services.

Chapter 3 highlights the methodology used in this study. Tools for data collection and methods for data analysis are presented in the chapter.

Chapter 4 discusses the findings of this research and Chapter 5 provides the researcher's conclusion and recommendations.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Financing solid waste management continues to be challenging for the majority of municipalities in developing countries. Rapid urbanisation, economic and population growth have led to increase in solid waste generation thus calling for authorities to put in place measures and systems for sustainable solid waste management. In most countries, solid waste management has been decentralised to local authorities and municipalities, with central government support coming in policy making and financing expensive disposal facilities such as landfills. Costs associated with solid waste collection and other operation and maintenance costs are the responsibility of local authorities.

With limited financial resources generally shared among different essential services, municipalities are not able to fully cover these costs. In accordance with “polluter pays” principle, user fee is being implemented where waste generators are charged for solid waste collection services. However, users may resist to pay the fee if it was set without considering how they value the service or whether they are willing and able to pay and factors behind that willingness to pay. Surveys pertaining to households’ perception and willingness to pay for solid waste management provide information on public expectations and the level of their participation as well as acceptance of user charges as a means of funding waste collection services.

The willingness to pay, sometimes referred to as reservation price is defined as the maximum amount of money that consumer accepts to trade for a given quantity of good or service (Wertenbroch and Skiera, 2002). This willingness to pay varies from customer to customer due to extrinsic differences which are observable factors such as age, income, education,...and unobservable factors referred to as intrinsic differences (Stobierski, 2020).

Determinants of willingness to pay also differ depending on prevailing local conditions of a particular region. A number of researchers tempted to investigate determinants of households’ willingness to pay for improved solid waste management services in different countries and their findings show clearly that one factor may have different influence on willingness to pay in different settings. The following paragraphs discuss the findings of different studies on households’ willingness to pay for solid waste management services.

2.2 Empirical literature

Various works employed Contingent Valuation Method to elicit the willingness to pay for waste management services while binary and multiple regression models such as Probit, Logit and Tobit were used to determine how different social economic factors affect the households' willingness to pay.

Generally, all the studies show that the respondents are willing to pay a certain amount for improved services with few being reluctant to pay at different levels. A study conducted in Kampala in 2012 revealed that only 48% of the respondents are willing to pay for improved waste management. The low percentage was attributed to the fact that in 2012, waste management was a new practice and the majority of respondents considered it as the responsibility of the Government (Ojok et al., 2012), thus not willing to pay for that service.

The study by Awunyo-Vitor et al. (2013) had a "Yes response" rate of 57% in Kumasi, Ghana. On the other hand, the studies by Aklilu (2002), Kassahun & Birara (2020) in Ethiopia found that 91% and 86.3% of the households respectively are willing to contribute financially to the improvement of solid waste management conditions. Similar high percentage (95%) of willingness to pay was identified in Madurai, India where the respondents understand that improper solid waste management constitutes health issues especially for children and elderly people (Muniyandi, 2019).

The main reasons for non-willingness to pay include the perception that it is the Government responsibility to provide waste collection services (Murad et al, 2007, Ojok et al., 2012 and Afroz and Muhamad, 2011) especially where these services used to be subsidized. There were also concerns over the quality and reliability of the service (Ezebilo, 2013; Kassahun & Birara, 2020), lack of waste management services and others found it "not necessary to pay for waste while there are other equally important issues" (Awunyo-Vitor et al., 2013).

Regarding the determinants of willingness to pay, studies have contrasting findings around the influences of age, income, education, gender, employment status, satisfaction of the service and household size on the willingness to pay.

Concerning age factor, Veronica et al., 2019 argued that age of household's head positively influences the willingness to pay. This is in line with the findings of Hamdiyah et al., (2017), Murad et al. (2007), Afroz and Muhamad (2011), Nkansah and Kwabena (2015) and Mukarati

et al., 2017. The reason put forward being that older people are very conscious about health and environmental issues and take mature decisions than younger ones.

The above finding however contradicts with the work of Niringiye and Omotor (2010), Dagneu et al., (2012), Raheel (2013) and Ayenew et al., (2019) that showed a negative and significant effect of age on willingness to pay for solid waste management services. This is probably a result that older respondents were accustomed to free disposal of waste or government subsidized services unlike the younger people exposed to cost sharing (Niringiye and Omotor, 2010, Cointreau-Levine and Coad, 2000). Another reason of a negative and significant influence of age on willingness to pay put forward by Ayenew et al., (2019) is that younger people may know and appreciate the importance of solid waste management more than old people.

Increase in household's income is believed to positively influence the willingness to pay for solid waste management. This was confirmed by Murad et al., (2007), Afroz and Muhamad (2011), Ezebilo (2013), Akhtar et al., (2017), Kansah et al., 2015, Dagneu et al., (2012), Kassahun & Birara (2020) and Ayenew et al., (2019) who found that an increase in household's income led to higher willingness to pay for waste management service. This suggests that waste management is considered as normal good as its demand increases with income (Dagneu et al., 2012). As the income increases, the household needs and values more waste management services and hence the willingness to pay for those services increases. In addition, as discussed by Kassahun & Birara (2020), the rise in income increases the purchasing power of the household hence making it easy to afford an additional cost. Veronica et al., (2019) however had a contradicting of a negative and significant effect of increase in income on the willingness to pay.

The study by Amfo-Out et al., 2012 and Veronica et al., 2019 concluded that the level of education of the household head does not have any significant influence on the willingness to pay for improved solid waste management. In contrast, Hamdiyah et al., (2017); Afroz & Muhamad (2011), Ezebilo (2013); Ndaou & Tilley (2018); Awunyo-Vitor et al., (2013) and Kassahun & Birara (2020) discussed that education has a positive and significant impact on household's willingness to pay. This explains that as people get more educated they intend to understand the importance of clean environment hence more willing to pay for removal and treatment of waste.

As for gender, Veronica et al. (2019) in Cameroon, Awunyo-Vitor et al., (2013) in Ghana and Ezebilo (2013) in Nigeria found that women were more willing to pay for waste management services than men. This is in line with tradition that women are responsible for cleanliness and hygiene at household level. Amfo-Out et al., 2012 found that gender has no statistically significant influence on willingness to pay while the study by Afroz and Muhamad, 2011 in Malaysia showed that men are more likely willing to pay for solid waste management services most probably because they are the ones who have reliable income.

Type of housing also has different influences on willingness to pay for solid waste collection services. Veronica et al., 2019 found that this variable has a negative and significant effect on willingness to pay. The researchers suggest that people residing in confined areas such as flats or bungalows with no compound are more willing to pay for waste collection services than those staying in detached houses with enough space to keep the waste. The study of Ezebilo (2013) had a different finding that people in single-family house were more likely to pay for solid waste management than those in multi-family dwelling. This is probably because people in single-family house (detached house) “have more space and potential to generate more quantity of waste and have less incentive to enjoy benefits of services free of charges or with less payment than those in multi-family units” (Ezebilo, 2013).

Galgalo et al., (2019); Ayenew et al., (2019) and Kassahun & Birara (2020) found that the household size negatively influences the willingness to pay suggesting that more children in the house will perform solid waste management activities. Kassahun & Birara (2020) also discuss that the increase in the number of household’s members leads to increase in food and nonfood expenditure. Consequently, more income is needed to fulfil the minimum requirements of the household’s members (Kassahun & Birara, 2020). In this case, the willingness to pay for waste collection service will be low.

This is not the case for Tema in Ghana where Nkansah et al., (2015) found that the household size positively influences the willingness to pay. This postulates that as the number of household member increases, the household will try to keep the environment clean to prevent any disease outbreak that may cause harm to household members. In addition, the finding of Galgalo (2019) may not be applicable to places where waste collection services have to solely be provided by a designated service provider. The household has no other choice than to pay for that service regardless of its members that can do it.

The finding of the study by Niringiye and Omotor (2010) showed that marital status has no significant effect on household's willingness to pay for waste collection services. This contradicts with Ojok et al., (2012) finding that being married has a positive and significant influence on household's willingness to pay for waste management services. This is based on the ground that married people are more mindful of the clean environment than single ones. Raheel (2013) had similar observation that married people are more likely willing to pay than unmarried people.

Other studies considered ownership of the house, satisfaction of provided services and waste quantity as other factors influencing the households' willingness to pay for waste collection services. The study by Dagneu et al., (2012) found that house ownership has a positive influence on willingness to pay for improved solid waste management. Owners of the houses are likely to pay for the removal of waste to keep their property compound clean while those who rent consider the stay as temporal and the willing to engage in additional costs is low.

Ndau and Tilley (2018) found that respondents who are satisfied with current waste management system expressed high willingness to pay that those who are unsatisfied. Amfo-Out et al., (2012) showed that satisfaction about the provided services has no significant influence on the households' willingness to pay for waste management services.

The quantity of waste may also influence the willingness of the household to pay for waste collection services. This was found by Ayenew et al., (2019) while studying about household's willingness to pay for improved solid waste management in Shashemene town of Ethiopia. Concerning the quantity of waste, Niringiye and Omotor (2010) points out that the higher the quantity of waste generated the more the household faces challenges of disposing that waste thus showing a greater willingness to pay for its removal.

In Rwanda, studies carried out in solid waste management looked at other aspects, only few of them briefly mentioned about willingness to pay for solid waste management services, highlighting that the non-willingness to pay the set user fee affected the quality and sustainability of waste collection service.

Using the case of the City of Kigali, Nishimwe (2016) studied the privatisation of solid waste collection services as a tool to sustainable waste management in developing countries. The study showed that private service providers report not being able to attain full cost recovery as intended by the Government for solid waste collection services and 31% of respondent households expressed that they are willing to pay less than what is currently being charged.

Rajashekar et al., (2019) assessed waste management services in Kigali and one of the findings is that only 50-60% of middle income households and 20% of low income households pay for waste collection service. The non-payment is reported to be due to tariffs, which are high for low and middle-income households.

Global Green Growth Institute conducted a situation assessment and potential interventions for solid waste management in secondary cities of Muhanga and Huye Districts and found out that “households are unlikely to use waste collection service due to unaffordability and irregularity of the service”. Also, service providers face financial challenges partly due to low willingness to pay of households (GGGI, 2019).

Despite the fee set by Districts Councils, a number of households claim it to be not affordable. For example in Huye District, the monthly user fee ranges between 2,000 and 3,000 FRw with 16% of respondent households reporting unaffordability. In Muhanga District, the fee is between 1,000 to 4,000 FRw while 22% of households cannot afford it and their reported willingness to pay being 200 to 1000 FRw (GGGI, 2019). The reason attributed to non-willingness to pay is that the fee is not affordable however, there may be other underlying reasons of why households are not willing to pay and why the existing fee is not affordable.

The willingness to pay is assessed in order to know or inform of the potential price that could be given to a non-market good or service. The challenge is then to set price low enough to be affordable by users yet high enough to sustain the provision of the service (Karen and James, 2004). One of the approach to estimate how customers’ preferences would be at different prices is to ask them how much they are willing to pay for the service.

Knowing the households’ willingness to pay may help the municipalities in planning for improved waste collection services. Some surveys showed that citizens are prepared to pay even more for improved service. In Bharatpur, households are willing to pay additional 10–28% on top of what they pay for waste collection service provided at the given date and time in each week (Rajesh et al., 2019). Another study conducted in Ghana revealed that “more than 51% of city households, regardless of the type of collection system, were generally willing to pay a higher fee for better collection services” (Oduro-Appiah et al., 2013).

Sometimes households may not pay for the service not because the fee is not affordable but due to poor quality of service. As an example, in the City of Dar- es Salam, waste management user fee is between 1 and 6 Euro per household per month and it is deemed affordable however, due to poor quality of waste collection service, the user fee collection efficiency is as low as 25% and consequently waste collection coverage is 30-45% (Reka, 2017).

2.3. Overview of literature

The difference in findings discussed above shows that each country, city and community willingness to pay for waste management service may be driven by different factors. It could be misleading to assume that influence of income or any other factor on willingness to pay will be the same in Rwanda as it is in another country or that it is similar among different parts of the same country. The reason is that socio-economic conditions and perceptions of households are diverse and specific for a particular region.

As an example, people in highly populated areas where houses are confined would be likely willing to pay for a more frequent waste collection service than those in a more spaced residential area. The later have enough space to create waste corners for a less frequent collection.

A more sensitized community aware of importance of solid waste management services would be more likely willing to pay for the provision of those services than a community with no knowledge about waste management. In countries like Rwanda where only authorised operators provide waste collection service, households may be more likely willing to pay for that service than where individuals can carry the waste themselves to the disposal site.

Other factors such as ability to pay, perception of the service in terms of quality, age and other socio economic factors may positively or negatively influence the willingness to pay or even have no influence at all. The purpose of the present study was to assess the level of households' willingness to pay for solid waste collection services in secondary cities of Rwanda, determine different factors influencing it and draw similarities and differences in findings of other studies.

CHAPTER THREE: METHODOLOGY

This chapter describes the methodology that was used to carry out this study. According to Kennedy (1982), “methodology means the philosophy of research process”. Research design, study population, sample size, techniques of data collection and methods of data analysis are well explained in this section.

3.1 Research Design

The research design is a plan for the study, used as a guide in collecting and analysing data. It outlines how an investigation takes place and typically includes how data are collected, what instruments are used, how the instruments are used and the intended means for analysing data collected (Churchill, 2002). This study uses quantitative approach to analyse households’ willingness to pay for solid waste collection services in secondary cities of Rwanda, determine how much households are willing to pay and identify factors influencing this willingness to pay.

3.2 Data collection

3.2.1. Study population identification

As defined by Jill and Roger (2003), a population is a group of individuals or a body of people or any collection of items under consideration from which samples are taken for measurement (Jill and Roger, 2003). The target population of this study are the households located within urban boundaries of secondary cities of Rwanda in Huye, Muhanga, Musanze, Nyagatare, Rubavu and Rusizi Districts.

To be able to respond to the research questions and objectives, a representative sample was selected from each of the six cities and a structured questionnaire was administered to randomly sampled households.

3.2.2. Sampling frame and sample size calculation

The research used primary data collected from households in urban areas of secondary cities of Rwanda. The reason being that in urban areas, the demand for solid waste collection is high compared to rural areas where quantity of waste generated is low and households still employ other alternatives of solid waste handling such as composting. To estimate the number of respondent households for the present research, the following Cochran's formula was used (Taherdoost, 2018; Bartlett at al., 2001):

$$n = \frac{p(1-p)z^2}{E^2} \text{ Where: } n \text{ is the sample size to be calculated,}$$

P is the standard deviation which indicates variation among the responses. It is recommended to use P of 50% as "it results in the maximum of variance and produce the maximum sample size" (Taherdoost, 2018).

E is the margin of error and Bartlett (2001) suggests using 5% as margin of error for dichotomous data. Here the confidence level is considered 95% therefore; the margin of error is 5%.

Z known as Z -score is a constant value set based on confidence level. It indicates the number of standard deviation between the value and the mean of the population. At 95% confidence level, Z value of 1.96 is considered.

$$n = \frac{p(1-p)z^2}{E^2} = \frac{0.5(1-0.5).196^2}{0.05^2} = \frac{0.9604}{0.0025} \approx 384$$

Replacing the values in the formula, the sample size $n = 384$

The expected non-response rate of 10% was considered to account for non-response caused by missing respondents or refusal to participate in the survey. Therefore, the initial sample calculated was adjusted with non-response rate and the final sample is 422 households.

The study area was limited to urban area of cities considered as secondary cities of Rwanda. For this purpose, sectors of urban area were first identified and at the second stage only urban cells were identified for data collection. In each cell, the respondent households were picked randomly in order to have a mixed and representative response from all layers of households: high income, middle income and lower income households. Precautions were taken to ensure that no household is questioned more than once.

The original plan was to proportionally distribute the overall sample size of 422 households among the six secondary cities of Rwanda however, data collection was constrained by logistical issues on one hand and the restriction of movements in Districts as pandemic prevention measures on the other hand. As a result, the number of households per city was adjusted as presented in table 1 below taking into account the field organization and logistical constraints.

Table 1: Sample distribution per City

City	Total Number of urban households¹	Original sample size plan	Households per City
Huye	7,791	80	91
Muhanga	4,986	51	40
Rubavu	10,396	106	71
Rusizi	5,037	52	77
Musanze	9,118	93	59
Nyagatare	3,875	40	84
Total sample size	41,203	422	422

Source: NISR, 2012 and primary data

3.2.3 Method and tools for data collection – Contingent Valuation Method

Contingent Valuation Method (CVM) or “stated preference” was employed to elicit households’ willingness to pay for solid waste collection services. This method is used to estimate the monetary value that specific changes in the provision of non-market goods or services represent for the consumers (Carmona-Torres and Calatrava-Requena, 2006). It is called “contingent valuation” because the valuation is contingent on the hypothetical market scenario presented to the respondents.

The CVM method has been used by economists to value environmental goods such as water and sanitation services. It has the advantage over other methods due to its ease of data collection and requirements. It also captures both use and non-use values (Kamshat et al., 2015). The main disadvantages of this method however is that respondents have little incentive to reveal their “true” willingness to pay (Niringiye and Omotor 2010).

¹ According to PHC Census 2012, NISR

In CVM, the respondents are first asked whether they are willing to pay for a given good or service. If the answer is yes, they are then asked how much they are willing to pay from the proposed amounts. There are different CVM procedures for obtaining the amount that the respondent is willing to pay:

- **Open-ended question:** the respondent is asked the maximum amount he/she is willing to pay for the good or service
- **Close-ended procedure:** there are 3 different types of close-ended format:
 - ✓ **Dichotomous choice or referendum:** the respondent is presented with a defined amount and he/she should accept or reject it (Kamshat et al., 2015). It is a “Yes” or “No” response to a predefined price of good or service
 - ✓ **Double bound referendum or dichotomous choice with follow up:** This method consists of asking the respondent whether he is willing to pay a certain amount (X). If the answer is yes, he/she is again asked whether or not he can pay another amount (Y) higher than the starting amount ($Y > X$). If the answer to the starting amount is no, the respondent is asked whether or not he/she can still pay an amount (Z) less than the original amount ($Z < X$).
 - ✓ **Trichotomous choice:** for the provided amount, the respondent is requested to choose from three choices: “Yes”, “No” or “Indifferent”.

The present study used double bound referendum and the starting amount was two thousand (2,000) Rwandan francs. The positive answer to this starting amount led the respondent to be asked whether he/she can pay an increased amount of three thousand (3,000) Rwandan francs. For a “no” answer to the starting amount, the respondent was asked whether he/she is willing to pay one thousand (1,000) Rwandan francs. The bids were closed at one thousand as the minimum and three thousand as the maximum amount.

In case the respondent is not willing to pay for solid waste collection service or the answer to the proposed minimum amount, he/she was asked to choose among the provided reasons for a non-willingness to pay. The survey also included questions that depict socioeconomic characteristics of the respondent households in order to elucidate the factors that affect the willingness to pay of the respondents. During the survey, questionnaires were physically administered by enumerators to the households to gather the required data. The responses are discussed in chapter 4.

3.3 Data analysis

3.3.1 Method of Analysis

The data analysis was done by descriptive statistical method to analyse data into quantitative by showing frequency, percentages and cumulative percentage.

The cross tabulation was used to show the relationship between dependent and independent variables and a binary logistic regression model was used to predict the odds ratios and probability of willingness to pay for waste collection service in secondary cities as well as the relationship between the dichotomous dependent variable and independent variables.

This model was chosen and used because the dependent variable has two categories (willingness to pay, or not). It is the most common type of logistic regression and is often simply referred to as logistic regression (Agresti and Finlay, 2009).

3.3.2 Choice of explanatory variables

Referring to literature, the researcher considered using the following factors to determine their influence on households' willingness to pay for solid waste collection services in secondary cities of Rwanda. Table 2 provides the description of variables as of how they were used in the regression model.

- **Expenditure (X_1):** This is the average monthly expenditure of the respondent household. This is a proxy of household's income and the theory of demand for environmental good assumes that as the income increases, the demand for improved environmental quality becomes high (Tietenberg and Lewis, 2010). It is therefore assumed that households with high monthly expenditure have a significant income and will be more likely willing to pay for solid waste collection services.
- **Age (X_2):** This refers to the age of the respondent in terms of number of years. It is expected that this variable positively influences the willingness to pay as older people are more conscious about clean environment. However, Niringiye and Omotor D. (2010) argue that older people consider waste management service as Government responsibility hence not willing to pay for that service.

- **Education level (X₃):** this refers to the level of education of the respondent. It is hypothesized that individuals that are more educated are more aware and knowledgeable about the benefits of clean environment and hence more likely willing to pay for waste management services.
- **Gender (X₄):** In some traditions where women are responsible for the cleanliness of residential area, households headed by women are assumed to be more willing to pay for waste collection than men. However, due to women empowerment programs that led to women being involved in income generating activities and jobs as men, a different scenario may be observed where sex of household's head may not significantly influence the willingness to pay for waste collection services.
- **Household size (X₅):** This relates to the number of individuals in a household. A larger household with members aware of the consequences of poor solid waste management will be more willing to pay for improved services. On the other hand, there is a possibility that members of the households may decide to share domestic chores including waste management than paying for it (Veronica et al., 2019). In this case, the willingness to pay will be low.
- **Employment status (X₆):** It is expected that people that are employed are more likely to pay for solid waste collection service due to reliable income. This may however depend on the type of employment and other conflicting domestic demands.
- **Ownership of the house (X₇):** People staying in their own house have interest in keeping the surrounding clean hence more willing to pay for the removal of waste than those renting.
- **Marital status (X₈):** It is assumed that married people are more conscious about keeping a clean environment hence more likely willing to pay for waste collection services than unmarried people.

Table 2: Description of variables

Variable	Description	Definition
Willingness to pay	Dummy variable	1 if yes 0 if no
Expenditure	Categorical variable	$\leq 50,000$ $>50,000$ and $\leq 75,000$ $>75,000$ and $\leq 100,000$ $>100,000$ and $\leq 150,000$ $>150,000$
Age	Categorical variable	18-25 26-35 36-45 46-55 56-65 > 65
Education	Categorical variable	No education Primary Secondary University
Gender	Dummy variable	1 if male 0 if female
Household size	Continuous variable	1,2,3,4,.....
Employment status	Categorical variable	Unemployed Private Employed
Ownership of the house	Dummy variable	1 if owned 0 if rented
Marital status	Categorical	Single Married Others (widow or divorced)

Source: Primary data

3.3.3 Empirical model

The purpose of the present research is to assess the households' willingness to pay for solid waste collection services, the amount they are willing to pay and the factors influencing their willingness to pay. The willingness to pay part involves dichotomous responses therefore, the binary logistic regression is appropriate. To determine the factors affecting willingness to pay, logit transformation was done to linearize the non-linear relationship between the dependent variable and explanatory variables (Dale, 2017) hence making the model estimation using Ordinary Least Square (OLS) possible.

The statistical equation is: $Y_i^* = \beta X_i + \varepsilon_i$

Y_i^* is the unobserved dependent variable which measures the difference in utility derived from willing to pay by household i ,

X_i is a set of explanatory variables β is the vector of intercept and coefficients (β_0 and β_i for X_i) and ε_i is the error term.

The answer to the question of whether the household is willing is either “yes” or “no”, therefore the binary logit model was employed to estimate the probability of households’ willingness to pay ranging between 0 and 1. If the household is willing to pay, Y_i takes the value of 1 and zero otherwise. The probabilities that the household is willing to pay (yes) or otherwise (No) are given by:

$$\text{Prob}(yes) = \frac{1}{1 + e^{-\beta X_i}} \quad (1) \quad , \quad \text{then} \quad \text{Prob}(No) = 1 - \frac{1}{1 + e^{-\beta X_i}}$$

$$\text{Or} \quad \text{Prob}(No) = \frac{1}{1 + e^{\beta X_i}} \quad (2)$$

Logit transformation

Dividing equation (1) by equation (2) gives the ratio of the probability of Yes answer to the probability of No answer.

$$\text{Prob (Yes) / Prob (No) = } e^{\beta X_i}$$

Taking the logarithm of the ratio gives the mathematical equation of the households’ willingness to pay

$\text{Ln [Prob (Yes) / Prob (No)] = } \beta X_i$; $Y_i = \beta X_i$ Including the error term gives the statistical model as follows: $Y_i = \beta X_i + \varepsilon_i$

Y_i is the observed households’ willingness to pay, β is the vector of intercept and coefficients that need to be calculated. X_i is the vector of explanatory variables (factors affecting the willingness to pay). ε_i is the error term representing other factors that may affect the willingness to pay but which are not included in our model.

Assuming a normal distribution, WTP for individual i , is modelled as: $\text{WTP}_i (X_i \varepsilon_i) = X_i \beta + \varepsilon_i$
 X_i represents explanatory variables, ε_i is the error term and β represents the coefficients

To determine the mean WTP given, $WTP = \beta_0 + X_1 \beta_1 + \dots + \beta_n X_n + \epsilon_i$

$$\text{Mean WTP} = 1 / \beta_1 * \ln(1 + e^{\beta_0})$$

β_1 is the coefficient associated with the amount, β_0 is the sum of the estimated coefficient associated with the constant and other independent variables multiplied by their mean.

The WTP equation can be written as:

$$\text{WTP} = \beta_0 + \beta_1 \text{Amount} + \beta_2 \text{Income} + \beta_3 \text{Age} + \beta_4 \text{Education} + \beta_5 \text{Gender} + \beta_6 \text{Household size} + \beta_7 \text{Employment} + \beta_8 \text{Ownership of the house} + \beta_9 \text{Marital status} + \epsilon_i$$

The sign of calculated β s indicate how the considered variables affect the probability that the household is willing to pay for solid waste collection services.

3.3.4. Multicollinearity test

Multicollinearity occurs when independent variables in a regression model are correlated. High degree of correlation between independent variables interferes with the fitness of the model and may lead to biased results. As the independent variables increase in correlation with each other, the standard errors of the logit (effect) coefficients become inflated and the solution to the model becomes indeterminate. Multicollinearity issue only affects the reliability of estimates but the regression coefficients remain unchanged. The Variance Inflation Factor (VIF) test was used to detect multicollinearity issue of independent variables. According to Kennedy (1982), a VIF greater than 10 indicates harmful collinearity. When the VIF reaches this threshold, researchers may feel compelled to reduce the collinearity by eliminating one or more variables from their analysis; combining two or more independent variables or perform variable transformation, etc.

3.3.5 Test for linearity among variables and normality of error terms

The logistic regression does not assume a linear relationship between dependent and independent variables and normal distribution of error terms. This study tested the linearity between the dependent variable (Willingness to pay: yes, or no) and the independent variables: age, gender, marital status, education level, employment, expenditures, ownership of house and household size.

3.4 Ethical Considerations

To ensure confidentiality of the information provided by the respondents and to ascertain the practice of ethics in this study, the researcher observed the following: The respondents participated voluntarily in this study, the data were anonymized to keep the confidentiality of the information provided by the respondents. In conducting this study, where there was a use of others ideas and thoughts, the authors were acknowledged, quoted, or cited and referenced.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the results obtained from analysis of data in line with the study objectives of assessing the willingness of households to pay for solid waste collection services and identifying factors influencing the households' willingness to pay for these services in secondary cities in Rwanda. This study used a logistic regression model to describe the probability of willingness to pay and how it is affected by independent variables. Chi-square test was performed to examine the relationship between dependent variable and independent variables used in the model. The results of the regression as well as socioeconomic and demographic characteristics of the respondent households are discussed in the following paragraphs.

4.2 Characteristics of the respondents

This section provides descriptive statistics for variables related to 422 respondents such as age category, gender, marital status, education level, monthly expenditure, household size, ownership of the house as well as location.

4.2.1. Socioeconomic characteristics of respondents

Table 3 provides a summary of descriptive statistics of respondents that participated in this study. The total sample included 224 male and 198 female respondents, respectively representing 53% and 47% of the total study respondents. 69.7% of interviewed respondents were married while 30.3 % were single including 9% who were either divorced or widows.

As of the distribution of respondents by city, 21.6% of respondents were in Huye while Muhanga had the least representation of 9.5% of the total respondents. The majority of respondents, 66% were employed including 43.4 % self-employed and 22.8% employed in Government and other institutions. 34% of the respondents were not employed.

In terms of education level, 337 respondents attained a certain level of education, that is 79.9% of the total respondents out of which 16.6% have primary, 46% have secondary school level and 17.3%, university education level. 20.1% revealed not having any form of education.

The majority of respondents fall in the age group of 36-45 years (30.3%) and those aged above 65 years represent 3.1%.

Regarding the ownership of the house, 55.7% of interviewed respondents lived in rented houses while 44.3% live in their own houses.

Table 3: Socioeconomic characteristics of respondents

Variables	Categories	Frequency	Percentage	Cum.percent
Gender	Male	224	53	53
	Female	198	47	100
District	Huye	91	21.6	21.6
	Rusizi	77	18.3	39.8
	Rubavu	71	16.8	56.6
	Musanze	59	14.0	70.6
	Muhanga	40	9.5	80.1
	Nyagatare	84	19.9	100.0
Marital status	Single	90	21.3	21.3
	Married	294	69.7	91.0
	Divorced/Widower	38	9.0	100.0
Education level	No Education	85	20.1	20.1
	Primary	73	17.3	37.4
	Secondary	194	46.0	83.4
	University	70	16.6	100.0
	Unemployed	143	33.9	33.9
Employment status	Self Employed(Private)	183	43.4	77.3
	Government/Organization	96	22.7	100.0
Age category	18-25	71	16.8	16.8
	26-35	91	21.6	38.4
	36-45	128	30.3	68.7
	46-55	84	19.9	88.6
	56-65	35	8.3	96.9
	Above 65	13	3.1	100.0
House ownership	Renting	235	55.7	55.7
	Owned	187	44.3	100.0
Total		422	100.0	

Source: Primary data, 2020

4.2.2. Monthly expenditure and household size

The respondents were asked about the monthly household expenditure, which was considered as proxy for household income. As presented in figure 4, the responses on monthly expenditure were grouped into five categories. It was found that except in Rusizi, more than 32% of the respondents spend more than hundred fifty thousand Rwandan francs per month.

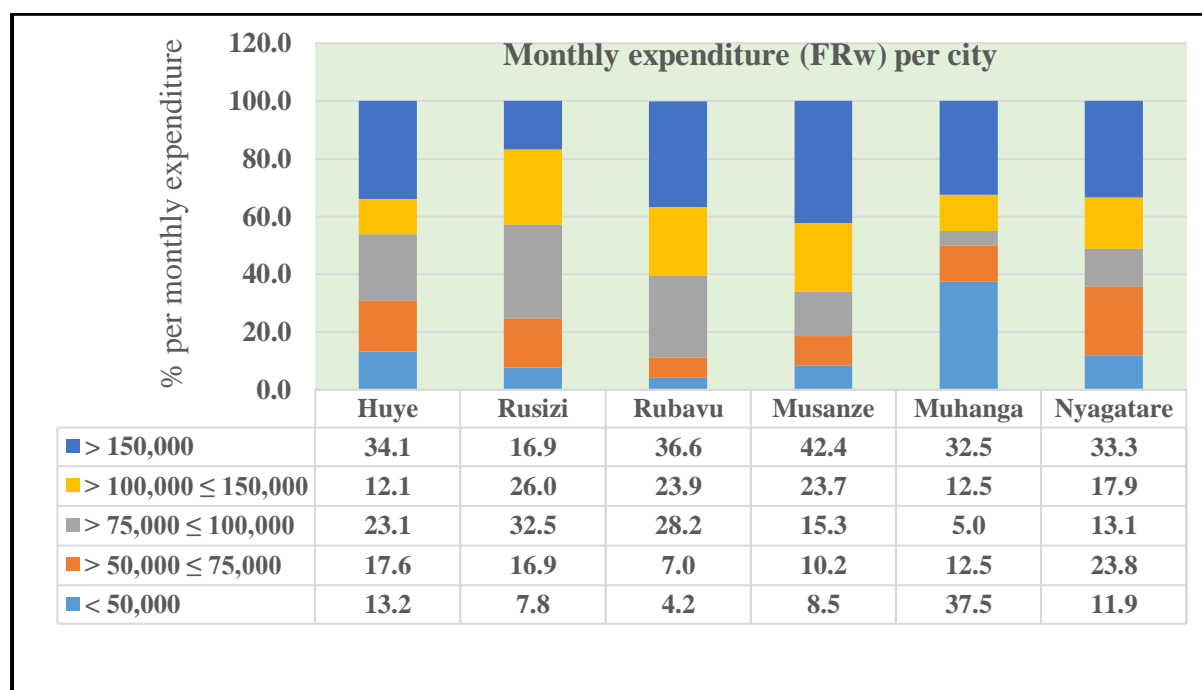


Figure 4: Monthly expenditure per City Source: Primary data, 2020.

The average monthly household expenditure was found to be 136,287 Rwf with Musanze and Rubavu having the highest expenditure compared to other cities. This can be attributed to high agricultural productivity and touristic potentials of these cities. Households in Rusizi presented the lowest monthly expenditure. The average household's size was 4.2; Muhanga and Nyagatare were found to have the lowest household size compared to other cities. Table 4 presents the summary of the statistical information about average household monthly expenditure and household size.

Table 4: Mean monthly expenditure and average household size

District	Mean Monthly Expenditure (FRw)	Average Household Size
Huye	144,069	4.3
Rusizi	115,338	4.7
Rubavu	156,746	4.8
Musanze	159,915	4.3
Muhanga	121,300	3.1
Nyagatare	120,308	3.8
All sample	136,287	4.2

Source: Primary data, 2020

4.3 Solid waste management practices

4.3.1 Sorting and disposal of domestic solid waste

The study considered asking respondent households on how they treat their solid waste and what they think can be done in order to address problem that may be caused by the fact that waste is not removed from household compound. Asking about existing waste management practices was purposely to introduce the willingness to pay section of the questionnaire. Regarding waste sorting; only 34% of the respondent households said that they segregate biodegradable and non-biodegradable waste while 66% do not separate waste.

A significant portion of biodegradable waste (67.1%) is collected and disposed to the dumpsite and 18.2% is composted and applied to farmlands, which are still available at the verge of town centres. This is one of the motivations for separating decomposable waste from non-biodegradable waste. It was also informed that some waste such as banana and potato peels as well as food leftovers are given to pigs. Non-biodegradable waste of a proportion of 79.7% is mainly disposed of at the dumpsite.

It was noted that some households still have individual pits for waste disposal while others still employ practices that are not allowed such as burning and disposing solid waste into pit latrines. These practices, though at low scale (7.7% for burning and 0.7% thrown into pit latrines) should be discouraged and eradicated completely as they have side effects on environment and public health.

Concerning non-separated waste, table 5 below presents the responses of households on the means of disposal of waste. Still, disposal of waste into pit latrine, burning and throwing waste in undeveloped areas and forest were observed.

Table 5: Existing solid waste disposal practices

Means of disposal	Frequency	Percentage	Cumulative %
Separate waste pit	44	15.8	15.8
In the farm	55	19.7	35.5
In the toilet	3	1.1	36.6
Dumpsite	30	10.8	47.3
Waste collectors	138	49.5	96.8
Other	9	3.2	100.0
Total	279	100.0	

Source: primary data, 2020

It was observed that systematic solid waste collection by official service provider has started in secondary cities of Rwanda but still at low scale as confirmed by 30 responses of waste being taken to dumpsite. It is to be noted that the reported waste collectors include individuals collecting specific type of waste such as banana peels and food waste for pigs and leave other waste behind.

The low level adoption of waste collection service indicates that households still prefer non-payable waste disposal practices to those services provided by a recognised private operator. As a result, the collection coverage is very low, waste may be disposed off in unacceptable sites and the employed alternatives for waste disposal may put the users' life at risks, cause other negative impacts on environment and public health thus interfering with the overall government plan of developing these cities.

4.3.2 Consequences of keeping waste at home

The survey showed that 94.5% of respondent households are aware of the problems associated with keeping waste at home for a long time. The main identified issue is untidiness of the compound, responded by 54.9% of households. Other problems include breeding environment of disease vectors and unpleasant smell.

Table 6: Responses on issues related to keeping waste at home

Any problem to keep wastes at home for a long time	Frequency	Percentage	Cumulative %
No	23	5.5	5.5
Yes	399	94.5	100
Issues			
Untidiness	219	54.9	54.9
Bad/Unpleasant smell	84	21.1	75.9
Disease vector	74	18.6	94.5
Air, water and soil pollution	22	5.5	100.0
Total	399	100.0	

Source: Primary data, 2020.

The study also asked the households about the possible solutions and measures to be put in place in order to address the above identified problems of keeping solid waste at home.

Table 7 highlights the suggested solutions with majority of respondents (67.1%) proposing to have a service provider to collect waste from home. The suggestion that the Government should provide appropriate landfill, which was given by 27.7% of the respondents also implies that there should be waste collection services. It was observed that respondent households are not aware of solid waste recycling and resource recovery. This is indicated by a low percentage (5.2%) of respondents proposing compost making and production of animal feed from biodegradable waste.

Table 7: Suggested solutions to avoid problems of non-collected waste

Suggested Solutions	Frequency	Percentage	Cumulative %
To avail appropriate dumpsite	117	27.7	27.7
To employ waste collection service provider	283	67.1	94.8
Other solution	22	5.2	100.0
Total	422	100.0	

Source: Primary data, 2020

All interviewed households were asked about what could be the frequency of solid waste collection. 272 respondents representing 64.5% said that waste should be collected once a week, 26.5% proposed a collection frequency of once a month, 5% twice a month and 4% suggested that waste be collected every day. The choice of waste collection frequency depends not only on the quantity of waste generated but also on whether the household employs other waste disposal alternatives. The household composting its biodegradable waste and keeps only non-putrescible waste would prefer a less frequent collection than the household that does not have alternative for disposal of both types of waste.

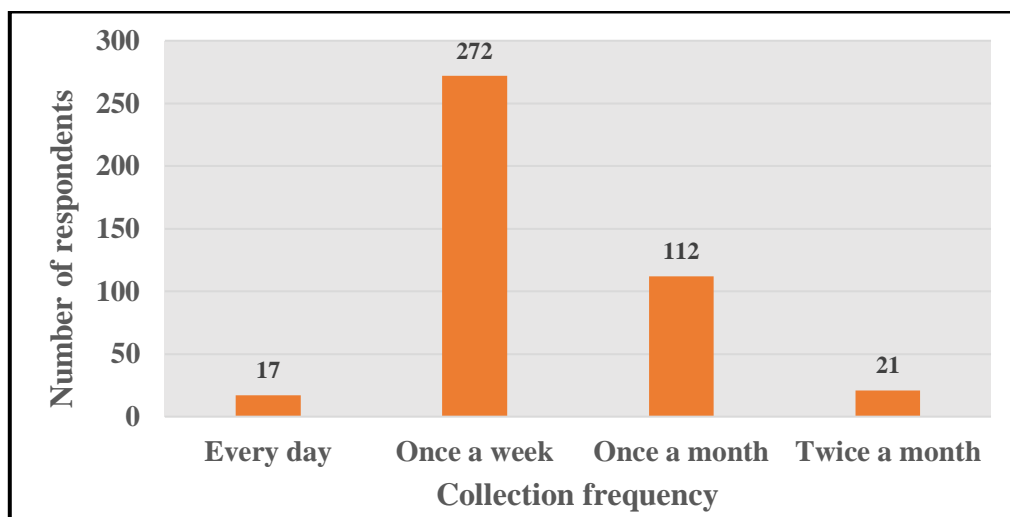


Figure 5: Proposed waste collection frequency

Source: Primary data, 2020

4.4 Households’ willingness to pay for solid waste collection services

4.4.1 Willingness to pay

The main objective of this study was to know whether the households in secondary cities of Rwanda are willing to pay for solid waste collection services and how much they are willing to pay in case there is a private operator to provide those services. For the first stage, the respondent would answer “yes” for willingness and “no” for non-willingness to pay. As presented in table 8, the results of the survey showed that 327 respondents corresponding to 77.49% are willing to pay for solid waste collection services while 95 households representing 22.51% reported not willing to pay for the services.

Table 8: Willingness to pay responses per City

City	Total number of respondents	Willingness to pay			
		Yes responses	Percentage	No responses	Percentage
Huye	91	67	15.88	24	5.69
Rusizi	77	56	13.27	21	4.98
Rubavu	71	57	13.51	14	3.32
Musanze	59	50	11.85	9	2.13
Muhanga	40	23	5.45	17	4.03
Nyagatare	84	74	17.54	10	2.37
Total	422	327	77.49	95	22.51

Source: Primary data, 2020

Figure 6 below shows the frequencies of different reasons for the non-willingness to pay; limited financial capacity and use of other methods for waste disposal are the main reasons. Lack of trust in the quality of service delivered by waste collection service providers, consideration of waste collection as a government responsibility were also identified as reasons for resisting to pay for solid waste collection.

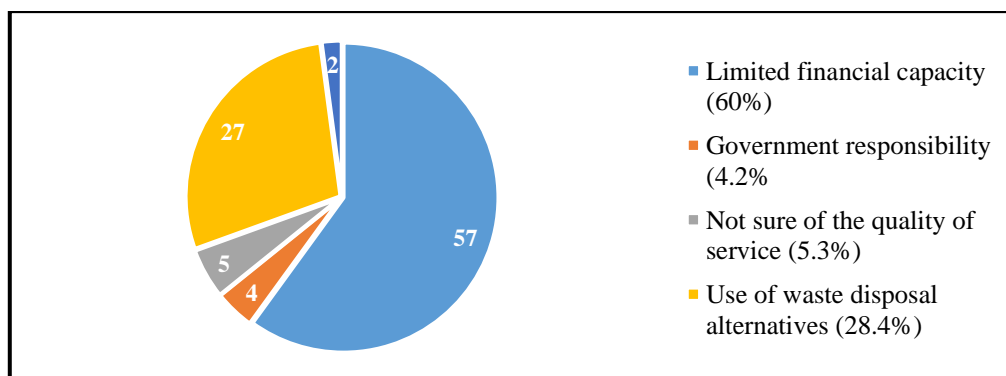


Figure 6: Frequencies of non-willingness to pay reasons Source: Primary data, 2020

4.4.2. Average amount of willingness to pay

The respondents who expressed the willingness to pay for waste collection services were asked how much they would pay per month. The starting bid was two thousand (2,000) Rwandan francs, a yes answer led to asking about an increased amount (3,000 FRw) while those who answered no to the starting bid were offered a less bid of one thousand (1,000) Rwandan francs. The detailed respondents' reactions towards the amount to pay for waste collection services are presented in figure 7 below.

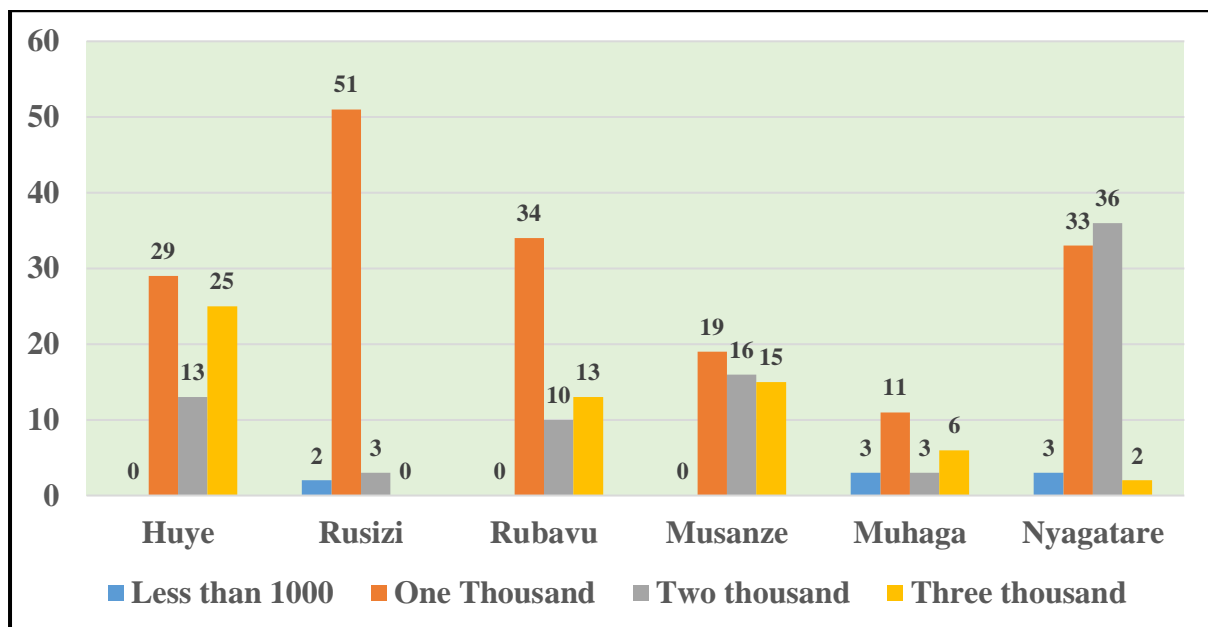


Figure 7: Responses of willingness to pay amount per City Source: Primary data, 2020

Generally, the amount of money that consumers would willing to pay for a given service depends on their income, the importance, the quality and need for that service. The existence of alternatives as well as the level of awareness about the service may also affect the value that consumers place on the service. The overall average amount the households are willing to pay for solid waste collection service in secondary cities was found to be around one thousand six hundred Rwandan francs (precisely 1,596 FRw). As indicated by table 9, the highest mean amount was identified in Huye (1,940 FRw) and Musanze (1,920 FRw) while the lowest mean amount was observed in Rusizi (1,018 FRw).

Table 9: Average amount of households' willingness to pay for waste collection service

District	Average amount willing to pay	% of households willing to pay				Total
		Less than 1000	One Thousand	Two Thousand	Three thousand	
Huye	1,940	0.0	8.9	4.0	7.6	20.5
Rusizi	1,018	0.6	15.6	0.9	0.0	17.1
Rubavu	1,632	0.0	10.4	3.1	4.0	17.4
Musanze	1,920	0.0	5.8	4.9	4.6	15.3
Muhanga	1,522	0.9	3.4	0.9	1.8	7.0
Nyagatare	1,500	0.9	10.1	11.0	0.6	22.6
Total	1,596	2.4	54.1	24.8	18.7	100.0

Source: primary data, 2020

This study found that the majority (54.1%) of the household favoured one thousand Rwandan francs as the price for the service, 24.8 % agreed to pay a fee of two thousand and 18.7% would pay tree thousand Rwandan francs on condition that they get high quality service. It was also noted that few households representing 2.4% of the respondents were willing to pay but a less amount than one thousand Rwandan francs.

4.5 Determinants of households' willingness to pay for solid waste collection services

4.5.1 Regression Models Assumption

4.5.1.1 Multicollinearity test

From table 10, the results revealed that there was no problem of multicollinearity among independent variables, since in all cases, the VIF is less than 10. Therefore, there is no correlation between independent variables used in the model.

Table 10: Multicollinearity test

Independent variables	VIF	1/VIF
Education level	1.73	0.578
Employment Status	1.51	0.662
Age	1.39	0.717
Expenditures	1.37	0.730
Marital Status	1.35	0.738
HH size	1.28	0.784
Ownership of House	1.14	0.879
Gender	1.05	0.956
Mean VIF	1.35	

Source: Primary data, 2020

4.5.1.2 Linearity test

The results from table 11 show that the largest correlation coefficient is 0.49 which is recorded between employment status and the willingness to pay. Thus, there is no variable which exhibits strong linear association with dependent variable. All correlation coefficients are different from zero, in other words this implies that all variables can be used in the model.

Table 11: Variables correlation matrix

Variables in model									
Willingness to pay	1.00								
Age	0.02	1.00							
Gender	0.06	0.05	1.00						
Marital Status	-0.18	0.47	-0.04	1.00					
Employment Status	0.49	0.05	0.14	-0.02	1.00				
Education level	0.41	-0.12	0.17	-0.21	0.55	1.00			
Household size	0.05	0.26	0.09	0.10	0.13	0.04	1.00		
Ownership of House	-0.07	0.22	0.03	0.18	-0.01	-0.07	0.29	1.00	
Expenditures	0.46	0.05	0.06	-0.09	0.33	0.42	0.30	0.02	1.00

Source: Primary data, 2020

4.2.5.1.3 Test of association between the dependent and independent variables

The empirical studies reviewed on determinants of willingness highlighted economic status, demographic characteristics of the households among the key factors. The test of independency was performed to ensure that all independent variables used in the model are not dependent with each other.

Table 12: Chi square test of independency of variables

Variables in the Model	Chi square values	Df	Asymp. Sig. (2-sided)
Age of respondents	26.66	5	0.000
Gender	1.47	1	0.023
Marital status	19.30	2	0.000
Employment	100.98	2	0.000
Education level	173.47	3	0.050
Household size	21.72	11	0.027
Ownership of House	1.92	1	0.017
Expenditures	244.89	76	0.000

Source: Primary data, 2020

At 5% level of significance, the results indicate that there is association between willingness to pay and the following predictor variables. Hence, all independent variables are used in the model.

4.5.2 Logistic Regression Model

The Binary logistic regression analysis was used to find out the factors influencing the households' willingness to pay for solid waste collection in secondary cities in Rwanda. Table 14 presents the results of a binary regression odd ratios in relation to the willingness to pay for waste collection in secondary cities. All variables were used in the model as they were found to be statistically significantly correlated. The variables are re-examined to identify those which are statistically significant determinants of willingness to pay for waste collection in secondary cities of Rwanda.

4.5.2.1 Overall model fitness test

In this study, the considered level of significant is 0.05. If the "Prob > chi²" or P-value is greater than 0.05, the chi-square is statistically significant and the null hypothesis is true. This means that the independent variables do not influence the dependent variable. If the "Prob > chi²" or

P-value is less than 0.05, the chi-square is not statistically significant and the null hypothesis is rejected. In this case, independent variables have influence on the dependent variable.

Table 13: Model fitness test

Logistic regression	Number of obs	=	422
	LR chi2(8)	=	252.28
	Prob > chi ²	=	0.000
Log likelihood = -101.42104	Pseudo R ²	=	0.56

Source: Primary data, 2020

The results of fitness test presented in table 13 above show that the P-value is less than 0.05 indicating that the model is statistically significant. In other words, the independent variables (age, gender, household size, ownership of the house, education, employment and marital status) taken altogether correctly predict the regression model. The value of Pseudo R² of 0.56 indicates that 56% of the variation in the willingness to pay is caused by independent variables and the remaining 44% is due to other factors not considered in the model.

4.5.2.2 Determinants of households' willingness to pay

The value and signs of calculated coefficients indicate how the considered independent variables influence the willingness to pay for solid waste collection services. However, the statistically significance of influence is confirmed by the probability value. The present study used a significant level of 0.05 and any P-value below 0.05 implies that the independent variable associated to this P-value has positive or negative significant influence on the dependent variable. For numerical variables such as expenditure, education, age,...a positive sign of the coefficient connotes that an increase of one unit of the variable will increase the chances that the household is willing to pay for solid waste collection while the negative sign show a decrease in the chances of the household to pay for the services.

A binomial logistic (logit) regression was run to understand the effects of age, gender, education level, monthly expenditure, employment, marital status, household size and ownership of the house on the households' willingness to pay for waste collection service in secondary cities of Rwanda. Table 14 summarizes the results of this regression.

Table 14: Logistic regression model of factors affecting households' willingness to pay.

Variables in the Equation	Coef (β_i)	Std. Error	Odd Ratio	[95% Conf. Interval]		P.Value (coef.)
Age	0.393	0.252	1.481	1.061	2.068	0.021
Gender	-0.264(**)	0.296	0.768	0.361	1.635	0.494
Marital Status	-0.372(**)	0.268	0.689	0.322	1.475	0.338
Employment	1.468	1.677	4.341	2.036	9.256	0.000
Education level	2.256	4.402	9.547	3.867	23.569	0.000
Household size	-0.318	0.074	0.728	0.597	0.887	0.002
Ownership of House	-0.202(**)	0.337	0.817	0.365	1.832	0.624
Monthly Expenditures	1.310	0.682	3.705	2.582	5.316	0.000
Intercept	-3.791	0.023	0.023	0.003	0.162	0.000

(**) Not statistically significant because P-value (alpha) is greater than 5%. Source: computed from primary data collected in 2020. Dependent variable: Willingness to pay (1=Yes, 0=not)

Source: Primary data, 2020

At 5% significance level, age, employment, education level, expenditure and household size were found to be statistically significant meaning that they influence the willingness of the household to pay for solid waste collection services. The probability linked to gender, marital status and ownership of the house is higher than 0.05 indicating that these variables do not have effect on the households 'willingness to pay.

The results of logistic regression presented in table13 were interpreted based on the signs and values of statistically significant coefficients (β_i) associated with independent variables. The following paragraphs discuss individual variables that were found to significantly influence the households' willingness to pay for waste collection services at 5% significant level.

The results indicate that age, education level, employment and monthly expenditure have positive and statistically significant effect on the probability that the household is willing to pay for solid waste collection while household size exhibits negative and statistically significant impact. On the other hand, gender, marital status and ownership of the house do not have any significant influence on households' willingness to pay for solid waste collection services.

Age

The age coefficient has a positive sign (0.393) and is statistically significant. This literally means that, holding other factors constant, an increase of one year in age causes the probability of willingness to pay to increase by 0.393 times. This implies that as people grow older their willingness to pay for waste collection services increases. This confirms the findings of the study conducted by Veronica et al., 2019 in Cameroon, Hamdiyah et al., (2017) in Ghana and Murad et al., (2007). Similar results were also reported by Afroz and Muhamad (2011), Nkansah and Kwabena (2015) and Mukarati et al., 2017.

As people get older, they become conscious about the health issues associated with unclean environment, they are anxious of getting sick easily due to their advancing age. Also, in most cases, old people have secure income and stable life and find it easy to incur additional cost therefore they are more willing to pay for waste collection services than young people who may still be at school or struggling to get stable employment and earning.

Employment

The coefficient associated with employment exhibits a positive and statistically significant effect on households' willingness to pay for waste collection services. In this study, employment status included self-employed respondents and those employed by public or private institutions. The results in table 14 above show that willingness to pay is increased by 4.3 times more when the households' heads are employed than unemployed households' heads. Employment coefficient has a positive sign and it is statistically significant (P-value = 0.000) meaning that keeping other factors constant, being employed positively increases the households' willingness to pay by almost 1.5 times.

The results confirm the expectation and can be explained by the fact that employment offers a regular and reliable income hence increasing the chances that the household would be willing to pay for waste collection services. Similar observation was made by Amfo-Otu et al., (2012) but it contrasts with the finding by Veronica et al., 2019 and Nkansah et al., 2015 of a negative and significant influence of employment on households' willingness to pay for waste management services.

Education

As expected, the coefficient of education level variable shows a positive and significant relationship between respondent education level and willingness to pay. It was observed that an additional year to education level increases the households' willingness to pay for waste collection services by 2.256 times keeping other factors unchanged. The odd ratio indicates that educated people are willing to pay almost 10 times (9.547) more than people with no form of education. This corroborates the findings of Nkansah et al., 2015; Zerbock (2003); Hamdiyah et al., (2017); Kassahun & Birara (2020); Afroz & Muhamad (2011); Ezebilo (2013) and Ndau & Tilley (2018).

Positive and significant influence of education level on the willingness to pay insinuates that educated people understand the importance of proper waste management and seek to live in healthy and clean environmental conditions, hence more willing to pay for solid waste collection services. Moreover, higher education level is generally linked to higher possibilities of getting a well paying job with reliable income.

Expenditure

In this study, the monthly household expenditure was used as proxy for monthly household income. This was done in order to avoid getting false responses about household income as in most cases people are reluctant to reveal their real income. It is more easier for them to say how much money they spend than how much they earn. Also, economic theories state that expenditure is positively associated to income, the more income the more expenditure.

The coefficient of expenditure revealed a positive relationship and significant influence on households' willingness to pay at 5% significant level. Keeping other factors the same, one unit increase in expenditure increases the likelihood of the household willing to pay for solid waste collection services by 1.310 times. People who spend more probably earn more and are likely to generate more waste that need to be collected. This is in line with the theory of demand for environmental goods that as the income increases (so does the expenditure), the demand for improved environmental quality becomes high (Tietenberg and Lewis, 2010) hence high willingness to pay for waste management services.

The results meet the expectation that households with high monthly expenditure are more likely to have a high willingness to pay for solid waste collection than the households with low monthly expenditure.

Studies by Hamdiyah et al., (2017) in Ghana, Murad et al., (2007) in Malaysia and Afroz and Muhamad (2011), Kassahun & Birara (2020) in Ethiopia and others also found similar positive and significant impact of household's income to its willingness to pay for waste management services.

Household size

It was assumed that a larger household with members aware of the importance of waste management would be willing to pay for solid waste collection. However, the results showed a negative and significant impact of household size on willingness to pay. At 5% significant level, the coefficient for household size variable was found to be -0.318 with a P-value of 0.002 and odd ratio of 0.728 . This means that one additional member to the family will cause the household's willingness to pay to decrease by 31.8% .

Ezebilo (2013), Raheel (2013) and Kassahun & Birara (2020) had similar finding that an increase in household size reduces the household willingness to pay for waste management services. This is partly due to the fact that the household's members may decide to share home chores including the removal of waste but also as the members of the household increase and the disposable income remains the same, it is difficult for the household to incur additional costs such those associated with solid waste collection services (Raheel, 2013).

The results of logistic regression showed that variables such as gender, marital status and ownership of the house do not have any significant influence on households' willingness to pay for solid waste collection services in secondary cities. This is indicated by coefficients P-values (0.494 , 0.338 and 0.624 respectively) which are higher than 0.05 . The results inform that the fact that the respondent is a male or female, married or not married, owns the living house or not does not affect the household's willingness to pay and this is applicable to Rwandan context where the communities are sensitized about keeping the neighbourhood clean.

Also, women are empowered to equally engage in other economic activities like men therefore, cleanliness of the house is no longer a task for women or men only. Regarding gender referred to sex in some studies, Dagneu et al., (2012) and Amfo-Otu et al., (2012) had similar finding that sex of household's head has no significant influence on willingness to pay. In their research, Mulat et al., (2019) also found that marital status and ownership of the house have no significant impact on the willingness to pay for improved solid waste management in Ethiopia.

CHAPTER FIVE: CONCLUSION AND SUGGESTIONS

Solid waste management is one of the challenges faced by local authorities mainly due to limited financial capacity. Generally, Government funding serves as capital investment for big projects like construction of solid waste treatment facilities (landfill, recycling centres,...) but solid waste collection costs and other operation costs are borne by municipalities. One of the financing options being explored is the public participation through user fee for solid waste collection services.

The present research studied the households' willingness to pay for solid waste collection services in secondary cities of Rwanda located in Huye, Muhanga, Musanze, Nyagatare, Rubavu and Rusizi Districts. Specifically, the study aimed at determining whether households in urban areas of these Districts are willing to pay, what is the average amount they would pay and what are socioeconomic factors that influence the households' willingness to pay for solid waste collection services factors.

Using Contingent Valuation Method, 422 households selected randomly in those 6 cities were interviewed to collect information about their willingness to pay. Logistic model was employed to determine the influence of age, gender, education, employment, expenditure, marital status, household size and ownership of the house on the willingness to pay for solid waste collection services. The following paragraphs summarize the study findings and provide suggestions for future researches and policy making in solid waste management.

5.1 Summary of findings

5.1.1 Socioeconomic characteristics of respondents

The analysis of socioeconomic characteristics of the respondents showed that 53% of the respondents were male while women represented 47%; 69.7% were married and 30.3% were single including divorced and widows. 337 respondents representing 79.9% of the total interviewees had a certain form of education with 17.3% having attained university level. The majority of respondents (51.95) fall under the active age group of 26-45 years. 55.7% of the interviewed people lived in their own houses, 279 are employed with self-employment counting to 65.6% of the recorded employed respondents.

The average monthly expenditure was found to be 136,287 FRw with the highest average amount observed in Musanze (159,915 FRw) and Rubavu (156,746 FRw). The lowest average monthly expenditure of 115,338 FRw was recorded in Rusizi. The mean household size was found to be 4.2 members per household.

5.1.2 Solid waste management practices

The study showed that residents of secondary cities of Rwanda have a certain level of awareness about solid waste management. It was even observed that waste collection has started though households' participation is still low. 143 respondents (34%) informed that they separate waste into biodegradable and non-biodegradable waste and 18.2% compost biodegradable waste for application to agricultural land. Non-biodegradable waste is mainly disposed off at Districts' dumpsite.

The study however, found some households (8.4%) who still use improper waste disposal means such as open burning and disposing waste into pit latrines and undeveloped plots. Respondents were also aware of health issues associated with keeping waste for a long time. Untidiness, bad smell and breeding environment for disease vectors were the main issues raised by 94.5% of the respondents. 283 respondents supported the idea of having a professional service provider for solid waste collection and 64.5% of the total respondents suggested a weekly waste collection frequency.

5.1.3 Willingness to pay

Questioned on whether they would be willing to pay for solid waste collection services in case a private operator provides these services as profit making business, 327 respondents corresponding to 77.49% answered yes and 95 respondents said "no". The main reasons for non-willingness to pay are lack of financial capacity (57 respondents) and use of alternative means of waste disposal (by 27 participants).

The average amount that the households would pay for solid waste collection services per month was calculated as one thousand five hundred ninety-six Rwandan Francs (1,596 FRw almost \$1.5). For the presented bids, 54.1% of respondents willing to pay would pay 1,000 FRw; other 24.8% would pay 2,000 FRw and 18.7% would pay 3,000 FRw per month. Again, the lowest average amount to pay per month (1,018 FRw) for solid waste collection services was recorded in Rusizi. Eight people out of 327 respondents willing to pay expressed that they would pay an amount less than one thousand Rwandan francs.

5.1.4. Determinants for households' willingness to pay

The logistic regression of dependent variable (willingness to pay) against explanatory variables revealed that at 5% significant level, age, education level, employment status of the respondent and monthly expenditure of the household have positive relationship with and significantly influence the households' willingness to pay for solid waste collection services in secondary cities of Rwanda. This means that an increase in any of these variables will increase the likelihood that a household is willing to pay for the services keeping other factors constant.

Older people are more conscious about clean environment and would be more willing to pay for the removal of waste than younger people. Educated person understands well the importance of solid waste management and as the level of education increases, it is easier to get employed and secure a stable income. It will therefore be easier for that person to incur extra cost for services like waste collection more than a person still struggling to get a living.

On the other hand, households' size was found to have a negative and significant impact on household's willingness to pay for waste collection services. This implies that if other factors remain the same, an additional member to the family will cause the household's willingness to pay for solid waste collection services to drop. In other words, a household with few dependent members is likely to be more willing to pay for the services than a household with more dependent members. This is because if the family have more members with no earning will spend more to ensure other living necessities and it will be difficult for the household to pay for additional services such as solid waste collection.

Gender, marital status and ownership of the house showed no significant impact on household's willingness to pay. This is attributed to various awareness campaigns and other instituted programs such as "*Umuganda*" where cleanliness of individual compounds as well as neighbourhoods is emphasized. Back in time, ensuring that the house is clean was more of women responsibility but it is no longer the case as women are now empowered to engage in income generating activities and employment like men, either a man or woman can assume that responsibility. Moreover, the Rwandan culture encourages people to live in a clean environment whether married or unmarried, renting or living in their own house.

5.2 Recommendations

The present study was carried out mainly to determine the households' willingness to pay for solid waste collection services and its influencing factors. Based on the findings, the study recommends the following for better solid waste management services in secondary cities of Rwanda:

- Though the level of willingness to pay for waste collection services is satisfying (77.5%), the remaining 22.5% is a big portion when scaled up to the whole urban area. Other waste management practices as 2nd top reason for non-willingness to pay should be scrutinized by local authorities to ensure that they meet quality, health and safety standards. Moreover, as the cities get more urbanized, these practices especially composting will no longer be practical in the middle of the city. Therefore, that remaining portion of residents should be prepared to adhere to organised solid waste collection services;
- Education was found to positively influence willingness to pay. Public sensitisation programs should continue and be strengthened in order to raise awareness on solid waste management and its importance;
- Lack of financial capacity was mentioned as the main hindrance for the households to pay for solid waste collection services. Therefore, programs that financially empower residents of secondary cities in terms of job creation should be intensified;
- The average amount that the households are willing to pay per month was found to be 1,596 FRw, the study could not go further to determine whether this amount is sufficient enough to ensure adequate and full coverage solid waste collection services. This fee can serve as a benchmark but the Authority in charge of setting the tariff should engage in further studies to determine appropriate fee to cover the cost of waste collection services. Options such as cross subsidization among waste generators whereby the rich pays more to subsidise the poor that cannot afford to pay for the service;

- Sustainable solid waste management considers waste disposal at dumpsite or landfill as the last option. However, the study observed that it is the predominant choice of household for disposal of collected waste. The Government should put much effort in sensitizing population about waste recycling and encourage private sector to engage in activities aiming for resource recovery. This will not only create jobs for locals but also will save the land that would rather be used for waste disposal.

The present study is the first of the kind in the field of solid waste management in secondary cities of Rwanda and due to logistical constraints; it was conducted to a small sample size compared to the recommended sample size for this kind of study. This could lead to biased results therefore, further researches are encouraged to verify and constructively challenge these findings for the sake of knowledge advancement and informed decision making.

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