AN ECONOMETRIC ANALYSIS OF DEMAND FOR IMPROVED SOLIDWASTE MANAGEMENT IN NAIROBI (A CASE STUDY OF PANGANI ESTATE)

BY

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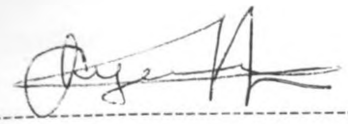
Research paper submitted to the department of economics, University of Nairobi in partial fulfillment of requirement for the degree of masters of Arts in economics.

DECLARATION

This research paper is my original work and has not been presented for a degree in any other university.



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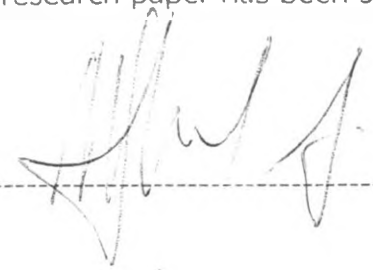

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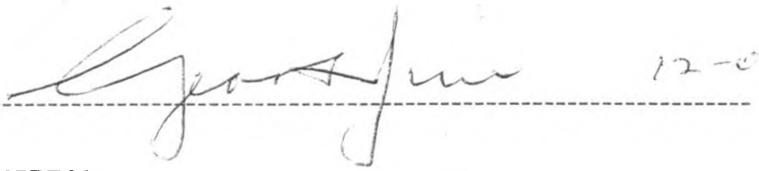

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DEDICATION

This research paper is dedicated to late father Mr Michael Mugendi Murigu may God rest his in soul peace.

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Abstract

The study analysis factors that influence solid waste management in Nairobi. It uses contingent valuation method to obtain household willingness to pay for improved waste management in Nairobi .A case study was done at Pangani estate and 200 respondents were interviewed. Systematic random sampling was applied in this study.

Ordinary least square techniques was applied in the data analysis to investigate the influence of the identified explanatory variables on the willingness to pay. These variables included social economic factors for example, education, family size, marital status, age etc. Also environmental factors eg health attitude of the respondents

The findings from the OLS regression reveals that an individuals income, family size education level and house ownership are some of the factors that influences willingness to pay

The probit model was used and various explanatory variables were regressed against wtp. These helped to get the determinant of probability of wtp. The results revealed that factors like income, family size , education level are some of the factors that determine probability of willingness to pay.

The estimated results included both descriptive as well as econometric analysis on the entire sample which indicates that as regards to willingness to pay, a higher percentage of men were willing o pay more than women but more women than men are concerned with the environment. Household currently being served by city council indicates more concern in relation to the existing solid waste services problem, the frequency of collection and their current disposal methods as compared to those already being serviced by private providers.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Waste Management in Nairobi

The history of waste management in Nairobi is a sad representation of disjoined duplication and a near total lack of coordination. As for now, there are four major responses to dealing with garbage in the city

(a) At the most basic level are the people who bury or burn and recycle their household garbage in their own small shambas by passing city council completely.

(b) The city produces an overwhelming amount of waste, and not everybody has his or her own compound. According to most estimates, more than half of this waste is organic and organizations like the Mukuru Recycling Center and City Garbage recycles, recycle this waste and make compost manure and waste fuel briquettes. These community groups are few and under appreciated

(c) At the third level are the private collection companies like Bins Nairobi Services Ltd. This is the city's largest and oldest private garbage collection Service, it has made significance progress since it started in 1988 and it has benefited from city council's efficiency vacuum. There are now, by city hall's count 70 garbage collection companies in Nairobi, many of that have greatly assisted the city in its effort to become cleaner All the council requires from a company setting itself as a licensed garbage collector is K.Shs 7000. And because operators are required to pay a fee to dump waste in Dandora, many dump elsewhere.

(d) At the fourth level are the industrial recycling firms which collect waste paper, plastic, tins and a variety of other waste materials mainly from large manufacturing concerns and

turn them into useful second generation products such as cardboard packaging and plastic containers.

There are few if any links between these four levels of waste management. Each operates on its own, rarely improving or expanding operations. As a result, most of the city's garbage goes uncollected. According to JICA (1998), about 1,130 tonnes of the total 1,500 tonnes of garbage that the city generates each day is not collected. this is about 67 percent.

Table 1.0 Total Amount of Waste Generated each day in the City.

Weight per Unit (Kgs)			Total Number		Total Weight (Tonnes)
	Person	Shops	Population	Shops	
Mixed (resd.)		6.79		5,600	38
Mixed (others)		1.39		39,900	56
High income	0.654		511,000		334
Middle income	0.595		585,000		348
Low income	0.551		1,095,000		603
Commercial		2.425		34	82
Total			**2,191,000**		**1,530**

Source: JICA Report 1998.

According to UNEP by the year 2010, it is estimated that four out of ten people in developing countries will live in cities These statistics do not augur well for the future of our environment especially in urban centers. Today, dumping sites have become a threat to the environment especially for those people who live near by. Air pollution resulting from

the garbage has a range of effects on human health including respiratory illness and aggravation of heart problems, blood changes leading to reduced oxygen carrying capacity, hyperactivity and neurobehavioral effects

Kenya population is growing at about 2 5 %, the urban population is growing at about 7%. With such growth, it is expected that both the amount and variety of solid wastes generated by industrial, domestic and other activities will rapidly expand. Left unattended Kenya will bury itself in wastes. The problem is very critical and requires urgent attention. In the national Development Plan, 1997 -2001, the Kenya Government has recognized the problem of Municipal Solid Wastes. The plan calls for the government " to adopt a waste treatment and sound management approach focusing on generating as little waste as possible, recycling wastes in a manner that ensures that appropriates technology is used to avoid environmental destruction and to maintain economic feasibility of such technology".

The plan identifies four types of wastes, namely. - organic waste and inorganic waste, agricultural wastes and other secondary wastes.

With indiscriminate allocation of public lands within the municipal boundaries it is improbable that more space will continue to be found for dumping sites or landfills. While some wastes will continue to be disposed off through landfills, it is prudent to advocate that future developments t should place greater emphasis on minimization of waste arising and on reclamation and recycling

Figures in table 1.1 shows that households and consumer wastes constitute the major component of solid municipal waste. They consist of a mixture of organic materials, paper plastics, textile, glass, metals and ash. Food remains also form a major component of household waste in Kenya. The moisture content of local household waste is high and

makes it not readily combustible. Litter also constitutes a major fraction of all wastes in our cities. It is a hazard to many animals and human beings. Packing materials (Glass and Plastics, bottles, cans, paper clips, paper and plastic wrapping) are the major constituents of litter. The use of non-returnable containers has increased the volume of litter. Furthermore, the production and widespread use of non-biodegradable plastics in packing materials has made the finding of solutions to litter problems more difficult.

Table 1.1 Nairobi City waste constituent in weight

Constituent	Total tonnes per day
Food waste	734
Paper - Recyclable	206
- Others	41
Textiles	38
Plastic - Container	67
- Others	102
Grass / wood	96
Leather	13
Rubber	21
Combustion sub-total	1,317
Glass - Containers	21
- Others	11
Metals – Containers	25
- Others	13
Any other	74
Non-combustible subtotal	109
Grand total	**1,500**

Source: JICA Report 1998.

Demolition and construction wastes arise from reconstruction of new buildings. At present contractors are left on their own to find dumping sites for their waste The waste may

include soil, rock and inert dirt or tailings from an extraction, which are contaminated with metals or chemicals.

Disposal of hazardous waste is expensive. In order to avoid costs some countries have sent their waste to unsuspecting developing countries under false declaration Parselelo K (2000). Landfills will continue to be a safe method of waste disposal for the foreseeable future. Such landfills areas should be scientifically developed. Biodegradation with energy recovery offers the second best alternative for rural communities. However, Municipal wastes hazardous waste & sewage sludge are suitable for incineration.

Thus the generation of city garbage and its management are a concern to be addressed not only to improve the state of the environment in terms of reduced pollution but to make use of any economic value it may possess.

1.2 Statement of the Problem.

Residents of Nairobi or indeed any major Municipality in Kenya know what a nuisance and irritation the problem of solid waste is. Disposing solid waste near the residence and around buildings is not only an irritation to the eye but also causes bad smell, it also provides an ideal habitat for flies and rats which are agents of diseases Domestic solid wastes and also industrial wastes pose health hazards. Inability of municipal councils to have an effective waste collection, proper disposal and good disposal sites has called for urgent re-look into waste disposal laws in the country.

Development of controls over solid waste and their implementation has been left to the local government. As a result, very low priority has been given to improvements of control

measures. Today landfills, which are uncontrolled and unhygienic, are the predominant mode of disposal. Open-air incineration, which is banned in most countries, is widely practiced in Kenya. Widespread and uncontrolled combustion of waste causes air pollution problems. The low priority given to waste disposal by both central government and local government is in stack contrast to the harm in adequate management could cause to human health and environment. In addition, most urban dwellers are dissatisfied with the present mode of collection services. The efforts of the city to provide basic waste disposal services to all residence have rarely been successful. This may be due to budgetary consideration (Holmes 1984). The provision of urban amenities is usually the concern of municipal council, which face inadequate and inelastic revenue bases. Due to this reason, service provisions that depend on such revenues suffer.

Provision of solid waste disposal services in Nairobi mainly targets the middle & high-income areas ignoring the lower income groups, the garbage from high-income areas is transported to low-income areas e.g. Dandora dumping site. This study therefore aims at providing information on the extent of demand for improved waste management services in Nairobi. The services include having adequate storage bins and the waste will be transported frequently away from residential areas to designated land fills.

1.3 Objective of the study.

The main objective of the study is to investigate households WTP for improved solid waste management.

Specific objective

To estimate extent of demand for improved solid waste disposal services.

To estimate empirically responsiveness of household to improved solid waste management.

To estimate expected revenues from providing improved solid disposal services.

To draw up appropriate policy implications and recommendations based on the findings

1.4 Significance of the Study

Valuation is an important aspect of public choice. Ideally, cost-benefit comparisons guide choices among various options available (World Bank 1995). In project appraisal the value of environment impacts similarly need to be integrated into the evaluating process.

In this regard one must rely on alternative methods that will elicit the value consumers place on an improved environment. If they are willing to pay for the improved service, then the welfare gains may be considerable otherwise these resources would be of better use elsewhere. Policy planners in their effort to gauge at what levels to provide the services in an efficient profitable & equitable manner may use WTP estimates.

The setting of environmental standards should be informed by valuation analysis. This study will help the government to see the demand for improvement of environmental quality. Though a previous study has estimated willingness to pay for improved waste disposal services (Mugo, 1995). The model did not include certain variables, which also explain willingness to pay e.g. home ownership health attitude and gender. Inclusion of these variables may help to shed more light. Sampling will be in a new area i.e.Pangani estate which has inadequate waste disposal services. This will compliment what has already been done and still it will provide for future empirical research on the subject.

2.0 LITERATURE REVIEW

2.1 Definition of waste

According to UNEP (2000) waste is any substance which constitutes a scrap material or other unwanted supply substances arising from the application of any process of its any substance which require to be disposed of as being broken, worn out, contaminated or otherwise spoiled. In practice social priorities, public perceptions and legal practicability have led to selectivity of regulatory control over wastes in most countries (Wynne, 1987). In UK, 'controlled waste' is defined as comprising household, industrial and commercial waste based on the source of the waste arising.

The industrial revolution led to increase in the volume of waste arising and also transformed the nature of wastes and the potential hazards that they presented to the environment through improper disposal practices. The advent firstly of mass metals production and then of dynamic chemical synthesis developed numerous synthetic materials production. This dramatically increased the environment persistence of many waste materials (Grishm, 1986).

The perception of waste as unwanted, 'useless' materials with no intrinsic value has dominated attitude to their disposal practices. This is governed by the philosophy " out of sight out of mind". Many industrial waste generators relegated responsibility for waste disposal to the lowest level of management and, in keeping with its non-productive status, sought disposal at the lowest cost. Dumping on land and into rivers and seas was the most common form of disposal, although much of this practice was legal and regarded as acceptable at the time.

2.2 Studies on solid waste management

Abebe and Kebede (1999) while assessing awareness and practice of solid waste in Addis Ababa maintained that communities particularly the rural folk expect the municipal clearing and collection services hence their WTP is not only low but also negative at times. However, in a study on willingness to pay for community based solid waste management and its sustainability in Bangladesh. Saleofuzzam et al (2001) maintained that once a community perceives that new facilities provide a service level that is much higher than the existing management, they will be more enthused to pay a higher contribution. This, according to them is particularly the case, if the users are not satisfied with the present service level. This argument, however, has one main limitation, that is it assumes that residents have perfect knowledge about the perceived or envisaged alternative waste management for them to be enthused to make higher payments.

Saleofuzzam et al (2000) further argued that communities with low income and low ability to pay are less willing to pay for improved services because they need their financial resources for other basic needs such as food, health care, education and shelter. Though this argument shed light on the ability to pay (measured in terms of income) as a determinant of W.TP, it again has a major draw back, it assumes that the ability to pay measures assures that the residents with the same income level have the same preferences for the service. It could be the case that individuals with the same income have different preferences, hence varying levels of WTP.

Buyene (1999) while investigating management of solid waste in Addis Ababa argued that creating healthy environment not only depends on raising public awareness. But also on the creation of mechanism of controlling generation of waste at the source and sharing of responsibilities between the general public, local institutions, business community, non-

governmental organization and governmental institutions. His argument is consistent with the findings of Snel (1999) who maintained that social stigma on waste disposal can be reversed if responsibilities are shared.

Similarly. Olley and Olbino (1999) argued that involvement of professional collector teams of residents' committee workers can prove effective in solid waste management than involving only one institution. In the same vein Coker and Sikim (1999) argued that private institutions are better placed in the management of solid waste than public institutions. Osuocha (1999) on improving refuse management in urban Nigeria also argues in a similar way. He maintains that one of the major problems of refuse management is the inadequacy of the institution framework. This is attributed to lack of understanding of the magnitude of the refuse job.

Bartone et al (1991) while writing on private and sector participation in solid waste services proposed that a flat benefit tax charged to all households as apart of their waste or property tax. Bill may be the most effective for cities in developing countries to pay for municipal solid waste management, reduce incentive to dump waste illegally and possibly subsidize management services for poor neighbors. However, without strict supervision this method does not provide an incentive to reduce solid waste. Nonetheless, most of the recyclable or reusable materials may be covered by the time waste is put out for collection.

In developing countries the least costly options for disposal of waste i.e. dumping in public spaces or burning it openly are often the most popular (Barton and Bertntein, 1993). They argue that although in expensive in terms of out-of-pocket costs and environmental effects to those who develop or burn waste, these act may impose large cost to society Aesthetic,

environmental and wealth problems may result, especially in densely populated urban areas.

2.3 Contingent valuation method "willingness to pay" (WTP)

The contingent valuation method (CVM) is used to estimate value for environmental amenities and other non-market goods and services. Surveys are used to ask respondents about their monetary values or other means of payment. Therefore, the transactions are hypothetical. CVM has been applied in hundreds of studies, many of which has received considerable acceptance in the United State, it has gained international attention and now its applied in many countries.

The questions asked in CVM are usually in the form of a biding game involving "yes/no" answers to questions regarding maximum willingness to pay (WTP). Econometric techniques are then employed to find the mean bid values of WTP. This method is also supported by Rubinfield & Pindyck (1989) who add that the most direct way to obtain information about demand is through direct interviews in which consumers are asked how much of product they might be willing to buy at given price, vice versa.

In order for CVM to yield economic values, study participants must be both willing and able to reveal their values. They may be unwilling to reveal such values either because they perceive strategic responses to be in their best interest or because they have little incentive to take the valuation process seriously. Even if they are willing to respond accurately, they may be unable to do so Chances are participants have never before been asked to express their preferances for environmental goods in monetary terms.

Despite the advances that have occurred in CVM technique, economists are somewhat divided over the usefulness of the CVM in measuring value and guiding policy. The journal of economic perspectives published a symposium on the usefulness of the CVM in its fall 1994 issue. Diamond and Hausman (1994) raised the issue that all surveys are vulnerable to responses effect, also known as embedding bias (small changes in wording or order of survey questionnaire material can sometimes cause significant changes in survey responses).

Another criticism of the CVM is that the survey process itself creates the values reported as empirical data – people just make something up when asked. The standard view of rational human in economics is based on people's having a pre-existing valuation map in their heads that ranks all the possible choices available in contemporary markets, yet as Hanemann (1994) points out, this view is inconsistent with much of the contemporary research in cognition. The issue is whether the preferences are stable and recent studies support this (comparing value).

One also argues that there is the potential for strategic bias in CVM survey data, in which people may inflate their stated values because they do not have to "put their money where there mouth is". The modern referendum-style CVM studies have compared the hypothetical responses to actual parallel reference and have found that in modern CVM studies there are often times no significant difference in responses.

Also critics argue that CVM surveys responses cannot be verified. This statement is not always true. Survey responses can be validated through replication, comparison with estimates from other sources and comparison with actual behavior. Hanemann (1994) reports that there are now more than 80 studies offering comparison of CV with other

methods. Similar verification has been provided in comparison of CVM responses with actual voluntary contribution Sinden (1988).

Non-market valuation, through the economic measures of willingness-to-pay (WTP) has continually been accorded a considerable amount of attention in environmental economics literature. This method uses survey questions to elicit people's preference for public goods by finding out what they would be willing to pay for a specified improvement in them. Respondents are presented with information consisting of three parts -

a) A detailed description of the good being valued and the hypothetical circumstance under which it is made available to the respondent

b) Questions which elicit the respondent's willingness to pay for the good or service.

c) Questions about the respondent's socio-economic characteristics. This information is integrated into the regression estimation to estimate a valuation function for the good or service

2.4 Studies done using CVM

Whittington et al (1993) using a contingent valuation conducted a study to estimate households WTP for improved sanitation services. Improved ventilated pit latrines and water closets connected to a sewer system. Most households were willing to pay for improved sanitation than they were currently paying for the existing sanitation system (mostly public and bucket latrines), but potential revenues from households are not large. The study confirms that conventional sewerage system is not affordable to the vast majority of households without massive government subsidies. However, only modest subsidies are required for on-site sanitation (ventilated pit latrines). WTP is above as high as it is for water closets and ventilated pit latrines are much cheaper to supply. The study

involved 1200 households and a danger to public health was found from existing sanitation system. For example the study found that only 10% of generated human waste is removed from the city. Expenditure on sanitation services was $1.50 per capita per year and correspondingly, households were getting very poor services. Households were quite open to the idea of simple, low. cost, on site solution to the sanitation problems.

Shechter et al (1991) in a study in the city of Haifa in northern Israel valued air quality in terms of its human effects. Evidence accumulated over time has indicated a noticeably higher occurrence or respiratory illness in the polluted sections of the Haifa region, especially in relation to respiratory symptoms and diseases. The focus of the study was to capture WTP. A prime finding of this study was that if the gross WTP exceeds the abatement costs, the improvement can be considered socially profitable, setting aside the income distribution issue.

Jorge Rogat (1995) undertook a study that involved 455 households to determine WTP for air quality improvement in Santiago in Chile. Despite the intensity of the problem, only 17 percent of the respondents considered environmental pollution a priority of most concern. He analyzed the influence that different individual attributes have on WTP for quality air improvement in Santiago Chile. Income, education and number of children in the household are some of the factors that influenced WTP positively at the time of decision. Other factors such as sex, education and whether members of the household are suffering from pollution related diseases or not, seem to have had less influence on WTP. These results however, looked confusing due to fact that the problem of air contamination affecting Santiago was so critical that it could also imply that people did not perceive the problem with the same intensity.

Loomis (1996) performed a CVM study on the benefits of removing dams and restoring the Elwha River in Washington State. Loomis used a modern dichotomous – choice voter referendum form of CVM study to obtain estimates of willingness to pay for removing two dams on the Elwha river on the Olympic Peninsula in Washington state and restoring the ecosystem, with particular attention to the benefit of enhancing the salmon runs. Loomis found that mean annual value per household was estimated to be $59 in Clallam county, Washington and $73 for the rest of Washington state. The aggregate benefits of the residents of the state of Washington were estimated to be $138 billion annually for ten years.

Loomis (1987) used the CVM to quantify non-marketed environmental benefits from natural aquatic conditions. In this case the problem was to determine the public trust values of mono lake at alternative lake levels. Loomis found out that the economic benefits to California residents of preserving mono lake could conservatively be estimated to be $1.5 billions annually. Purchase of replacement water and power would cost Los Angeles $26.2 million per year. Thus on efficiency grounds the reallocation of water for maintenance of public trust values in mono lake could be warranted.

California has lost more than 50 percent of its historic wetland, the largest percentage of any state in the United States. Allen et al (1992) surveyed the literature to determine low, median, and high valuations of the various "services" provided by wetlands, including flood controls, water supply, water quality, recreation, commercial fisheries, and wildlife habitat. Their overall median annual benefit was estimated to be $9.96 billion.

Schultz (1983) used the CVM to study the economic benefit of visual quality in the Grand Canyon. Visibility in the Grand Canyon and other nearby natural areas was impaired by a large coal-fired electricity-generating plant. Schultze et al surveyed residents of Albuquerque, Denver, Los Angeles and Chicago to determine the maximum a household would be willing to pay in higher entry fees or higher utility bills to maintain the park's visual quality. The average figure was $7 to $10 per month per household, leading to an aggregate estimate (taking into account socio-economic household characteristics) of $6 billion per year. Note that for 99 percent of the households, these represents "existence" values rather than direct consumption values, as only about 1 percent visit the park, an indication of the important role of non use of existence values.

Walsh et al (1982) used the CVM to determine how much people value allocating an additional 2.6 million acres as federal wilderness in Colorado. Their survey was designed to gain insight into the relative importance of key value areas use option and existence on average, recreation was worth $18.50 per visitor-day yielding a total of $28 million per year. Passive use values (existence, option) totaled $135 million per year. This totals into the billions when one calculate present value of this stream of benefits .I

Carson et al (1992) conducted a national survey to measure the loss of passive use values that resulted from damage of natural resources by the Exxon Valdex oil spill. His results yielded the estimate that lost existence values were $3 billion. Cartson et al assessed the theoretical validity of the contingent values for a ship escort service, which would reduce the risk of future spills by estimating a valuation function. The valuation functions showed statistically significant relationships that are consistence with economic theory Individuals indicated that they are willing to pay for the ship escort service.

A study by Desvousages et al (1992) tested the hypothesis that wiling to pay estimates would increase as the level of natural services increased for two goods. The first good was prevention of three levels of migratory water flows deaths in oil wastage ponds. Desvousges et al hypothesized that the amount individuals were willing to pay would be higher for the higher level of death. They also tested hypothesis by asking independent shopping-mall intercept samples about preventing two different levels of oil spills. Their results failed to support the hypothesis that WTP estimates would increase as the level of natural resources increased.

CHAPTER THREE

3.0 THEORETICAL FRAMEWORK AND METHODOLOGY

3.1 Introduction

This study made use of the contingent valuation method to estimate and determine the maximum amount individual households with different socio-economic characteristics will pay for the improved solid waste disposal services. The CV method is a survey-based method used to value environmental goods. The principal idea underlying this method is that people have true but hidden preferences for all kinds of environmental goods. It is further assumed that people are capable of transforming these preferences into monetary units (Dirge 1985).

This study used both the direct and indirect approaches.

a) Indirect approach - The respondents were asked if they were willing to contribute towards the project, in this case, improvement of solid waste disposal services or not. Therefore respondents were asked to either accept or reject the offer to contribute to a trust fund that would be used to ensure that the project is implemented.

This involved use of dichotomous responses hence an attempt to relate the conditional probability of making a particular choice to various explanatory variables being specified in log-linear form.

Because a no/yes answer only gives information about one point on a valuation distribution function and the answer may be offered without respondents seriously considering the problem hence we also considered direct approach.

b) Direct Approach – This approach simply asked an individual how much he or she would be willing to pay for the provision of improved solid waste management (Whittinston

et al 1990, Beihaj 1996). Generally economic theory predicts a positive relationship between individuals income and their WTP amount (Varcan 1984). WTP is also related to other social-economic, demographic and environmental condition factors.

3.2 Model Specification

Here we examined how different explanatory variables influenced the probability of obtaining a positive WTP answer, thus we applied probit model. The study further looked how these explanatory variables influenced' individuals WTPS. It was thus a multiplicative model.

Following Belhaj (1996), factors thought a priori (with modifications) likely to affect individual valuation and hence willingness to pay for an improvement of the environment include: -

- y - Income
- Ag - Age of the respondent
- Fs - Family size of the respondents' household
- Ed - Education level of the respondent
- At - Health attitude
- Ge - Gender of the respondent
- Ar - Individual ranking of relocation of dumping site to other problems like water, security etc.
- mg - Marital status of the respondent
- Ho - Home ownership

Empirical studies point to these factors as significant determinants of the WTP e g Belhaj (1996) has shown that the level of income, level of education and awareness of environmental problems influence WTP for reduction on environmental pollution.

Cocheba and Langford (1978) found income to be a significant determinant of willingness to pay (WTP). Walingo (1995) found income and education significant determinants of WTP for a recreation facility.

1 Multiplication model

To test the extent to which these factors affect WTP, we adopted a multiplicative model previously used by Abala (1984), Walingo (1995), Belhaj (1996) and Tulyenge (2002) in similar studies, but now with one more variable the health attitude.

The model becomes: -

$WTP = \alpha_0 y_1^{\alpha 1}. ag^{\alpha 2}.fs^{\alpha 3}.ed^{\alpha 4} at^{\alpha 5} ho^{\alpha 6} ge^{\alpha 7} ar^{\alpha 8} mg^{\alpha 9} u$

Note that we have binary or categorical variables that is ge, ar, and mg which are combined to form a complex equation:

$WTP = \alpha_0 y_1^{\alpha 1}. ag^{\alpha 2}.fs^{\alpha 3}.ed^{\alpha 4}.at^{\alpha 5}.ho^{\alpha 6}.e^{x}$

Where $x = ge^{\alpha 7}.ar^{\alpha 8}.mg^{\alpha 9}$

The appropriate transformation for the estimation of this function is to work with logarithms of the variable to base e, we get

$\ln WTP = \alpha_0 + \alpha_1 Lny + \alpha_2 Lnag + \alpha_3 Lnfs + \alpha_4 Lned + \alpha_5 Lnat + \alpha_6 Lnho + \alpha_7 Lnge + \alpha_8 Lnar + \alpha_9 Lnmg$

Where α_0 α_1 α_2 α_9 are parameters to be estimated.

The above model has an advantage that it gives respective elasticities directly However, it has the disadvantage that if any of the non-dummy variables takes a zero the model collapses, also working with logarithms may be involving.

2 Use of probit model

This helps in calculating the expected willingness to pay (Tony 1998). This model predicts probability of rejecting the amount offered as a function of the amount and several explanatory variables such as net income. This indigenous dummy variable takes only two values, one for positive answer and zero otherwise. The probit model is associated with the cumulative normal probability function. In this model the probability of giving a positive WTP (pi) is the dependent variable and thus we will predict the likelihood of the WTP given a set of household characteristics attributes.

$Pi = F(\alpha_0 + Bxi + e_t)$

Where

Pi is the probability of obtaining WTP for improved solid waste disposal.

Improved services (1 = yes, 0 = otherwise) given xi

F = accumulative probability distribution function assuming a normal distribution

α_0 = The intercept terms

Bi = Respective variable coefficients

Vi = A vector of social-economic, demographic and environmental characteristics which in a priori ground is expected to have either positive or negative influence (or uncertain on the probability of obtaining a positive WTP from a respondent).

e_i = is a random term with normal distribution

3.3 Estimation Techniques

The study employed econometric techniques namely OLS and probit models. The OLS was used in the empirical analysis of the impact of social – economic, demographic & environmental variable on individual WTP bids

Probit model was used for the discrete (binary Yes or No) case with regard to an individual giving a positive WTP to establish the influence that different variables have on probability of obtaining a positive WTP answer. In the probit models MLE was employed to estimate the conformable parameters αo and bi.

3.4 hypothesis of the study

The income of the respondent does not influence the WTP, against the alternative hypothesis that it does i.e.

Ho : $\delta w / \delta y = 0$

Ha : $\delta w / \delta y \neq 0$

Education level of an individual does not influence his WTP for improved waste disposal services ($\alpha_4 = o$) against the alternative one that it is not equal to zero.

Ho : $\delta w / \delta ed = 0$

Ha : $\delta w / \delta ed \neq 0$

WTP for improved waste disposal services is not dependent on individual marital status ($\alpha_9 = o$) against the alternative that its not equal to zero.

Ho : $\delta w / \delta mg = 0$

Ha : $\delta w / \delta mg \neq 0$

It is hypothesized that age does not influence WTP against the alternative hypothesis that it does, ($\alpha_2 = o$)

Ho : $\delta w / \delta ag = 0$

Ha : $\delta w / \delta ag \neq 0$

It is hypothesized that the size of the household does not influence WTO against the alternative that it does ($\alpha_3 = o$)

Ho : $\delta w / \delta fs = 0$

Ha $\delta w / \delta fs \neq 0$

Improved services is of higher priority compared to other problems, it does not influence WTP ($\alpha_8 = o$)) against the alternative that it is not equal to zero.

Ho : $\delta w / \delta ar = 0$

Ha : $\delta w / \delta ar \neq 0$

Gender does not influence WTP for improved services ($\alpha_7 = o$) against the alternative one that it does influence

Ho : $\delta w / \delta ge = 0$

Ha : $\delta w / \delta ge \neq 0$

Health attitude does not influence WTP ($\alpha_5 = o$)against the alternative that it does influence

Ho : $\delta w / \delta at = 0$

Ha : $\delta w / \delta at \neq 0$

Home ownership does not influence the WTP ($\alpha_6 = o$) against the alternative that it does influence.

Ho : $\delta w / \delta ho = 0$

Ha $\delta w / \delta ho \neq 0$

3.5 Data type and sources

In order to achieve the objective of the study, primary data was collected from the residents of Pangani estate. Questionnaire was used to collect the data and it was administered to200 respondents .The questionnaire was divided in three parts.

Section A-This section asked the respondents questions on their age, education, income, and marital status, it mainly dealt with social characteristic of the household.

Section B- This section asked the respondent their views regarding their perception about the existing state of the environment and specifically regarding the waste disposal services. Households were also asked about their attitude towards solid waste disposal services and how they rank the good. It mainly dealt with household view on environmental quality.

Section c-started mainly by describing the hypothetical market, this sets the reason for payment for the services. Then respondents were asked how much they were willing to pay.

Three-trained research assistants then administered the questionnaires. Before the real study the questionnaire was pre-tested to view the respondents reactions and also to see whether any improvement of the questionnaire was needed. Each questionnaire took about 20 minutes to be filled. The survey was done by face to face interview.

3.6 Biases of CVM and how they were avoided.

In this study, we tried to minimize bias that exists in cvm these includes:

(a) Strategic bias –this exists if the respondents believe that bids will be collected, they may understate their wtp for welfare improving because environmental good are typically non excludable in consumption.(the free rider problem).Alternatively if the respondent believe their bids are purely hypothetical , they may overstate their wtp for an

environmental benefit as this increases the probability of the improvement going a head These were reduced by:

•Suggesting that the survey results were indeed to influence policy not purely hypothetical

•Stressing that payment by others is guaranteed

•Concealing other respondent's bids

•Making them understand that the environmental change would depend on the bid given by the respondent.

3.7 sampling design

The population from which the sample was drawn consisted of household residing at Pangani estate. Pangani estate was selected because no previous studies regarding solid waste has been done. Also because it would be a good representative of the population of Nairobi in terms of social-economic characteristics. It is also an area that is covered by most waste disposal services providers.

Pangani estate by description is characterized by a high population of more than 30000 residents. The housing structure in this area is not homogenous and includes flats, maisonnette and plots. It's also close in proximity to the city and this implies easy access of city-council services but this is not the case particularly as concerns poor solid waste disposal services. This manifest more clearly than any other environmental problem, indeed it is because of lack of any evident good waste disposal services.

After selecting the area, we clustered according to the similarities in housing structure i.e. we divided it into three sections and samples were drawn from each section. The initial

household was selected randomly and the systematic sampling method was then used to select subsequent households from the estate.

CHAPTER FOUR

4.0 DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction

This chapter deals in details the procedures followed in data presentation, data analysis and results. It presents a description of how the data was transformed from the administered questionnaires into study variables The chapter begins by giving descriptive results followed by regression results. The chapter concludes with testing of the hypothesis.

4.2 Descriptive Analysis of variables.

The descriptive analysis was done on the variables that affect willingness to pay, these include social, economic and demographic variables. The analysis of social characteristics of the area residents was obtained from frequency tables whose data was part of the questionnaire. Data for this analysis was obtained from Pangani estate. The questionnaire used in this study was designed in away that it would capture all information regarding the socio-economic characteristics of the individuals living in Pangani Estate In what follows, we present each of them distinctly.

4.2.1 **Disposable income**

The income reported was a summation of all types of income earned by the respondent income from the respondent main occupation and other sources.

The table below summarizes income earnings of interviewed respondents

Table 4.2.1 Income earnings of Pangani respondents

Income	Frequency	percent	Cumulative
0-5000	24	12	12
5001-10000	48	24	36
10001-15000	55	27	63.5
15001-20000	42	21	84.5
20001-25000	22	11	95.5
25000and over	9	485	100
Total	200	100	

Source - primary data

From the above table its clear that most of the people from Pangani estate earns between 10,000 and 15,000 and few earn above 25,000. 64% of people in Pangani earn a salary of less than 10,000. This is why the Kenya Bureau of Statistics has classified Pangani estate as middle income area, which its range starts from 8,000 to 20,000 incomes per person.

4 2.2 **Education**

Education is an important social indicator of development. In this study it was included as a variable that affect household WTP for improved waste management.

The table below shows the summary of the level of frequency among the interviewed persons

Table 4.2.2 Education level of the respondents

Level	Frequency	percent	Cumulative perc
Primary	3	1 5	185
Secondary	57	28 5	30.0
Collage	81	40.5	70.5
University	59	29.5	100
Total	200	100	

Source –primary data

The table above shows that most of the people from Pangani estate (40.5%) have attained college level education. This means that most of those people are educated. 29% have got University education and 28.5% have secondary education. Only 1.5% of Pangani residents has primary education. This shows that people in Pangani estates are highly educated.

4.2.3 **Family size**

Table 4.2.3 Family size of the respondents

No. in hse hold	Frequency	percentage	Cumulative perc.
1	33	16.5	16.5
2	47	23.5	40
3	50	25	65.0
4	47	23.5	88.5
5	19	9.5	98.0
6	1	1	98.5
7	3	1.5	100
Total	200	100	

Source-primary data

Most of the interviewed households have a family size of 3 persons, which represents 25%. Others have 2 persons which represents 23.5%, 4 persons which also presents 23.5%, 11.5% have a family size of more than 5 persons. By any standard the family size is small confirming nucleated family set up among Pangani residents. This is probably because most of these residents are working people and are not living with their families.

4 2 4 **Age**

Table4.2.4 summary of age level of the respondents

No of years	Frequency	Percent	Cumulative percent
19	3	1.5	3
20	5	2.5	4
21	5	2.5	6.5
22	6	3	9.5
23	15	7.5	17
24	13	6.5	23.5
25	24	12	35.5
26	4	7	42.5
27	10	5	47.5
28	6	3	50.5
29	17	3.5	54
30	15	7.5	61.5
31	5	2.5	64
32	7	3.5	67.5
33	1	0.5	67
34	5	2.5	68
35	12	6	70.5
36	9	4.5	76.5
37	5	2.5	81
38	8	4	83.5
39	6	3	87.5
40	5	2.5	90.5
41	1	0.5	93
42	2	1	93.5
43	3	1.5	94.5
45	5	2.5	96
46	1.	0.5	98.5
47	1	0.5	99
50	1	0.5	99.5
TOTAL	200	100	100

Source- primary data

Age was included because it is an important variable in determining an individual decision-making, and hence households willingness to pay towards improved solid waste management. The table above shows a summary of the level of age among the intervened persons.

From the above table most of the respondents had an age of 25 years which represented 12 percent. The maximum age was 50 years while the minimum age was 19 years. We avoided interviewing respondents' below18 years because we considered them immature to make rational decision more than 90 percent of the respondents were below 40 years, this may be because most of them are working people.

4 2 5 **Gender**

Gender is also a variable that determines wtp of an individual. Among the interviewed households, 52.5% represented the female and 47.5 represented the male.

Table 4.2.5 Gender of the respondents

Gender	Frequency	percent	Cumulative percent
Female	105	52.5	52.5
Male	95	47.5	100
Total	200	100	

Source primary data

According to the above results the number of female are more than for male 52.5 percent of the respondent were female while 47 5 percent represented the males. The number of female was more probably because the males are not mostly in their houses and hence the interviewed percentage is smaller than for female.

4 2 6 **Marital status**

In this study marital status was an important factor that was considered to affect willingness to pay and therefore it was included. The table below shows the summary of married and non-married persons that were interviewed.

Table 4.2.6 Marital status of the respondents

Marital status	Frequency	percent	Cumulative
Single	99	49.5	49.5
Married	101	50.5	100
Total	200	100	

Source- primary data

From the above graph 50.5% interviewed persons were married and 49.5% were single. This shows that the estate is lived mostly by married people.

4.2.7 **Home ownership**

In this study we considered home ownership as a major factor that determines the willingness to pay for improved waste management. The table below shows the summary of frequency of rented and owned houses in Pangani estate.

Table 4.2.7Home ownership of the respondents

Type of hse	Frequency	percent	Cumulative percent
Owned(1)	22	11	11
Rented(0)	178	89	100
Total	200	100	

Source-Primary data

From the above table it's clear that 89% of the residence of Pangani estate have rented the houses. This means that most of the owners of the houses don't live in their houses but

they have rented them. The owners occupy only 11% of the houses and this is a small percentage comparatively.

4.3 Nature of waste management in pangani.

Solid waste management in Pangani estate is done by private provider and city council, the residence pays a small fee for the service, however some of the household in Pangani do not pay any fees and hence they dispose their solid waste along the street and others as garbage heap. Most of the private provider charges a small fee of ksh 80 on each house hold per month but disposals are not done as regularly as they are required. The table below shows the summary of how they currently dispose their waste. From the table below its clear that 52.5% of the households disposes their solid waste through the private collection provider.

Table 4.3.1 Service provider of solid waste management at pangani estate

Service provider	Frequency	Percent	Cum.percent
City-council	44	22	22
Private firms	105	52.5	74.5
Garbage heap	48	24	98.5
Street	3	1.5	100
Total	200	100	

Source-primary data

These private firms that collect solid waste in the estate do it very irregularly. Some of them collect the solid waste once per month and others after every 2 weeks. This means Pangani estate generates more solid waste than it's collected

From the above table 22% of the residence disposes these solid waste through the city council. The city council charges a smaller fee, shs.50 per household but it does a shoddy

job. It collects the waste sometimes even after two month. All of those households who use city council in collection of their solid waste are not satisfied with the service.

24 5% and 1.5% of the other household disposes these solid waste on garbage heap and streets respectively. This is enough percentage to make the estate dirty. Some of the solid wastes are hazardous in context e g. broken bottles, clinic or hospital wastes etc. other solid waste are mainly plastic and vegetable matter with very limited recycling and composting waste.

Even after above waste disposal most of the households are not satisfied with the existing term of waste disposal.

Table 4.3.2 level of satisfaction

Satisfied	Frequency	percent	Cumulative percent.
No	149	70.5	70.5
Yes	59	29.5	100
Total	200	100	

Source -Primary data

From the above table its clear that 70% of the residence are not satisfied with the current disposal services, there are mainly those who deposits there waste a long the streets, garbage heap and also the city council collection.

30% of the residence are satisfied with the current waste disposal services. These are mostly the households who dispose their solid through private providers. Those who disposes along the streets and garbage heap and are not willing to pay any fee said that they are satisfied

Table 4.3.3 willing improved service

Improve service	Frequency	percent	Cum.percent
Yes	199	99.5	99.5
No	1	0.5	100

Source-Primary data

Even though 30% of the residence are satisfied with the current waste disposal services and 70% are not satisfied, almost all of them need an improved services that is 99.5% and 0.5% do not need any improvement.

Table 4.3.4 willingness to pay for the improved service

Willing to pay	Frequency	Percent	Cum. percent
No	18	9	9
Yes	182	91	100
T0tal	200	100	

Source Primary data

However, it's only 91.0% want to pay for the improved services and, 9% do not want to pay for it most of those interviewed who do not want to pay for the service believe that, its work of the government to dispose all the waste Others had a reason that they do not have money to do so.

4.3.4 Willingness to pay for the improved solid waste management.

Willingness to pay (wtp) for solid waste management was one of the main variables under investigation. Wtp was considered as a price, which was a function of improved environmental conditions to be enjoyed by the residents. The improvements of solid waste services were considered as a proxy for quantities of the good and/or amenities to be consumed or enjoyed. Wtp for disposal improvements was captured using a direct

elicitation of yes-or-no and direct bidding method that was captured in section C of the were told the effect of the solid wastes and the government could improve questionnaire. Respondents the services through the city council if only residents generate extra funds. This set a reason for payment for the service. After the contingent market was made explicit, the households were asked the maximum amount of money that would be willing to pay for the improvement of solid waste disposal services. The results of the descriptive statistics of the WTP are summarized in the table below.

Table 4.3.5 Amount paid by the respondents

Amount Kshs.	Frequency	Percent	Cumulative percent.
00	18	9	9
20	4	2	11
30	10	5	16
35	2	1	17
40	5	2.5	19.5
50	9	4.5	24
60	3	11.5	25.5
70	4	2	27.5
80	4	2	29.5
90	9	4.5	34
100	22	11	45
120	14	7	52
125	7	4.5	55.5
130	20	10	65.5
134	1	.5	66
140	11	5.5	71.5
145	1	.5	72
149	1	.5	72.5
150	17	8.5	81
160	3	1.5	82.5
165	1	.5	83
170	2	1.0	84
180	3	1.5	85.5
190	3	1.5	87
200	22	11	98
225	1	.5	98.5
240	2	1	99.5
250	1	.5	100
Total	200	100	

Source- primary data

From the above table 9% of the residence were not willing to pay anything (0 bid). 91% were willing to pay in the direct bid method. Majorities of respondents were willing to pay Kshs.100 per month 22% and also Kshs.200, which is 22%. This is higher considering the current figure that is paid of Sh.80. the highest monthly WTP bid is Kshs.250 whereas the minimum bid is zero. The average monthly bid is Kshs.110.25, which is fairly above the average currently level of Kshs.80.

Table 4.3.6 respondent willing to pay

	Frequency	Percent	Valid percent	Cum. percent
Yes	18	9	9	9
No	182	91	91	100
Total	200	100	100	

Source primary data

Using the yes-or-no direct elicitation method, 182 persons responded "Yes" (i.e. were willing to pay) for improved solid waste management, this represents 91% and 18 persons responded 'No' which represents 9% Individuals who had very low bids were either from households whose monthly income against their family size were very low relative to the monthly income and believed that the authorities should solve the problem in question.

Statistical summary of some of variables

Table 4.3.7 some statistical variables

Variable	N	MEAN	MEDIAN	MINIMUM	MAXIMUM
Age	200	29.72	28	19	50
Family size	200	3	3	1	7
WTP	200	110.06	120	00	250
Income	200	3.08	3	00	6

Source-Primary data

4.4 Regression analysis

Several variables were regressed against willingness to pay, these variables are:

Wtp – Willingness to pay for improved solid management.

y - Monthly income

Fs - Family size

ag - Age of the respondents

Ed - Education level of the respondent

ar -Individual ranking

Dummy variables

ge - gender of the respondent (1 = male, 0 = female).

mg - Marital status (1 = married, 0 = Single)

at - Health attitude (1 = Yes, 0 = No)

ho - House ownership (1 = owned, 0 = rented).

4.5 OLS Estimates results for WTP model for improved solid waste disposal management.

In this study we regressed willingness to pay for improved solid waste management against other explanatory variables that affect WTP. These included social-economic, demographic and environmental attributes. We adopted a multiplicative model and the results are presented in the table below.

Tabl 4 5.1 Ordinary least square results

source	SS	df	MS	Number of obs =	182
			F(9, 172) =	13.15	
Model	24.6866075	9	2.74295639	Prob > F	= 0.0000
Residual	35.8769283	172	.208586793	R-squared	= 0.6076
			Adj R-squared =	0.5766	
Total	60.5635359	181	.334605171	Root MSE	= .65671

wtp	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
y	.5030808	.0789687	0.371	0.000	.3472084	.6589533
lag	.2872739	.0976658	0.0941	0.004	.0944961	4800516
led	.1163896	.1272705	0.0915	0.362	-.1348234	.3676027
lat	.3607841	.6783644	0.532	0.596	-.978207	1 699775
lge	.1811343	.1037235	1.746	0.083	-.0236005	.3858691
lar	-.1680609	.1005457	-1.671	0.096	-.3665233	0304015
lmg	-.0458289	.1061281	-0.432	0.666	-.2553102	1636523
lfs	.2157559	.0743707	0.090	0.004	.0689592	3625525
lho	.013153	.155533	0.085	0.933	-.2938462	.3201521
_cons	2.818538	.3536709	7.969	0.000	2.120444	3.516632

Source- primary data

The models from above results is **WTP= 2.81 +0.50y+0.28ag+0.12ed+0.36at+0.18ge-0.16r-0.045mg+0.22fs+0.13ho**

Most of the variables have the expected sign except for individual ranking of improved solid waste management. According to the above results income has a coefficient of 0.503 which is the highest value. This means that keeping other factors constant, increasing the income by 1 unit will increase the willingness to pay for solid waste management by 0.50. From above confidence level of 95% , we can see that income is significant. This means that income is an important factor that determines wtp and by increasing income expected willingness to pay also increases.

Education level has also a positive coefficient and its significant at 5% significant level It has a coefficient of 0.12, this means that increasing education by one level increases willingness to pay by 0.12. This is probably because people who are more educated are aware of the dangers of the solid wastes and hence are willing to pay than less educated people.

Family size has the expected positive coefficient, which implies that the expected willingness to pay for solid waste management increases by 0.22 as the family size increase by 1 person. The coefficient also is significant at 5% significant level. Also those who rank the need for improved solid waste disposal services as a priority are willing to pay more than those who do not consider a cleaner environment as a priority, however the coefficient of individual rank is not significant at 5% significant level. This means that individual ranking is not a major factor that determines expected willingness to pay.

Women theoretically are expected to pay more than men do because it's assumed that they bear the burden of sick children as result of poor environment. The above results shows that men are willing to pay more than women, this may be contributed by the fact that most of the women were assuming that paying for a cleaner environment is the role of men. And also most women in Nairobi are dependent of men and hence they were less willing to pay than men. The gender variable is significant at 5% level of significant meaning that it's a major determinant of expected willingness to pay.

Also from the above results single people are willing to pay more than married people, this is wrong theoretically because married people will bear more the consequence of bad environment than single people. It's therefore expected that married people should be willing to pay more than singles people.

Also from above results a married person is expected to pay 0.045 of a shilling per month less than a single person. This theoretically is not correct because a married person is expected to pay more than a single person. But the above scenario can also be contributed by the fact that a married person has a lot of expenses than a single person hence meant to minimize his expenses by paying less to improved solid waste management. However the marital status variable is not significant at 5% significant level this means that it is not an important factor in determining expected willingness to pay.

From the results those people who own houses are expected to pay 0.013 of a shilling more than the ones who have rented the houses. The variable is also significant at 5% significant level and hence important factor in determining expected willingness to pay.

The coefficient of age has the expected positive sign and also its significant at 5% level of significant this means that willingness to pay is affected by age. From the above results age has a coefficient of 0.287, which shows that increasing the age by 1 year also increases expected willingness to pay by 29 cents, cetris -peribus.

The intercept for the regression bears a positive coefficient and its significant at 5% level. This means that if all the explanatory variables are set to zero, wtp is positive. that in people are willing to pay for improved waste management regardless of all the other factors that determine wtp.

According to the model 57.78% of the variables in the model are explained by the independent variables included in the model.

In this study most of the explanatory variables are significant at 5% thus they have an influence on willingness to pay, these variables include income, education, health attitude,

home ownership etc. The insignificant variables include gender, individual ranking and marital status.

Overall, the existence of the correct signs for most of the explanatory variables is consistence with economic theory specified a priori and other empirical studies (Behaji 1996, Deffal 1997).

4.6 Probit results for improved waste management

Probit model was used in this study. The probit equation was used to relate the probability of yes' and 'no' answers to each suggested amount must be estimated

From the theoretical model it was assumed that P = 1 and 0=otherwise We also assumed that probability of a positive wtp response was also a dependent of social economic, demographic and environmental factors. The results are represented below.

Table 4.6.1 Probit results forsolid waste management

Probit estimates Number of obs = 200

LR chi2(9) = 39.54

Prob > chi2 = 0.0000

Log likelihood = -40.738106 Pseudo R2 = 0.6267

wtp	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
y	.1897726	.1387576	0.368	0.171	-.0821872	.4617325
ag	.0511818	.0269352	0.090	0.057	-.0016102	.1039737
fs	.0549551	.1132532	0.485	0.628	-.1670171	.2769273
ed	.1224362	.1854819	- 0.166	0.509	-.485974	.2411016
at	-1.644626	.742643	0.215	0.027	-3.100179	.1890723
ge	.8496313	.3945398	0.153	0.031	.0763474	1.622915
ar	-.5238563	.2783836	-1.882	0.060	-1.069478	.0217656
mg	-.0126012	.3490385	-0.036	0.971	-.6967041	.6715017
ho	.5691497	.745028	0.764	0.445	-.8910784	2.029378
cons	.4976553	1.474063	0.338	0.736	-2.391456	3.386766

Source-Primary data

According to the above results, income variable has the expected theoretical sign i.e. positive. It has a coefficient of 0.1898, this means that an increase of income by 1 shilling will increase the probability of expected willingness to pay by 0.18 The coefficient in is significant at 5%, this means that income is one of the factors that determines the probability of willingness to pay.

Age is also a variable that is used in this study, the result shows as age increases the probability of willingness to pay also increases. This is because older people are conscious of the environment they live in, and hence they are willing to pay more, from the results increasing the age by 1 year increases the expected probability of willingness to pay by 0.05. The coefficient is also significant at 5% level meaning that age is a factor that determines probability of wtp

The variable family size has a positive sign and is significant at 5% level. It has a coefficient of 0.054, implying that an increase of family size by 1 person also increases the probability of wtp by 0.054 However as postulated from the results the family size variable does not have a significant positive influence on the probability of willingness to pay

Education is having the correct theoretical expected sign, which is positive. The result shows that education influences probability of wtp positively. A more educated individual by one level increases the probability of willingness to pay for solid waste management by 0.12. The coefficient is also significant at 5% level.

To be married reduces the probability of wtp by 0.2234, this is contrary to the expected sign which is positive. The variable is also significant at 5% levels, this means that it's an important factor that determines probability of willingness to pay.

From the model, it is evident that to be a male impacts positively on the probability of wtp. This means that the probability of wtp increases with men than women e.g. to be a man increases the probability by 0.85 and this coefficient is significant at 5% level. This is

contrary to the fact that women bear the brunt of the problem of solid wastes in and around homestead as mostly stay at home. This is inconsistent with other studies which posit that most families women are caretakers of home (Ndimba, 1999). They are responsible for construction and maintenance of solid waste cleanliness.

Finally the probability of WTP for improved solid waste management is increased by 0 57 by owning a house. The results shows that those who own houses have higher probability of paying. This is probably because, a person with his/her house is more conscious of their surrounding than those who have rented a house.

4.7 Correlation Analysis

In our study to signal a spurious regression results important that the data is subjected to some diagnostic statistical tests such as correlation analysis between and among the explanatory variables.

Table 4.7.1 correlation analysis results

corr y ag fs ed at ge ar ho

(obs=200)

	y	ag	fs	ed	at	ge	ar
y	1.0000						
ag	0.3918	1.0000					
fs	0.1954	0.3458	1.0000				
ed	0.1135	0.0703	0.0362	1.0000			
at	-0.1291	-0.0245	-0.0879	0.1642	1.0000		
ge	0.2662	0.1623	0.1483	0.0388	-0.1683	1.0000	
ar	0.0266	-0.0374	-0.0289	-0.0025	0.2218	-0.1236	1.0000
ho	0.0387	0.0797	0.1245	0.1087	0.0461	.00464	-0.0232

Source primary data

According to the above results income is the highest positively correlated variable with age. It has a coefficient of 0.3918. This means that an increase of one year increases the income of a person by 0.3918, hence older people have higher income than young people. Other positively correlated variables include family size and income, family size and age, education and income, education and age, etc.

Also some variables have highly negative correlation, these includes marital status and age, marital status and income and marital status with education. However using the thumb rule (Gujarati 1995), we conclude that there is no significant correlation between the explanatory variables as there correlation coefficients are less than the cut-off mark of ± 0.5 and hence correlation was not a major problem and is therefore envisaged not to affect the results.

4.8 Hypothesis testing

The first hypothesis tested was whether income of the respondent does not influence the WTP, against the alternative hypothesis that it does. From results of OLS from table 4.41, the coefficient of income is 0.50 and its highly significant at 5% significant level. We therefore reject that null hypothesis and conclude that income influences wtp

Hypothesis two was that education level of an individual does not influence his WTP against the alternative one that its does. From the results on table 4.41 education has coefficient of 0.12 and its highly significant at 5% level, therefore we reject the null hypothesis and conclude that education level influence WTP.

Hypothesis three was that an improved waste disposal service is not dependent on individual marital status against the alternative that it does. From our results its clear that individual marital status is significant at 5% significant level. We therefore reject the null hypothesis and conclude that individual marital status influences wtp.

Hypothesis four was that age does not influence WTP against the alternative that it does And from our results in table 4 41, the coefficient of age is 0.287 and it's highly significant at 5% level. This means that we reject the null hypothesis and conclude that age do influence the willingness to pay for improved solid waste management.

Hypothesis five was that the size of the household does not influence WTP against that it does. The coefficient of the family size from above table is 0.22 and it's highly significant at 5%. This means that we reject the null hypothesis and conclude that family size do influence the willingness to pay.

Hypothesis six was that improved services are of higher priority compared to other problems against that its not. From the results from table 4.41 it's clear that individual ranking has coefficient. Of -0.16 and its not significant at 5%level. This means that we accept the null hypothesis and conclude that improved services do not influence wtp.

Hypothesis seven was that gender does not influence wtp against that, it does. From our results we accept the null hypothesis and conclude that gender does not influence wtp.

Hypothesis eight was that health attitude does not influence wtp against that it does. From our results in table 4.41, health attitude has coefficient of 0.36 and its significant at 5% level, this means that we reject the null hypothesis and conclude that health attitude does influence wtp.

4.9 DISCUSSION OF RESULTS

The results of probit and OLS models have revealed important outcomes. Coefficient of most of all the variables had correct theoretical and empirically accepted signs. The existence of the correct sign consistent with economic theory is one of the criteria used to assess the goodness of a model A good model must be well specified based on economic theory. Therefore on strength of this we can say that the results were fairly plausible.

The study specified that willingness to pay was affected by social, economic, demographic and environmental factors. These factors that were specified influenced willingness to pay for solid waste management. Other related studies had found similar conclusions e.g. (Whittington et al 1992, Belhaj 1996. Rogat 1995).

The wtp bid that was given showed that household really considered quality environment as important. This showed that environmental quality is a normal good where more of it is demanded as income increases.

In OLS estimation all the variables had expected results except for gender. Women theoretically are expected to pay more than men because its assumed that they bear the burden of sick children as result of poor environment .The above results shows that men are willing to pay more than women , this may be contributed by the fact that most of the women were assuming that paying for a cleaner environment is the role of men. And also most women in Nairobi are dependent on men and hence they were less willing to pay than men. The gender variable is significant at 5% level of significant meaning that it's a major determinant of expected willingness to pay.

Also from the above results single people are willing to pay more than married people, this is wrong theoretically because married people will bear more the consequence of bad environment than single people. It's therefore expected that married people should be willing to pay more than single. But the above scenario can also be contributed by the fact that a married person has a lot of expenses than a single person hence meant to minimize his expenses by paying less to improved solid waste management. However the marital status variable is not significant at 5% significant level this means that it is not an important factor in determining expected willingness to pay.

Education level has also a positive coefficient and it's significant at 5% significant level. This means that increase in level of education increases the willingness to pay. This is probably because people who are more educated are aware of the dangers of the solid wastes and hence are willing to pay than less educated people.

Family size has the expected positive coefficient, this means that wtp increases as family size increases. The coefficient also is significant at 5% significant level.

Also those who rank the need for improved solid waste disposal services as a priority are willing to pay more than those who do not consider a cleaner environment as a priority, however the coefficient of individual rank is not significant at 5% significant level. This means that individual ranking is not a major factor that determines expected willingness to pay.

In probit estimation variables like gender, education and health attitude had negative influence to wtp, this is inconsistent with economic theory. All the other variables e.g. family size, income, age, etc had positive sign as expected.

CHAPTER FIVE

5.0 CONCLUSION AND POLICY RECOMMEDATIONS

5.1 Introduction

This chapter presents the finding of economics analysis of contingent valuation study on improved solid waste management in Nairobi. The study was done specifically in Pangani estate where the solid waste management has been poor. Generally the OLS and probit estimates shows that social- economic, demographic and environmental factors are important determinants of individual willingness to pay towards improvement of solid waste management.

5.2 Survey of the results

The survey data has shown that house hold are overwhelmingly dissatisfied with the existing solid disposal services and are responsiveness to public and private benefit of improved management. Also households viewed this improved service as priority and were willing to pay for it. From the econometric and descriptive analysis we can say that the application of contingent valuation methods and micro economic theory can assist in formulation of demand oriented environmental policies as regard solid waste disposal services and environmental services.

Given that the resident are willing to pay an average monthly fee of ksh 110 per household, it means that if Nairobi City council can properly manage the waste from this area it can collect approximately KSh 3.3 millions per month as revenue.

The significant economic values not withstanding, the estimated values of wtp should be regarded as approximations because they are not only contingent upon hypothetical market scenario presented to the resident, but also upon the statistical analysis. Although the wtp was overwhelmingly positive the mean wtp was a bit smaller, this can be because of

1) The low wtp is dependant on poverty among house holds and individuals .the reason being as income grows, people have more discretionary income and hence more scope for choice to the disposition of their income. From this study we can conclude that individuals with low income spends less towards an improvement in environmental quality.

2) The low wtp may have been motivated in some instances by strategic behavior of some residents who believed that the municipal council should solve the problem in question.

3) The low wtp bids was may be due to undesirable characteristic of households towards environmental goods such as that, they trade off environmental improvements for other private consumption

These reasons not withstanding the existence of a positive wtp among the residents indicates that there are true preferences for an improvement in the good in question.

5.3 Further suggestions

To properly manage the waste the government should think of ways to reduce the waste if not eliminated. The production of waste can be drastically reduced in many instances From our study the results shows that Nairobi waste constitute of food waste, papers and plastics as the main waste .The local government should design plants so that less waste should be produced thus plants will help in reusing or recycling such waste that is produced. There is no doubt that efforts to reduce and minimize waste can bring substantial dividends, not only is there a substantial financially inducement, but there is

also other benefit that cannot be estimated in direct monetary terms. If for instance the volume of waste produced was halved, the problems associated with its disposal will be halved.

5.4 Policy recommendations and directions for policy initiatives

This study focussed on the storage and frequency of collection of waste, by asking households their satisfaction with the existing service, thus policies aimed at improved solid waste should provide adequate solid waste storage facilities. The storage volume required for households waste is a function of number of premises served, rate of waste generation, household size and frequency of collection. Policies should also be geared towards ensuring frequent collection interval so as to avoid waste accumulation at the household level.

The city council should have explicit policies and laws necessary to discourage waste and encourage more recycling and research into alternative raw materials. Companies should not be left to draw up there own production guide lines which are dictated more by commercial interests rather than by moral or long-term environmental considerations.

Also the city council currently charges a flat tariff service charge to all area residents but it should charge progressive rate so that higher income earners pay more for the service. This would raise the revenue, which could be used to improve low-income areas, as these people cannot be able to pay for the service.

5.5 Limitations of the study

Specific limitation faced during the study include non-response, household even after identification still were reluctant to participate in the study. In addition house questioned the

questionnaire style, questions pertaining to household characteristics e.g. incomes, home ownership, family size and age were not important.

They argued that those questions had nothing to do with waste disposal practices, but in order to ensure completed questionnaire, the researcher explained why the study was being undertaken and the relationship between each questionnaire section. Its due to time and money constrain that only 200 respondent were interviewed, ideally larger sample would produce robust results. Despite these problems, households showed interest in study because they have experience with the service and were willing to provide information for the same. In additional the area was accessible from the city center

BIBLIOGRAPHY

Abala D (1987), "A Theoretical & Empirical investigation of willingness to pay for recreation services;" A case study of Nairobi National Park, East African Economic Review vol No. 2

Abebe and Kabende (1999), "Assessing awareness and practice of solid wastes in Pickfold John (1999) Integrated development of water and sanitation" 25th WEDC conference

Allen G (1992), "The information of binary responses," PhD dissertation, economic department, University of California, San Diego

Bartone C L., Luiz L. Thelma (1991), "Private Sector participation in Municipal solid waste services; Experiences in Latin America" Waste management and research 9: 495 – 509

Belhaj Mohammed (1996) "The willingness to pay to reduce air pollution." A CUM experiment E.E.U Gothenburg University, Sweden.

Buyene, G. (1999) "Managing solid wastes in Addis Ababa" in Pickford John 1999 Integrated development for water and sanitation, 25th WEDC conference

Carson R.N. Flores and W.M. Hanemann (1992) "On the creation and destruction of public goods, the matter of sequencing", Agricultural and resource economics UC Berkeley.

Coker A.O. and Sikiru K.A. (1999) "Characterization and management of solid hospital wastes"

Pickford John 1999 "Integrated development for water and sanitation", 25th WEDC conference.

Coleman R. (1985) "The economic of municipal solid waste." The World Bank research observe vol 10 No. 2

Des Vousage W.H (1992) "Option price estimates of water quality": A contingent valuation study for Mongahel river, journal of environmental economics & management 14 (3) p 248 – 267

Fullerton D. and Kinnamon T.C. (1993) "Garbage recycling and illicit burning or sampling national bureau of economics research" (N B E R)

Grishm R.G. (1986), "The solid waste problems of poor people in third world cities", in managing solid waste in developing countries" J.r. Holmes (ed) John Willey and sons.

Gujarat, D. N. (1988) "Basic Econometrics," Mc-Graw Hill New York, USA.

Hanemann J.A. (1994), "Contingent valuation and the value of marketed commodities" Amsterdam, elsevier Scince publisher B V.

Hanley W and Splash C.L. (1993), "Cost-benefit analysis and the environment." London Edward Elgar

Jorge R.A. (1995) "On the measurement of congestion in the provision of local public goods", Journal of urban economics Vol. 24 July pp 85 – 94

Loomis J.B. (1996) "Comparable reliability of the dichotomous choice & open ended contingent valuation techniques", Journal of environmental economics and management 18 (1) pp 78 – 85

MC Jadden D. (1974) "Conditional Logit Analysis of qualitative behavior" inzerembka P Frontiers of econometrics, Academic Press, New York.

Mugo D.G. (1995) "A theoretical and Empirical estimation of the willingness to pay for reduction in air pollution" : A case study of Zimmerman Estate, University of Nairobi M.A. Thesis (unpublished)

Olley J and Olbina R (1999) "Innovative solid waste management in China" In Pickford John 1999 Integrated development for water and sanitation, 25th WEDC conference

Omar B.D. (2002), "An economic analysis of improved environmental sanitation in Wajir town" M.A Thesis University of Nairobi

Osuocha C.P. (1998) "Improving refuge management in urban Nigeria", Pickford John 1999 Integrated development for water and sanitation, 25th WEDC conference

Parselelo K. (2000), "Nairobi dirty secrets" Eco-forum journal, environment liaison center international pp (11 – 14)

Pindy ck R.S and Rubinfield D.L. "Econometric Models and Economics forecast" : MC Grawhill International

Salequzzaman M.D, Sadique A, Mostafa (A 2000) "Willingness to pay for community based solid waste management & its sustainability in Bangladesh", Murdoch University Austria.

Schulze W.D. (1983) "Valuing environmental goods" A state of arts assessment of the contingent valuation method." Totawa, N.J. Rowland and Allan heed Publishers.

Sinden J. A. (1988) "Empirical test of hypothetical cases in consumer surplus surveys" Journal of Agricultural Economics Vol32, pp 98 – 112 Austria

Snel M (1999), "Social stigma and the waste collection scheme in Pickford" John 1999 Integrated development for water and sanitation, 25th WEDC conference

disposed properly and not left lying around in rubbish heaps which may create health problems.

16 Will you be interested?

Yes ☐

(ii) No ☐

17. If No, what are the main reasons?

Satisfied with the existing services. ☐

Services will not be available. ☐

Others (specify).....

Suppose the city council introduces this improved services aimed at improving the current solid waste disposal services in this area, what is the maximum amount would you be willing to pay as service per month for this improved service?

.....

THANK YOU FOR YOUR COOPERATION

Street ☐

Are you currently satisfied with the existing form of waste disposal service?

(i) Yes ☐

(ii) No ☐

How frequently are solid wastes collected in this area?

Once a week ☐

Others (specify) .....

Do you consider that uncollected solid waste within this area and other areas in Nairobi is harmful to your health?

(i) Yes ☐

(ii) No ☐

In relation to other needs e.g. food, security. water etc how would you rank the need for improved solid waste disposal services?

Very important ☐

Important ☐

Not important ☐

SECTION 3 Willingness to pay

Suppose a new improved waste disposal services is offered to residents in this area and other areas in Nairobi. The household will be provided with containers for waste storage where the disposed waste will be isolated to its components mainly organic waste, plastic and papers, glass and metals. The solid waste would be picked two times per week and

What is the level of your education?

Primary	☐	College	☐
Secondary	☐	University	☐

8. (a) What is your occupation? .....

(b) How much is your monthly income? (in K.Shs.) .....

0	-	5000	☐
5001	-	10,000	☐
10,001	-	15,000	☐
15,001	-	20,000	☐
20,001	-	25,000	☐
25,001 and Above			☐

9. Is this house?

Rented	☐
Owned	☐

SECTION 2 - Views on environmental quality

10. Is solid waste disposal a problem in this area?

Yes	☐
(ii) No	☐

11. How do you currently dispose off the household solid waste?

City council collection	☐
Private provider	☐
Garbage heap	☐

APPENDEX 1

QUESTIONNAIRE

How are you? I am a student of Nairobi University I am currently interviewing households in this area regarding the improvement of solid waste disposal services, and policy makers to make informal decisions will use your views. The answers are confidential and for my academic purpose only The interview will take a few minutes. Please answer these questions as truthfully as you can. Your cooperation will be highly appreciated

SECTION 1 - Household Characteristics

1. Name .....

2. Gender Male = 1 ☐
   Female = 0 ☐

3. Marital Status Married ☐
   Single ☐

4. How old are you? .....(Years)

5. Are you the household head? Yes = 1 ☐
   No = 0 ☐

How many are you in your household? ..... (No. of people)

Tulyenge A.W. (2002) "Willingness to pay for air pollution control." A case study of Webuye town and its environments in Kenya. M.A. research paper University of Nairobi (unpublished.)

Walingo A.N. (1995) "Valuation of forest recreation" A case study of Karura forest M.A. research paper University of Nairobi.

Whittington D D T, Lauria and smul (1991), "Water vending and willingness to pay for improved sanitation in Kumasi" A CVM study in E W. Crawford, Oxford University Press

Wynnen (1987), "Estimating the willingness to pay for water services countries": A case study in Haiti. Economic Development and cultural change vol 38 no2

Varian (1987) "Intermediate Micro-economics" A modern approach, W W. Norton and co New York.