UNIVERSITY OF GHANA

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SOCIOECONOMIC ANALYSIS OF IMPROPER SOLID WASTE DISPOSAL IN GHANA.

BY

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DEPARTMENT OF ECONOMICS

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DECLARATION

I, *SAMUEL OSEI AFRIYIE*, hereby declare that this thesis is an original research undertaken by me under the guidance of my supervisors; and with the exception of references to other people's work which have been duly cited, this thesis has neither in part nor in whole been submitted for another degree elsewhere.

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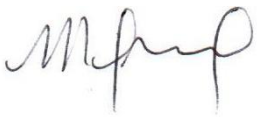

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ABSTRACT

The alarming rate of waste generation in Ghana, coupled with the adoption of improper solid waste disposal methods by most Ghanaians has necessitated several interventions of which the polluter pays principle is key. However, its implementation has not yielded the desired results yet, since the exploration of the main factors underlying the use of improper solid waste disposal (SWD) methods as well as the decision to pay for SWD has not been exhaustive. This thesis therefore seeks to analyze the socioeconomic determinants of improper SWD methods and the decision to pay for SWD in Ghana. In view of this, the seventh round of the Ghana Living Standards Survey was used as the data source for the thesis employing the utility theory framework.

Results from the logistic regression showed that, the choice of improper SWD methods is significantly influenced by the gender, age and level of education of a household head, as well as the geographical location, wealth status, type of dwelling and the occupancy status of a household. Renting and rent-free occupants were found to be 8% and 6.4% less likely to adopt improper SWD methods as compared to owner occupant households. With respect to the decision to pay for SWD, the gender, age and level of education of a household head, the geographical location, size, wealth status, type of dwelling and the occupancy status of a household were the significant determinants Evidently, there is a 30.2% likelihood for residents of urban areas to pay for SWD relative to those in the rural areas. . In light of the findings, the thesis recommends the strategic development and implementation of a rural solid waste collection policy to curtail the predominance of improper SWD methods in rural areas, whilst strengthening and promoting of private-public partnerships in SWC to enhance the smooth and frequent provision of solid waste collection (SWC) services amidst a competitive market setting. Also, structured price discrimination in the pricing of SWC services to make enough funds available to ensure the smooth running of these services should be

adopted by the various solid waste management companies with government's support in its implementation. Furthermore, mandatory subscription to a SWC service should be incorporated in house rent agreements and implemented strictly by the rent control departments.

DEDICATION

To my parents, my sisters and anyone who has supported my academic pursuits in one way or the other.

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LIST OF ABBREVIATIONS

CSIR	Council for Scientific and Industrial Research
EPA	Environmental Protection Agency
FAOSTAT	Food and Agriculture Organization Corporate Statistical Database
GAMA	Greater Accra Metropolitan Area
GHG	Greenhouse gas
GLSS	Ghana Living Standards Survey
GoG	Government of Ghana
GSMA	Ga South Metropolitan Area
GSS	Ghana Statistical Service
IEAE	International Atomic Energy Agency
ISWD	Improper Solid Waste Disposal
KMA	Kumasi Metropolitan Assembly
MLGRD	Ministry of Local Government and Rural Development
NDPC	National Development Planning Commission
PAYT	Pay as you throw
PFSWD	Payment for Solid Waste Disposal

SWC	Solid Waste Collection
SWD	Solid Waste Disposal
UNCF	United Nations Children's Fund
UN-DESA	United Nations Department of Social and Economic Affairs
UNEP	United Nations
WEF	World Economic Forum
WHO	World Health Organization
WRI- CAIT	World Resources Institute Climate Data Explorer
WRI	World Research Institute

CHAPTER ONE

INTRODUCTION

1.1 Background

Waste as conventionally defined is any unwanted material at the point of generation that does not have immediate use (Chandrappa & Das, 2012). As such, there is the need to either get rid of it permanently or temporarily. As shown in the waste hierarchy, the options of waste prevention, reduction, reuse, recovery and recycling are prioritized, leaving disposal as the least desired option (Hakami, 2015). Unfortunately, the least desired option, disposal, is the commonly used method in most developing countries. Tadese (2009) points out urbanization, rapid population growth, and financial challenges as factors which constrain the effectiveness of the various options aside disposal in developing countries.

Generally, the major problem associated with waste is its higher levels of generation; which accompanies the economic development of countries and an unmatched waste management system especially in developing countries. Zohoori and Ghani (2017) agree that the development of countries from low-income to medium then to high-income status is associated with the evolution of waste management issues. However, the desire of most developing countries to be developed is usually harbored without a provision for pertinent issues like the management of waste.

The huge amounts of waste generation in the century is therefore attributed mainly to economic development and modernization (Mukhtar et al., 2016). The relationship between urbanization, economic development and waste generated is elaborated by Hoornweg and Bhada-Tata (2012). They explained that a country's economic wealth increases as they urbanize. This will then lead

to an improvement in the standard of living, an increase in the disposable income and an increase in the consumption of goods and services too. This further leads to an increase in the amount of waste generated. However, the rate of waste generation is higher in low and middle-income countries than in high-income countries (IMF, 2020). This has been attributed to rapid population growth, scarcity of financial resources and the little capacity to manage environmental issues in most developing countries. It is anticipated that the daily per capita waste generation in high income countries will increase by 19% in 2050 whereas about a 40% increment is anticipated in low and middle-income level economies (Kaza et al., 2018). An estimation of the levels of waste generated globally in 2016 by Kaza et al., (2018) showed that, 0.74 Kilograms of solid waste was generated per person, per day globally. This translates to a total of 2.10 billion tonnes of solid waste being generated globally. It is therefore projected that there will be a 70% increase in municipal solid waste generated by cities by the year 2050 (Kaza et al., 2018).

Ferronato (2019), adds that of these huge volumes of waste generated, over 90% is disposed in unregulated dumps or burnt openly in low-income countries. This is associated with far reaching consequences on the climate, economic development as well as the health of individuals. These consequences include, the pollution of water bodies, breeding of vectors that transmit diseases, increased respiratory problems due to airborne particles from burnt waste, blocking drains to cause flooding and decline in tourism which affects economic development. In 2016, 1.6 billion tonnes of carbon dioxide (CO_2) equivalent of greenhouse gas emissions was generated from solid waste treatment and disposal (Ritchie & Roser, 2017). This represents 5% of greenhouse gas emissions globally. These gases include carbon dioxide, methane and particulate matter, which are associated with air pollution and can lead to severe cases of respiratory disease such as asthma. Kaza et al.,

(2018) projects solid waste emissions to reach 2.38 billion tonnes of CO_2 equivalent per year by 2050 if no improvements are made in the disposal and treatment of waste.

The situation in Sub-Saharan Africa is not significantly different from other parts of the world. With a 174 tonnes and 0.46 Kg annual and per day waste generation rate respectively, the region has the least waste generation rate (Wahba, 2019). However, with the rapid population growth and urbanization in the sub-Saharan Africa (SSA) region, it is anticipated that the current rate will triple by 2050 (World Bank Group, 2019). The 2018 World Urbanization Prospects report (UN-DESA, 2019) showed that SSA had an urban population growth rate of 4.1% whereas the global rate was 2.0%. This phenomena is associated with some benefits like increased economic growth and development. For instance the 143 cities in SSA generated 50% of the entire Gross Domestic Product (GDP) in the region (UN-DESA, 2018). There is a threat of a decline in this contribution if the problems associated with this phenomena is not checked. One of such problems is poor waste management.

According to the World Bank Group (2019), only 44% of solid waste generated in SSA is collected with 69% of the remainder being burnt or dumped openly. Relative to the 44% waste collection rate, the consequences associated with the 69% of total solid waste that is burnt or openly dumped will be aggravated over time (Wahba, 2019).

The Ghanaian story on waste generation and urbanization is also similar to that of the world. Miezah et al., (2015) showed that, with the estimated population of Ghana as at 2015 being 29,614,337 million, with a growth rate of 2.39%, the corresponding waste generation rate for the country was 0.47kg/person/day. This translates to a daily waste generation of about 12,710 tonnes on the average of which Accra and Kumasi, the largest cities in Ghana are estimated to generate about four thousand (4,000) tonnes of waste. Thus only these two urban areas are contributing over

30% of the total waste generated in the country. The study also found out that with the exception of Tamale, the average household waste generated among metropolitan cities was as high as 0.72kg/person/day which was above the national average. Also, relative to metropolises' average waste generation rate of 0.63/kg/person/day, that of municipalities was 0.40kg/person/day. This is concurrent with the rapid increase in the urban population of Ghana from 32.1% to 43.8% and to 50.9% during the years 1984, 2000 and 2010(Ghana Statistical Service, 2012).

Ghana's journey towards the achievement of the Sustainable Development Goal 11; Making cities inclusive, safe, resilient and sustainable is beset with the predominance of improper waste disposal methods. The methods of solid waste disposal (SWD) available to various households in Ghana are diverse just as their choice. Although there has been variations in methods available and the choice of households over time, some early methods like dumping into water bodies, burying it in soil and dumping on land are still being used especially in low-income countries (Ferronato and Torretta, 2019). The 2010 population census as well as the seventh round of the Ghana Living Standards Survey records public dumps, public indiscriminate disposal, collection and burning as the methods of household SWD being used in Ghana (Ghana Statistical Service, 2012; 2017). As explained by Adzawla et al., (2019), of these methods of waste disposal, the most appropriate is the one that has minimum effects on the environment, which is collection by both private waste collection companies and designated public sector institutions. The collected solid waste is then transported to either an engineered landfill or a dumpsite for final disposal, thus ensuring the effects of waste disposal is minimized. Thus, following the classification of inappropriate SWD methods by Adzawla et al., (2019), the operational definition for improper SWD in this study will be any method of waste disposal aside collection. The method of collection can either be through

a public container collection service or house-to-house collection. This leaves burning and indiscriminate disposal as the improper methods of SWD.

According to the 2010 housing and population census in Ghana, 37.7% of households disposed solid waste in the open places such as public dumps, 23.8% disposed into public waste containers, 14.4% had their waste collected, while 10.7% burned the solid wastes generated by their households (Ghana Statistical Service, 2012). Evidently, the results of the 2010 housing and population census shows only 38.2 % of households adopted a proper method of waste disposal as at 2010. The 6th round of the Ghana Living Standards Survey conducted in 2013 also showed that even though there was an improvement in the percentage of households using proper methods, there were still about 40% of households in Ghana using the improper methods of SWD. This practice has negative effects on the health of households as well as the quality of land, air and water (Ejaz et al., 2010; Chhipa, 2014; Abdel-Shafy et al., 2018).

However, some measures are being put in place by the various stakeholders to curb the problem. In Ghana, for instance, the declaration of the first Saturday of every month as 'Sanitation Day', to be commemorated with clean-up exercises is a major nationwide intervention towards sanitation improvement (Ghana News Agency, 2014). This is aimed at sensitizing Ghanaians on the effects of poor sanitation and rally their support to tackle the problem. Also, in line with the Paris Agreement (2015) for ensuring sustainable development through climate change mitigation, Ghana has adopted a vision of increasing the rate of urban waste collection from 70% to 90% by the year 2030. However, the anticipated results has not been realized. It is therefore expedient to assess all the motives behind the choice of a waste disposal method to better inform waste disposal policies.

Another common intervention to curbing improper SWD is the pay as you throw principle which requires households to pay an amount of money for their waste to be properly disposed. However, most households are still not willing to pay for SWD. Thus, the factors that influence the decision to pay for SWD need to also be assessed to help promote the use of SWD methods.

1.2 Statement of the Research Problem

Ghana, over the years has a bad reputation when it comes to waste management. This was reflected in the ranking of Ghana as the seventh worse performing country with respect to proper waste management practices in the year 2015(UNICEF and WHO, 2016). This can be attributed to the rapid levels of waste generation, spearheaded by rapid urbanization and the use of improper waste disposal methods by Ghanaian households. According to the 2010 housing and population census in Ghana, the two most urbanized regions are the Greater Accra and Ashanti regions with 90.5% and 60.6% respectively of their population living in urban areas (Ghana Statistical Service, 2014). It is not surprising that the capital cities of these two regions, Accra and Kumasi contributed over 30% of the total waste generated in 2015 (Miezah *et al.*, 2015). As at 2018, 16,517 million Ghanaians representing 56.1% were living in urban areas (UN-DESA, 2018). It is projected that the urban population will continually increase to 57.3%, 63.4%, 68.6% and 73.2% in the years 2020, 2030, 2040 and 2050 respectively. Similarly, the level of solid waste generation is estimated to be increasing over time and will reach 27 million tonnes by 2050 (Karak, *et al..*, 2012). With these huge volumes of waste being generated, households' choice of SWD method will have immense effects on the health of households and on the environment.

As cited in Frimpong (2014), there could be a reduction of about 40% in the rate of major killer diseases globally if there is environmental improvement at both household and community levels. In 2017, there were over 6 million cases of malaria alone which was the highest cause for outpatient morbidity (Ghana Health Service, 2019) and could have been reduced if households adopted good SWD methods. Also, improperly disposed waste has been identified as one of the causes of greenhouse gas emission. As a matter of fact, 5 % carbon dioxide (CO_2) equivalent of the global greenhouse gas emission in 2016 is attributed to waste treatment and disposal (Kaza *et al.*., 2018). In Ghana, about 4% of Greenhouse gas (GHG) emissions in 2011 was attributed to waste mismanagement but almost doubled to 7.5% in 2016 (WRI CAIT 2.0, 2015 and FAOSTAT, 2015). According to the EPA 2019 report, gases like methane, black carbon, hydrofluorocarbons and carbon monoxide which are emitted when waste is burnt or disposed improperly significantly account for GHG emissions. The emission of these gases then prevents the heat released from the earth from radiating into space, thus making the earth warmer and consequently retaining more water and changing weather patterns (World Economic Forum, 2018).These changes in weather patterns have several consequences on the nation.

According to the National Disaster Management Organization's (NADMO) 2007 report, severe weather conditions due to climate change led to some floods in Ghana. These floods led to the collapse of one hundred and ninety nine (199) classrooms in addition to about two hundred and ten (210) schools which were also affected. In October 2018, another devastating flooding hit the Northern part of Ghana. The Ghana Red Cross Society (2019), reported that 26,083 people were affected and 19 deaths were reported in the Upper East Region. Also, 133 households were displaced and over 2,218 houses were totally destroyed with 3,743 others partially destroyed. The

report also showed that a total of 116 communities from 13 districts were negatively affected by the floods.

Another effect of improper waste disposal via climate change is related to water supply. As improperly disposed solid waste emits GHGs which contribute to climate change, changes in intensity and patterns of rain coupled with the intensity of heat destabilizes the supply as well as preservation of water especially from natural sources. The CSIR-WRI 2011 report on Climate Change and water resources reports that there would be a reduction in annual river flows by 30-40% by the year 2050 if climate change is not checked. With rain dependent agriculture in Ghana, the difficulty in predicting rainfall coupled with reduction in alternative sources of water, climate change can rid the country off the many benefits gained from agriculture. These possible losses include a decline in gross domestic product, food security, which will aggravate poverty and eventually slow down economic growth and development. The improper disposal of solid waste by households has been identified as a direct and major cause of most of the recent flooding in the country (Tasantab *et al.*, 2018). It was pointed out in his paper that about 4 million people have been affected by floods over 50 years and has resulted in economic damage exceeding USD$780 million.

However, it is worth acknowledging the efforts being put into the improvement of waste management by various stakeholders. For instance the introduction of one household one –dustbin policy in the Ga South Municipal area (GSMA, 2018) with the aim of controlling the indiscriminate dumping of refuse in the metropolis. Also, the government of Ghana through the Ministry of Sanitation and Water Resources introduced the street litter bins programme which aims to curb public littering and also promote a clean environment in the capital city, Accra. The interventions are not only being initiated in the Greater Accra Region. The declaration of the first

Saturday of every month as sanitation day, to be commemorated with clean-up exercises is a major nationwide intervention towards sanitation improvement (Ghana News Agency, 2014). This is aimed at sensitizing Ghanaians on the effects of poor sanitation and rally their support to tackle the problem. Oduro-Kwarteng (2011) records the various management interventions in solid waste collection from 1957 to 1999. These interventions began from public service provision and the latest form of management which was introduced in 1999 is the public-private partnerships. In each of the management interventions, the aim was to make solid waste management more efficient through the provision of apt solid waste collection services. Common to these interventions is the requirement of payment from households for these services. But have these interventions yielded the expected results?

These challenges still persist after all these interventions not because they are bad initiatives but the lack of exploration of the root cause of these actions of Ghanaian households. Two of such key factors is the housing characteristics and financing of SWM programs. According to Amenyah and Fletcher (2013), the type of housing of a household is a direct indicator of their welfare and as such, their ability to afford services like that of SWD. Again, Gilbert (2008) identified rental housing as a common type of housing all over the world. However, BoG (2007) and Ato Kwamena (2016) adds that housing rental in Ghana is associated with a high cost which leads to a strain in accessing facilities like that of solid waste disposal. Also, the introduction of the polluter pays principle as a means of financing SWM has to be assessed to know what informs households' decision to pay for SWD. It is worth noting that Frimpong (2014) assessed the factors influencing the willingness of households in the Greater Accra Metropolitan Area (GAMA) to pay for waste disposal. Also, Adzawla *et al*., (2019) assessed the factors that influence the choice of each disposal method but did not narrow in on the improper methods and also the housing

characteristics. Thus this study will present an extended study into improper waste disposal methods and housing characteristics with the aim of closing the gap in literature, understanding the underlying causes and propose solutions to curtail the use of improper SWD methods. Also, this study having identified the correlation between the inappropriateness of a SWD method and the feature of nonpayment for SWD will extend the previous studies in smaller geographical areas to a coverage of the entire country. This will help in resolving the dilemma, why do some households choose the improper waste disposal methods and are also unwilling to pay for waste disposal after all the various interventions?

1.3 Research questions

In the quest to resolve the problems associated with the choice of improper solid waste disposal (SWD) methods and the unwillingness of some households to pay for SWD, the following questions are raised;

- What housing and household characteristics influence household's choice of waste disposal method?
- What determines households' decision to pay for proper solid waste disposal?

1.4 Research objectives

The general objective of this work is to ascertain the factors influencing Ghanaian households' choice and payment for SWD methods. The specific objectives are;

- To examine the extent to which housing and household characteristics influence Ghanaian households' choice of SWD method.

- To examine the extent to which housing and household characteristics influence Ghanaian households' payment for SWD.
- To recommend solutions to improper solid waste disposal to policy makers.

1.5 Significance of study

Even though the issue of improved sanitation has received attention in recent times, less efforts have been channeled into identifying the causes of improper waste disposal methods especially at the national level. Scores of literature on waste management are available but a relatively less number ascertains the reasons for the choice of improper SWD methods and the decision to pay for SWD by households in Ghana. Adzawla *et al*., 2019 focused on the general factors influencing all methods of waste disposal. However, that did not bring out the factors peculiar to only improper waste disposal even though such factors would have to be identified in order to curtail this canker. This study will therefore focus on factors pertaining to only the improper methods of disposal. Again, with payment for SWD being encouraged to tackle improper waste disposal, an enquiry into the determinants of payment for SWD will aid in properly structuring this agenda to achieve the desired results. With regards to the decision to pay for waste disposal, studies have been conducted for smaller geographical areas like regions, communities and municipalities (Frimpong, 2014 – {GAMA}; Awunyo-Vitor *et al.*, – {KMA}, 2013; Addai and Danso-Abbeam, 2014 – {Dunkwa-on-Offin}; Tamura, 2005 – {Accra}) but none for the entire country. Although these studies provide essential information, inferences from them for the country would be biased due to attributes peculiar to only specific areas. Thus, the findings of this study will be representative of the prevailing issue of improper SWD in Ghana and also recommend policies in this regard. This study again seeks to fill this gap and help improve SWD at the national level. The effects of

improper SWD emphasizes the relevance of the role of households in improving the environment and as such an enquiry into the factors influencing their decisions on waste disposal methods is very important. Also, the enquiry into factors influencing the decision to pay for SWD will help increase the adoption of proper SWD methods by providing innovative ways of implementing interventions which require payment. The introduction of the pay as you throw (PAYT) principle has not been successful in most geographical areas in Ghana. Kyere *et al.,* (2019) pointed out that, the areas that successfully implemented the PAYT principle was due to the participation, involvement and enforcement of indiscriminate SWD laws by designated institutions and stakeholders. Since the participation and involvement of households is crucial in enhancing proper SWD through the PAYT principle, the characteristics of households that will inform their participation has to be assessed. Thus, this study will assess these characteristics (household and housing) to aid in properly implementing the PAYT principle and control improper SWD in Ghana.

Again, inadequate waste disposal and a weak coordination of waste management were found to have accounted for the inability of Ghana to achieve Millennium Development Goal target 6C; halt and reverse the incidence of malaria and other major diseases (NDPC, 2015). Without an assessment of the factors accounting for this failure, Ghana faces a risk of failing again in the achievement of SDG 11.6; reduce the adverse per capita environmental impact of cities, including by paying special attention to municipal and other wastes' management (NDPC, 2018). Since few studies have focused on the factors accounting for improper SWD and payment for SWD and none at the national level, this study will help fill this gap by providing evidence of factors responsible for both improper SWD and payment for SWD in Ghana.

1.6 Scope of the study

As opposed to the three generally accepted means of final waste disposal or treatment (incineration, landfilling and recycling), this study is restricted to household solid waste (refuse) and how they are disposed prior to their final disposal. This is because, refuse forms the majority of total waste generated and the inception of waste management begins with how households handle waste (Nagabooshnam, 2011). Again, the study will consider the methods of SWD as determined by the payment for their usage since financial constraints have been identified as a challenge to the use of proper SWD methods. Thus, methods that require households to pay an amount of money and those that do not; to help understand the role of payments in the choice of proper SWD methods. The most recent Ghana Living Standards Survey (GLSS) dataset, which is the seventh round is used in this study. The study looks at how housing and household characteristics influences the choice and payment for a waste disposal method by households. Particularly, the study will ascertain what households choose improper waste disposal methods over the appropriate methods. Finally, the study will assess the extent and relation between various factors and the choice as well as payment for SWD methods.

1.7 Organization of study

The study is organized into five (5) chapters. The first chapter entails a background of the study, a statement of the research problem, research questions and research objectives, significance of the study and the scope of the study. Chapter Two will focus on reviewing theoretical and empirical literature underpinning the study, whereas an overview of households' SWD and housing characteristics will be discussed in the third chapter. In Chapter Four, the methodology adopted

for the research, data analysis, discussion and interpretation of results will be covered. The fifth and final chapter will include a summary, conclusion and policy recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

In this chapter, the theoretical and empirical literature for this study area will be presented to elaborate on the research questions raised. The first part of this chapter will look at some theories of solid waste management whereas the latter part will focus on review of studies in the study area. This chapter is therefore aimed at providing a theoretical underpinning and reviewing relevant empirical and methodological literature in the study area.

2.2 Theoretical Literature Review

The study of waste management is an interdisciplinary one since it has effects peculiar to diverse disciplines (Ferronato et al, 2016). This has resulted in the use of theories in several disciplines, including economics, to study the subject. In this section, some economic theories used to study SWM will be discussed to set the framework for this thesis.

2.2.1 Economic theories and Solid Waste Management

The demand for most household utility services has been modeled after the traditional theory of demand which proposes that the demand for a commodity depends basically on the price of the commodity, prices of related commodities and the income of the consumer (Marshall, 1890).

Thus the demand function according to (Marshall, 1890) is given algebraically as;

$$Qd = f(P, Pr, M) \quad (2.1)$$

Where: Qd = the quantity demanded a good or service

P = the price of the good or service

Pr = the price of a related good or service

M = the income of consumers

However, other factors aside the three indicated above have been found in other studies to also influence the demand for solid waste disposal service. These other factors include the gender, age and level of education of the household head, the size, geographical location and level of welfare of a household and the type and occupancy status of a household's dwelling (Adzawla et. al, 2019; Tadese and Hagdu, 2009).

Again, the difficulty in establishing a price for some commodities and services which stems from the absence of a market for them, the lack of payment for their use or the inability of prevailing prices to reflect their value hinders valuation and estimating the demand for them. The absence of a market for improper SWD has therefore necessitated the use of implicit or non-market valuation techniques in several studies to help assess the demand for it. Thus, some of these implicit market techniques are reviewed to ascertain how they help value non-marketable goods such as improper SWD.

2.2.2 Non market valuation for non-market goods

Non market goods refer to a good or service for which no or limited market exists and for which people do not pay money to receive them. An example is the market for improper SWD methods

which no monetary payments is required for its use. However, the effects of the adoption of this method has effects on the environment which can be measured through economic valuation techniques. This will help realize the costs associated with the use of improper SWD methods and help in resolving it. Thus, economic valuation techniques are employed to value non market goods and ensure sustainability.

Economic valuation has to do with assigning economic values to non-market goods and services. This is done by identifying the various components that make up the Total Economic Value (TEV) of the good or service in question. Thus, the economic value of the use of improper SWD methods can be categorized into use, non-use value and option value. These two components make up the TEV of improper SWD methods.

Use value refers to the benefits a society or an individual gains from the use of a resource. The use value is further categorized as direct and indirect values (Perman *et a*l., 2003). However, Pearce, Atkins and Mourato (2006) added another category; optional value to the two by Perman *et al.* (2003) making it three categories of use value. Direct use value of a resource refers to the benefits obtained from the direct use or its contribution to the current production or direct consumption of services provided by the resource. Indirect use value of a resource on other hand, refers to the regulating services the resource provide to the production system. Option value refers to the willingness to pay for the ability to use an environmental resource in the future.

According to Perman *et. al.* (2003), the theory of economic valuation is rooted on individual preferences and choices as expressed in individual utility functions. Thus, the choices or preferences of people are driven by the utility they derive from the use of a commodity or service.

Based on the how preferences of individuals are inferred, non-market valuation is broadly classified into two (Hadley *et al*., 2011). These are the Revealed Preference Techniques and the Stated Preference Techniques. Mishra (undated), also classified non-market valuation on the basis of using money as the numéraire or not as pecuniary or non-pecuniary. Pecuniary methods according to Mishra (undated) are methods in which money equivalent of goods or services being valued is obtained whereas non-pecuniary methods do not seek to assign monetary value to non-market goods to value them. Thus, in non-pecuniary methods, any standard or value rather than money may be used as the numéraire. Mishra (undated) further grouped the pecuniary methods into Revealed Willingness to Pay, Imputed Willingness to Pay/Circumstantial Evidence and Expressed Willingness to Pay methods. In this study, the classification according to Hadley *et al.* (2011) will be elaborated.

2.2.2.1 Revealed Preference (RP) Techniques

According to Tietenberg and Lewis (2009), Revealed Preference methods are based on actual observable choices and from which actual resource values can be directly inferred. These methods include Hedonic Pricing Method (HPM), Travel Cost Method (TCM), Averting Behavior Method (ABM), Defensive Expenditure Method, Household Production Function, Dose Response Method and Cost of Illness and Lost of Output Method. However, only the methods relevant and applicable to this study are discussed.

The Hedonic Pricing Method (HPM)

This method relies on the assumption that the price of a good depends on the attributes of the good and that an individual values the attributes of the good more than the good itself. Thus, it uses market price of a good to estimate the value of an environmental attribute which is embedded in

the price of the marketed good. However, since some goods may have environmental components which are difficult to value, the HPM is useful for valuing such components. The HPM is also known as Property Value Approach in properties market whereas in the labour market, it is known as the Wage Differential Approach.

The HPM measures the value of attributes of a good by assessing how the price of a good changes subject to a change in a particular attribute. Adjei-Mantey (2013) regressed the price of a good on its attributes to yield the function; V = f (Yis). Where V is the value or price of the marketed good and Yis are the attributes of the good. From this function, one can calculate the how the value of the good changes when there is a marginal change in the explanatory variables (the attributes).

HPM assumes weak complementarity and this is a weakness of this method. Weak complementarity here means that for a person who does not use the good or pay for the good, his value of its characteristics is zero which includes the environmental qualities of the good. For a property, this means that HPM will only value the environmental quality of the neighbourhood within which the property is located and not for other places. This method also assesses use values only since it measures environmental changes' effects on price that an individual is willing to pay of the good. It does not measure non-use values and hence cannot be used in this study.

The Production Function Method (PFM)

In the Production Function Method (PFM) of valuation, an investigation into how environmental qualities affect the output levels of an economic activity is used to infer the value of the environment. The PFM is based on the assumption that some natural resources and environmental qualities are inputs in production functions. Therefore, changes in these resources or environmental qualities will influence production through the changes in the market price of the

good. Thus, the PFM measures how much production cost and output changes due to attributes of nature.

A major criticism raised against the PFM is its biasedness in considering only the producer and neglecting consumer side issues like consumer surpluses. Also, Neil (2007) argued that losses resulting from cost of production due to fluctuations in natural resource or environmental quality may not accurately capture the value a society associates to ecosystem and environmental quality. In addition, some producers may adopt averting behavior techniques to reduce the impact of the reduction in environmental quality from their production activities. This distorts the accuracy of the assessment of production losses emanating from changes in environmental quality. The inability of this method to account for surpluses which the market price failed to offer coupled with its limitation to production losses makes it difficult to estimate the total economic value and as such unsuitable for this study.

The Replacement Cost Method

The Replacement Cost Method (RCM) determines the value of an environmental resource by using the costs incurred in replacing the resource or services provided by the resource. For instance, air pollution has been associated with improper SWD so the amount incurred in ridding the environment of this pollution due to improper SWD will be the value of improper SWD. This approach is also inappropriate for this study due to its inability to account for consumer surpluses and also determine the economic value of environmental goods.

The Averting Behavior Method (ABM)

In this method, the total cost associated with actions adopted by individuals to avoid or lessen the risk they will face if the quality of a resource deteriorates. This method is based on the assumption that, individuals are fully aware of the consequences associated with the depletion of

environmental quality such that they seek to prevent these effects through their actions. The cost incurred by so doing is the value of the resource according to the ABM.

Critics have raised concerns about the fact that the cost incurred to mitigate the impact of the depletion of environmental resources may not be a true reflection of how much a resource is valued. Also, the fact that individuals do not adopt a means to mitigate the depletion of environmental quality does not necessarily imply they do not value the environment. Economic constraints for instance can prevent the initiation of such risk averting actions. Finally, the cost incurred in averting a risk of environmental deterioration may not be equivalent to the value of the resource to a person. These shortfalls coupled with the inability to include non-use values, this method cannot be adopted in this study.

2.2.2.2 Stated Preference Techniques (SP)

According to Hadley *et al.,* (2011), stated preference techniques are used to obtain the direct preferences of individuals for non-market goods through surveys based on stimulated markets. This method entails the Choice Experiment Method and the Contingent Valuation Method.

The Choice Experiment Method (CEM)

The Choice Experiment Method (CEM) seeks to elicit the willingness to pay (WTP) for the use of environmental resources, given a set of hypothetical alternatives. Thus, these resources possess similar characteristics but at different levels so that a choice has to be made by an individual. According to Garrod and Willis (1999) as cited in Mantey (2013), choice experiments are contingent valuation method underpinned by the random utility theory and Lancaster's characteristic theory of value which posits that, the value of a good is determined by attributes that make up the whole. The CEM therefore seeks to value each of the attributes of a particular

environmental resource or good offers by providing consumers with alternative choices of the attributes that have different levels of satisfaction. The consumer can either maintain the status quo or choose an option. An analysis of the tradeoffs between options therefore helps to elicit consumers' WTP. The CEM is advantageous due to give relevant information about an environmental good through its attributes and also reflect real life decision taking by consumers.

The Contingent Valuation Method (CVM)

The contingent valuation method was promoted by Ciriacy – Wantrup in 1947 as a means of estimating the market value of a non-market good. It elicits consumers' willingness to pay (WTP) for a particular good or improve upon a service or their willingness to accept (WTA) a compensation for the destruction of an environmental resource. Usually, a survey or questionnaire is used to elicit individuals' WTP or WTA given a good or service with certain characteristics. Thus, the value of a good or service is the maximum amount an individual is WTP for that good or service and it caters for consumer surpluses as well. The name contingent valuation is derived from the fact that the method elicits the WTP of individuals contingent or dependent on a certain presumed framework. By generalizing the average of values of an environmental resource stated by individual respondents, the value of the resource is determined.

In the conduct of contingent valuation surveys, questions can either be open-ended or closed-ended. With the open-ended format, respondents have a free range from which they choose a value. The major drawback of this approach is the inability of respondents, especially illiterates to accurately value a good or resources. Also, the wide variations in values may bias the average value arrived at. In the closed-ended approach, a discrete or dichotomous choice question is presented with a particular value for which respondents are to respond "yes" if they would pay that amount or "no" if otherwise. This latter approach is representative of the real life scenario where

consumers choose to buy a good at the current market price or not. The CVM comes with the advantage of inculcating both the use and non-use value in finding the total economic value of a non-market good or service.

However, due to the unavailability of accurate prices for improper SWD methods coupled with the several drawbacks identified with each of the valuation techniques, the consumer choice theory (Utility) will be adopted in this study. Also, the theory of utility builds on the preferences and incomes of individuals to provide a framework to assess the relation between demand and features of the good being demanded as well as characteristics of the individual (Hayes, 2019). Thus, eliminating the issues of inaccurate valuation and pricing peculiar to the other theories discussed.

2.3 Empirical Literature Review

A number of studies have assessed the demographic and socioeconomic factors that influence the choice of waste disposal (SWD) method and payment for it in several geographical areas from local to regional and national levels. However, key socioeconomic variables like housing and occupancy status has been barely explored.

According to Jenkins *et al*. (2000), the determinants of households' SWD method includes economic (which includes households' income), social (including the gender, age, level of education, housing characteristics, size of household and geographical location) as well as pricing dimensions which looks at the cost of SWD. Adzawla *et al.* (2019) assessed the factors influencing the choice of SWD methods in general. Thus, their study was not concerned with the appropriateness or inappropriateness of a particular method. Hence, this study in considering the factors influencing the choice of improper over proper SWD methods will help implement policies

to adequately tackle this menace of improper SWD. Again, although housing was acknowledged to be significant to the study by Adzawla *et al.*, (2019), the study explored only one type of dwelling (compound house) and one type of dwelling agreement (ownership). This approach overlooks some individual relations which may be crucial in curbing improper SWD so this study will explore all the types of dwellings and ownership statuses to bring out their differences and similarities, thus giving a better understanding to households' choice to be able to come up with policies to tackle the problem.

Again, Frimpong (2014) using the cost incurred in disposing waste categorized SWD methods as being proper and improper. However, due to some interventions by both the government and private institutions, the cost of disposing waste is waived for some households so that even though they do not pay for SWD, they adopt a proper SWD method. Again, their study was limited to the Greater Accra Metropolitan Area. Thus, this study will adopt this approach, this time to assess the factors influencing the willingness to pay for SWD in light of the polluter pays principle which has been introduced to check improper SWD. This section will therefore discuss a few studies on the effects of the identified factors on SWD and payment for it. For simplicity, the identified socioeconomic factors are categorized under household and housing characteristics. Also, the first part will focus on the choice of improper SWD method and the second part, payment for SWD.

2.3.1 Household Characteristics and the choice of solid waste disposal method

Gender

There have been several studies enquiring into the effect of gender on the choice of solid waste disposal method. An example is a study by Mamady (2016), which sought to assess households' solid waste management with regards to the factors influencing safety behavior, attitude,

knowledge and practice of the best practices in Conakry, Guinea. A sample of 1093 residents in the study area was selected through a combination of random, stratified, multistage as well as clustered sampling techniques. Using a binary logistic regression to analyze the data collected, the study found that the gender of an individual is positively related and significant in the choice of a waste disposal method by households. Specifically, the odds ratio showed that females were about thrice as likely to adopt good disposal practices relative to their male counterparts. The study identified Municipal Accredited Dumpsites (MAD) and Accredited Private Sector (APS) dumps as the good methods of disposal whereas burning and open land disposal made up the bad method of disposal.

Similarly, a recent study by Adzawla *et al.* (2019), using cross-sectional data from Ghana as recorded in GLSS 6 to assess the determinants of household solid waste disposal corroborated the findings of Mamady (2016). Using a multinomial logistic regression, they found that female headed households mostly had their solid waste either collected or disposed at a public dump rather than disposing it indiscriminately or burning it. Particularly, with burning as the base outcome and being a male as the reference category for gender, the study showed that there is a negative relation between being a male household head and having your waste collected or disposed at a public dump. Also, the study showed a positive association between being a male household head and dumping solid waste openly or indiscriminately. This implies that females are more likely to use appropriate methods of waste disposal; collection and public dump as compared to their male counterparts.

Age

An enquiry into the effects of socioeconomic factors on waste disposal practice in Ibadan metropolis, Nigeria, showed that, the age of a person is positively correlated with the choice of

waste disposal method (Kayode and Omole, 2011). After analyzing the responses to a structured questionnaire by 215 residents in the metropolis, the study showed that older people resort to efficient methods of waste disposal relative to younger residents. This result was achieved through a correlation analysis. Again, Adzawla *et. al*., (2019) found that age was significant in the choice of each of the methods of disposal. The study explicitly showed that age positively affected waste collection and public dumping whereas a negative relation was found between age and open dumping of waste. This showed that older people are likely to patronize proper waste disposal methods such as collection and public dumping. Also, Owusu (2010) pointed out that there is social cohesion between the older generation and the younger ones due to the poor behavior of the latter to waste disposal practices in Sabon zongo, Accra. The study showed that older people are more likely to adopt proper waste disposal methods as compared to younger ones and this creates a social tension between the two groups. It was explained that due to the vulnerability of the elderly to health problems, they tend to be cautious of their health and as such, they are more likely to adopt proper SWD methods.

Level of education

The impact of education on waste disposal has been analyzed in several studies. A study by Ojewale (2014) on the effects of socioeconomic factors on waste disposal practices in Lagos metropolis, Nigeria, attested to the fact that education status is significant in the choice of waste disposal method. In this study, six common methods of disposal namely; disposal in nearby open space, dumping in drains, roadside disposal, burning, the use of Accredited Private Sector Participation services (PSP) and the Lagos State Waste Management refuse facility were identified. Of these, the two latter methods were considered appropriate and as such encouraged.

Also, the education status of residents was categorized into primary, secondary and tertiary school education for the purpose of analysis. The analysis of data obtained from 384 respondents through the systematic random sampling technique showed that, the odds of residents with at least tertiary level of education using the PSP was higher than all other methods of disposal. Also, relative to residents with tertiary education, the study showed residents with only primary or secondary level of education had a higher probability of going in for the inappropriate methods of waste disposal such as roadside disposal, burning, dumping in drains and open spaces. This shows that the higher the level of education of an individual, the more likely it is for the person to adopt a proper waste disposal method. Another distinction made in this study is the possibility of a household to use more than one method of disposal. This helped to avoid self-selection bias in the analysis.

Size of household

Just as the number of people in a household influences the rate of waste generation, it also informs the choice of disposal method (Ng'ang'a, 2012). In a study to find out the factors that influence disposal of household solid waste in Central Division Garissa District, Kenya, Ng'ang'a (2012) found that most households had between four (4) and nine (9) individuals and they mostly chose open dumping as their means of disposal. Although proper methods like recycling and collection was available, the study showed that since these methods come at a charge per volume generated and larger households were found to generate higher volumes of waste, it implied they had to pay higher sums of money if they are to choose the proper methods of disposal. Thus, larger households would prefer methods of waste disposal which are free and apparently improper to the ones they would have to pay for. In a similar study for a low- income suburb in Accra called Gbawe, Anaman and Nyadzi (2015) found that households with higher number of residents had a likelihood of

adopting unimproved methods of solid waste disposal like burning and burial of waste. The study identified the improved methods of disposal as the ones which involved a monetary cost, thus, collection by private companies or disposal at a public container. Hence, a logit regression was conducted to analyze the effects of socioeconomic variables like the household size on the choice of improved waste disposal methods. The results therefore showed that the household size is negatively related to the adoption of improved waste disposal methods.

Household welfare

Household welfare is generally found to influence all aspects of life. However, researchers use different indicators to assess welfare. Income and wealth are some common measures of welfare mostly used. Alemayehu *et. al.*, (2017) showed that, household heads with an average monthly income less than 3000 ETB (Ethiopian Birr) are more likely to adopt improper waste management practices in Dire Dawa city, Ethiopia. The study stipulated proper waste management involved storing your waste in a suitable container and having it collected at a suitable time for disposal whereas any other alternative was considered as improper. These included burning, dumping in bushes or gutters and indiscriminate disposal. The exact relation according to the logistic regression of the responses of 511 respondents selected through the multiphase sampling was that, the household heads with lower average income are thrice likely to adopt improper waste management practices in their homes. Therefore, a positive association exists between proper waste management and income. In a similar study in Nyeri Municipality, Kenya, Mukui (2013) also found that the income of a household is positively related to their choice of waste disposal method. In his study, Mukui (2013) used descriptive statistics to infer the relation between the income, location of residence and the choice of waste disposal method. It was found out that households in higher income brackets mostly live in formal residential areas who have access to

proper waste disposal services like having a receptor for storage, depositing into a compost pit/ garbage chamber or using curbside collection services. Thus, the access to proper waste disposal services by higher income residential areas increased the likelihood of its residents to adopt proper disposal methods relative to poorer households who mostly live in informal settlements. Thus, poorer households will be more likely to go in for burning or burial of their solid waste, which are considered as improper.

Likewise, Adzawla *et al.* (2019) measured household welfare using per capita expenditure and found a positive association between proper waste disposal (collection and public dump) and welfare. However, per capita expenditure was found to be insignificant in the choice of improper methods of disposal (burning and open dumping). This can be explained by the fact that the improper disposal methods may not involve monetary costs (as in the case of using the public dump), hence one's income will not directly influence its choice as a method of solid waste disposal.

Geographical location

A comparative analysis of waste disposal methods in rural and urban areas in the Greater Accra and Ashanti Regions of Ghana showed a significant difference in methods adopted by residents in each area (Boateng et. al, 2016). This conclusion was arrived at through a Pearson's chi-squared analysis and descriptive statistics of cross-sectional data obtained from 400 randomly sampled residents in the study areas. Whereas over 78% of rural dwellers dumped their solid waste openly, over 70% of urban dwellers had their waste properly collected through home collection, communal container or roadside collection. It was evident from the study that the location of a house significantly influences the waste disposal choices of a household.

Adzawla *et al.* (2019) also found out that there is a positive association between the locality of a household and their choice of proper waste disposal method. This result was achieved through a multinomial logistic regression with locality captured as a dummy variable. This implies that households living in urban areas have a higher probability to have their waste collected or use a public dump for their household waste as compared to rural dwellers. Also, the study did a regional analysis for the ten regions in Ghana as at 2013 and found that with the Greater Accra region as the reference category, all the other regions had a negative relation with waste collection. Thus, residents in the Greater Accra region are more likely to have their waste collected relative to the residents in the other regions. In contrast, residents in the nine other regions had a lower probability of dumping their waste in open places as compared to households in the Greater Accra region.

2.3.2 Housing characteristics and the choice of solid waste disposal method

The relevance of housing in waste disposal decisions has been acknowledged in several studies (Adzawla *et al.*, 2019; Awunyo – Vitor et. al 2013; Frimpong, 2014). This essence is again captured in the definition of a house as a dwelling including all the services such as waste disposal which is needed to support its inhabitants (GSS, 2012). However, there is a gap to be filled with respect to the exploration of the specific housing characteristics that affect households' choice of waste disposal methods. According to the GLSS 7, there are varieties of dwellings, occupancy statuses and forms of ownership of dwellings which makes up the housing characteristics of a household. However, the various studies have not showed how each of the various types of dwellings, occupancy statuses and forms of ownership individually affect a households' decision on how to dispose solid waste. Meanwhile the association between the type of dwelling as well as occupancy status and the choice of a SWD method has been pointed out by Ato Kwamena (2016)

and Amenyah and Fletcher (2013). Specifically, Amenyah and Fletcher (2013) points out that the type of housing of a household is an indicator of their level of welfare as well as a major factor in their decision making. This implies poorer households live in impoverished homes and are less likely to pay for services like that of SWD. This further encourages the adoption of improper SWD methods like burning and indiscriminate disposal. Thus, this study will examine how each type of housing in terms of ownership, occupancy and dwelling individually influences the choice of household solid waste disposal method.

Type of dwelling

Focusing on a particular type of dwelling which is compound houses, Adzawla *et al.* (2019) found out that there exists a positive relation between the type of building and the choice of SWD method by households. The study found out that residents in this type of dwelling are more likely to use a public dump or have their waste collected rather than burning or dumping it indiscriminately.

Likewise, Opoko and Oluwatayo (2016) using a multiple regression to assess the choice of solid waste disposal method by informal settlers in Lagos, Nigeria also found the type of house to be significant in this decision. The study showed that the income status of a household informs the type of building they live in and this is associated with their choice of solid waste disposal methods. Thus, whereas wealthier households will live in houses corresponding to their economic status, they would not be constrained by money if that is what it takes to choose a proper SWD method.

Occupancy Status

Again, Adzawla *et al.* (2019) found a negative relation between housing arrangement and collection of waste and the use of a public dump. However, the study found a positive relation between housing arrangement and burning as well as indiscriminate disposal of waste. This implies that house owners are more likely to adopt improper SWD methods whereas those renting are more

likely to use proper SWD methods. This is because, owners of houses may designate space or a pit in the house to either burry or burn their solid waste (Opoko and Oluwatayo, 2016). Onwuemele (2015) further attributes this action of house owners to the irregularity in solid waste collection by the various institutions, thus forcing households to find alternatives like burying or burning which are improper.

According to Dhungana (2017), the ownership of a house is positively related to households' willingness to pay for improved waste disposal in Leknath, Nepal. A multiple linear regression model was used to analyze the data collected from 217 randomly sampled residents in the study area to arrive at that conclusion. The model showed that people living in their own houses are more likely to pay for improved waste disposal as compared to residents who may not be the owners of the house.

2.3.3 Household characteristics and the payment for solid waste disposal

Gender

Payment for solid waste disposal has been associated with the appropriateness of solid waste disposal adopted by various households (Frimpong, 2012; Adzawla et al, 2019). Thus, since methods of waste disposal require monetary payments are regarded as being proper, then studies assessing individuals' willingness to pay for solid waste disposal can be used to infer their choice of SWD method. A study by Fonta *et al.* (2008) in Enugu state, Nigeria, showed that females are willing to pay more for improved solid waste management in their homes as compared to males. This result was obtained through a probit regression of data collected from 182 residents in the study area.

Likewise, Addai and Danso-Abbeam, (2014) in a study of the WTP for improved solid waste management in Dunkwa-on-Offin, Ghana, found being male to be negatively related to their WTP. The study used the multi-stage, stratified and simple random sampling techniques to select a sample of 100 residents from the study area. A logistic regression was then used to assess the WTP for improved solid waste management in the 3 strata (high middle and low income residential areas) which were identified through the stratified sampling process.

On the contrary, Banga *et al.,* (2011) found that being female is negatively related but not statistically significant in determining the WTP for improved waste disposal services in Kampala, Uganda. Using a sample 381 household heads in Kampala, a questionnaire was used to collect relevant data after which a Contingent Valuation Model (CVM) was used to assess the WTP of households. The results showed that males are more willing to pay for improved waste collection services than females. This contradiction was explained to be due to males mostly being in charge of the finances of the household and females mostly not working in the study area. Thus, even though females are believed to choose proper methods of waste disposal, their decision is constrained by their ability to pay for it since these methods usually come at a charge.

Age

Awunyor *et. al*., (2013) in assessing the willingness to pay for waste disposal services in Kumasi – Ghana, found the age of a person to be positively related but not significant. This results was arrived at through a logit regression assessing how individuals decide whether to pay for improved waste disposal services or not. In this same study, age was found to be positive and significant to the amount an individual is willing to pay for improved waste disposal services. This implies that even though the age of a person is not relevant to the decision to pay or not to pay for waste disposal services, it matters in the amount willing to be paid by households.

On the contrary, Murad et al., (2007) found the age of respondents to be positively associated with their willingness to pay for improved access to solid waste collection and disposal services. Studying residents of flats and squatters in Kuala Lumpur, Malaysia, a contingent valuation method together with a multiple linear technique was adopted to arrive at this conclusion. This was ascribed to the likelihood of older people to be higher income earners due to their experience and seniority at the workplace. Also, aging factors that makes older people susceptible to environmental related sickness will urge them to promote a safer environment through their WTP for SWD services.

Level of Education

Contrary to the findings of Ojewale (2014), Ajani (2007) found the education of households to be negatively related to the WTP and the use of public waste collection services (PWCS). The study made use of a binary logit regression to assess factors aiding the choice of PWCS and a multiple linear regression to find out the association between selected variables and the use of PWCS. In both analysis, education was found to be negatively related and significant. Gauging the level of education with the years spent in schooling, the study showed the longer an individual stays in school, the less likely it will be for them to be willing to pay for or use public waste collection service. This contradiction was ascribed to the fact that the amount paid for public waste collection services is the main factor considered in this decision. Thus, individuals with longer stay in school will not certainly be willing to pay higher amounts since their income may not necessarily be high because they stayed in school for long. Again, the type of education being received was factored to be a probable cause of this relation. Thus, if the course or program studied does not have environmental safety and hygiene in its syllabus, then a longer schooling period may not necessarily influence the choice of public waste collection services.

In assessing the determinants of the willingness to pay for improved solid waste management in Lehknath, Nepal, Dhungana (2017) found that, the level of education of a person is positively related to the amount he would be willing to pay for the improved disposal of his waste. The study also found that majority of households agreed recycling is the most appropriate method of waste disposal. Thus, this result implies that the more educated a person is, the higher his willingness to pay for his waste to be recycled. This result was achieved through a multilinear regression analysis of data collected from 217 households through multistage sampling technique.

Household size

Anilkumar and Chithra (2016) established that a positive association exists between the volume of waste generated and the household size. Aggrey and Douglason (2010) added that a higher level of solid waste generation is associated with challenges which incentivizes households to tackle it even if it requires some monetary obligations. However, the findings of Addai and Danso – Abbeam (2014) did not support this. They rather found the household size to be negatively associated with payment for improved SWD services. This negative association waste as found by Addai and Danso – Abbeam (2014) was ascribed to the fact that the area chosen for the study, Dunkwa, is a low-income area and as such most households are unable to afford SWD services. Again, this justifies the larger household size since larger household sizes is mostly associated with low-income earners.

Household wealth

In an assessment of households' WTP for improved waste collection services in Mekelle city, Ethiopia, Tadese and Hagdu (2009) found that it was only the monthly income and distance from a home to waste container that are significant to the decision to pay and the amount to pay for

waste collection services. Their study used a sample of 300 households' responses to a structured questionnaire to illicit their choice of disposal method and their WTP for an improvement in services delivered. Through an Ordinary Least Squares and Maximum Likelihood Logit regressions, the conclusion that waste collection services is a normal economic good was reached. This conclusion was supported by the fact that the monthly income of households was found to be significant and positively related to households' WTP for improved waste collection services. Hence, the higher the income of a household, the more they will be willing to pay for improved waste collection services.

Similarly, Tamura (2005) arrived at a similar result in assessing the demand for waste collection services in Accra. The study assessed the willingness to pay low, medium-low, medium-high or high amounts for waste collection using the ordered probit model. The midpoint value of amounts respondents are willing to pay was used for the classification as follows; low WTP = 0 to GH₵1.75 ($ 0.30), medium-low WTP = GH₵ 2.25 ($[1] 0.39) to GH₵4.25 ($ 0.74), medium-high WTP = GH₵4.75 ($ 0.82) to GH₵6.75 ($ 1.17) and high-WTP = GH₵7.25 ($ 1.26) to GH₵12.50 ($ 2.17). Based on data collected from 151 respondents in the study area, the analysis showed that the monthly income of respondents is positively related to the amount of money they would want to pay for waste disposal. It was concluded from the study that as the income of an individual increases, the more willing will he be to pay for solid waste disposal. However, this relation was found to be statistically significant for all categories except for the medium-low category.

[1] Using the exchange rate as at 05/08/2020 (GH₵ 1 = $ 0.17)

Geographical location

Likewise, Frimpong (2014) found out that households living in urban areas are about seven times likely to pay for their waste disposal, thus adopting proper waste disposal methods. Also, the study did a regional analysis for the ten regions in Ghana as at 2013 and found that with the Greater Accra region as the reference category, all the other regions had a negative relation with waste collection. Thus, residents in the Greater Accra region are more likely to have their waste collected relative to the residents in the other regions. In contrast, residents in the nine other regions had a lower probability of dumping their waste in open places as compared to households in the Greater Accra region.

2.3.4 Housing characteristics and the payment for solid waste disposal

Type of dwelling

On the contrary, Frimpong (2014) found a negative relation between households' willingness to pay for waste disposal and dwelling in a compound house. This conclusion was a result of an assessment of the WTP for SWD in the Greater Accra Region. The study used a sample of 1,257 households as recorded in the fifth round of the GLSS. In analyzing the data collected, a logistic regression, a bivariate as well as multivariate level analysis was done. The logit regression showed that the type of dwelling and place of residence of a household were significant in the decision to pay or not to pay for SWD in the study area.

This contradiction can be ascribed to the fact that the cost of collection was used as a proxy for the method adopted by a household in the study by Frimpong (2014) whereas Adzawla *et al* (2019) used the methods as presented in the data. Thus, the type of dwelling has a negative relation to the

amounts households are willing to pay for waste disposal but a positive relation to the actual choice of a method of waste disposal.

Occupancy status

In assessing the WTP for improved final solid waste disposal in Malaysia, Pek and Othman, (2010) showed that the ownership of a house was significant in such a decision in their study. In their study, they used contingent valuation technique to illicit the mean amount the 813 sampled household heads were willing to pay for improved solid waste disposal. Thereafter, a logistic regression was conducted to find out the probability of households to decide on paying for improved SWD methods. The result of the logistic regression showed that households occupied by owners were more willing to pay for improved waste disposal services as compared to those renting. This positive relation was explained to be due to the sort of permanency that comes with ownership relative to renting or leasing a house.

Similarly, Oteng-Ababio (2010) used the logit regression to arrive at the conclusion that residents of owner-occupied houses like flats and bungalows were more likely to pay for improved waste disposal services as compared to renting residents in the Greater Accra Metropolitan area. The random and stratified sampling techniques were adopted to sample 920 residents from the study area after which a logit regression was used to assess their WTP. It was also made evident that although most people in low-income residential areas are willing to pay for improved waste disposal, they are usually not considered for such services.

According to Dhungana (2017), the ownership of a house is positively related to households' willingness to pay for improved waste disposal in Leknath, Nepal. A multiple linear regression model was used to analyze the data collected from 217 randomly sampled residents in the study

area to arrive at that conclusion. The model showed that people living in their own houses are more likely to pay for improved waste disposal as compared to residents who may not be the owners of the house.

2.4 Conclusion

This chapter clarified some of the contradictions in the findings of various authors. This was basically seen in the relation between variables and their significance in each study. Also, the variations in results of different authors helped to understand the impact of geographical differences on SWD. The discussion further looked at the relation between SWD methods as well as payment for waste disposal and gender, age, education, size of household, household welfare, type of dwelling, occupancy status and ownership of dwelling. Most of the studies focused on a smaller geographical location and as such conclusions could not be reached at the national level.

Again, in terms of methodology, the logistic regression (binary and multinomial) are the common statistical procedures used in assessing the determinants of the choice of SWD. With regards to the WTP, most studies have used the probit and tobit regression models to assess the amount households are WTP for improved SWD methods.

CHAPTER THREE

OVERVIEW OF SOLID WASTE DISPOSAL AND HOUSING CHARATERISTICS IN GHANA

3.1 Introduction

This chapter gives an overview of solid waste, household solid waste disposal (SWD) methods as well as the housing characteristics in Ghana. The chapter will be divided into five (5) subsections, with the first part devoted to reviewing the composition of solid waste. The second subsection will look at SWD in Ghana and also review the relation between localities and the choice of SWD method. In the third (3) part, housing characteristics in Ghana will be reviewed focusing on the trends in households' dwelling types, occupancy status and ownership of dwelling. The fourth (4) part looks at the institutions tasked with solid waste collection and the regulations for their successful operation whereas the final part reviews policy and legal structures in the broad area of solid waste management and narrow it down to the most appropriate form of disposal; collection.

3.2 Composition of Household Solid Waste

Amasuomo and Baird (2016) explained that waste generally comes in different forms and as such can be classified accordingly. They added that the common classes of waste was according to their physical properties, source or environmental impact. Defining solid waste, Tchobanoglous *et al.,* (1993) focused on their physical characteristics and concluded that solid waste is any solid or semisolid form of waste generated through human activities and thus discarded as being useless. According to Zerbock (2003), solid waste is defined as including non-hazardous industrial,

commercial and domestic waste which forms part of household organic waste, waste from sweeping the streets, institutional and construction wastes. This definition basically looks at the various sources and environmental impact of solid waste. Again, Amasuomo and Baird (2016) added that the categorization of waste will determine how it is disposed in order to have minimum environmental impact. Thus, this section will look at the various constituents of household solid waste and underscore the need for appropriate disposal. The constituents of solid waste in Ghana are shown in a bar chart in figure 3.1.

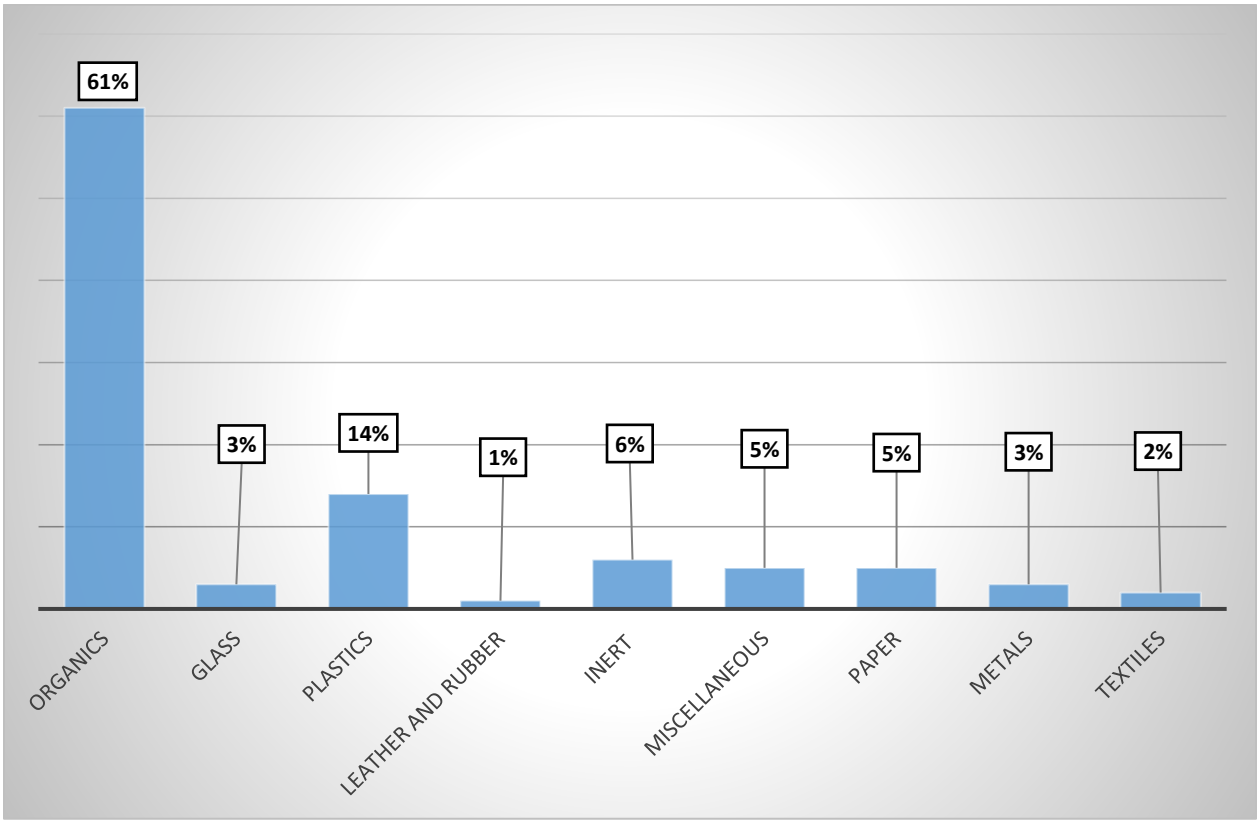

Figure 3.1: The Composition of Household Solid Waste in Ghana
Source: Miezah *et al.* (2015)

Miezah *et al.*, (2015) reported that household solid waste in Ghana is made up of 61% organics, 14% plastics, 6% inert, 5% miscellaneous, 5% paper, 3% metals, 3% glass, 1% leather and rubber,

and 1% textiles. For each of these categories, the study further identified the sub-components for each of them. The organic solid waste category, which constitutes the majority (61%) of household solid waste (HSW) is made up of food waste, animal droppings, wood and grass trimmings, whereas 5% of HSW is paper and consists of newsprints, office papers, cardboards and tissues. These two categories of waste; organic and paper, are known as biodegradable since they can be decomposed by bacteria or other natural organisms thus, can be reused or recycled as a source of energy or compost (Abalo *et al.*, 2018). Therefore, if biodegradable solid waste is properly sorted and reused or allowed to decompose, about 66% of the total household solid waste in Ghana could be disposed of without causing pollution whilst providing benefits through renewable energy supply and income generation (IAEA, 2005). According to the UNEP (2010), effective energy generation from waste is preceded by adequate separation of organic and inorganic solid waste. Unfortunately, the rate of source separation in Ghana is very low even though there is a high willingness to separate solid waste at source (Oduro-Kwarteng *et al.*, 2015; Yoada *et al.*, 2014; Anarfi, 2013; Kyere *et al*., 2009). This, coupled with the adoption of improper SWD methods like burning and indiscriminate SWD makes reuse, recycling and decomposition impossible.

The other components of solid waste which make up about 44% of total HSW in Ghana are non-biodegradable, so it is best to reduce, reuse or recycle them in order to mitigate their associated pollution on the environment (Quartey *et al.*, 2015). As shown in figure 3.1, 5% of HSW in Ghana is miscellaneous solid waste which is made up of construction waste, batteries, paints and any other type of solid waste which is not classified under any of the other categories. Also, 6% of HSW is inert solid waste which consists of sand, fine organics and ash, whereas 3% of HSW are metals including scraps, cans and tins. Plastics, the second most common type of HSW making up about 14% of the total HSW in Ghana is made up of Polyethylene terephthalate (PET), High

density polyethylene (HDPE), Polyvinyl chloride (PVC), Low density polyethylene (LDPE), Polypropylene (PP), Polystyrene (PS) and other plastics. Abota (2012) showed that the percentage of plastic waste in total solid waste which has been increasing over the years was due to the increasing demand for plastic products which had also attracted huge capital investments mostly from the private sector into the plastic industry. It was further pointed out that in addition to the about 10,000 metric tons of finished plastic products imported into the country, 26,000 metric tons were being produced by the about 40 plastic manufacturing companies as at the year 2000 in Ghana (Owusu-Sekyere *et al.*, 2013). The three least found categories of solid waste are leather and rubber, glass and textiles and makes up 1%, 2% and 3% respectively of HSW in Ghana.

According to Hoornweg and Bhada-Tata (2012), the composition of waste is influenced by the culture, economic development, geographical location, climate, as well as energy sources. Miezah *et al.*, (2015) showed that there was a great variation in the composition of HSW in the various geographical areas of Ghana. To be exact, whereas the proportion of organic solid waste was highest in the coastal zone, it decreased in the forest zone towards the northern savannah. This was ascribed to the boom in economic activities coupled with the proximity to the sea which makes the area a commercial hub attracting a lot of people. With the high dependence on agricultural products in Ghana, the higher population in the coastal areas leads to a higher organic waste generation. However, organic waste was found to be the most predominant HSW in all the regions of Ghana due to the high dependence on agricultural products.

3.3 Solid waste disposal in Ghana

The generation of solid waste in the daily lives of individuals has made SWD indispensable. However, how solid waste is disposed is dependent on individual choices as informed by key

factors like socioeconomic and housing characteristics (Yoada *et al*., 2014). The Ghana Statistical Service in its publication of the Ghana Living Standards Survey identified collection, burning, public dump and indiscriminate disposal as the four methods of solid waste disposal (SWD). Whereas collection entails house to house collection by waste management companies usually at a charge, the public dump consists of public waste containers and open spaces designated for waste disposal often at a lower or no cost to households. Households who dispose their household solid waste in gutters, bushes, roadside or any place which is not designated for that purpose are classified as using the indiscriminate disposal method. Finally, the burning of solid waste either in the open or enclosed space like covered pits is a method adopted by some households to dispose their solid waste. This section will therefore look at the recent data on the adoption of different SWD methods as recorded in Ghana Living Standards Survey (GLSS) 6 and 7 in table 3.1.

Table 3.1: Methods of Household Solid Waste Disposal in Ghana

Method of SWD	(Percentage (%) of Households)		
	2012/2013	2016/2017	Change
Collection	18.2	21.90	+ 3.7
Burned	16.60	19.50	+ 2.9
Public Dump	52.40	47.80	- 4.6
Indiscriminate disposal	12.80	10.80	- 2
Total	100	100	

Source: Author's computation from GLSS 6 and GLSS 7

Table 3.1 highlights some important variations in the choice of solid waste disposal methods by Ghanaian households between 2012/2013 and 20162017. Appendix 1 shows that the difference

between households' choices of SWD methods in the two periods is statistically significant with a 0.045 difference in means and a p-value of 0. As at 2017, 21.9 % of Ghanaian households were having their waste collected whilst 19.5%, 47.8% and 10.8% had their solid waste burned, disposed at a public dump and disposed indiscriminately respectively. This brings the tally of proper solid waste disposal to 77.8%. Even though there is a high percentage for the use of proper SWD methods, they are still faced with constraints like inadequate collection services which is also triggered by financial constraints (Oduro-Kwarteng, 2013). Probing into the factors distracting the effectiveness of solid waste collection services (SWC), Fei-Baffoe *et al.*, (2014) found irregular solid waste collection (SWC), inadequate staffing and inadequate public containers to be some of the practical causes. Also the harmful effects associated with the improper SWD, thus the remaining 22.2% necessitates an enquiry into the factors influencing their choice.

As indicated in table 3.1, the public dump remains the predominant method of SWD with more than half of the population of households using this method. This is due to its availability and low cost involved relative to the collection method (Yoada et al., 2014). However, there was a 4.6% reduction in the number of households using public dumps method over the period 2012/2013 to 2016/2017. The collection method, although the second most used method of disposal, has less than a quarter of the household population using it since it is mostly available in a few urban areas. Relative to the percentage of solid waste collection usage in 2016/2017, there was a 3.7% increase from the 2012/2013 value of 18.2%. This improvement can be ascribed to the implementation of policies like the national sanitation day and free dustbin distribution service between 2013 and 2017 (Abalo *et al.*, 2017). Also, the method of burning solid waste recorded a 2.9% increase in its usage between the years under review whilst indiscriminate SWD reduced by 2%. The net effects show that improper SWD increased by 0.9% whereas proper waste disposal also declined by the

same percentage. Kanhai *et al.*, (2019) explained that although most households in Accra knew of waste-related diseases, they did not believe it was responsible for such illnesses in their households, thus, their continuous use of these improper SWD methods. They further added that the lapses in the frequency in waste collection drove some households to get rid of their waste by burning it when collection delays. Over time, this becomes their default choice of SWD which becomes difficult to change due to its low cost and convenience.

3.3.1 Locality and Solid Waste Disposal Methods

The quest to achieve economic development has led to rapid urbanization globally and Ghana is no exception. Just as the distribution of residents in rural and urban areas is unequal, the access to facilities and services like that of solid waste disposal is not evenly distributed (Boateng *et al*., 2016). Mostly, residents in urban areas have access to a variety of solid waste disposal (SWD) options whereas rural dwellers are stuck with only a few options. According to Amfo-Otu et al. (2012), the local government and private companies engage in waste collection at a fee in urban areas whereas residents of rural areas dump their household waste in open spaces for free. This action was explained to be due to the perception that rural dwellers do not have the purchasing power for waste collection services (Boateng et al., 2016). Since the availability of a SWD method greatly influences the choice of a household, a review of the choices by residents in the various localities will help explain the reasoning behind these choices. Again, with the increasing rate of urbanization and the current estimated urban population of 17,625,567 which is 56.7% of the total population of Ghana, the changes in the choice of SWD methods by households can be assessed alongside the change in the locality distribution. Thus, table 3.2 is a representation of the choice of SWD method in the various localities.

Table 3.2: Methods of Solid Waste Disposal According to Locality

Method of SWD	Location (% of Households)			
	Urban 2012/2013	Rural 2012/2013	Urban 2016/2017	Rural 2016/2017
Collection	29.8	3.8	36.2	3.7
Burned	13.4	20.7	16.1	23.8
Public dump	52.3	52.5	43.7	52.9
Indiscriminate disposal	4.5	23.0	3.9	19.6
Total	100%	100%	100%	100%

Source: Author's computation from GLSS 6 and GLSS 7

Comparing the methods of SWD adopted in rural and urban areas between 2012/2013 and 2016/2017, Table 3.2 indicates that there was an increase in the number of urban households using the collection method from 29.8% in 2012/2013 to 36.2% in 2016/2017. As indicated in appendix 1, the difference between households' choices of SWD methods in the two periods is statistically significant with a 0.064 difference in means and a p-value of 0. On the contrary, the use of this method declined from 3.8% to 3.7% over the two periods respectively in the rural areas. This difference has been explained by Gutberlet (2017) to be due to uneven geographical development which compels waste management agents to engage in selective SWC in various geographical areas. This is further highlighted by the dominance of SWC as the method of SWD in the Greater Accra region. The GLSS 7 report revealed that 65.4% of households in the most urbanized region, such as the Greater Accra Region alone had their solid waste collected, whereas most of the other regions with higher rural dwellers barely had 10% of households having their waste collected (GSS, 2018).

Unfortunately, the use of the burning method, which is an improper method of SWD has been increasing both in the rural and urban areas over the years under review. Particularly, from 13.4% to 16.1% in the urban areas and 20.7% to 23.8% in the rural areas in 2012/2013 and 2016/2017 respectively. However, the efforts such as the establishment of waste management departments (WMDs), Private Sector Involvement and Public Private Partnerships in solid waste management, aimed at reducing improper SWD has yielded results by reducing indiscriminate SWD in both localities (Oduro-Kwarteng, 2011) . In the urban areas, indiscriminate SWD decreased from 4.5% to 3.9% and likewise, decreased from 23.0% to 19.6% in rural areas. Even though the public dump method remains the predominant method of SWD in both localities, the number of households using this method declined in urban areas but increased in rural areas. Particularly, public dump usage declined from 52.3% to 43.7% in the urban areas whereas it increased from 52.5% to 52.9% in rural areas from 2012/2013 to 2016/2017. Nevertheless, the 6.8% increase in SWC in the urban areas in the same period compensates for the decline in the use of the public dump since they are both proper methods of SWD. Besides, Adzawla *et al.*, (2019) pointed out that even though the public dump is a proper method of SWD, collection is the most appropriate method.

3.4 Housing in Ghana

A household refers to a group of related or unrelated persons, living together in the same housing unit, share the same housekeeping and cooking arrangements, are considered as a unit and acknowledge an adult male or female as their head (GSS, 2014). Housing is also defined as encompassing all factors and conditions that go to produce a dwelling with all the attributes of adequate and decent dwelling. Thus, housing is not restricted to only the building but all the services required to make the unit function form part of it. Thus, SWD services are essential to all

housing units. Housing has been explained to influence the willingness to pay for SWD services and as such, the choice of SWD method too (Frimpong, 2012). Particularly, the study found out that whereas households living in separate houses (flats and semi-detached houses) are more likely to pay for SWD, those living in impoverished or compound houses are less likely to pay; thus adopting improper SWD methods. This section therefore assesses the trends in the various housing characteristics in Ghana to better understand their relation to SWD practices adopted by households.

3.4.1: Types of Household Dwellings in Ghana

As at the year 2016, the types of dwelling in Ghana were; compound, separate and semi-detached houses, Flat/Apartment, Huts/Buildings (same compound), Huts/Buildings (different compound), Tent, Improvised home (kiosk/container, etc), Living quarters attached to office/shop, Uncompleted building and Others (GSS, 2017). These types of dwelling were further grouped as official and official on the basis of being captured in Ghana's building codes and regulations or not. According to this categorization, only semi-detached houses, flats and compound houses are official since they are captured in the building codes and regulations of Ghana. However, since data for some types of housing for the periods under review are unavailable and the frequency of some of the types of dwellings are very small and insignificant, this study will review the significant ones; separate, semi-detached and compound houses, flat/apartments and huts/buildings. The definitions of these types of dwellings as given in the census dictionary (ABS, 2011) will be averred to support the premise that the level of poverty or wealth of a household; which influences the choice of solid waste disposal method, can be stipulated from their type of dwelling (Amenyah & Fletcher, 2013).

A separate house is defined as a dwelling that is at least half a meter from other dwellings whereas a semi-detached building is a dwelling that has its own private grounds and no other building beneath or above it. A flat/apartment refers to dwellings in blocks of flats or units of flats that do not have their own private grounds and do not share a common entrance. These three types of dwellings according to Amenyah & Fletcher (2013) are occupied by wealthier households who can afford and are most likely to be willing to pay for SWD.

Also, a compound house refers to a traditional house design made of a large rectangular structure that is arranged around three sides of a courtyard and has several rooms (Fiadzo, 2004). A hut as defined in the Cambridge Advanced Learners' dictionary (2020) as a small, simple building consisting of one room. Its simplicity is reflected in the use of cheaper materials like wood, mud, grass and stones in its construction which again shows that households in this type of dwelling are not economically sound and as such will be less likely to pay for SWD or choose a proper SWD method (Amenyah & Fletcher, 2013). The other types of buildings as specified by the Ghana Statistical Service are also considered to reflect a poor economic status of households since they mostly are improvised means of housing to support poor households. Thus, if a necessity like housing cannot be afforded, then other services like proper SWD will be less likely to be patronized by such households. Hence, table 3.3 shows the types of dwellings in Ghana over three periods of time.

Table 3.3: Types of Household Dwellings in Ghana

Type of Dwelling	(Percentage (%) of Households)		
	2005/2006	2012/2013	2016/2017
Separate house	4.00	15.20	28.00

Semi-detached house	3.50	7.00	4.70
Flat/Apartment	3.00	3.60	3.30
Compound house	43.70	60.60	57.30
Huts/buildings	35.50	10.40	4.30
Others	10.30	2.90	2.50
Total	100	100	100

Source: Author's computation from GLSS 6 and GLSS 7

As shown in table 3.3, although compound houses remain the most common type of dwelling in Ghana, there was a 3.3% decrease in the number of households living in this type of dwelling from 2012/2013 to 2016/2017. Similarly, the percentage of households living in semi-detached houses, apartments and huts also decreased by 2.30%, 0.30% and 6.1% respectively between the same time period. However, the population living in separate houses more than tripled from 2005/2006 to 2012/2013 and almost doubled from 2012/2013 to 2016/2017. Specifically, the percentage of households living in separate houses was 4.0%, 15.20% and 28.20% in 2005/2006, 2012/2013 and 2016/2017 respectively. This increment in separate house dwelling and decline in compound house dwelling can be ascribed to the shift in era from direct provision of housing by government to the Structural Adjustment Programmes (SAPs) and Economic Reform Programmes (ERP) era (GSS, 2014). In the new era, housing delivery has been rooted in private sector participation and empowerment of individuals (ISSER, 2013). This new era therefore aims at focusing on the needs of low-income earners who are mostly housed in dwellings lacking access to basic services like SWD services.

3.4.2: The Occupancy Status of Households in Ghana

The occupancy status of a household refers to the tenure agreement under which they have agreed to occupy a dwelling unit (GSS, 2010). As at 2016, the four main occupancy statuses identified in Ghana were the owning, renting, rent-free and perching. In relation to the choice of solid waste disposal method, Frimpong (2014) explained that households who own their dwelling are more likely to choose SWD methods that are paid for and as such use a proper SWD method since ownership comes with a sense of responsibility for ensuring all needed services like SWD are obtained.

Table 3.4: The Occupancy Status of Households in Ghana

Occupancy status	(Percentage (%) of Households)		
	2005/2006	2012/2013	2016/2017
Owning	44.60	45.90	42.10
Renting	22.80	26.80	27.60
Rent-free	31.90	27.00	29.70
Perching	0.70	0.30	0.50
Total	100	100	100

Source: Author's computation from GLSS 6 and GLSS 7

With regards to occupancy status, ownership of dwelling has over the period been the most popular occupancy status with 44.60%, 45.90% and 42.10% of households having this type of status in 2005/2006, 2012/2013 and 2016/2017 respectively as shown in Table 3.4. However, there was a 3.8% decrease in the percentage households owning houses they live in between 2012/2013 and

.2016/2017. This decline has been attributed to a failure of the several policies aimed at making tenants home owners (GSS, 2014). Furthermore, the percentage of households renting their dwelling place and paying for it has been increasing over the years under review, that is, increasing from 22.80% to 26.80% and further to 27.60% in 2005/2006, 2012/2013 and 2016/2017 respectively. This increased has been explained to be as a result of urbanization which increases the urban population such that demand for houses exceed their supply and most households; especially high and middle income earners, are forced to choose renting rather than owning (Akaabre et al., 2018). Also, there was an increase in the percentage of households who were perching or squatting and renting for free between 2012/2013 and 2016/2017. This was attributed to the challenges of the housing market; high cost of rent which forced most low-income earners and the poor to seek for safe dwellings either illegally or for free (GSS, 2014).

3.5 Institutional and Regulatory Framework for Solid Waste Collection in Ghana

The roles of the diverse actors at the various stages of solid waste management (SWM) of which solid waste collection (SWC) is key are captured in the institutional and regulatory arrangements for SWM along with the delivery mode and financing of SWM programmes in Ghana (Oduro-Kwarteng, 2011). He again noted the transitions in the institutional framework for the provision of SWC services from the central government to the local government and currently, the inclusion of the private sector which has had direct implications on the involvement of households, the private and public sector in Ghana's SWC. A summary of the major historical events in SWM are provided in Table 3.6. From this summary, subsections have been developed for the various institutions responsible for SWC from 1957 to the present days. Thus, the role of the central

government as well as the private sector in SWC will be reviewed to understand how the regulation of SWC has been influenced by these institutions.

Table 3.5 History of Solid Waste Collection in Ghana

Year	Management mode
1957	Public service provision by Public Works Department (PWD)
1985	Waste Management Departments (WMD) were established in all the major cities, equipped and funded by the German Agency for Technical Co-operation (GTZ).
1988	Provision and delivery of basic public services were decentralized to local government (Adarkwa, 2005).
1990	In the early 1990s, there was policy shift towards private sector-led development, led to contracting out and franchising the solid waste collection services to the private sector in Accra and Tema.
1995	Private sector involvement (PSI) in solid waste services in four selected cites (Tema, Takoradi, Kumasi, Tamale) was supported as component of Urban Environmental Sanitation Project (UESP-World Bank funded), (private sector was to collect 40% of waste).
1999	Policy shift in public private partnerships arrangements (private sector to collect 80% of waste),
2010	The implementation of the new Environmental Sanitation Policy which involved all stakeholders

Source: Adapted from Oduro-Kwarteng, 2011

3.5.1 Public Sector provision of solid Waste Management

The colonial and early post-colonial days saw the dependence on the central government for the provision of public services like SWC. It was in this regard that the government after independence in 1957, established the Public Works Department (PWD) to provide sanitation services in all areas of Ghana. However, the government was hardly able to manage the wide range of services and this led to a degeneration in public service provision in the 1970s. Coupled with the economic downturn in the early 1980s, the PWD was crippled with insufficient finances to acquire capital

equipment which resulted in the frequent breakdown of vehicles, plants and equipment. Consequently, most households resorted to dumping their waste indiscriminately since they lacked access to SWC services.

Following the failure of the PWD, the Waste Management Departments (WMDs) were established by the government with the help of the United Nations Development Program (UNDP) and technical as well as financial support from the German Agency for Technical Co-operation (GTZ) in 1985 (Oduro-Kwarteng, 2011). Under this partnership, house to house collection was started in high-income residential areas of Accra. Donkey drawn carts were used for these collections from houses after which they were dumped in a container. This initiative was implemented with 15 donkeys and 10 staff who were able to go for 3-4 trips and covered 75-100 houses each day (Kyere *et al.,* 2019). The exit of the GTZ left waste management to public provision which was poor in terms of coverage and quality of service. For instance coverage in Accra which had increased to about 80% declined to about 45% after the exit of the GTZ (AMA, 1995). This necessitated a more decentralized control system to include the private sector in SWM.

According to Adarkwa (2005), the management and supply of public services including SWC and sanitation was decentralized to the Local government (LG) in 1988. This arrangement brought about the setting up of service units by the local government whose services were more or less free. According to Awortwi (2003), there was a degeneration in solid waste and sanitation services provided by the local governments due to issues like frailty in service operations, behavior of residents towards SWM, poor administration and organization, inadequate implementation of solid waste and sanitation by-laws and apathetic waste management workers.

3.5.2 Private Sector Involvement in Solid Waste Collection

The role of the local government in solid waste collection was faced with criticisms stemming from the progress in sanitation of developed countries which greatly involved the private sector in providing such services coupled with the Structural Adjustment Program which was rolled out in Ghana in the 1980s. This led to the beginning of contracting-out and franchising of solid waste collection (SWC) and sanitation services in Accra and Tema to private service providers. However, there was no legal backing for private sector involvement (PSI) in the provision of these services until 1992. A major landmark in private sector involvement (PSI) in SWM is the World Bank funded Urban Environmental Sanitation Project (UESP) which was implemented from 1995 in Kumasi, Takoradi, Tema and Tamale. Particularly, the distribution of household dustbins, skips and skip pads and the promotion of PSI in solid waste collection were sub-projects in the third component of the project; SWM. Again, it was anticipated that the Local Governments provide about 60% of the basic services and the remainder of 40% to be provided by the private sector in the short to medium term. In the quest to ensure the sustenance of the private sector, the Local Governments were required to set levies at practical and economically feasible levels with provisions for periodic cost recovery and depreciation of capital equipment as well as equipping the private sector to get access to capital investments. Awortwi (2003) added that the shift from the direct provision by LGs to the private sector provision implied the LGs had to completely re-organize, reorient their management and regulatory apparatus and strengthen their human capabilities to facilitate, regulate and monitor the private sector's provision of SWM services. Currently, the decentralized (Metropolitan Municipal and District Assemblies) MMDAs under the supervision of the Ministry of Local Government and Rural Development (MLGRD) are responsible for waste management in Ghana (MLGRD, 2010). However, the Ministry of

Environment, Science and Technology (MESTI) through the Environmental Protection Agency (EPA) is the authority in charge of regulating waste management. The task of solid waste collection and final disposal are specifically undertaken by the Waste Management Departments (WMD) and Environmental Health and Sanitation Departments (EHSD) of the various MMDAs. The ESHDs specifically provide guidance and technical assistance to the MLGRD on environmental sanitation as well as regulating all service providers and disseminating the outcome of research in environmental sanitation (MLGRD, 2010).

3.6 Policy Legal Structures in Solid Waste Management in Ghana[2]

Policy refers to a document which outlines the intentions, decisions and course of action adopted by the government towards achieving a goal (Oduro-Kwarteng, 2011). The desire of government to ensure efficient environmental sanitation has resulted in several policy frameworks including, the Local Government Act (1994), the National Environmental Sanitation Policy (NESP) of Ghana (1999), the Environmental Protection Agency Act (1994), Act 490, the Pesticides Control and Management Act (1996), Act 528, the Environmental Assessment Regulations 1999, (LI 1652) and the Guidelines for the Development and Management of Landfills in Ghana. However, none of these policies was purposely designed to tackle solid waste management (SWM) or solid waste disposal so this review will focus on aspects of the various policies that concern SWM.

The Environmental Sanitation Policy of Ghana

The Environmental Sanitation Policy (ESP) is the first major policy on environmental sanitation in Ghana and was prepared by the Ministry of Local Government and Rural Development

[2] Adapted from the Sanitation Profile for Ghana, UN

(MLGRD) in consultation with other stakeholders in the year 1999. With the objective of developing and maintaining a clean and safe physical environment in human settlements as well as outlining the responsibilities of the various stakeholders of environmental sanitation, the policy covers a range of environmental health aspects including both solid and liquid waste management. However, this review will focus on the solid waste management (SWM) aspects of the policy to assess its objectives, challenges faced with its implementation and its current state.

The strategies towards the achievement of the objectives of the NESP included;

- the formal establishment of an environmental sanitation subsector in the national development programme,
- Establishment of a National Environmental Sanitation Policy Coordination Council within the Ministry of Local Government and Rural Development
- Establishment of a National Environmental Sanitation Day to be observed one day in a year by all citizens
- Development and strengthening of the community's role in environmental sanitation
- Development of human resources and strengthening institutional structures for managing environmental sanitation
- Assigning delivery of a major proportion of environmental sanitation services to the private sector through contract, franchise, concession and other arrangements
- Development of a strong legislative and regulatory framework, and capacity for supervising environmental sanitation activities and enforcing standards
- Promotion of research to review sanitation technologies
- Identification and dissemination of cost-effective, appropriate, affordable and environmentally friendly technologies to address environmental sanitation needs

- Adoption of the cost recovery principle in the planning and management of environmental sanitation services.

The main challenge to the successful implementation of these strategies is weak enforcement by the various institutions responsible (Kyere *et. al*., 2019).

As part of ensuring the effective implementation of the ESP 1999, a series of reviews which were conducted over time were used to revise the ESP in 2008. Again, the amended ESP was to upgrade its content, address current developmental goals and get all actors on board. It is the major policy document guiding the environment and sanitation sector in Ghana currently (MLGRD, 2008). In accordance with the updated NESP in 2008, MMDAs were to draft by-laws to control environmental sanitation and prevent pollution in their domain of authority. Again, the four main functions of the assemblies in ensuring environmental sanitation as outlined in the NESP are; provision of waste management services, public health management services, environmental monitoring services as well as planning, monitoring and public relations. With the shift into an era of PSI in waste management from the 1990s, the NESP also has a target of boosting SWC by ensuring 80% of SWC services are being provided by the private sector.

Again, after the MESTI published the NESP in 1999, the MLGRD used it as a source document to develop a guideline document called 'The Expanded Sanitary Inspection and Compliance Enforcement (ESICOME) Program guidelines. At the various MMDAs, the program guidelines were implemented to cover environmental health inspections, dissemination of sanitary information, pest/vector control and law enforcement. These guidelines were implemented along with waste management plans developed by the various MMDAs. However, due to the involvement of several institutions and agencies in this policy, a general council called the National

Environmental Sanitation Policy Co-ordination Council (NESPoCC) was set up to facilitate effective communication and cooperation between the several agencies tasked with managing the environment in their various districts (MLGRD, 2004).

Other efforts of the government at improving waste management has been enacted through legislations like; the Environmental Assessment Regulations, 1999 (LI 1652); Criminal Code, 1960 (Act 29); Water Resources Commission Act, 1996 (Act 522); Pesticides Control and Management Act, 1996 (Act 528) and National Building Regulations, 1996 (LI 1630) Anku (2008). Specifically, Act 29 of the 1960 criminal code stipulates that whoever disposes or allows to be disposed, any refuse, or garbage, or any offensive or otherwise unwholesome matter, on any street, yard, enclosure, or open space, except at such places as may be set apart by the local authority or health officer for that purpose commits a punishable offence. This law therefore aims to ensure that residents take responsibility for the streets in front of them as well as their premises. The National Building Regulations (NBR), 1996 (LI 1630) provides that a garbage disposal facility should be incorporated in every building meant for residential, commercial, industrial, civic or cultural use. In addition, a requirement of a standardized dustbin or receptacle approved by the Assembly for temporal storage of waste generated in each dwelling unit was incorporated in the NBR. The NBR again provides for transfer stations to be located within the reach of households and preferably protected from rain and the prevention of spreading, pest infestation, and scavenging activities.Again, the MLGRD in collaboration with the MESTI, the Ministry of Health and the EPA prepared some guidelines and standards for waste management. These include; National Environmental Quality Guidelines (1998), Ghana Landfill Guidelines (2002), Manual for the preparation of district waste management plans in Ghana (2002) as well as the Handbook for the preparation of District level Environmental Sanitation Strategies and Action Plans (DESSAPs).

Provisions for sanitation and SWM are made in all of these policy and legal frameworks thus, the services of the various institutions to implement and enforce these laws to ensure effective SWD and SWM at large. As clearly seen, a lot of policies have been targeted towards proper SWM generally but a few are specifically targeted at proper SWD. The effect of this lag in policy can be associated with the failure of other efforts to yield the desired results as improper SWD still persists.

3.7 Conclusion

This chapter places the current state of solid waste disposal (SWD) in Ghana in perspective with the help of existing literature. The chapter therefore discussed the composition of household solid waste, the methods adopted by households and its distribution over the various localities using data from some rounds of the Ghana Living Standards Survey. It was found that the composition of solid waste in Ghana should serve as a drive to have waste properly disposed due to its associated benefits. Again, although improper SWD is a national phenomenon, the overview showed that much is to be done especially in the rural areas to correct the problem. Also a description of the housing sector entailing the types of dwellings and occupancy statuses was done before the institutional, legal and policy framework for solid waste management was reviewed. Finally, it was found out that there is a gap in terms of policies targeted at proper SWD which has to be filled. Finally, the enforcement of set regulations needs to be adhered to in order to achieve the desired results.

CHAPTER FOUR

METHODOLOGY AND ANALYSIS OF RESULTS

4.1 Introduction

This chapter seeks to present the methodological technique as well as the assumptions underlying the objectives specified in this study. The chapter begins with the presentation of the theoretical framework from which the estimated model for the study is derived. Also, the necessary diagnostic tests are specified and conducted to ensure the efficiency, consistency, reliability and unbiasedness of results. In addition, the variables to be used in the study are defined and their expected relation with the independent variables; improper solid waste disposal (SWD) methods and payment for SWD discussed. This chapter further describes the data source which is the 7th round of the GLSS. Finally, the results of the two estimated models are presented and discussed. All estimations are carried out using STATA version 14.

4.2 Theoretical Framework

This study is aimed at assessing the factors influencing the choice of improper solid waste disposal as well as the decision to pay for solid waste disposal (SWD). This can be better explained using consumer choice models, of which the utility theory is a major component. According to Louviere (2011), choice models are able to accurately predict the actions of individuals under specific instances.

The traditional theory of utility posits that individuals maximize their satisfaction subject to their budget (Saros, 2020). In economics, qualitative response models, which are related to the theory

of utility are often used to assess the drivers of an individual's choice given two or more alternatives (Mishra and Perry, 1999). Adapting the framework used by Tadese et al., (2007), it is assumed that an individual *i* has j mutually exclusive solid waste disposal alternatives j ε m and the derived utility, which is made up of a systematic and a random component can be represented as;

$$Uij = \beta X_{ij} + \varepsilon_{ij} \quad (4.1)$$

Where: U_{ij} is the indirect utility derived by household i from the adoption SWD method j, x_{ij} is a matrix of household income and other factors and characteristics of the alternatives that influence SWD, ε_{ij} is the unobserved component and β is the vector of parameters of the model. Therefore, a household chooses SWD method j such that his utility, U_{ij} is maximized. In this study, there are two SWD methods; proper and improper which are grouped in set j as the independent variable.

Thus, denoting Y = 1when a household chooses an improper SWD method, the probability of choosing an improper SWD method is given as;

$$P(Y = 1|X) = P(U_{ij}) = Max(U_{ij}) \quad (4.2)$$

Assuming the probability of a household choosing an improper SWD method is a linear function of his income as well as other socioeconomic factors, then from equation (1), the following logistic regression model can be used to estimate a household's probability of choosing an improper SWD method;

$$Y = \beta X + \varepsilon \quad (4.3)$$

Where Y, the dependent variable is a dummy variable which takes on a value of 1 when an improper solid waste disposal method is chosen and 0, if otherwise. X is the combined effect of

income and other explanatory variables as identified in other studies and β is a vector of regression coefficients and ε is an error term which captures unobserved variable.

4.3 Model Specification and Empirical Framework

Since this study is aimed at assessing the factors underlying the choice of improper solid waste disposal methods and payment for SWD methods in general, a model describing the probability of the choice of a household will be appropriate. Rising from the theoretical framework and following the study by Tadese *et al*. (2007), the empirical model for the thesis is specified as;

ISWD / PFSWD = f (socioeconomic variables) (4.4)

Expressing equation 4.4 in the functional form becomes;

ISWD = f (Ge, Age, Educ., HH_size, We, loc, Dw, Occ,) (4.5)

PFSWD = f (Ge, Age, Educ., HH_size, We, loc, Dw, Occ,) (4.6)

Finally, equations 4.5 and 4.6 can be specified in the mathematical form as:

$$ISWD = \beta_0 + \beta_1 Ge + \beta_2 Age + \beta_3 Educ. + \beta_4 HH\_size + \beta_5 We + \beta_6 Loc. + \beta_7 Dw. + \beta_8 Occ. \quad (4.7)$$

$$PFSWD = \beta 0 + \beta_1 Ge + \beta_2 Age + \beta_3 Educ. + \beta_4 HH\_size + \beta_5 We + \beta_6 Loc. + \beta_7 Dw. + \beta_8 Occ. \quad (4.8)$$

Where:

ISWD is the choice of an improper SWD method, PFSWD is the decision to pay for SWD, Ge is the gender of the household head, Age is the age of the household head, Educ. is the highest level of education attained by a household head, HH_size is the household size, We is the welfare quintile of the household, loc is the geographical location of the household, Dw is the type of dwelling of the household and Occ. is the occupancy status of the household.

Thus, the binary logistic model which is underpinned by the random utility theory will be utilized in this study.

Following the general specification of the logistic model by Gujarati (2004);

$$P_i = P\ (Y = 1 \mid X_i) = \beta_0 + \beta_i X_i \ldots + \varepsilon; \quad i = 1, 2 \ldots n \tag{4.9}$$

Where:

$P_i = P\ (Y = 1 \mid X_i)$ is the probability that a household chooses an improper SWD method / pays for SWD

Y=1 means choosing an improper SWD method / paying for SWD; Y=0 means otherwise.

X_i = vectors of explanatory variables (Housing and household characteristics)

β_0 = the intercept

β_i = the corresponding coefficients

n = the sample size

ε = the error term

The underlying structural model for the probability is given as;

$$Pi = P\ (Y = 1 \mid X_i) = \frac{1}{1+\exp[-(\beta 0 + \beta 1 Xi)]} = \frac{1}{1+\exp\ (-Zi)} \tag{4.10}$$

Where: $Z_i = \beta 0 + \beta 1 Xi$ is known as the Logistic Distribution Function and ranges between - ∞ and ∞. Also, the two conditions required for this probability; Pi ranging between 0 and 1 and non-linearly related to Zi is also satisfied.

Given that Pi is the probability of choosing an improper SWD method or paying for SWD, then the probability of choosing a proper SWD method or not paying for SWD respectively will be 1 – P. Thus, the odds ratio that an improper SWD method or not paying for SWD will be the choice of a household is given by$P/(1-P)$. The model for choosing an improper SWD method or paying for SWD can then be simplified as;

$$Y = (Y=1) = F(Z^{1}_{it}\beta + \varepsilon_i) \quad (4.11)$$

Where: Z^{1}_{it} = Vector of explanatory variables which affect both the choice of SWD method and payment for SWD.

B = Vector of coefficients

ε = the error term

Therefore we can write

$$Y = (P/1-P) = Z^{1}_{it}\beta + \varepsilon_i \quad (4.12)$$

After introducing the necessary components of Z in equation 4.12, the empirical models as expressed in equations 4.7 and 4.8 were attained.

4.4 Justification for the use of the Logistic regression in the study

As both response variables in the two models of this study take on a binary response, it would be inappropriate to use the Ordinary Least Squares (OLS) to estimate, since it would make the error terms not normally distributed. The requirement of a value between positive or negative infinity ($\pm\infty$) for normally distributed error term is violated in the case of binary response variables because, the error terms for their dependent variable either takes on a value of zero or one (Gujarati,

2009). This brings about heteroscedasticity since the variance of the error term will depend on the explanatory variables (Jones, 2005). This further leads to the violation of the assumption that there is no correlation between the error term and any of the explanatory variables as specified in the OLS estimation. This leaves the probit and logit models as the only appropriate models for dichotomous variable regression models as in this study.

In both the logit and probit models, it is assumed that a continuous latent variable determines a particular activity. Assuming Y* is the latent variable, then in this study, Y* represents the choice of solid waste disposal method in model 1 and payment for SWD in model 2. From model 1, if a household chooses an improper SWD method, then the observed binary outcome is (1) and it is (0) if otherwise. In model (2), if a household pays for SWD, then the observed binary outcome is (1), otherwise (0). With this, the latent variable can be modelled by a linear regression function (Jones, 2005). However, the logistic regression is adopted for the estimations in this study due to its advantages of representing systematic taste variation accurately and capturing the dynamics in repeated choices.

With regards to interpreting results of a logistic regression model, the coefficients of the dependent variable only show whether a change in an independent variable will increase or decrease the probability of an event occurring. This can be done using the odds ratio or the marginal effect. Whereas the odds ratio records the probability of an event occurring to it not occurring, the marginal effect measures the effect of a small change in the independent variables on the probability of choosing an improper SWD method or paying for SWD. The marginal effect interpretation is used in this study. Also, the response by households equates the indirect utility derived from choosing an improper SWD method over a proper method as explained by the RUT (Casetta, 2009).

4.5 Definition of variables and expected signs

In line with the objectives of this study, two models will be estimated using the same set of independent variables which are identified in the reviewed literature. The first model will have the method of solid waste disposal (SWD) as the dependent variable whereas that of the second model will be the cost of SWD. Also, the theoretical literature and findings from reviewed works will be the basis for the a priori expectations of the signs of the independent variables. All variables are extracted from the Ghana Living Standard Survey round 7 published in 2017.

4.5.1 Dependent variables

In assessing the determinants of improper solid waste disposal, the choice of solid waste disposal (SWD) method, which is a categorical variable will be the dependent variable in the regression equation. However, since the data source does not classify them as proper or improper, they will be recoded as such to facilitate the regression. The recoding adapts the definition of inappropriate SWD method as any method of SWD aside collection, as explained by Adzawla et al., (2019). Therefore the methods of burning and indiscriminate disposal are recoded as improper SWD method whereas collection and public dump are recoded as proper SWD method. Thus, the dependent variable will be a dummy variable which takes on a value of (1) if the method chosen by a household is improper and (0) if it is proper. Similarly, the amount paid for SWD will be the dependent variable in the second regression equation assessing the influence of housing and household characteristics on payment for SWD. In this equation, the dummy dependent variable will take on a value of (1) if a household pays for SWD and (0) if they do not.

4.5.2 Explanatory variables

The independent variables as identified from the theoretical framework and the reviewed literature are; the gender, age and level of education of the household head, the size, welfare and locality of household, the type of dwelling and the occupancy status of the household. The selection of these variables are based the objectives of the study and the findings of previous studies. Again, the same independent variables are used both regressions.

Gender of household head

The gender of a household head which is a dichotomous variable indicates whether the head of a household is a male or a female. Where a female is coded 1and a male is coded 0 (thus the reference category) in both regression equations. Females are naturally known to be more conscious of environmental cleanliness and as such would be more likely to choose a proper method of SWD. However, with respect to payment for services, it is observed to be the duty of the male especially in the African setting but different studies have found varying results thus making the relation inconclusive. Thus, it is expected that female household heads will be more likely to use proper SWD method but it is uncertain whether they will be willing to pay for SWD or not. Therefore, being a male household head is expected to be positively related to improper SWD methods but their willingness to pay for SWD will be uncertain. These expectations are consistent with the findings of Adzawla et al. (2019) and Danso-Abbeam (2014).

Age of household head

This is a continuous variable showing the number of years a household head has lived. The age of a household head has been identified as key in choosing a SWD method in several studies (Adzawla *et al.*., 2019; Kayode and Omole, 2015 and Owusu, 2010). A positive association has

also been established between age and the choice of proper SWD methods from these studies. Thus, a negative association is expected between the choice of improper SWD methods and the age of the household head. On the other hand, the age of a person to a certain extent correlates with his income status. Also, older people as pointed out by Owusu (2010) are more conscious of keeping their environment clean to promote good health. This involves the choice of proper SWD methods and the WTP for SWD. Thus, a positive relation is expected between the age of a household head and payment for SWD.

Level of education of household head

This is a categorical variable describing the highest level of formal education attained by a household head. It is coded as '1' if no formal education has been attained by a household head, '2' for a maximum of basic education, '3' for obtaining secondary education, '4' if the household head has acquired a vocational, technical or teacher training and '5' for obtaining a tertiary education. The level of education of a household head informs his decision making greatly and the decision to pay for SWD and choose a SWD method is no exception. It is believed that the more educated a person is, the more conscious he is to improved sanitation. Thus, such people are believed to be more likely to use proper SWD methods. This is in line with the study of Ojewale (2014) which showed that the higher the level of education of an individual, the more likely he is to use a proper method of SWD.

Also, a higher level of education generally implies a higher level of income so that such persons are more likely to pay for SWD services. This was confirmed in the studies of Dhungana (2017) and Frimpong (2012). However, Ajani (2007) found the level of education to be negatively related to the willingness to pay for SWD. Thus, in this study, a negative relation is expected between the

choice of improper SWD and the level of education of the household head. In terms of paying for SWD, a positive or negative relation is expected.

Size of household

The number of people living in a house makes up the household size. All things being equal, the larger the household size, the more solid waste that will be generated. This implies that more money would have to be paid by larger households for solid waste collection services. Thus, households in their quest to cut down cost will be likely to choose improper SWD methods, since such choice do no attract any punishment, usually in the form of fines. This also means that the more people there are in a house, the more likely they are to choose improper SWD methods and the less likely they will be willing to pay for it. As confirmed in the studies of Anaman and Worlanyo (2015) and Ng'ang'a (2012), it is expected in this study that, a positive relation exists between the choice of improper SWD methods and the household size but a negative relation between the household size and payment for SWD.

Household wealth quintile

The wealth quintile of a household will be used as the indicator for household welfare in this study. The wealth quintile shows the income limits of households based on their average annual expenditure. Following Frimpong (2012), households are ranked as poorest, poorer, middle, richer or richest based on their wealth quintile. As shown in some studies; Adzawla *et al.*., (2019), Alemayehu *et al.*., (2017) and Mukui (2013), the choice of proper SWD methods and payment for SWD is associated with higher household welfare levels. It is therefore expected that the richer a household, the less likely it would be to choose an improper SWD method but the more likely it would be to pay for SWD.

Geographical location of household

This is a dummy variable describing the location of a household. The location of a household being either rural or urban is influential in the decision to pay for and choose a SWD method. Since it is a dichotomous variable, it will be coded as 0 for Urban (reference category) and 1 for rural. Just as the economic status of a household can be inferred from their geographical location, the decision to pay for SWD can also be inferred. That is, since mostly people in urban areas are wealthier than those in the rural areas, they tend to be more likely to pay for SWD (Boateng *et. al*., 2016). Again, the relative availability of SWD services which require payments in urban areas also increases the probability of its choice by urban residents. Thus, it is expected that being an urban resident and paying for SWD will be positively related whereas choosing improper SWD method will be negatively related to living in an urban area.

Type of dwelling

This is a categorical variable capturing the type of house a household lives in. It is coded as '1' if the house is a Separate house, '2' if it is a Semi-detached house, '3' if it is a Flat/Apartment, '4' if it is a Compound house, '5' if it is Huts/buildings and '6' if it is Others. The type of dwelling occupied by a household informs the adequacy of shelter as well as contribute to household health and income (GSS, 2017). Thus, households with better or improved dwellings will tend to be wealthier and have a higher tendency to be health conscious so that they choose proper SWD methods and are also willing to pay for SWD (Amenyah and Fletcher, 2013). It is expected that dwelling in impoverished homes like huts and other buildings will be positively associated with the choice of improper SWD methods but negatively associated with the payment for SWD. On the other hand, a negative association is expected between dwelling in a Separate house, a Semi-

detached house or a Flat/Apartment and choosing improper SWD methods but a positive relation to payment for SWD.

Occupancy status

This is also a categorical variable showing the dwelling agreement for house occupied by a household. It is represented as '1' if the household head owns the house, '2' if the household is renting the house, '3' if the household lives in a house they do not own and are not require to pay rent, '4' if the household is perching and '5' if the household head is a Squatter. This is because each comes with tenure agreements which may directly or indirectly affect decisions taken by households.

4.6 Method of analysis

Two different logistic regression models are estimated in this study. The first model estimates the factors (housing and household characteristics) influencing the choice of improper solid waste disposal methods whereas the second model estimates the factors informing households' payment for SWD. The p-values as reported by STATA 14 at 90%, 95% and 99% confidence levels are used to either reject or fail to reject the null hypothesis that the variable in question is statistically insignificant, whereas the coefficients show the extent of influence each independent variable has on the dependent variables.

4.7 Data source

Data from the seventh (7^{th}) round of the Ghana Living Standards Survey (GLSS 2017) which is prepared periodically by the Ghana Statistical Service will be used in this study. The GLSS dates back to 1987 where it was initiated with the aim of gathering information on the living standards of individuals in the country. After the first round in 1987, the second, third, fourth, fifth, sixth and seventh rounds were conducted in 1988/1989, 1991/1992, 1998/1999, 2005/2006, 2012/2013 and 2016/2017 respectively.

In the seventh round, data collected included the demographic characteristics, education and housing conditions which is a representation of the national as well as regional populations. The study made use of the seventh sub section of the survey which encompasses housing characteristics and the means of solid waste disposal by households. A sample of 14,009 households' data was collected in the survey. Questions like how household disposes solid waste, who owns the dwelling and how much does household pay to dispose of refuse disposal and so on, which are some of the fundamental questions that were relevant to this study are also answered in this dataset. Thus, this data is helpful in assessing the determinants of improper solid waste disposal (SWD) and payment for SWD.

4.8 Presentation and Discussion of Empirical Results

In this section of the study, the results from analyzing the data from GLSS 7 was discussed. The analysis started with the presentation of the descriptive statistics for both the dependent and independent variables used in the study. Given that the study estimated two models, the dependent variables two, namely, ISWD and PFSWD which is also. The independent variables include the

gender, age and level of education of household head, size, locality and welfare of household, type and occupancy of dwelling. Again, the results from the binary logit models as given by the STATA 14 software are presented and discussed in subsequent sections.

4.8.1 Descriptive Statistics of Households

In this section, summary statistics of some household characteristics that influence the choice of SWD methods and the decision to pay for SWD as identified in the literature are discussed. In the GLSS 7, households were asked, how they dispose solid waste and the amount they paid for it. These two questions are the dependent variables whereas the factors as identified in the literature to influence them will be the independent variables for this study.

Table 4.1: Descriptive Statistics for Households' Choice of Solid Waste Disposal and Payment for Solid Waste Disposal

Dependent Variables	Observations	Proportions	Std. Dev.
Method of Solid Waste Disposal			
Proper	8,187	0.584	0.493
Improper	5,822	0.416	0.493
Total	14009	1.000	
Cost of Solid Waste Disposal			
Free	11,573	0.826	0.379
Paid for	2,453	0.174	0.379
Total	14009	1.000	

Source: **Author's computation from GLSS 7**

It is evident from Table 4.1 that more than 40% of the 14,009 households used improper SWD methods whereas more than 80% of the households did not pay any amount for SWD. Specifically, 23.14% burned their solid waste whilst 18.12% dumped theirs' indiscriminately. Also, 11,573 households making 82.62% of the total number of households did not pay any amount for SWD. The financial constraints faced in ensuring proper solid waste management as pointed out in previous studies is highlighted by the high percentage of households not paying for solid waste disposal. As indicated by Kyere *et. al* (2018), this makes the recovery of the full cost for SWM difficult thus necessitating the institution and adoption of suitable cost recovery mechanisms especially for low income households. An investigation of factors influencing payment for SWD will go a long way to help find and institute pertinent full cost recovery mechanisms for SWD. Again, the over 40% of households using improper SWD methods calls for an enquiry into the reasons for this choice to help reduce it and curtail its associated effects.

Table 4.2: Descriptive statistics of the explanatory variables

Variable	Proportion	Std. Dev.
Gender		
Male	0.688	0.463
Female	0.312	0.463
Age		15.912
Level of Education		
None	0.535	1.463
BECE	0.266	1.463
SSS/Secondary	0.091	1.463
Voc./Tech/Teacher	0.070	1.463
Tertiary	0.038	1.463
Household size		2.867
Household Wealth Quintile		
Poorest	0.224	0.417
Poorer	0.181	0.385

Middle	0.170	0.376
Richer	0.186	0.389
Richest	0.239	0.427
Geographical location		
Rural	0.570	0.495
Urban	0.430	0.495
Type of Dwelling		1.467
Separate house	0.276	0.447
Semi-detached house	0.047	0.211
Flat/Apartment	0.029	0.168
Compound house	0.542	0.542
Huts/buildings	0.093	0.093
Others	0.013	0.013
Occupancy Status		0.87
Owning	0.520	0.500
Renting	0.209	0.407
Rent-free	0.266	0.442
Perching	0.004	0.065
Squatting	0.001	0.038
Total observations	14009	

Source: Author's computation from GLSS 7

In Table 4.2, the summary of the independent variables in the study shows that, out of the 14,009 households being studied, there are more male household heads (68.83%) as compared to females, who make of 31.17% of the sample. This finding is in line with the trend in Ghana where most households are headed by males. The traditional recognition of males as the heads of families and by extension households is mainly responsible for this trend (GSS, 2013).

Also, the average age of a household head is 46 years whereas the youngest household head is 15 years and the oldest is 99 years of age. This average age of household heads is relatively low as compared to the global finding partly because of the youthful age structure of Ghana and the interrelations between house ownership, headship and income earning status (UN DESA, 2019). Thus, since mostly the head of the household is the owner of the house and owning a house

involves the financial obligations which most often people in the working class can afford, most household heads tend to be people who are a bit older.

Based on the highest educational attainment, majority of household heads (53.5%) had no formal education and only 3.8% had been educated up to the tertiary level or above. Also, 26.6%, 9.1% and 7.0% had Basic Education Certificate Examination (BECE), Senior Secondary School (SSS) /Secondary and Vocational / Technical /Teacher as their highest levels of education attained respectively.

Also, the largest household has 28 persons and the smallest had only 1 person. The average household size was 4 with a 2.87 deviation. This is consistent with the average household size of 4 found in the 6th round of the Ghana Living Standards Survey (GSS, 2013). This shows that the growth of household sizes has been steady due to the economic obligations associated with larger household sizes and the reduction of fertility period of women due to longer periods spent schooling and the ability to control birth better (Kim, 2016).

The welfare quintile is a measure of welfare that entails the average annual expenditure of a household. Again, the GLSS 7 data records a total of 3,137 and 2,532 households representing 22.39% and 18.07% in the poorest and middle welfare quintile respectively. The middle welfare quintile had the least number of people representing 17% whereas the highest quintile with 23.92% had the majority persons. The higher welfare quintile had 2,608 persons representing 18.62% of the population. According to the 2017 poverty profile of Ghana, relative to the 2013 profile, the current distribution shows an improvement in the welfare of only the top 10% experienced an improvement in welfare whereas that of the bottom 20% worsened (GSS, 2018). This implies the widening of the income inequality gap in Ghana. Following Frimpong (2012), the highest, higher,

middle, lower and lowest welfare quintiles are known as the richest, richer, middle, poorer and poorest groups respectively in this study.

In terms of geographical distribution, the locality of residence is used as a proxy, since it is able to capture distinguishing features such as population density, income distribution and availability of services in various geographical areas well. As shown in Table 4.2, majority of households (7,991) which represents 57.04% of the total population reside in urban areas whist the remaining 42.96% reside in urban areas of Ghana. This is consistent with the findings of the Ghana statistical service (GSS, 2012) in which the increasing rate of urbanization since independence has attributed to natural population increase and migration. With the types of dwelling, more than half of the population (54.21%) live in compound houses, followed by residents of separate houses which constitutes 27.61% of the population. The predominant use of the compound house has been explained to be due to the high rate of poverty in Ghana which makes households unable to afford the alternatives which are also relatively expensive (Boamah, 2010). Households residing in huts or buildings in the same compound, semi-detached houses and flats or apartments make up 8.40%, 4.66% and 2.92% respectively of the population whereas less than 1% reside in the other types of dwelling. The majority of households, which is more than half the population owned the houses they lived in whereas 0.42 and 0.14% were perching and squatting respectively. Of the remainder who were renting their houses, 25.56% were paying whilst 20.89% were not paying any amount for rent. Although the financial obligations to owning a house may be a barrier to acquiring this status, the discomfort associated with the other alternatives like the sharing culture in some renting and perching is enough motivation for even low income earners to own a house without considering its adequacy (Boamah, 2011). This accounts for a high proportion of inadequate

housing which also distracts access to basic sanitation services including proper solid waste disposal systems.

4.8.2 Diagnostic test

In ensuring that the estimates from the regressions are consistent, reliable, and unbiased, diagnostic tests need to be performed. The Variance Inflation Factor (VIF) is one of such tests which specifically tests the assumption of no multicollinearity in the classical linear regression model. If there is multicollinearity, ordinary least squares estimates will have large variances and covariance thus, making precision in estimation difficult to achieve (Gujarati, 2004). The results of the multicollinearity test is presented in Table 4.4.

Table 4.3: Variance Inflation Test for Multicollinearity

Variable	VIF	1/VIF
Gender		
Male		
Female	1.14	0.880102
Age	1.19	0.843420
Level of Education		
None		
BECE	1.30	0.769739
SSS/Secondary	1.28	0.783409
Voc./Tech/Teacher	1.22	0.821177
Tertiary	1.22	0.818898
Household size	1.38	0.723082
Household Wealth Quintile		
Poorest		
Poorer	1.57	0.635176
Middle	1.73	0.579244
Richer	2.01	0.496400
Richest	2.72	0.367893
Geographical location		
Rural		

Urban	1.46	0.684621
Type of Dwelling		
Separate house		
Semi-detached house	1.12	0.888896
Flat/Apartment	1.14	0.874315
Compound house	1.49	0.673398
Huts/buildings	1.29	0.775944
Others	1.08	0.921742
Occupancy Status		
Owning		
Renting	1.60	0.625335
Rent-free	1.38	0.725424
Perching	1.01	0.987856
Squatting	1.03	0.969247
Mean vif	1.40	

Source: Author's computation from GLSS 7

Following the rule of thumb by Kleinbaum *et al*.., (2008), the results of the variance inflation factor analysis as shown in Table 4.4 implies all the variables in this study are free of multicollinearity since none has a VIF of 10 or above. This implies that the independent variables have no linear association between each other which would have affected the output of the analysis. Thus, these independent variables are fit to be used in predicting the outcome variables.

4.8.3 Logistic regression Results and Analysis

In investigating the determinants of improper solid waste disposal (SWD) and payment for SWD in Ghana, two logistic regression models were used to analyze data obtained from the seventh round of the Ghana Living Standards Survey (GLSS 7). The first model has the method of disposal as the dependent variable whereas that of the second model is the cost of SWD. Again, the dependent variables took on a value of (1) if a household uses an improper method of SWD and pays for SWD in the first model and second models respectively and a value of (0) if otherwise. The logistic regression results are presented in Tables 4.5 and 4.6.

Table 4.4: Estimation Results for Determinants of Improper Solid Waste Disposal

Explanatory variables	Marginal effect	Robust SE
Gender of the household head		
Male (reference dummy)		
Female	-0.078***	(0.010)
Age of the household head	-0.001***	(0.002)
Level of education of household head		
No education (reference dummy)		
BECE	-0.079***	(0.012)
SSS/Secondary	-0.032*	(0.019)
Voc./Tech./Teacher	-0.024	(0.020)
Tertiary	-0.085***	(0.026)
Household size	-0.002	(0.002)
Welfare Quintile		
Poorest (Reference dummy)		
Poorer	-0.115***	(0.018)
Middle	-0.157***	(0.019)
Richer	-0.230***	(0.018)
Richest	-0.232***	(0.020)
Geographical Location		
Urban (reference dummy)		
Rural	0.104***	(0.011)
Type of Dwelling		
Separate house (Reference dummy)		
Semi-detached house	-0.004	(0.023)
Flat/Apartment	-0.060*	(0.032)
Compound house	-0.076***	(0.012)
Huts/buildings	0.191***	(0.022)
Others	0.138***	(0.042)
Occupancy status		
Owning (Reference dummy)		
Renting	-0.080***	(0.015)
Rent-free	-0.064***	(0.012)
Perching	-0.009	(0.079)
Squatting	0.075	(0.141)
Observations	14,009	

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1 Pseudo R2 = 0.0945

***, **, and * imply 1per cent, 5per cent and 10per cent levels of significance respectively.

Source: Author's computation from GLSS 7

4.8.4 Discussion of empirical results

Determinants of improper solid waste disposal in Ghana.

This section focuses on the factors influencing the choice of improper solid waste disposal (SWD) methods as presented in the regression results in Tables 4.5. Specifically, the result shows that relative to male household heads, female household heads are 7.8% less likely to use improper SWD methods at 1% significance level. This result can be ascribed to the natural tendencies of females to be more concerned about matters of cleanliness and maintaining hygiene. Thus, all things being equal, female household heads will be less likely to choose improper SWD methods relative to their male counterparts. Again, this result is in line with the studies of Mamady (2016) in Guinea and Adzawla (2019) in Ghana which found female household heads to be less likely to adopt improper solid waste disposal practices.

The age of the household head was also found to be negatively related to the choice of improper SWD methods with a 0.1% likelihood. Thus, at 1% significance level, older people are less likely to use improper SWD methods. This finding can be explained by the fact that older people are more conscious of their health such that decisions that will promote health like adopting proper SWD methods will be upheld by them. The findings of Kayode and Omole (2015) and Owusu (2010) corroborates this results, since they also found older people to patronize proper SWD methods in Ibadan, Nigeria and Sabon Zongo, Accra, respectively.

Contrary to the findings of Ajani (2007) but similar to that of Ojewale (2014), the level of education of a person was found to be negatively related to the choice of improper SWD methods. Specifically, at 1% significance level, household heads with education to the BECE and tertiary levels were 7.9% and 8.5% respectively, less likely to use improper SWD methods relative to

household heads with no education. Also, SSS /Secondary were found to be 3.1% less likely to adopt improper SWD methods whereas households having Vocational/Technical/Teacher training was found to be insignificant in this study. This is due to the fact that educated people have a better understanding of the implications of improper SWD as well as the benefits of proper SWD. As such, they would be willing to avoid the implications of choosing improper SWD methods and embrace proper SWD methods which promotes good health and a safer environment (Ojewale, 2014). The contradiction can be ascribed to the use of the length of education as the measure for education and also the focus on only public solid waste collection services alone in the study by Ajani (2007). Furthermore, the more educated the person is, the more health conscious the person will be, thus the less likely it would be to adopt improper SWD methods. This also corresponds to the findings of Dhungana (2017) and Frimpong (2012).

Although the positive relations between household size and the choice of improper SWD methods found in this study has also been established in similar studies, it was found to be statistically insignificant in this study. This is consistent with the findings of Tadese *et al*., (2007) in Ethiopia.

The empirical results from this study confirms the findings that higher wealth is associated with the choice of proper SWD (Alemayehu *et al.*, 2017 and Mukui, 2003). This can be explained by the economic theory of demand where by the demand for an inferior good (improper SWD methods) decreases as an individual becomes wealthier (Tadese and Hagdu, 2009). Thus, higher wealth comes with the purchasing power as well as a willingness to pay for services such as that of SWD. Particularly, it is evident from the study that households in the poorer, middle, richer and richest welfare quintiles were 11.5%, 15.7%, 23.0% and 23.2% respectively less likely to use improper SWD methods as compared to households in the poorest welfare quintile at 1% significance level. This finding is supported by that of Alemayehu *et al.* (2017) and Mukui (2003).

Specifically, whereas Alemayehu *et al.* (2017) used an income threshold of 3000 ETB to show that those earning below this amount were likely to adopt improper waste management practices, Mukui (2003) inferred from the statistics available that households in higher income brackets are more likely to adopt proper SWD methods.

Relative to residents of urban areas, rural dwellers were found to be 10.4% more likely to adopt improper SWD method at 1% significance level. This can be explained by the limited collection options available to residents of rural areas (Boateng *et al*., 2016). Mostly, the only appropriate SWD method accessible to them is the public dump containers which may be situated far away from their homes. This encourages the adoption of alternative SWD methods like burning and disposal in bushes which are improper and associated with health effects and environmental pollution. This is similar to the findings of Boateng *et al.* (2016). Specifically, Boateng *et al.* (2016) found rural dwellers to be more likely to adopt improper SWD methods relative to urban dwellers.

With respect to the type of dwelling, this study found all but semi-detached houses to significantly influence the choice of improper SWD methods. More so, there is a 6% and 7.7% likelihood for residents of a flat/apartment and a compound house not to adopt improper SWD methods respectively. However, residents of hut/buildings and other dwelling types were 19.1% and 13.8% more likely to use improper SWD methods respectively. This can be explained by the fact that the type of dwelling is a reflection of the economic status of a household (Amenyah and Fletcher, 2013). Therefore, improper SWD is an inferior good to residents of apartments and compound houses since they are more likely to be higher income earners than residents of huts and other types of dwelling such as uncompleted buildings and improvised dwellings. However, residents of a compound house may also be obliged to adopt proper SWD by their landlords thus making them

more likely to adopt such methods. However, the positive relation found between residing in semi-detached houses as compared to living in a separate house was statistically significant in this study.

Pertaining to the influence of occupancy status on the choice of improper SWD methods, the results of this study as shown in Table 4.6 found renting and rent-free statuses as compared to owning a house to be statistically significant. Specifically, renting and rent-free households were found to be 8% and 6.5% less likely to use improper SWD methods respectively. This is due to the mandatory subscription to solid waste collection services in some rented apartments coupled with the strict supervision of owners or care takers on rent-free dwellers since they would be summoned in case of any breach of sanitation regulations. Also, households who are perching were found to be 1% less likely to use improper SWD methods whereas squatting households were found to be 7.6% more likely to use improper SWD methods. However, perching and squatting were not statistically significant in the choice of improper SWD methods by households.

Table 4.5: Estimation Results for the Determinants for Payment for Solid Waste Disposal

Explanatory variables	Marginal effect	Robust SE
Gender of the household head		
Male (reference dummy)		
Female	0.030***	(0.010)
Age of the household head	0.002***	(0.000)
Level of education of the household head		
No education (reference dummy)		
BECE	0.055***	(0.012)
SSS/Secondary	0.076***	(0.016)
Voc./Tech./Teacher	0.045***	(0.016)
Tertiary	0.083***	(0.023)
Geographical Location		
Urban (reference dummy)		
Rural	-0.302***	(0.010)
Household size	0.017***	(0.002)
Wealth Quintile		
Poorest (Reference dummy)		
Poorer	0.082***	(0.017)

Middle	0.138***	(0.017)
Richer	0.213***	(0.016)
Richest	0.295***	(0.017)
Type of Dwelling		
Separate house (Reference dummy)		
Semi-detached house	0.065***	(0.023)
Flat/Apartment	0.100***	(0.025)
Compound house	0.017	(0.012)
Huts/buildings	-0.128***	(0.033)
Others	0.056*	(0.032)
Occupancy status		
Owning (Reference dummy)		
Renting	0.121***	(0.014)
Rent-free	0.048***	(0.012)
Perching	-0.002	(0.072)
Squatting	-0.032	(0.087)
Observations	14,008	

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
***, **, and * imply 1per cent, 5per cent and 10per cent levels of significance respectively.

Payment for SWD: Number of observations =13,990, Pseudo R2 = 0.1105

Source: Author's computation from GLSS 7

Determinants of payment for Solid Waste Disposal in Ghana.

The unsustainability of the reliance on government funds for managing solid waste disposal in Ghana has necessitated the implementation of the polluter pays principle in the form of the Pay as you throw principle to fund SWD (Boateng *et al*., 2019). This requires households to pay to have their solid waste properly disposed and managed to ensure minimum effects on the environment and health of people. This study therefore seeks to analyze the factors that influence the payment for SWD to help improve upon its efficiency.

The empirical findings are presented in the regression results as shown in Table 4.6. Specifically, the results show that relative to male household heads, female household heads are 3% more likely to pay for SWD at 1% significance level. Again, this result can be ascribed to the natural

tendencies of females to be more concerned about matters of cleanliness and maintaining hygiene (Adzawla *et al.*, 2019). These natural tendencies to cleanliness and maintaining hygienic conditions is a factor that boosts their willingness to pay for SWD. The findings of Addai and Danso-Abbeam (2014) and Fonta *et al.* (2008) point to females being willing to pay for improved solid waste management of which SWD is a part of. Thus, supporting the findings of the positive relation between being female and paying for SWD in this study.

The age of the household head was also found to be positively related to paying for SWD with a 0.2% likelihood of occurrence. Thus, at 1% significance level, older people are more likely to pay for SWD. This finding can again be explained by the consciousness of older people towards their health. This encourages decisions that will promote their health like adopting proper SWD methods such that they will be more willing to pay rather than choose free options which are harmful to their health. Awunyor *et al.* (2013) also found the age of a person to be positively related to paying for SWD which is affirmed from the results of this study.

Again, with no formal education as the reference category, household heads with education to the BECE, SSS /Secondary, Voc./Tech./Teacher and tertiary levels were found to be 5.4%, 7.6%, 4.5% and 8.3% more likely to pay for SWD respectively. Since the level of education of a person is positively correlated with their employment and earning potentials (Jamison *et al.*, 2006), the highly educated persons will be more willing to pay for SWD since they are likely to earn more. Furthermore, the more educated persons tend to be more knowledgeable about the health and environmental implications of improper SWD, thus the less likely it would be to adopt SWD methods that are harmful to human health and the environment even if they would have to pay for it. This also corresponds to the findings of Dhungana (2017) and Frimpong (2012).

In relation to household size and the payment for SWD, a positive relation was found. Specifically, at 1% significance level, households with larger sizes had a 1.7% probability of paying for SWD relative to those with smaller household sizes. This finding can be explained by the huge level of waste generation associated with larger household sizes such that they would be required to pay higher amounts for SWD. This forces such households to find alternatives like burning and burying which are cost effective but harmful to human health and the environment. However, the findings of this study is contrary to the findings of Frimpong (2012) in the Greater Accra Metropolitan Area. This contradiction can be ascribed to the fact that an urban area was assessed in the study by Frimpong but the inclusion of rural areas and other urban areas resulted in this difference.

Although different indicators have been adopted to show the relation between the welfare of a household and their decision to pay or not to pay for SWD, they all point to the fact that wealthier households are more likely to pay for SWD as compared to poorer households. This was explained to be as a result of the purchasing power associated with higher income earners such that they are willing and able to pay for SWD services. This was further elaborated as being due to the perception of solid waste collection services as a normal good to high income earners so that as the income of a household increases, they demand more of such services (Tadese and Hagdu, 2009). The results from this study also confirms this finding. Particularly, it is evident from the study that households in the poorer, middle, richer and richest welfare quintiles were 8.2%, 13.8%, 21.3% and 29.5% respectively more likely to pay for SWD as compared to households in the poorest welfare quintile at 1% significance level. This results is similar to that of Tamura (2005) who found that the higher the income of residents in Accra, the more they are willing to pay for SWD.

Relative to residents of urban areas, rural dwellers were found to be 30.2% less likely to pay for SWD at 1% significance level. Boateng *et. al*., (2016) pointed out that this can be attributed to the low earning potentials of rural dwellers which results in their inability or unwillingness to pay for SWD coupled with the unavailability of such services in most rural areas. The findings of this study is similar to the findings of Boateng *et al.* (2016).

As opined by Amenyah and Fletcher (2013), the type of housing is an indication of the income status of a household. Thus, residents of semi-detached houses and flats/apartments are most likely wealthy people who can afford to pay for SWD services. Likewise, residents of huts are most likely poor such that they barely afford basic necessities and would hardly consider paying for SWD. This is in line with the findings of Kayode and Omole (2011) in Nigeria. This study therefore found dwelling in semi-detached houses and flats/apartments to increase the likelihood of paying for SWD by 6.5% and 10% respectively at 1% significance level whilst dwelling in huts/buildings decreased the likelihood of paying for SWD by 12.8% at 1% significance level. Relative to residents of separate houses, residents of other types of dwelling like the uncompleted buildings or improvised homes were 5.6% more likely to pay for SWD services. Dwelling in a compound house was found not to be significant in deciding to pay for SWD services or not.

Pertaining to the influence of occupancy status on the choice of improper SWD methods and payment for SWD, the results of this study as shown in Table 4.6 found being a renting or rent-free occupant as compared to owning a house to be statistically significant in the decision to pay for SWD. Specifically, renting and rent-free occupants are 12% and 4.8% more likely to pay for SWD at 1% significance level. This is because most owners of houses are observant of practices adopted by their tenants so that if they use improper SWD methods which do not require payment, may risk losing their residence. This keeps renting and rent-free households in check such that

they are more likely to pay for SWD if that is crucial to them keeping their residence. With respect to the perching and squatting occupancy statuses, they were found not to be statistically significant in the decision to pay or not to pay for SWD services in this study.

4.9 Conclusion

This chapter began with a discussion of the theoretical framework being utilized and further developed the empirical models and their justification for the estimation in this study. Also the variables to be included in the model; the gender, age and level of education of a household head, the geographical location, size and welfare quintile of a household, the type of dwelling and the occupancy status of a household were identified and their expectations analyzed in addition to the description of the data source. Using the logistic regression, the results of the two estimations shows that socioeconomic factors significantly influence the choice of improper solid waste disposal methods as well as the decision to pay for SWD. Particularly, with the exception of the household size, a household head having attained a vocational or Technical or Teacher training education, living in a semi-detached house, perching or squatting, all other variables were statistically significant in the choice of improper solid waste disposal methods. With regards to the decision to pay for SWD, all but dwelling in a compound house, perching and squatting were statistically significant.

CHAPTER FIVE

SUMMARY, CONCLUSION AND POLICY RECOMMENDATION

5.1 Introduction

In this final chapter, a summary of the thesis, conclusion and the recommendations from the main findings of the study are presented. The subsequent sub-section is dedicated to the summary findings of this study. In section 5.3, the conclusions based on the regression analysis are presented. Section 5.4 outlines strategic policy recommendations drawn from the findings of the study and finally, section 5.5 discusses the limitations of the study to serve as grounds for further research.

5.2 Summary

Owing to the predominant use of improper solid waste disposal methods in Ghana, a series of measures such as the polluter pays principle have been introduced to curtail this problem. However, the resultant effect has not been as anticipated due to the perfunctory exploration of the main factors underlying the use of improper solid waste disposal (SWD) methods as well as the decision to pay for SWD. This thesis was therefore aimed at contributing to the solid waste disposal literature by enquiring what socioeconomic factors influence households' choice of improper solid waste disposal methods as well as their decision to pay for SWD in Ghana. Adapting Tadese *et al.*, (2007)'s theoretical framework which is based on the theory of utility, a model for the choice of improper SWD methods and the decision to pay for SWD within the logistic regression framework was used in the thesis. In the first estimation, the choice of a SWD method was the dependent variable whereas that of the second estimation was the decision to pay

for SWD. Both dependent variables were coded as dummy variables with 1 being the choice of an improper SWD method and the payment for SWD in the first and second estimations respectively. The independent variables included; the gender, age and level of education of the household head, the size, welfare and locality of household, the type of dwelling and the occupancy status of the household. The reviewed literature elaborated on the association between the choice of improper SWD methods as well as the decision to pay for SWD and each of the explanatory variables identified.

The study uses the seventh round of the Ghana Living Standards Survey which was conducted by the Ghana Statistical Service in 2016/2017. The data provided a sample of 14,009 household heads whose responses were analyzed using a logistic regression. In this study, interesting issues and facts were identified and highlighted in all five chapters of the study. Whereas some of the results from other studies were confirmed in this study, others were contradicted.

It was found out that between 2012/2013 and 2016/2017, there has been a 0.9% increase in the number of households using improper SWD methods like burning and indiscriminate disposal. This was in tandem with the projected 1% decrease in the percentage of households using proper SWD methods like collection and public dumps. Again, whereas only 15% of households were paying for SWD in 2012/2013, it increased by 2% in 2016/2017. With regards to policies and institutional framework, it was seen that currently, the institutions responsible for solid waste management are the decentralized (Metropolitan Municipal and District Assemblies) MMDAs under the supervision of the Ministry of Local Government and Rural Development (MLGRD). Again, it was observed that there is a disparity in the provision of solid waste collection services between rural and urban areas which accounted for the higher patronage of improper SWD methods in rural areas. However, the urban areas also had a substantial proportion of households

subscribing to improper SWD methods due to the distance from their houses to public dumps as well as the poor services render by some waste collection companies.

The logistic regression results for this study show that, the sex, age, level of education, welfare quintile, geographical location, type of dwelling and occupancy status significantly informed the choice of improper solid waste disposal methods. However, some of the categorical variables had some categories to be significant but others insignificant. The sex, age and geographical location of the household head was found to significantly inform the choice of an improper SWD method. Also, all categories for the level of education except the vocational/ Technical/ Teacher training category was found to be significant in the choice of improper SWD methods. However, the negative relation which implies more educated people are less likely to adopt improper SWD was confirmed for all categories in this study. Although negatively associated with the choice of improper SWD methods, the house size was found to be insignificant in this study.

With regards to the level of welfare, all categories were found to be negatively and significantly associated with the choice of improper SWD methods. This finding as indicated in the reviewed literature implies households with higher levels of welfare are less likely to adopt improper SWD methods. Again, all types of dwelling except semi-detached houses was a significant factor in the choice of improper SWD methods. However, the finding that housing is an indicator of welfare (Amenyah and Fletcher 2013), was confirmed in this study. Particularly, whereas households of Flat/Apartment and Compound houses were more likely to adopt proper SWD methods, households of huts and other improvised houses were more likely to adopt improper SWD methods. This further affirms the finding that households in higher welfare quintiles are less likely to adopt improper SWD methods.

The only occupancy statuses found to be significant in the choice of improper SWD methods were the renting and rent-free statuses. These two types of occupants were found to be less likely to adopt improper SWD methods relative to owner-occupants.

The estimation results for the payment for SWD showed that all variables were significant in the decision to pay for SWD. However, some categories of some variables were found to be insignificant. The gender, age and level of education of a household head as well as the level of welfare and the size of a household were all found to be positively associated with the decision to pay for SWD.

Living in a rural area was found to be negatively and significantly associated with the decision to pay for SWD. This is consistent with the findings in the reviewed literature. However, all types of dwellings except the compound house were found to significantly inform the decision to pay for SWD. Also, renting and rent-free occupancy statuses were found to be positively and significantly related to the decision to pay for SWD relative to owner-occupants.

5.3 Conclusion

The canker of improper solid waste disposal has been met with some measures to mitigate the negative effects associated with it. One of such measures is the polluter pays principle. However, its implementation has been faced with challenges due to the lack of exploration of the underlying reasons for the choice of improper solid waste disposal (SWD) methods and the decision to pay for SWD by Ghanaian households. This thesis was therefore conducted to determine what informs the choice of improper SWD methods as well as the decision to pay for SWD. The gender, age and level of education of a household head, as well as the geographical location, wealth status,

type of dwelling and the occupancy status of a household were found to significantly inform the choice of improper SWD methods and the decision to pay for SWD.

5.4 Policy Recommendations

Based on the findings of the study, the following policy recommendations are made;

Provision of more solid waste collection services especially in rural areas should be prioritized. A rural solid waste collection policy which will make such services readily available to households. This can be done through a collaboration between the Ministry of Local Government and Rural Development as well as the Metropolitan Municipal and District Assemblies (MMDAs). Basing on the population and land size, various collection points can be established so that the distance between a house and a collection point will not be an incentive to adopt improper SWD methods. The Town and Country Planning departments of the various MMDAs must be involved to ensure appropriate collection points are selected. Again, the frequency of the disposal of the collected must be regular to prevent the collection points from being a source of pollution as a result of overflowing waste containers.

Also, more public-private partnerships like the National Waste Bin (NaWaBin) distribution must be encouraged. These partnerships must further incorporate waste separation, reuse and recycling programmes and not only waste bin distribution. Such programmes when implemented will minimize the volumes of waste to be disposed and the amount of money to be paid for SWD. Better still, the proceeds from recycled waste can be reinvested into financing SWC services to alleviate households of the burden of paying higher amounts of money for SWD.

Again, the significance of education in both decisions to use improper SWD methods and also pay for SWD necessitates environmental campaigns geared at educating households of the dangers of improper SWD as well as the need to pay for SWD. Similarly, the finding that females are more willing to adopt proper SWD methods and also pay for SWD can be incorporated into environmental campaigns. Thus, priority be given to males in such campaigns or making females lead such campaigns. Also, the specific roles in ensuring proper SWD must be highlighted in a way that households can easily relate to.

Also, price discrimination on the basis on welfare levels must be adopted in pricing of solid waste collection services to ensure its sustainability. Thus, households with a fairly inelastic demand for such services must be charged higher prices to make up for the lower charges to households with elastic demand. This can be better implemented with strong private sector investments in the sector.

Basing on the findings that the occupancy status of a household is crucial both in the choice of SWD method and the decision to pay for SWD, mandatory SWC services must be incorporated into rent control regulations to encourage the adoption of proper SWD methods. Also, building regulations to sanction house owners who create refuse dumps in their houses must be instituted and enforced.

Finally, since the level of wealth has been found to be positively and negatively associated the payment of SWD services and the choice of improper SWD methods respectively, policy regarding poverty reduction can incorporate the provision of SWD services. The LEAP, for instance can be used to encourage the adoption of these services by giving cash incentives for such purposes or better still, such services be provided for free for poor households. Again, this association shows

the problem of improper SWD and unwillingness to pay for SWD is more of an economic issue than technical. This requires a cost-effective marketing and pricing system to resolve the problem.

5.5 Limitations and recommendations for further studies

The study relied on the seventh round of the Ghana Living Standards Survey to derive the variables used in this study. However, some crucial variables like the distance from a house to a waste collection point which is crucial in the choice of a SWD method as well as the decision to pay for SWD were not available in this data. Again, the low R-squared values recorded shows that other factors which could not be assessed due to the limitation of the data source. For instance, behavioral and institutional factors could not be assessed with our quantitative analysis. Therefore, questions like; will the behavior of a household inform the choice of a SWD method? Does the distance to a waste collection point and the residential area of a household influence the choice of SWD method? These are valid questions which could not be answered in this study. Thus, it is recommended that further studies consider these questions to inform policy.

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APPENDIX

Appendix 1

Paired t test: Methods of Household SWD 2012/13 – 2016 / 2017

	obs	Mean1	Mean2	dif	St_Err	t_value	p_value
2012/2013 – 2016/2017	14004	2.641	2.687	-.045	.011	-4.25	0

Appendix 2

Paired t test: Locality distribution for Methods of Household SWD 2012/13 – 2016 / 2017

	obs	Mean1	Mean2	dif	St_Err	t_value	p_value
Rural – Urban	14009	1.571	1.506	.064	.006	10.95	0

Appendix 3

Explanatory variables	Logit coefficient ISWD	Logit coefficient PFSWD
Gender of the household head		
Male (reference dummy)		
Female	-0.448***	0.215***
Age of the household head	-0.008***	0.012***
Level of education of the household head		
No education (reference dummy)		
BECE	-0.442***	0.394***
SSS/Secondary	-0.169*	0.537***
Voc./Tech./Teacher	-0.130	0.323***
Tertiary	-0.478***	0.586***
Geographical Location		
Urban (reference dummy)		
Rural	0.556***	-2.347***
Household size	-0.008	0.126***
Wealth Quintile		
Poorest (Reference dummy)		
Poorer	-0.526***	1.008***
Middle	-0.734***	1.473***
Richer	-1.138***	1.989***
Richest	-1.146***	2.502***
Type of Dwelling		
Separate house (Reference dummy)		
Semi-detached house	-0.019	0.456***
Flat/Apartment	-0.317*	0.689***
Compound house	-0.416***	0.124
Huts/buildings	0.892***	-1.101***
Others	0.651***	0.394*

Occupancy status		
Owning (Reference dummy)		
Renting	-0.441***	0.847***
Rent-free	-0.349***	0.354***
Perching	-0.047	-0.016
Squatting	0.366	-0.258
Constant	0.780***	-4.105***
Pseudo R2	0.1253	0.2839
Observations	14,009	14,008