# THE DEMAND FOR SOLID WASTE COLLECTION IN ACCRA (GHANA):

# A WILLINGNESS-TO-PAY STUDY

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# THE DEMAND FOR SOLID WASTE COLLECTION IN ACCRA (GHANA): A WILLINGNESS-TO-PAY STUDY

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In Africa, many countries face various environmental problems such as air pollution, water pollution, low levels of sanitation, and solid waste issues. Populations of these cities have grown very fast because of migration toward cities. Ghana, especially Accra, is one of the cases in Africa.

In Ghana, the government started privatizing solid waste collection during the mid-1990s. Since then, Accra has been served by both the public and private sectors even though these services are neither effective nor efficient.

The purpose of this study is to investigate the individual attributes of the demand for solid waste collection in Accra. The data were collected using questionnaires to understand residents' characteristics of those affected by solid waste. This study shows that the more income respondents have, the more willing they are to pay for solid waste collection.

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#### **Chapter 1 Introduction**

In Africa, countries that have fast-growing urban populations tend to have serious waste disposal problems. These urban centers generate a tremendous amount of garbage from households, schools, medical facilities, and industrial areas (Boadi & Kuitunen, 2002). In Ghana, after the implementation of the Structural Adjustment Programs (SAPs) by the World Bank, the government started privatizing Solid Waste Collection (SWC) in the mid-1990s (Baud & Post, 2002). Even though the government has privatized SWC, the public sector still collects half of the city waste. Moreover, in Accra, the collection systems differ between the high-income and low-income residents. Low-income groups cannot afford to pay for proper garbage disposal and they tend to dump domestic garbage near their houses, in rivers, into sewage drains, and at other illegal sites. On the other hand, high-income groups tend to pay waste collection fees. According to Boadi and Kuitunen (2003), in 1998, 80 percent of waste was from the low-income residents, 17 percent came from middle-income residents, and three percent of waste was from highincome groups. Most of the waste generated from the low-income residents in Accra is not effectively collected.

Before 1995, 60 percent of waste was collected by the Waste Management Department (WMD) (Boadi & Kuitunen, 2002). After the government started privatization of SWC in 1995, the ratio of waste collection by the public and the private sectors increased up to 70 percent by 1999 (Post, Broekema, & Obirih-Opareh, 2003). About 30 percent of waste is still not collected by the public or the private sectors in Accra.

In high-income areas, the public and the private sectors collect solid waste at each

house--this is House-to-House (HtH) collection service. The poor, on the other hand, have to bring their waste to a public container where it is collected by the WMD--thus it is the Central Communal Container (CCC) system (Post & Obirih-Opareh, 2003). Lowincome residents cannot afford HtH collection. They criticize the CCC system because of the irregularity of SWC (Obirih-Opareh & Post, 2002). The collection points usually are not close to the areas where low-income citizens live. These residents say that they do not take their waste to SWC centers because it is far from their homes and also because of the irregularity of collection (Baud & Post, 2002).

Furthermore, there are many problems associated with SWC in Accra. These include lack of financial support, lack of service consistency (especially the CCC for low income residential areas), inadequate service facilities, and the difference of collection services between high-income and low income-groups. This thesis investigates the characteristics of those affected by garbage collection and how these characteristics affect their willingness to pay for more reliable municipal services in Accra. These findings will help the understanding of the issue of solid waste disposal with respect to the assessment of the benefits associated with policies for the improvement of garbage collection in Accra.

This thesis explores relatively uncovered areas of research, since existing studies of Solid Waste Management (SWM) in Accra do not attempt to estimate the benefit of garbage collection in the city. Thus, I focus on waste collection in this thesis. I collected the data on socio-economic attributes to provide an estimate of these benefits. So far, journals, books, and government documents analyze only the problems of SWM and related issues. There are partnerships between the public and the private sectors for sustainability of SWM, SWM financing, improvement of work conditions, legitimacy, cleanliness of residences, service quality, monitoring of SWC, choice of adequate sites for landfills, recycling, study of solid waste, the analysis of the impact of solid waste on environmental quality, and overall SWC management. However, the impact of socio-economic indicators, such as income, education, and family composition, on environmental quality, SWC, and management in relation to the valuation of SWC is rarely surveyed. Therefore, this thesis strives to fill the gap.

This thesis consists of five chapters including this introduction. Chapter 2 is a literature review associated with solid waste disposal issues in developing countries and in Ghana, specifically in Accra. Chapter 3 discusses socio-economic characteristics, the main developmental problems, and solid waste disposal issues in Ghana. Chapter 4 presents the statistical approach used to address my research question, the explanation of the data, and the empirical results and interpretation of the data. Finally, this thesis concludes in Chapter 5 with policy implications and suggestions for further research.

#### **Chapter 2 Literature Review**

Many developing countries face various urban problems such as household environment, and the increase of the amount of waste in cities. Waste in cities tends to negatively influence the physical environment and human beings. There are numerous articles on household environmental problems, health issues, sanitation, and solid waste disposal issues in many developing countries. The following articles, papers, and reports are examples of previous research on these issues.

Jacobi, Kjellen, and Castro (1998) discuss the environmental problems affecting households in Sao Paulo (Brazil). The authors conducted household surveys on individuals' perceptions of environmental problems in three different places: the center of Sao Paulo, mid-suburbs, and peripheral Sao Paulo. As they expected, they found that residents in the central city and suburbs tend to suffer from polluted air whereas residents in peripheral areas suffer from poor infrastructure. According to their surveys, residents insisted that the government should take action on municipal environmental problems such as polluted water, polluted air, sanitation, sewage, and solid waste management. In particular, the authors pointed out that in their surveys of how to reduce the amount of garbage, the idea that the government should educate residents got much attention, while improving the SWC got less attention. The authors recommend that both residents and the governmental agencies have to cope with municipal environmental issues.

Surjadi, Padhmasutra, Wahyuningsih, McGranahan, and Kjellen (1994) discussed issues related to the household environment in Jakarta, Indonesia. Their main purpose was to understand the need for improvements in the household environment. They focused on the issues of air pollution, water supply, sanitation, housing conditions, and solid waste conditions. They pointed out that the poor tended to face the most severe environmental problems and health risks. They suggested that one solution to the environmental problem led to another because various environmental problems are interrelated. In terms of solid waste, there was a correlation between children having diseases and garbage in their houses. Even though the authors analyzed the data from surveys, they did not suggest any policy remedies for these environmental issues.

Thomas, Seager, Viljoen, Potgieter, Rossouw, Tokota, McGrannahan, and Kjellen (1999) implemented surveys on health and household environment issues in South Africa. The purpose of this report was to investigate the relationship between health, households, and environmental problems. The authors discussed a large number of environmental issues, for example, domestic sanitation, urban health issues, air pollution, and domestic waste handling. With respect to waste handling in cities, they pointed out the lack of adequate waste collection and issues of littering, dumping and burning garbage in neighborhoods. The authors suggest the need for environmental development policies and management, and their implementation by public agencies.

In Ghana, Benneth, Songsore, Nabila, Amuzu, Tutu, Yangyuoru, and McGranahan (1993) conducted household surveys on environmental problems in the Greater Accra Metropolitan Area (GAMA). This research analyzed conditions of household water, sanitation, pests and pesticides, food contamination, household smoke, and solid waste. In addition, the authors discussed the management of environmental risks, and policy implications on those issues. They mentioned that after the crisis of the Ghanaian economy during the 1970s and the 1980s, SWC in cities worsened because of the lack of financial support. Finally, they insisted that increase of waste collection and disposal is

the key factor and collaboration between collection services and waste management policies is needed.

Songore and McGranahan (1998) conducted a survey on the link between women's status and environmental problems in the Greater Accra Metropolitan Area (GAMA), especially in low-income residences. They found that the women tended to stay in their houses with such household chores as cooking, taking care of young children, and so on. In addition, men subordinated women to keep them in their houses. In this way, women tended to be more exposed to such hazards as cooking fires, taking care of sick children, and bringing waste to communal containers. The authors also found that girls helped with household chores more than boys and are treated differently by their parents at home. They concluded that the challenge is to ease the traditional women's role at home in order to improve household environmental conditions and reduce household environmental risks. Since one of the main purposes of this thesis is to investigate socio-economic characteristics of the demand for SWC, in my questionnaires, I collected the data on sex, the number of children in their houses, education attainment, and their health problems.

These reports and articles mainly discuss various household environmental issues in developing countries such as Brazil, Indonesia, South Africa, and Ghana as well as relationships between hazards and gender differences in Accra. The next set of literature seeks to understand the difficulties of solid waste management in developing countries such as India, Pakistan, and South Africa.

Dahiya (2003), a researcher at the World Bank, uses community photographs to show waste management problems in Chennai (India) graphically. Some pictures illustrate the lack of basic services in a city, peri-urban environmental problems, meetings of residents for learning about waste, and collaboration with adjacent cities. In this paper, he reports that the city government does not have enough funds to buy trucks for garbage collection and also that residents tend to dump garbage in front of or near their houses. These problems have contributed to degradation of land and deterioration of sanitation. On the other hand, he finds that some of the districts in Chennai work on community study sessions. Residents meet together and learn about composting techniques. These activities are expanding to other districts within Chennai. This is one of the solutions to reduce urban waste.

Sudhir, Muraleedharan and Srinivasan (1996) discuss the municipal problems associated with public health, the informal recycling sector, and conservation of nonrenewable and renewable resources and solid waste in India. They also insist that opinions from residents not just policies by governmental agencies are important to improve urban solid waste disposal. Moreover, they conducted surveys on waste generation, composition of solid waste, means of waste transportation, solid waste disposal, and analysis of budgets. The authors concluded that understanding these modes of solid waste in cities allows governmental agencies and residents to improve the cleanliness of cities.

According to Altaf and Deshazo (1996), most developing countries face municipal solid waste problems in cities (Pakistan) and many governments have invested in the improvement of SWC. In other words, the supply side tried to increase the amount of total waste collection, but so far, these attempts by governmental agencies have not been efficient or effective. The authors argue that in order to reduce the amount of waste in cities, the demand side has to be considered when governmental organizations make

waste management policies. The assumption is that residents are not attracted to solid waste services in contrast to other public services. However, based on the authors' research in Pakistan, solid waste is the highest priority within their communities. They suggested that demand-side input in making such policies is useful and also that governmental agencies should consider input by residents. Thus, they conclude that developing countries should also have such development capacities to improve the municipal solid waste collection.

Golooba-Mutebi (2003) argued that in Uganda modes of government changed during the 1980s from government control to outsourcing public services with respect to municipal solid waste collection. Decentralizing the power structure improved conditions of city environment. The author particularly focused on the city of Kampala in Uganda. He pointed out that although the devolution of such public services as solid waste collection was successful and residents enjoyed the transition of modes by reforming the government in the short run, outsourcing does not guarantee long-term improvements because of the lack of financial support and technological deficiencies of contractors with the government.

In South Africa, Korfmacher (1997) discussed the importance of improving SWC in both municipal and peripheral areas with adequate collection systems. There is a case study about the validity of waste collection in cities such as the Winterveld and Bophuthatswana. The author conducted a survey in these communities concerning the composition of waste and resource management. He pointed out that most developing countries do not have adequate or effective solid waste collection systems in municipal areas but mentioned some successful cases of working with scavengers in communities.

However, he also observed that successful modes of solid waste collection, disposal, and management quite often do not fit other cities.

In sum, other developing countries also confront the difficulties of managing municipal solid waste by implementing various policies, taking opinions from the demand side, and outsourcing the power structure. The following examines previous research on municipal solid waste management and collection in Ghana.

SWC has been one of the crucial issues in fast-growing cities in Africa. In the case of Accra, it has been studied from many different aspects. Baud and Post (2002) examined solid waste management in both Accra and Chennai. In both cities, they analyzed solid waste collection in terms of the collection difference between public and private management, financial aspects of both sectors, the environmental impact of solid waste in Accra and the level of cleanliness in communities, and employment conditions. The authors conclude that the SWC in Accra by the private sector is much better than the public one because, although low-income groups did not receive waste collection service or were not covered by the public sector daily, the private sector covered this region twice a day. In terms of Chennai (India), to some extent, primary collection by the public sector was more effective than the private sector. They found both city governments of Accra and Chennai still skeptical about the idea of public-private partnership since they used to monopolize the market, but now some of the regions are served by the public sector.

Moreover, Post and Obirih-Opareh (2003) also concentrated on the partnerships of SWC by the public and private sectors. They emphasized the importance of assessment of SWC in Accra. The privatization actually benefited the consumers in terms of SWC service frequency and the expansion of service areas in Accra. These two researchers looked at the impact of SWC on environmental quality in Accra. They suggested that the government should improve the management of SWC and clarify their responsibility since the government still lacks accountability in their public services and management.

In addition, Post, Broekema, and Obirih-Opareh (2003) analyze the problems of SWC in Accra and Hyderabad (India). In Accra, they first examined the privatization of SWC. They identified the fact that privatized firms did not want to contract with the government since the government tends to postpone payments. In terms of the operation of waste collection in Accra, while house-to-house collection was more efficient than the central communal containers, house-to-house collection is too expensive for low-income groups. In Hyderabad, privatization of garbage collection was introduced in 1995. After privatization, government waste collection workers earned three times more than employees in the private sector. Also, workers in the public sector received health insurance, work clothes and boots, while employees in the private sector did not. The authors discovered that SWC in Accra was worse than in Hyderabad due to a weakness of finance and management.

Obirih-Opareh and Post (2002) summarize the privatization of solid waste collection in a historical context. While solid waste collection has increased because of competition from the private sector, the environment around Accra has apparently not improved. In addition, they analyzed the quality of service, conditions of employment, legitimacy, environmental practices at the community level, reuse and recycling of garbage, description of waste collection in Accra, and monitoring of waste management. The authors concluded that government policies for solid waste collection should also

be taken into account to improve sanitation as well as the level of waste collection management. In questionnaires, to understand the demand for SWC, satisfaction with SWC was asked of those who utilize a House-to-House (HtH) collection system.

These articles mainly focus on how SWC has managed so far, what the financial problems of institutions were, what the waste collection systems were, what conditions the collection workers faced, and how SWC was assessed, and so on. Thus, they suggest some community participation and the reform of the government. However, they do not focus on how much solid waste each socio-economic group generates each year, or how the waste of these groups affects environmental quality.

On the other hand, Devas and Korboe (2000) analyze the relationship between city governance and poverty in Kumasi, the second largest city in Ghana. They discuss how governance influenced urban poverty and how the public services were performed in Kumasi. These public services, including sanitation, sewage, and solid waste disposal, were not effective in poor residential areas compared to the high-income groups in Kumasi. The problem is that residents in Kumasi still utilize the traditional authorities and land distribution systems. Devas and Korboe identify the problems of the city government.

Post (1999) also conducted research in Kumasi. He found that the residents in Kumasi wanted to change SWC from the public to the private sector and that the Kumasi city government was also willing to make the shift. The author discusses the negative aspects of privatization. He analyzes the structural adjustment programs, especially the privatization of state-operated enterprises (SOEs). He insists that privatization does not always affect the economy positively since firms are not ready to be privatized because of

a lack of international competitiveness, of financial support, and of managerial skills. Other cities in Ghana also have similar problems. In Kumasi, middle- and high-income groups are willing to pay for waste collection, while the low-income residents strongly object to paying for it since several years ago they received free waste collection. In this thesis, the willingness to pay for SWC by each individual was asked in questionnaires.

Boadi and Kuitunen (2002) analyzed the effect of garbage disposal on the condition of the river in Accra. They examined the environmental conditions in the Korle Lagoon district. The river in this region has been severely polluted and the authors say that this river is one of the most contaminated rivers on Earth since industrial sectors have polluted near this district. Garbage from households, schools, and hospitals has also contributed to degradation of the land. In addition, this region has no sanitation facility to improve the quality of the community environment. Based on the conditions in this region, the authors conclude that rapid urbanization in Accra is the main cause of the low level of environmental quality in the city, especially because of insufficient sanitation services. They suggest that people must have environmental concern and must learn the impact of pollution in Lagoon. In questionnaires, health problems were asked because of the low levels of sanitation in the city.

Boadi and Kuitunen (2003) review the urban situation in solid waste management in Accra. While the middle-class citizens can afford to pay for garbage removal there, low-income households cannot spend money on trash collection. In addition to the problem of income inequality, although the privatization of solid waste management was introduced in Accra during the mid-1990s, it has not improved the inadequate waste management because of constraints, such as financial problems and lack of workers. Thus, even though private companies work on SWC in Accra, the environmental situation has not changed significantly. Furthermore, since low-income groups tend to dump and burn garbage near their houses, these practices have deteriorated the urban environment. The authors suggest that the solid waste collection firms should improve the management and condition of their firms, and low-income communities should be educated. In this thesis, each respondent was asked his or her education attainment to estimate the willingness to pay for SWC.

Based on all these articles, SWC and solid waste management, the privatization of SWC, the difference in the collection system between the high- and low-income residents, and the management difference between the public and the private sectors are studied.

However, the demand, or the valuation of waste collection services by the population, has not yet been investigated for the city of Accra. By taking initial steps towards the estimation of the perceived benefit of garbage collection by the local population, this study contributes to the assessment of potential policies meant to improve garbage collection in Accra.

#### **Chapter 3 Socio-Economic Background**

In this chapter, there are three sections. The first discusses population and poverty in Ghana. These topics are very important to understanding the issue of environmental problems affecting rural and urban areas. The second section deals with the main developmental problems that Ghana has faced for decades. The final part is associated with the background of solid waste collection (SWC) and its problems. These three sections contribute to better understanding of the socio-economic background in Ghana.

#### A. Socio-Economic Context

In this section, issues of population and poverty associated with income in Ghana will be discussed. The information gives an understanding of population and poverty issues, and of the need for municipal services in Ghana.

Most African countries face a number of problems directly affecting their population. Some have seen a severe reduction of their population because of HIV/AIDS, while others are hard pressed by a drastic expansion of population. Ghana increased its population from 12,296,081 in 1984 to 18,412,247 in 2000 (Ghana Statistical Service, 2002). According to the World Development Indicators (http://www.worldbank.org), the population increased up to 20,425,910 in 2003, representing a 1.67% rate of growth that year. World Development Indicators report that the rate of population growth has been decreasing since the 1980s (http://www.worldbank.org). While the population growth rate was stable at the national level, it differed in urban areas. In other words, residents from rural regions moved to cities such as Accra, Tema, Kumasi (Ghana Statistical Service, 2002, see Map 1, Ghana). According to the United Nations Population Division (2004), between 1960 and 2000 the ratio of the population in urban areas increased from 23.3%

to 43.9% respectively, while the ratio of the population in rural areas decreased from 76.7% to 56.1% (http://esa.un.org/unup/). Thus, the population movement has moderately expanded Ghana's population, and net migration has been occurring from rural to urban areas since the 1960s. Such growth in urban population increases the demand for urban garbage collection and increases the pressure on the urban environment.

In addition to the population issue, World Development Indicators report that Ghana's Gross Domestic Product (GDP) per capita has remained around \$300 for two decades (http://www.worldbank.org). According to the World Development Report 2005 (2004), the rate of population living below the poverty line at the national level increased from 31.4% in 1992 to 39.5% in 1998. The population living with less than \$1 and \$2 a day was 44.8% and 78.5% in 1999 respectively (World Development Report 2005, 2004). In addition, the distribution of income will be shown by quintiles of the population 8.4%, 12.2 %, 15.8%, 21.9%, and 41.7% respectively (World Development Report 2005, 2004). Thus, the richest 20% of the population hold 41.7% of national income, whereas the poorest 20% hold only 8.4%. This pattern of inequality is reflected in the access the poor have to services, such as sanitation, garbage collection, health services and education.

Map 1 Ghana



Source: CIAO Atlas Maps and Country Information, April 14, 2005. <a href="http://www.ciaonet.org/atlas/countries/gh\_map.html">http://www.ciaonet.org/atlas/countries/gh\_map.html</a>

#### **B.** Main Development Issues

Access to basic services that impact life quality and ability to move away from poverty is very limited to the poor majority. The gap between the high- and low-income residents in cities tends to negatively influence the low-income residents in terms of education attainment and access to sanitation services. These low-income groups in cities cannot afford to pay for these services. Thus, the following section focuses on education and sanitation issues.

Access to education in Ghana separates boys from girls in terms of school attendance and attainment. Traditionally, girls tend to be less educated than boys, and their access to education is influenced by the income level of their households (Boadu, u.d.). Because women are responsible for such household chores as cooking, washing, and taking care of young children, a large demand for household chores kept women away from formal education compared to men. On the other hand, men play a much less important role at home, causing boys to attend school more often than girls (Boadu, u.d.). Furthermore, the demand for jobs by educated men in the formal sector is higher than the demand by educated women (Boadu, u.d.). The rate of completion of primary school education by girls (relevant age group) was 56% whereas the same rate for boys was 60%in 2000. World Development Indicators show that the ratio of girls to boys in primary and secondary education was about 88% in 2000 and that the literacy rate in Ghana (for ages 15 and above) was 81.9% for males and 65.9% for females in 2002 (http://www.worldbank.org). Basically, men tended to work in the formal sector such as governmental agencies while women stayed home and supported the domestic chores.

This gap between men and women implies that women tended to be more exposed

to health hazards due to handling of contaminated water and household waste under poor sanitation conditions (Boadu, u.d.).

Lack of knowledge about the consequences of poor sanitation contributes to increased exposure of the poor, especially women, to urban environment hazards. To tackle this problem, the Environmental Education Department of the National Environmental Protection Agency (2001) implemented educational policies to build public awareness with respect to the importance of sanitation and health issues. It did so by holding environmental exhibitions and festivals, networking with religious organizations, district assemblies associated with waste management, and Non-Governmental Organizations (NGOs), and by training teachers to supply environmental education at schools in the cities.

In addition to the educational policies to improve the low levels of sanitation in Ghana cities, the World Bank (2003) implemented recently the "Second Urban Environmental Sanitation Project: Environmental and Social Assessment." The main purpose of this project was to impose urban sanitation by improving sewers, solid waste management, and by increasing the number of toilets in schools. Low- and middle-income residents had less access to adequate sanitation facilities compared with high-income residents in Accra. The major reasons for carrying out sanitation projects were the linkages between low levels of sanitation and related health problems, especially malaria and diarrhea. Provision of adequate sanitation facilities helped minimize environmental risks to residents, specifically women, since they tended to be more exposed to hazardous waste than men (Songsore & McGranahan, 1998).

The government, especially the Waste Management Department/Accra

Metropolitan Assembly (WMD/AMA), is responsible for waste management in Accra. The government agency and firms collect garbage and take it to the landfill. The collectors often utilized open containers in which residents put their household garbage. Frequently, these open containers catch rainwater and breed mosquitoes. Malfunctioning sewers also contribute to favorable conditions for mosquitoes to breed (Benneth et al., 1993). Children often play near these containers and sometimes pick up garbage inside them and, therefore, are often highly exposed to mosquito bites and easily contract malaria. Thus, the understanding of the importance of education and the improvements in sanitation are important to diminish environmental risks in cities.

One of the most effective ways to ameliorate environmental risks to residents is to provide adequate waste disposal in municipal areas. The next section of this chapter focuses on how the governmental agencies handle waste disposal in Accra.

#### C. Solid Waste Disposal in Accra

In Ghana, after the implementation of the Structural Adjustment Programs (SAPs) in the mid-1990s by the World Bank, the Ghanaian government started privatizing solid waste collection (Baud & Post, 2002). Even though the government has privatized Solid Waste Collection (SWC), half of the waste collection activities are still done by the public sector. Also, in Accra, the collection systems differ between high-income and low-income residences. The low-income groups tend to dump domestic garbage near their houses, rivers, sewage, and open sites. On the other hand, the high-income groups tend not to dump near their houses since they can afford to pay the collection fee. Both the public and the private sectors have financial problems and tend to lure workers to work long hours at low wages (Post et al., 2003).

Privatization of solid waste collection, the financially constrained public and private sectors, labor conditions, the gap between high- and low-income groups, and the different waste collection systems negatively influence environmental quality in different areas of Accra.

Since the 1980s, the Ghanaian government has implemented neoliberal policies to reform the national economy. In the mid-1990s, the government started privatizing garbage collection in Accra. This SWC privatization has expanded gradually, not dramatically. A similar process of privatization has been implemented in Kumasi, the second largest city in Ghana (Post, 2002).

In Accra, according to Post et al (2003), there are reasons that the privatization did not go as expected. One was the skepticism of the Ghanaian government. In Ghana, private companies were limited to small-scale activities and many of them were in the informal sectors. The second reason was the unstable economy and politics. The Ghanaian economy has struggled since the 1980s because of high inflation and the change of political regime. Thus, even though private companies wanted to invest in SWC, these firms hesitated because of the unstable economic and political situations (Post et al, 2003). These reasons slowed the progress of privatization of solid waste collection in Accra. Moreover, regarding Kumasi, even though the city government started privatizing SWC during the 1990s, there were many residential areas, especially in low-income groups, that were not served properly. This condition degraded local environmental quality (Devas & Korboe, 2000).

SWC by the public sector was not financially sustainable, causing the government to privatize it to reduce public spending. However, even though the government reduced the spending on SWC, half of solid waste collection services were still provided by the public sector, which is WMD under AMA. Because there was already a financial problem in waste management, the situation could not improve much unless the government changed its management style (Baud & Post, 2002). Therefore, in order to reduce its role of providing public services, the World Bank (1996) implemented the "Urban Environmental Sanitation Project." This was followed by the "Second Urban Environmental Sanitation Project: Environmental and Social Assessment" (World Bank, 2003). Having the financial problem, the AMA determines the fees of SWC in each year.

SWC fees depend on the type of service, and residents pay either the WMD or private firms. According to AMA (2004), there are three collection fees and they are basically determined by AMA each year. The first class applies to House-to-House (HtH) service, in which the public and the private sectors collect garbage by going from one house to another, to high-income residences; the second class applies to middle-income residents with HtH service, and finally the third class applies to low-income residences serviced by the Central Communal Container (CCC) system that both the public and private sectors collect once a day from certain waste collection points. The first two income strata pay for collection fees either to WMD or to private firms. The first income stratum is served by HtH at Airport, Airport West, Cantonments, Labone and Ridge areas (See Map 2, Accra), and fees are 79,000 cedis per month (\$1 equalled about 9000 cedis in late 2004). The second income stratum is also served by HtH and the corresponding residential areas are Ringway Estates, Osu, Kneshie, Dansoman, South La, South Odorkor, North Kaneshie, Tesano, and Lartebiokorshie and fees are 46,000 cedis per month. Typically, the low-income residents comprising the third stratum do not pay a fee.

However, some residents who use certain collection sites pay about 1000 cedis per day. In addition to the differences among residential classes, fees also depend on the firms that serve particular collection sites. That is why residents usually complain about the prices that WMD and firms collect.

Both the public and the private sectors have collected solid waste since the privatization of SWC in 1995; however, the amount of garbage collected was unexpectedly low (Boadi & Kuitunen, 2002). Up until 1995, the public sector, WMD, monopolized SWC in Accra. According to Post et al (2003), the WMD collected 60 % of all garbage in Accra in 1995 and 70 % were collected with the public-private partnership in 1999. Both of these research groups claim that the consumers have benefited by the public-private collaboration whereas Boadi and Kuitunen (2002) state that the performance of SWC was still at 60 % in 2002. The remaining 40 % of the garbage was not collected by either sector. In 1999, although the Ghanaian government interfered in this situation because of the low level of collection, matters did not change as expected. Through this reality of SWC, environmental quality in the city was negatively affected.

There are two waste collection systems in Accra: HtH and CCC. Typically, private firms serve middle- and high-income residents with the HtH collection system. These residents have to register with the WMD to get the healthier system of having garbage collected at home (Baud & Post, 2002). According to Post et al (2003), the private sector provides HtH and collection workers visit each residence registered and paid for garbage collection. The other system, CCC, is served by the public sector in the low-income residential areas.

## Map 2 Accra



Source: Ghana Home Page, Maps of Ghana, April 9, 2005. <a href="http://www.ghanaweb.com/GhanaHomePage/images/accra">http://www.ghanaweb.com/GhanaHomePage/images/accra</a> map.jp> The service frequencies also differ from each other. In the case of HtH collection, firms usually collect garbage once a week, sometimes twice. On the other hand, with the CCC system residents are served once a day, with irregular collection. Even though in low-income areas garbage is supposed to be collected once a day, irregularity is an annoyance (Post et al., 2003). However, Baud and Post (2002) claim that, "The overall annual collection performance went up from 639,000 cubic meters in 1998 to 753,000 cubic meters in 1999" (p. 227).

These characteristics of the HtH and CCC collection systems contribute to local urban environmental problems. Under the HtH system, residents are served once a week, and this frequency is too low. On the other hand, the CCC collection system is more frequent, but irregular. Finally, some residents do not have access to any garbage collection service. The impact of garbage collection services on the well-being of the population sets the stage for my analysis: The investigation of the valuation of improved garbage collection by the local population. In particular, I estimate residents' willingness to pay (WTP) for better quality waste collection services and study the characteristics of the demand for these services.

In terms of waste generation in Accra, according to Kramer, Jechimer, Lengsfeld, and Nartey-Tokoll (1994), high and middle-income residents tend to generate more than low-income residents do. Low-income residents generate 0.40 kg per capital per day whereas high- and middle-income residents produce 0.68 and 0.62 kg per capita per day respectively. In addition to waste generation by each income resident, the components of waste are the following, organic (73.1%), inert (10.5%), paper (6.6%), plastics (3.3%), textiles (2.2%), metals (2.1%), glass (1.5%), and others (0.7%). Based on these, in Accra

solid waste from 1,200 to 1,500 tons are generated per day according to the Accra Metropolitan Assembly/Waste Management Department (2004).

One of the reasons for the low amount of the total waste was that from 1986 to 1992, in Accra, reduction of the number of solid waste collection employees negatively influenced the total amount of waste collected (Obirih-Opareh & Post, 2003). Also, recruitment for solid waste collection workers was banned by the government. Privatization was the only way to increase the number of solid waste workers. In 1995, as the government started privatizing solid waste collection in Accra, the number of workers increased gradually. The reason for this gradual change was that SWC was not an attractive job. The working conditions were dirty and no one, except unemployed citizens or retired workers, was willing to take the jobs. Moreover, work conditions for public and private workers differed. According to Obirih-Opareh and Post (2003), in the public sector workers were provided full medical care and a housing allowance whereas the private sector companies usually did not have any contract with employees. Thus, workers in the public sector were better compensated than those in the private sector, although both groups worked under similar hazardous conditions (Baud & Post 2002). Residents in Accra, especially low-income groups, tend to dump garbage wherever they want so there are many open dumping sites. Even though collection workers were supposed to wear gloves, they tended not to do so. Thus, workers collected garbage without gloves and they inhaled the offensive smell as well.

Some of the most important environmental problems in Accra are air pollution, water pollution, and low levels of sanitation. The lack of adequate SWC services significantly worsens local environmental quality. Garbage collection contributes further to air pollution to the extent that the financially constrained public and private sectors use old trucks with poor emissions standards and without net covers to prevent spills and reduce odor (Obirih-Opareh & Post, 2002).

SWC also contributes to water pollution in Accra. Boadi and Kuitunen (2002) claim that "The Korle Lagoon has become one of the most polluted water bodies on earth, serving as a cesspool for most of Accra's industrial and municipal wastes" (p. 302). Most garbage was dumped by residents, schools, and industries. Among these sectors, over 70 % of the total amount of waste was organic waste (Boadi & Kuitunen, 2002). Most poor residents of Korle Lagoon were served by the Waste Management Department with the CCC system. Even today, according to Boadi and Kuitunen (2002), 40 % of the total amount of waste is not collected.

This uncollected 40 % of solid waste puts low-income residents under severe health conditions (Boadi & Kuitunen, 2002). These poor residents tend to dump household garbage into rivers, sewage, and open dumping sites, thus helping to degrade air quality, water quality and health conditions.

In summary, there is a large gap between the demand for garbage collection services and its supply in Accra. Nevertheless, little is known about this demand or how local residents value the improvement of garbage collection services in the city. This thesis attempts to fill that gap in the literature by investigating the characteristics of those affected by garbage collection and how these characteristics affect their willingness-topay for better service.

#### **Chapter 4 Data Analysis**

#### A. Method-Ordered Probit Model

The purpose of this thesis is to study the characteristics of the demand for garbage collection in Accra. In order to do this, I analyze the data I collected from a survey to elicit willingness to pay for improved solid waste collection (SWC) services and the socio-economic attributes of the respondents. Since this is a hypothetical exercise and respondents were asked to report how much they would be willing to pay for specific improvements in the services to which they currently have access, respondents might not have an accurate sense of their true willingness to pay (WTP). Therefore, instead of treating their reported WTP as a precise benchmark, I grouped these values into qualitative categories. More specifically, based on the responses to my survey, I grouped the reported WTP values into four categories: Low WTP, medium-low WTP, medium-high WTP, and high WTP. Next, I estimated an econometric model to calculate the probability that a reported WTP fell in each of these categories conditional on the characteristics of the respondent.

The econometric tool I used to estimate the above probabilities is the ordered probit model. This model is applied when the dependent variable is a categorical variable and the ordering of the categories matters—in this study low WTP < medium-low WTP < medium-high WTP < high WTP, and these categories are labeled 1, 2, 3, and 4 respectively. The observed dependent variables in my model are thus, Y = 1, Y = 2, Y = 3 and Y = 4, where Y stands for reported WTP. Estimation of the ordered probit model hinges on the assumption of a latent or unobserved variable y\*, such that  $y^* = \beta'x + \varepsilon$ , x are the attributes or characteristics of the respondent and

 $\begin{array}{ll} Y=1 & \mbox{if} & y^* < \mu_1, \\ Y=2 & \mbox{if} & \mu_1 < y^* < \mu_2, \\ Y=3 & \mbox{if} & \mu_2 < y^* < \mu_3, \mbox{and} \\ Y=4 & \mbox{if} & \mu_3 < y^*. \end{array}$ 

The  $\mu_i$ 's are unknown parameters to be estimated with  $\beta$ , under the assumption that  $\epsilon$  is distributed according to the standard normal distribution (Greene, 2000). Thus, in general, the estimated probabilities for each of any *J* ordered intervals is:

Prob 
$$[y = 1] = \Phi (-\beta'x)$$
  
Prob  $[y = 2] = \Phi (\mu_1 - \beta'x) - \Phi (-\beta'x)$   
.  
Prob  $[y = J] = 1 - \Phi (\mu_{j-1} - \beta'x),$ 

where  $\Phi$  is the cumulative standard normal density function.

The marginal effects or contribution of a small change in each independent variable on the probabilities of interest can be calculated as follows:

$$\partial \operatorname{Prob}[y=1] / \partial x = - \emptyset (\beta' x) \beta,$$
  
$$\partial \operatorname{Prob}[y=2] / \partial x = (\emptyset (-\beta' x) - \emptyset (\mu_1 - \beta' x)) \beta,$$

$$\frac{\partial Prob[\mathbf{y} = \mathbf{J}]}{\partial \mathbf{x}} = \emptyset (\mu_{j-1} - \beta^{2}\mathbf{x}) \beta,$$

where  $\emptyset$  is the standard normal probability density function.

Figure 1 depicts the estimated marginal effects for income for each WTP interval (WTP = 1 to 4). Table 4 shows marginal effects for each independent variable, evaluated at their average values, for each WTP interval. In the case of binary explanatory variables such as sex (Female = 1 and Male = 0), marginal effects refer to the impact of a change from 0 to 1 on the probabilities of interest.

#### **B.** Explanation of the Data and Surveys

The data that I used were collected during the winter break in Accra, Ghana, November 26, 2004, to December 23, 2004. I asked questions, using questionnaires (See Appendix), in about 30 areas within Accra. In terms of selection of respondents, I walked along the streets in a large number of areas and talked with various local residents from low-income to high-income residents. Although some respondents could not speak English and I could speak the local language only slightly, I asked respondents' friends who could speak English to help us. It took about five minutes to complete questionnaires. There were 224 observations; however, 73 of them were deleted because questionnaires for these individuals were incomplete.

In this thesis, the dependent variable is the willingness to pay (WTP) for SWC. Respondents were asked to select one of the ranges of WTP for SWC and they specified the type of solid waste disposal services they currently use. The possibilities were no services, central communal container (CCC) services, and House-to-House (HtH) services. If respondents chose HtH services, they were asked the following questions: How often does the garbage collector collect solid waste per week? Are you satisfied with the waste collection service? Dissatisfied respondents were asked the reason why they were not satisfied. During the survey, the payment card was used and respondents reported one of the WTP intervals. The midpoint value of WTP applied to the estimated WTP for SWC. The value of each WTP is assigned as follows. The low WTP interval (WTP 1) is from 0 to 17,500 cedis. The medium-low WTP interval (WTP 2) is from 22,500 to 42,500 cedis. The medium-high WTP interval (WTP 3) is from 47,500 to 67,500 cedis. The high WTP interval (WTP 4) is from 72,500 to 102,500 cedis.

In addition to the dependent variable questions, respondents answered questions concerning socio-economic explanatory variables, for example: gender, age, marital status, the place where they live, the number of residents in their houses, the number of children in their houses, education attainment, the range of income, the type of solid waste disposal, hours of work they were willing to donate to improve SWC, and health problems. Among these explanatory variables, some of them were not used in the econometric analysis.

One of the independent variables is the sub-metropolitan districts. The city of Accra is divided into six sub-metropolitan districts. They are Ashiedu, Ablekuma, Okaikoi, Ayawaso, Osu Klottey, and Kpshie (See Map 3). This independent variable is a dummy variable which takes the value of 1 if respondents live in a given district and 0 otherwise. I combined Ashiedu and Osu Klottey. These two districts are downtown in Accra, and I omitted them from the estimated model. According to the EPA Ghana (2001), in Ashiedu, most houses have in-house light industries, companies and some residential areas. In this sub-metropolitan district, economic activities are transport stations, food markets, hotels, churches, and schools. Environmental problems are oil waste from automobile industries, and low levels of sanitation in unplanned settlements. Mainly middle-income residents live in this sub-metropolitan district. In Osu Klottey, economic activities are fuel services, transport stations, food markets, and paper product industries. There are some international organizations and embassies--the World Bank and the United Nations Development Programme. Environmental problems are dust nuisance from small activities, and industrial pollutions (air and noise pollution). Ablekuma is a sub-metropolitan area of mainly residences of middle-income residents. Economic

activities are car washing bays, churches, medical laboratories, hospitals, and fuel service stations. Environmental problems are generation of dust, noise from factories, and poor sanitation conditions. In terms of Okai Koi, economic activities are fuel stations, textiles industries, food market centers, car washing bays and hotels. Environmental problems include dust from industries, noise pollution, and oil waste from industrial activities. Ayawaso' economic activities are light industries, enterprises, hotels, fuel stations, and car washing. Environmental problems are oil waste, noise pollution, and low level of sanitation conditions. One of the major differences in this sub-metropolitan area is that it has a large number of Muslim communities as well as the wealthiest residents in Accra. Concerning Kpeshie, this sub-metropolitan district has military institutions such as academy and camp. Economic activities in this area are large industries, social amenities-churches, schools, and entertainment centers. Environmental problems are noise from religious activities, chemicals from mechanical factories, and discharge of liquid waste into water bodies.



**Map 3 Sub-Metropolitan Districts** 

Source: FAO Corporate Document Repository, March 13, 2005. <http://www.fao.org/documents/show\_cdr.asp?url\_file=/DOCREP/003/X6972E/x6972e0 4.htm> "A" represents Ashiedu, one of the sub-metropolitan districts.

Gender is another dummy variable (female=1). The total number of males is 95 whereas the total number of females is 56 (See Table 1).

Only people over 18 years old were asked to participate in this questionnaire. In this survey, the oldest respondent was 62 years old whereas the youngest was 18. The mean age was 36.1 (See Table 1).

Marital status is classified into three categories of married, single, and divorced/separated. If respondents are married, 0 is assigned, 1 for single, and 2 for divorced/separated. In an estimated model, 0 is assigned for married and 1 for not married. Nearly 60% of respondents were married in this survey (See Table 1).

Children, which is also one of the independent variables, indicates the number of children in the house. The mean of the number of children is 6.86.

Education attainment is categorized into six levels: No education, elementary schools, junior secondary school (JSS), senior secondary school (SSS), community college (Comcoll), and university (Univ). No education and elementary school form the control group, meaning that the estimated coefficients for each level of education are relative to the control group.

Respondents were also asked to provide their monthly income. However, if respondents reported their daily income, this was converted into monthly income after the survey. Income was divided into 21 intervals and then the midpoint value of the reported income in each interval was used in the research.

Types of solid waste collection were classified into no service, central communal containers (CCC), and House to House (HtH) services. This is also a dummy variable and communal container was the omitted variable.

Income		Gender	No.	%	Marital status	No.	%	Age	
Mean	790,397c	Males	95	63	Married	90	60	Mean	36.1
Highest	2,500,000c	Females	56	37	Not married	61	40	Highest	62
Lowest	50,000c	Total	151	100	Total	151	100	Lowest	18

Source: Based on the questionnaire.

WTP	Num obser	ber of vations	Male		Female	
	No.	%	No.	%	No.	%
WTP 1	73	48.3	46	48	27	48
WTP 2	45	29.8	27	28	18	32
WTP 3	24	15.8	15	16	9	16
WTP 4	9	5.9	7	7	2	3

Table 2 Willingness to Pay Related to Number of Observations and Gender

Source: Based on the ordered probit analysis.

Note: Table 2 shows the distribution of willingness to pay by interval with the number of observations and percentage of males and females.

#### Table 3 Average WTP for Each Waste Disposal Type

Ave.WTP
33,438
21,543
35,612
26,540
25,048

Source: Based on the questionnaire.

Note: Table 3 shows that the average WTP for each disposal type and the total average WTP with standard deviation. The currency of the average WTP is in Ghanaian cedis.

#### **C. Empirical Results and Interpretation**

The ordered probit model is utilized to estimate the impact of individuals' socio-

economic attributes on their valuation of garbage collection services. Table 4 shows the

estimated coefficients of all independent variables associated with WTP for solid waste collection, P-values, and marginal effects for each WTP interval (dy/dx (1) to (4)).

Independent variables such as Ayawaso and Kpeshie are statistically significant at the 0.7% and 7% level respectively compared to Ashiedu and Osu Klottey that are dropped from the analysis to WTP for SWC. Other sub-metropolitan districts such as Ablekuma and Okaikoi are not statistically different from Ashiedu and Osu Klottey with respect to WTP for SWC. The only statistically significant educational level was JSS. Income and HtH are both statistically significant at the 0.3% level (See Table 4).

variable	coefficient	P-value	dy/dx (1)	dy/dx (2)	dy/dx (3)	dy/dx (4)
Ablekuma	0.1973	0.593	-0.0732	0.0113	0.0264	0.0354
Okaikoi	0.444	0.223	-0.1639	0.0125	0.059	0.0923
Ayawaso	0.9998	0.007	-0.341	-0.0114	0.114	0.2378
Kpshie	0.7123	0.07	-0.2409	-0.0189	0.0827	0.1771
Gender	0.0312	0.892	-0.012	0.002	0.0043	0.0056
Age	0.0051	0.678	-0.002	0.0003	0.0007	0.0009
Married	-0.3561	0.215	0.1356	-0.0201	-0.0487	-0.0667
Residents	-0.0089	0.615	0.0034	-0.0006	-0.0012	-0.0016
Children	0.0387	0.224	-0.0149	0.0026	0.0053	0.0069
JSS	-0.5633	0.075	0.2204	-0.0595	-0.076	-0.0847
SSS	0.0724	0.797	-0.0278	0.0044	0.01	0.0133
Comcoll	0.1146	0.463	-0.0443	0.0078	0.0159	0.0205
Univ	-0.0951	0.855	0.037	-0.0075	-0.0132	-0.0162
Income	6.00E-07	3.60E-02	-2.32E-07	4.09E-08	8.34E-08	1.07E-07
Non	-0.1234	0.773	0.0482	-0.0104	-0.0171	-0.0205
HtH	0.7526	0.003	-0.2732	0.018	0.0962	0.1589
μ1	0.9346					
μ2	1.8695					
μ3	2.4624					

Table 4 Willingness to Pay for Solid Waste Collection: Basic data

Source: From the ordered probit analysis.

Note: dy/dx from 1 to 4 are marginal effects of willingness to pay for SWC.  $\mu$ 1,  $\mu$ 2, and  $\mu$ 3 are unknown parameters calculated with each independent variable.

The third column of Table 3 indicates whether specific independent variables are statistically significant or not. Thus, the next stage of the interpretation of this survey would be to calculate the marginal effects, that is, the contribution of each variable to the probability of each WTP interval.

Based on the calculation of marginal effects (See Figure 1), the higher the income, the less likely an individual is to have a low WTP, and the more likely he or she is to report a medium-high or high WTP for SWC.



Figure 1 Willingness to Pay for Solid Waste Collection

Source: Based on the ordered probit analysis.

Independent variables Ayawaso and Kpeshie were statistically significant at the 0.7% and 7% levels. Based on the survey data, these two sub-metropolitan districts have residences from the lowest to the highest incomes, 49 have HtH services. More than half of the respondents were not satisfied even with HtH services. The reported reason for no

satisfaction is that waste collection workers do not come as scheduled in many cases. Those who have twice-a-week HtH services tend to be satisfied with SWC whereas those who have once-a-week service often tend to complain about service frequencies.

Even though the variable Gender is not statistically significant, the sign of the estimated marginal effects indicates that women are more likely to report higher WTP compared to men (See Appendices Tables 5, 6, 7, and 8). This is supported by Boadu (u.d.), who states that women tend to be more exposed to hazardous wastes than men.

Even though the independent variable University is not statistically significant, signs of the estimated marginal effects seem to be interesting. Those who had university education were more likely to report a low WTP compared to those who had no education and had gone only to elementary school.

In terms of the low WTP interval (See Table 4), there are five statistically independent variables, Ayawaso, Kpeshie, JSS, Income, and HtH. Ayawaso is statistically significant at the 0.1% level and those who live in Ayawaso are 34.1% less likely to select the low WTP interval compared to residents of Ashiedu and Osu Klottey. Kpeshie is statistically significant at the 2.9% level and respondents who live in Kpeshie are 24.09% less likely to choose the low WTP interval compared to residents of Ashiedu and Osu Klottey. JSS is statistically significant at the 7% level and those who had education up to JSS are 22.04% more likely to choose the low WTP interval compared to those who had no education and went to elementary school. HtH is statistically significant at the 0.1% level and those who have HtH services are 27.32% less likely to choose the low WTP interval compared to those who have MTP interval compared to those who have CCC services.

Interestingly, in the medium-low WTP interval (See Appendix Table 6), there are

no independent variables which are statistically significant. In the case of the mediumhigh WTP interval (See Appendix Table 7), there are five independent variables that are statistically significant. Ayawaso is statistically significant at the 0.6% level and those who live in Ayawaso are 11.46% more likely to select the medium-high WTP interval compared to residents of Ashiedu and Osu Klottey (See Appendix Table 7). Kpeshie is statistically significant at the 3% level and respondents who live in Kpeshie are 8.27% more likely to choose the medium-high WTP interval compared to residents of Ashiedu and Osu. JSS is statistically significant at the 5.9% level and those who had education up to JSS are 7.6% less likely to choose the medium-high WTP interval compared to those who had no education and went to elementary school. HtH is statistically significant at the 1.2 % level and those who have HtH services are 9.62% more likely to choose the medium-high WTP interval compared to those who have CCC services.

Finally, in the high WTP interval (See Appendix Table 8), there are four independent variables that are statistically significant. Ayawaso is statistically significant at the 2.8% level and those who live in Ayawaso are 23.78% more likely to pick up the high WTP interval compared to residents of Ashiedu and Osu Klottey. JSS is statistically significant at the 6.3% level and those who had education up to JSS are 8.47% less likely to choose the high WTP interval compared to those who had no education and went to elementary school. HtH is statistically significant at the 1.3% level and those who have HtH services are 15.89% more likely to choose the high WTP interval compared to those the high WTP interval compared to those who have CCC services.

In summary, in this analysis, there are five independent variables that are statistically significant. These are Ayawaso, Kpeshire, JSS, Income, and HtH. One of the

interesting points is that those who have education at the university level are less likely to select high WTP intervals compared to those who had no education and go to elementary school. One of the reasons is that those who have university education are aware of the corruption and inefficiency of administrative management in governmental agencies. Moreover, as an article argues, women tend to be more exposed to hazardous waste than men (Songsore & McGranahan, 1998). Even though the independent variable sex is not statistically significant, the results show that women tend to value SWC more than men. Finally, these findings of socio-economic characteristics will help the understanding of the environmental risks related to the type of SWC, income, education attainment, and the places in which respondents live.

#### **Chapter 5 Concluding Remarks**

This thesis attempts to determine how residents evaluate SWC by utilizing the ordered probit model to investigate the socio-economic attributes of those affected by garbage collection and how these characteristics affect their willingness to pay for more reliable municipal services in Accra. There are numerous articles related to sanitation, women's education, poverty, population and solid waste disposal issues in Ghana. However, examination of the valuation of SWC by residents in Accra has barely been surveyed as far as the author is concerned. I hope these findings will help the understanding of the issue of solid waste disposal with respect to the assessment of the benefits associated with policies for the improvement of garbage collection in Accra.

The empirical results from the ordered probit model show that five independent variables--Ayawaso, Kpeshie, JSS, Income and HtH--are statistically significant. In terms of income's marginal effects, Figure 1 shows that the low WTP interval indicates that the more income respondents have, the less likely they are to report a low WTP. The medium-low WTP is not very clear compared to the low, medium-high, and high WTP. The medium-high and high WTP indicate that the more income respondent has, the more likely they are to report a higher WTP for SWC. The results from this survey were expected since when people earn more money, they tend to spend more on other materials than on basic needs.

According to this survey, many complained about the lower frequency of SWC because the waste collection workers do not come as scheduled. In the case of HtH, waste collection workers are normally scheduled to collect garbage once a week, however, they often do not come even that often. Some respondents complained that waste collectors

sometimes did not come even once a month. The low levels of service frequency would diminish the WTP for SWC to the present services by both public and private sectors. Typical reasons that workers cannot collect once a week are that they are under pressure and they have to collect as much as they can. However, there are a large number of collection points. They cannot provide stable services to residences. Moreover, the equipment they possess has basically been over-used for a long time. In many cases, collection trucks are broken down along the street because roads are not well-maintained. In the process of policymaking, public and private sectors have to be monitored for their service frequencies. Also, if the service frequencies increase, it is assumed that the amount of collected garbage will increase and residents could have healthier service.

Surprisingly, higher education does not seem to contribute to increase WTP for SWC since independent variable, university, was not statistically significant (See Table 4). Those who have university education tend to understand the inefficiency of administrative management and corruption in the governmental agencies.

Moreover, the sub-metropolitan districts of Ayawaso and Kpeshie have wide ranges of income residences from low to high. The lowest income groups, called Nima and Mamobi, are in Ayawaso, whereas the highest income groups are in the Airport residential areas, Dzourulu residential areas, Abelemkpe, and Roman Ridge. Analysis of marginal effects of the low WTP shows that Aayawaso was statistically significant at the 0.1% level. Those who live in Ayawaso are 34.1% less likely to report a low WTP for SWC compared to the two sub-metropolitan districts that were omitted although Ayawaso has a wide range of income groups. Respondents who live in Ayawaso are 11.46% and 23.78% more likely to select the medium-high and high WTP intervals respectively. Contrary to common perceptions, this survey suggests that individuals are willing to pay for improved solid waste management in Accra, Ghana. The average of WTP for those without garbage collection shows 33,438 cedis. The average of WTP served by CCC collection system shows 21,543 cedis. Finally, the average of WTP for those utilizing HtH shows 35,612 cedis. The average of total WTP for improved waste services is 26,540 cedis with standard deviation 25,048 cedis (See Table 3). These results could be the foundation for the extension of the market for garbage collection in the city.

In addition, those with HtH service are willing to pay more than those with CCC service. Therefore, there is room for improvement of garbage collection service even with those services considered to be the best in the city. Furthermore, to the extent that these are richer households, their higher WTP might endorse not only improved garbage collection services to households but also increased cross-subsidization of SWC services to the poor.

Other results show that the sign of women's coefficients (dy/dx) are positive at the medium-low, medium-high, and high WTP for SWC intervals (See Tables 5, 6, 7 and 8) although these coefficients are not statistically significant. This result is supported by Songsore and McGranahan (1998), who point out that women have greater exposure to hazards than men, because women tend to be at home doing household chores. Furthermore, they tend to be less educated than men. Division of labor at home shows that girls are assigned to household chores more often than boys (Songsore and McGranahan, 1998). For future research, the author should take these results into account when developing questionnaires.

The findings from this research by questioning residents about the demand for

SWC will help fill the gap in information on the socio-economic characteristics with respect to garbage collection in Accra because the articles, books, and reports discuss how waste collection services are more efficient by analyzing financial aspects, the mode of collection, labor conditions, privatization, and environmental risks in the city. However, the characteristics of the demand for SWC regarding individual attributes are rarely surveyed, even in other countries' SWC systems. Therefore, I hope this thesis helps to fill this gap and provide better guidance to solid waste management policies.

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#### Appendix

#### Questionnaires

#### Introduction

I am a graduate student at Ohio University, USA. I am currently working on my Master's degree thesis on solid waste disposal in Accra, Ghana. The purpose of my thesis is to investigate the value of and the demand for garbage collection. These findings will help the understanding of the issue of solid waste disposal in Accra.

Today's questionnaires should take about 5 minutes. If you have any questions at any point, do not hesitate to ask. The information that I collect today is **confidential and no direct reference will be made to individuals**.

Thank you for your participation.

- 1. Gender: Male [ ] Female [ ]
- 2. Age:
- 3. Marital status: Married [] Single [] Divorced/Separated []
- 4. What area of the city do you live?
- 5. How many people live in your house?
- 6. How many children live in your house?
- 7. Select your highest education attainment (Degree completed).

None	[]
Elementary	[]
Junior secondary school	[]
Senior secondary school	[]
Community college	[]
University or higher	[]
, ,	

8. How much do you earn per month?

wonuny			
0 - 100,000 cedis	[]	1,000,000 - 1,500,000	[]
100,000 - 300,000	[]	1,500,000 - 2,000,000	[]
300,000 - 600,000	[]	2,000,000 - 2,500,000	[]
600,000 - 1,000,000	[]	2,500,000 - More	[]
If answers daily, ask	t how m	any days worked per wee	ek.
Income/Day:			
Days/Week:			

9. Which type of waste disposal do you utilize?

House to House	[]	(Go to C)
Communal Container	[]	(Go to B)
Other:	[]	(Go to A)

A. If you pick Ot	<u>her:</u>								
A.1. How much	would	you be	willing	to pay	for	Communal	Container	service	per
month?									
0 cedi	[]	30,001 -	35,000	[]	65,0	001 - 70,000	[]		
1 - 5,000	[]	35,001 -	40,000	[]	70,0	001 - 75,000	[]		
5,001- 10,000	[]	40,001 -	45,000	[]	75,0	001 - 80,000	[]		
10,001- 15,000	[]	45,001 -	50,000	[]	80,0	001 - 85,000	[]		
15,001 - 20,000	[]	50,001 -	55,000	[]	85,0	001 - 90,000	[]		
20,001 - 25,000	[]	55,001 -	60,000	[]	90,0	001 - 95,000	[]		
25,001 - 30,000	[]	60,001 -	65,000	ĪĪ	95,0	01 - 100,00	[] 0		
					100,0	)01 - More	[]		

A.2.If you pick 0 cedi, how many hours of work would you be willing to donate per week to help with the operation of a Communal Container?

to help v	with the	operation of	1 a CO	ininunai Conta	iner !
0 hour	[]	7 - 8	[]	14 - 15	[]
0 - 1	[]	8 - 9	[]	15 - 16	[]
1 - 2	[]	9 - 10	[]	16 - 17	[]
2 - 3	[]	10 - 11	[]	17 - 18	[]
3 - 4	[]	11 - 12	[]	18 - 19	[]
4 - 5	[]	12 - 13	[]	19 - 20	[]
6 - 7	[]	13 - 14	[]	20 - More	[]

### **B**. If you pick **Communal Container**:

**B.1**. How much would you be willing to pay for **House to House** service per month?

0 cedi	[]	30,001 - 35,000	[]	65,001 - 70,000	[]
1 - 5,000	[]	35,001 - 40,000	[]	70,001 - 75,000	[]
5,001- 10,000	[]	40,001 - 45,000	[]	75,001 - 80,000	[]
10,001-15,000	[]	45,001 - 50,000	[]	80,001 - 85,000	[]
15,001 - 20,000	[]	50,001 - 55,000	[]	85,001 - 90,000	[]
20,001 - 25,000	[]	55,001 - 60,000	[]	90,001 - 95,000	[]
25,001 - 30,000	[]	60,001 - 65,000	[]	95,001 - 100,000	[]
				100,001 - More	[]

**B.2.** If you pick 0 cedi, how many hours of work would you be willing to donate per week to help with the operation of House to House garbage collection service?

0 hour	[]	7 - 8	[]	14 - 15	[]
0 - 1	[]	8 - 9	[]	15 - 16	[]
1 - 2	[]	9 - 10	[]	16 - 17	[]
2 - 3	[]	10 - 11	[]	17 - 18	[]
3 - 4	[]	11 - 12	[]	18 - 19	[]
4 - 5	[]	12 - 13	[]	19 - 20	[]
6 - 7	[]	13 - 14	[]	20 - More	[]

C. If you pick House to House:

**C.1** How often does the garbage collector collect solid waste per week? **C.2.** Are you satisfied with the waste collection service? Yes [] No [] If not, why? Please state your reason.

**C.3.** How much would you be willing to pay per month for a more reliable (less uncertain) service?

0 cedi	[]	30,001 - 35,000	[]	65,001 - 70,000	[]
1 - 5,000	[]	35,001 - 40,000	[]	70,001 - 75,000	[]
5,001-10,000	[]	40,001 - 45,000	[]	75,001 - 80,000	[]
10,001- 15,000	[]	45,001 - 50,000	[]	80,001 - 85,000	[]
15,001 - 20,000	[]	50,001 - 55,000	[]	85,001 - 90,000	[]
20,001 - 25,000	[]	55,001 - 60,000	[]	90,001 - 95,000	[]
25,001 - 30,000	[]	60,001 - 65,000	[]	95,001 - 100,000	[]
				100,001 - More	[
<b>a i i b</b>	1 0		0		

**C. 4.** If you pick 0 cedi, how many hours of work would you be willing to donate per week to help improve the **House to House** garbage collection service?

week to	noip n		Touse	to mouse garde	$u_{\rm S} = 00$
0 hour	[]	7 - 8	[]	14 - 15	[]
0 - 1	[]	8 - 9	[]	15 - 16	[]
1 - 2	[]	9 - 10	[]	16 - 17	[]
2 - 3	[]	10 - 11	[]	17 - 18	[]
3 - 4	[]	11 - 12	[]	18 - 19	[]
4 - 5	[]	12 - 13	[]	19 - 20	[]
6 - 7	[]	13 - 14	[]	20 - More	[]

10. Do you have any health problems? Please specify.

Thank you for your co-operation

variable	dy/dx	std. err.	z-value	p-value	95%	c.i.	Х
Ablekuma	-0.0732	0.1354	-0.54	0.588	-0.3387	0.1921	0.3576
Okaikoi	-0.1639	0.1268	-1.29	0.196	-0.4126	0.0847	0.2251
Ayawaso	-0.341	0.1053	-3.24	0.001	-0.5475	-0.1345	0.2516
Kpeshie	-0.2409	0.1104	-2.18	0.029	-0.4573	-0.0245	0.086
Gender	-0.012	0.0886	-0.14	0.892	-0.1857	0.1616	0.3708
Age	-0.002	0.0048	-0.42	0.678	-0.0114	0.0074	35.1391
Married	0.1356	0.107	1.27	0.205	-0.0742	0.3455	0.596
Residents	0.0034	0.0068	0.5	0.615	-0.01	0.0169	15.4768
Children	-0.0149	0.0122	-1.22	0.223	-0.039	0.0091	6.8609
JSS	0.2204	0.1268	1.81	0.07	-0.018	0.4589	0.2516
SSS	-0.0278	0.1077	-0.26	0.796	-0.239	0.1833	0.2251
Comcoll	-0.0443	0.0604	-0.73	0.464	-0.1628	0.0742	0.2649
Univ	0.037	0.2038	0.18	0.856	-0.3625	0.4366	0.0993
Income	-2.32E-07	0	-2.11	0.035	-4.50E-07	-1.70E-08	790397
Non	0.0482	0.1691	0.29	0.776	-0.2833	0.3798	0.0529
HtH	-0.2732	0.0836	-3.27	0.001	-0.4371	-0.1093	0.3245

Table 5 Low WTP interval

# Table 6 Medium-low WTP interval

variable	dy/dx	std. err.	z-value	p-value	95%	c.i.	Х
Ablekuma	0.0113	0.018	0.63	0.53	-0.024	0.0467	0.3576
Okaikoi	0.0125	0.0148	0.85	0.396	-0.0164	0.0416	0.2251
Ayawaso	-0.0114	0.0406	-0.28	0.779	-0.0911	0.0682	0.2516
Kpeshie	-0.0189	0.0479	-0.39	0.693	-0.1129	0.075	0.086
Gender	0.002	0.0151	0.14	0.89	-0.0276	0.0318	0.3708
Age	0.0003	0.0008	0.4	0.691	-0.0013	0.002	35.1391
Married	-0.0201	0.017	-1.18	0.238	-0.0536	0.01334	0.596
Residents	-0.0006	0.0012	-0.49	0.626	-0.003	0.0018	15.4768
Children	0.0026	0.0024	1.07	0.285	-0.0022	0.0074	6.8609
JSS	-0.0595	0.0472	-1.26	0.207	-0.1521	0.0329	0.2516
SSS	0.0044	0.0163	0.27	0.784	-0.0276	0.0365	0.2251
Comcoll	0.0078	0.0121	0.64	0.521	-0.01603	0.0316	0.2649
Univ	-0.0075	0.047	-0.16	0.872	-0.0998	0.0846	0.0993
Income	4.09E-08	0	1.49	0.137	-1.30E-08	9.50E-08	790397
Non	-0.0104	0.0436	-0.24	0.81	-0.096	0.0751	0.0529
HtH	0.018	0.0239	0.76	0.449	-0.0287	0.0649	0.3245

variable	dy/dx	std. err.	z-value	p-value	95%	c.i.	Х
Ablekuma	0.0264	0.0485	0.54	0.586	-0.0687	0.1216	0.3576
Okaikoi	0.059	0.0468	1.26	0.208	-0.0328	0.1508	0.2251
Ayawaso	0.1146	0.0418	2.74	0.006	0.0326	0.1965	0.2516
Kpeshie	0.0827	0.0381	2.17	0.03	0.0079	0.1575	0.086
Gender	0.0043	0.032	0.14	0.892	-0.0584	0.0671	0.3708
Age	0.0007	0.0017	0.41	0.685	-0.0027	0.0042	35.1391
Married	-0.0487	0.0405	-1.2	0.229	-0.1282	0.0307	0.596
Residents	-0.0012	0.0024	-0.5	0.616	-0.0061	0.0036	15.4768
Children	0.0053	0.0045	1.18	0.239	-0.0035	0.0143	6.8609
JSS	-0.076	0.0402	-1.89	0.059	-0.1549	0.0027	0.2516
SSS	0.01	0.039	0.25	0.799	-0.0673	0.0874	0.2251
Comcoll	0.0159	0.0227	0.7	0.483	-0.0286	0.0605	0.2649
Univ	-0.0132	0.0725	-0.18	0.855	-0.1553	0.1288	0.0993
Income	8.34E-08	0	1.84	0.066	-5.50E-09	1.70E-07	790397
Non	-0.0171	0.0591	-0.29	0.771	-0.133	0.0986	0.0529
HtH	0.0962	0.0384	2.5	0.012	0.02	0.1716	0.3245

 Table 7 Medium-high WTP interval

# Table 8 High WTP interval

		-	-				
variable	dy/dx	std. err.	z-value	p-value	95%	C.1.	Х
Ablekuma	0.0354	0.0705	0.5	0.615	-0.1027	0.1737	0.3576
Okaikoi	0.0923	0.0876	1.05	0.292	-0.0794	0.2642	0.2251
Ayawaso	0.2378	0.1083	2.2	0.028	0.0255	0.4501	0.2516
Kpeshie	0.1771	0.1239	1.43	0.153	-0.0657	0.42	0.086
Gender	0.0056	0.0415	0.14	0.892	-0.0757	0.0869	0.3708
Age	0.0009	0.0021	0.42	0.671	-0.0033	0.0052	35.1391
Married	-0.0667	0.0565	-1.18	0.238	-0.1776	0.0441	0.596
Residents	-0.0016	0.0032	-0.5	0.616	-0.0078	0.0046	15.4768
Children	0.0069	0.0058	1.18	0.238	-0.0045	0.0184	6.8609
JSS	-0.0847	0.0455	-1.86	0.063	-0.1739	0.0044	0.2516
SSS	0.0133	0.0521	0.26	0.799	-0.0889	0.1155	0.2251
Comcoll	0.0205	0.02661	0.77	0.44	-0.0316	0.0726	0.2649
Univ	-0.0162	0.0844	-0.19	0.848	-0.1817	1.49E-01	0.0993
Income	1.07E-07	0	2.03	0.042	3.70E-09	2.10E-07	790397
Non	-0.02	0.066	-0.31	0.757	-0.1512	0.11	0.0529
HtH	0.1589	0.063	2.49	0.013	0.034	0.2837	0.3245

**Table 9 General Data on WTP** 

variable	coefficient	std. err.	z-value	p-value	95%	c.i.
Ablekuma	0.1973	0.3578	0.53	0.593	-0.51	0.9826
Okaikoi	0.444	0.3643	1.22	0.223	-0.27	1.1582
Ayawaso	0.9998	0.3686	2.71	0.007	0.2773	1.7223
Kpeshie	0.7123	0.3937	1.81	0.07	-0.0593	1.484
Gender	0.0312	0.2299	0.14	0.892	-0.4194	0.4819
Age	0.0051	0.0124	0.41	0.678	-0.0192	0.0296
Married	-0.3561	0.2873	-1.24	0.215	-0.9193	0.2071
Residents	-0.0089	0.0178	-0.5	0.615	-0.0439	0.0259
Children	0.0387	0.0318	1.22	0.224	-0.0236	0.1011
JSS	-0.5633	0.316	-1.78	0.075	-1.1828	0.0561
SSS	0.0724	0.2819	0.26	0.797	-0.4802	0.6251
Comcoll	0.1146	0.1563	0.73	0.463	-0.1916	0.421
Univ	-0.0951	0.5194	-0.18	0.855	-1.1132	0.923
Income	6.00E-07	2.86E-07	2.1	3.60E-02	4.00E-08	1.16E-06
Non	-0.1234	0.428	-0.29	0.773	-0.9623	0.7155
HtH	0.7526	0.2546	2.96	0.003	0.2534	1.2517