The Impact of an Environmental Disamenity on the Value of Land in Central Uganda

by

Assoc.Prof. Bernard Bashaasha
Department of Agricultural Economics & Agribusiness,
Makerere University
bashaasha@agric.mak.ac.ug or aspsmuk@infocom.co.ug

Collaborator: Ms Rosemary Emegu Isoto
Department of Agricultural Economics & Agribusiness,
Makerere University
emegur@yahoo.com or rosem@agric.mak.ac.ug[1]

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Abstract

The purpose of this research is to quantify the land-value impacts of proximity to a landfill as an environmental disamenity using the hedonic price model. The study combined elements of the attributes of the property, neighbourhood characteristics and distance from landfill as explanatory variables. Land price was used as the dependent variable. Marginal willingness to pay for an extra unit of distance (metre) away from the landfill was derived as the key policy variable. The findings in this study have indicated that proximity to the landfill negatively affects land value. Moreover, marginal willingness to pay for an extra unit of distance away from the landfill revealed that people are willing to pay more to live far away from the landfill. On the other hand amenities such as accessibility to public transport and city centre positively influence land values.

The study therefore recommends that a concrete policy on location and management of the landfills and waste recycling policies be enacted. Again, the concerned authorities need to ensure proper management of the landfill in terms of covering the garbage with soil and proper compaction be done. This study has also demonstrated that the hedonic price model can be used in a developing country such as Uganda.

Introduction

1.1 Background

Land is the most valuable natural resource and plays a critical role in economic development especially in developing countries. However, the usefulness and value of land can be influenced by several factors including environmental factors such as amenities and disamenities. These determine the willingness of the people to purchase and stay on a piece of land. Households take into consideration environmental factors, for example, disamenities existing on a given parcel of land in order to attach value to that land.

Disamenity is usually associated with the localised impacts of a site activity that generates negative reactions from those located in the immediate vicinity of that site. Christen Ostenfeld and Wriborg Jønson (COWI, 2000) specify disamenity impact as referring to the 'nuisance' caused locally as a result of the presence of landfill, airports and high traffic road ways, among others. It can be characterised by noise, dust, litter, odour, presence of vermin, visual intrusion and enhanced perceptions of risk.

The city of Kampala, which is the only urban city in Uganda, is one of the 104 districts of Uganda. It covers an area of approximately 176 square km and is surrounded by Wakiso District where a significant part of Kampala's day-time population resides. The population of Kampala was 774,241 at the 1991 census. Provisional results of the 2002 census, which is the most recent statistics available, put the night time population of Kampala at 1,208,544, indicating a growth rate of 4.13% per annum over the past 11 years. Recent projections put the population at 1,502,917 persons in 2007. Kampala city is administered by Kampala City Council (KCC). The average household size in the city is 4 persons and the per capita income is estimated at US$ 300 per annum (UBOS, 2002). Naturally, such a high urban population generates a significant amount of solid waste. These wastes include those from households, non-hazardous solid waste from industrial activities, commercial construction and institutional establishments (including hospitals, schools), market waste and street sweepings. It has been estimated that solid waste of approximately one kg per capita per day is generated in Kampala city and the collected wastes are dumped at selected locations within the district one of which is Kiteezi. A landfill located at Kiteezi generates enormous disamenity problems for the surrounding residents, which includes noise by trucks that come to offload the waste and odour from the decomposing waste.Table 1: shows trends of waste generation and waste management in Kampala city.

Table 1: Waste generation and waste management in Kampala City 1969 – 2007

Year	Population	Average monthly refuse generation (tons)	Number of refuse trucks available	Number of refuse containers (entire city)	Average quantity of waste collected (tons/month)	Percent coverage	Disposal method used
1969	330,700	8,929	12	Unknown	7,000	78	Unknown
1980	458,503	13,755	10	Unknown	Unknown	-----	Open dumping
1991	774,241	26,000	9	320	3,500	13	Open dumping
2002	1,208,544	36,256	20	500	14,000	39	land filling
2003	1,300,000	36,500	30	500	13,524	37	land filling
2004	1,400,000	38,000	30	500	15,643	41	land filling
2005	1,490,000	40,000	30	500	14,094	35	land filling
2006	1,500,000	42,000	40	500	14,256	34	land filling
2007	1,502,917	48,000	50	500	16,724	35	land filling

Source: Kampala City Council, Project Evaluation Report, August 2008.

The increasing refuse generation trends can be attributed to population growth, the continued consumption of unprocessed foodstuffs, peoples' feeding habits, increased usage of polythene bags, and lack of recycling and waste reduction strategies. As indicated in Table 1, currently, about 35% of the generated waste can be collected and transported to the landfill site. Until 1996, KCC used to dump waste openly at various locations such as Busega, Kinawataka, Bukoto, Wakaliga and Luzira, among others. Since 1996, all municipal solid waste collected in Kampala is disposed of by land filling, which is the cheapest method of municipal waste disposal. Although the change of the method of refuse disposal from open dumping to landfill signifies some improvement, a landfill has its own problems. These include odour generated by the waste, unpleasant sights, flies and other vermins, water contamination from seepage and the resultant loss in the value of property in its proximity.

Studies by Boyle and Kiel (2001) have showed negative impacts on property values from landfills, airports and high-traffic roadways. Brisson and Pearce (1995) have also reviewed several studies that estimate the impact from hazardous and municipal waste facilities. These studies show that municipal waste landfills, airports and high-traffic roadways can have localized negative effects on property values like houses and land, among others.

The waste stream generated in Kampala city is estimated to be predominantly organic (70-80%) while the rest is inorganic material such as glass, paper, metals, construction and demolition waste. The percentage composition of each component is as follows; vegetable matter is 73.8%, tree cuttings 8.0%, street debris is 5.5%, paper is 5.4%, metal is 3.1%, saw dust is 1.7%, plastic is 1.6%, and glass is 0.6%. About 10 percent of the collected waste could be recycled but, currently, no waste recycling is done by KCC.

However, the informal private sector salvages some recyclable items from the waste that is delivered to the landfill. This operation is controlled by the site management. Although an estimated one tonne of waste comprising mainly of waste paper, scrap metals, cardboards, and plastics is salvaged each day, this is negligible compared to the total waste generated, hence more needs to be done.

1.2 Problem Statement

Waste management is fast becoming a necessity rather than a luxury in developing countries due to the potential threats that improper waste disposal imposes on human health, the natural resource base of the earth and urban productivity. It is a complex task that requires appropriate organisational capacity and co-operation among various stakeholders in the private and public sectors. The city of Kampala, which is the only urban city in Uganda, is estimated to be generating over 48,000 tonnes of waste annually. Out of this figure, about 16,724 constituting 35% are collected and disposed off in a landfill. Although the use of landfill constitutes an improvement on hitherto open dumping method, the process of trucking, dumping, filling, sorting and operation of heavy equipment generates some environmental externalities. These externalities include noise and air pollution, and unpleasant sights as well as pollution of surface and underground water through seepage.

In order to estimate the environmental cost of the use of the landfill as a waste management policy option in Kampala, this research employs the hedonic pricing method that deals with property values. This method hypothesises that, after controlling for all other physical characteristics of say residential property, the marginal differences in property values (marginal willingness to pay) could be attributed to the proximity of the property to an environmental disamenity (e.g. noise or pollution) or amenity. Thus, in their search for sites for housing, families tend to equate landfill proximity with diminished environmental quality or quality of life (Arthur et al., 1992). To the best of our knowledge, no study exists on the impact of proximity of landfills on the value of land in Uganda making benefit transfers with regards to this problem very difficult. As a result, the KCC and as well as other countries in the region will benefit a great deal from the findings of this research.

1.3 Objectives of the study

The general objective of this study is to investigate the impact of the Kiteezi landfill on the value of land located in the surrounding area. The specific objectives are:

1. To characterise land and other property located in the Kiteezi area.
2. To quantify the influence of the landfill disamenity and other factors on the value of land in Kiteezi area.
3. To estimate the Marginal Willingness to Pay (MWTP) for an extra unit of distance away from the landfill.
4. To generate policy recommendations to guide the future location of landfills by KCC authorities.

1.4 Significance of the study

Kampala city is facing a lot of difficulties in managing the ever increasing amounts of solid waste generated by its urban population. To address this challenge, the KCC has adopted a sanitary landfill as an improved waste disposal strategy compared to the open dumping, which existed prior to this development. However the location, operation and management of a landfill imposes some environmental costs on surrounding properties. These include bad smells and noise from refuse trucks. Hence this study is timely as it addresses the impact of the manner of waste disposal on the value of land near Kiteezi landfill. The main output will be the marginal willingness to pay for an extra unit of distance away from the Kiteezi landfill and therefore putting a figure to the cost of the environmental disamenity resulting from the landfill. This will help the KCC to decide on alternative waste management policies or evaluate the potential benefits obtainable from improving the current state of the landfill. Moreover, this research will help policy makers to decide on the location of additional landfills in the future. The proposed study will therefore provide invaluable inputs into this policy decision process.

1.5 Scope of the study

This study was limited to Lusanja and Kitetika local councils (LCs) in Wakiso district, areas that were established through pilot/ preliminary visits to be affected most by the presence of the Kiteezi landfill.

2.0 Literature Review

2.1 Landfills

A landfill, also known as a dump, is a site for the disposal of waste materials by burial and is the oldest form of waste treatment. Historically, landfills have been the most common methods of organized waste disposal and remain so in many places around the world. There are different types of landfills, for example: hazardous waste landfill, sanitary landfills, inert waste landfill and open dumps. The open dump approach is the primitive stage of landfill development and remains the predominant waste disposal option in most of the developing countries. A default strategy for municipal solid waste management, open dumps involve indiscriminate disposal of waste and limited measures to control operations, including those related to the environmental effects of landfills. An operated or semi-controlled dump is often the first stage in a country's efforts to upgrade landfills. Controlled dumps operate with some form of inspection and recording of in-coming wastes, practice extensive compaction of waste, and control the tipping front and the application of soil cover. Operated dumps, however, implement only limited measures to mitigate other environmental impacts. Operated dumps still practice unmanaged contaminant release and do not take into account environmental cautionary measures such as leachate and landfill gas management.

As cities grow and produce more waste and their solid waste collection systems become more efficient, the environmental impact from open dumps becomes increasingly intolerable. The conversion of open or operated dumps to engineered landfills and sanitary landfills is an essential step to avoid future costs from present mismanagement. Therefore the first step and challenge in upgrading open dumps to sanitary landfills involves reducing nuisances such as odors, dust, vermin, and birds. The term sanitary landfill is generally used for landfills that engage in waste compaction and apply daily soil cover to reduce nuisances. In many cases, however, as much as 50% of the operational budget is consumed on daily cover. To the extent that soil cover is required to limit vermin, odors, and flies, limited and not daily application is recommended (Hjelmar *et al*., 1994).

Based on the experiences gained through visits to over 50 final disposal landfills in Asia, Latin America and Africa, Lars and Boyer (1999), observed that there are several categories of landfills in these regions but medium and long-term environmental effects of solid waste management are not well known in the three regions. For example the Kiteezi sanitary landfill site that receives solid wastes from the city of Kampala is not well located as it is close to a residential area (<200 m) and cattle farms (Mwiganga and Kansiime, 2005). It is also located upstream of a wetland. The landfill generates nuisances like bad odor; there is scattering of waste by scavenger birds, flies and vermin. Industrial and hospital wastes are disposed of at the landfill without pre-treatment. The concentration of variables (nutrients, bacteriological indicators, and heavy metals) in the leachate is higher than those recommended in the National Environment Standards for Discharge of Effluent into Water and on Land.

2.2 The Hedonic Price Model

According to Triplett (1986), hedonic methods were developed and employed in price indices, long before their conceptual framework was understood. Bartik (1987) claimed that the first formal contributions to hedonic price theory were those made by Court (1941), although there were other informal studies. For instance, Colwell and Dilmore (1999) mentioned that Harrison (1978) produced a hedonic study more than 15 years prior to Court, who first published the term "hedonic." Etymologically, the term "hedonics" is derived from the Greek word *hedonikos*, which simply means pleasure. In the economic context, it refers to the utility or satisfaction one derives through the consumption of goods and services.

Two main approaches contributed greatly towards the theoretical work on hedonic prices. The first approach was derived from Lancaster's (1966) consumer theory, and the second comes from the model postulated by Rosen (1974). Both of these approaches aimed to impute prices of attributes based on the relationship between the observed prices of differentiated products and the number of attributes associated with these products.

According to Butler (1982), since all estimates of hedonic price models are to some extent misspecified, models that use a small number of key variables generally would suffice. Butler suggested that only those attributes that are costly to produce and yield utility be considered in the regression equation. Mok *et al*., (1995) concurred that biases due to missing variables are small, and have negligible prediction and explanatory power on the equation. A practical solution to the problem of missing variables, which may cause bias in the estimated coefficients, is to ensure that the data set used is homogeneous. When there is homogeneity, the use of the hedonic price approach is justified.

Many studies have used hedonic pricing models to analyze the effects of open space on residential property values (Cheshire and Sheppard 1995, Garrod and Willis 1992). However, results from these studies are mixed due to different kinds of open space considered, specification of the open space variables, and differences across study regions.

The hedonic price model only works under the assumption of market equilibrium, and that there are no interrelationships between the implicit prices of attributes (Dusse & Jones, 1998). Market equilibrium is not plausible because there are imperfections in the real world property market. It is idealistic to assume that the price vector will adjust instantaneously to changes in either demand or supply at any point in time. The notion that there are no interrelationships between the implicit prices of attributes is also fallacious because it implies that the implicit price of an attribute does not vary throughout all areas and property types. It is not necessarily true that all attributes will give the same level of utility or identical levels of disutility to all buyers.

Despite these disputable assumptions, which involve substantial simplification and abstraction from a complex reality, the hedonic price model has been deployed extensively in environmental research (Chau et al., 2001; Freeman, 1979; Leggett & Bockstael, 2000). As astutely observed by Freeman, the data may be inadequate; variables are measured with error; and the definitions of empirical variables are seldom precise, but these do not render the technique invalid for empirical purposes.

The hedonic price approach does have its merits. Its main advantage is that one only needs to have certain information, such as the property price, the composition of land attributes, and a proper specification of the functional relationships. The marginal attribute prices are obtained by estimating the parameters of the hedonic price function. It is a straightforward approach because only the coefficients of the estimated hedonic regression are needed to indicate the preference structure.

Residential properties are multidimensional commodities characterized by durability, structural inflexibility, and spatial fixity (Chau et al., 2001; So et al., 1996). A review of extant literature reveals that many past studies that employed the hedonic price model focused on locational, structural, and neighborhood attributes. The following highlights these studies.

The location of a property has been conceived in most studies in terms of fixed and relative locational attributes. The fixed locational attributes (Follain & Jimenez, 1985; Orford, 1988) are quantified with respect to the whole urban area, and pertain to some form of accessibility measure. Relative locational attributes are quantified through surrogate measures such as pollution levels and proximity to local amenities (Dubin & Sung, 1990). Accessibility, in whatever form it has been measured, has some influence on housing prices (McMillan et al., 1992; Palmquist, 1992; Ridker & Henning, 1968). Transport accessibility is frequently associated with the ease of commuting to and from amenities, and is measured by traveling time, cost of travel, convenience, and availability of different transport modes (Adair et al., 2000; So et al., 1996). Buyers tend to trade-off housing costs against transport costs, but this is not always true because Edmonds (1984) found that costs of commuting (fares) may not be capitalized into site value. His study in Japan found that it is customary for firms to reimburse employees for commuting. Thus, in that case, the only apparent "costs" of commuting were probably time and discomfort. View is sometimes considered a residential amenity usually associated with the location of a dwelling site (Benson et al., 1998). Numerous studies have indicated that buyers prefer sites with good views, such as lakes or golf courses, and are willing to pay a premium for such sites (Cassel & Mendelsohn, 1985; Darling, 1973). Whereas bad views would discourage buyers of a property like land near a land fill.

Prices of properties are frequently related to their structural attributes. As Ball (1973) pointed out, if a house had more desirable attributes than others, the valuation of these attributes would be reflected in higher market prices for this house. However, other researchers have noted that structural attributes preferred by buyers may not always be identical. Kohlhase (1991) found that the significance of structural attributes can change over time, and may vary between nations. Chau et al., (2001) classified the physical conditions of the property such as size, floor level, age, and so forth as tangible attributes, whereas attributes such as accessibility, water view, environmental quality, and developer's good will are regarded as intangible attributes.

Goodman (1989) argued that while neighborhood attributes cannot be explicitly valued in the market place, they could be implicitly valued through hedonic pricing by comparing houses with differing neighborhood qualities. Goodman's caveat that failure to model neighborhood attributes can lead to substantive errors when valuing individual properties and the market in general, was validated by Linneman (1980). Kain and Quigley's (1970) study further demonstrated that higher income households with more education prefer to live in relatively high quality dwelling units located further away from the environmental disamenities. There are also studies on the externality of noise from traffic and its effect on property values (Palmquist, 1992). However, the reaction towards noise, or quiet, is dissimilar among different groups of people. Palmquist provided evidence that in an upper middle class neighborhood, property values were reduced by 0.48 % for each additional decibel of highway noise, whereas in a lower middle class neighborhood, this value was 0.3% per decibel. In the poorest neighborhoods, the effect was even lower, only 0.08 % per decibel. This indicates that in the case of the very poor, their marginal willingness to pay for quiet is comparatively very low, or perhaps it is just due to their inability to pay. The significant negative impact of toxic waste sites on housing prices was validated by Ketkar (1992) and Kohlhase (1991). Ketkar for example, found that if the number of hazardous waste sites in a municipality decreases by one, it leads to an increase in the median property value of $1255, or a rise of 2% in the property values. Asabere (1981a) in his study of Determinants of Land Values in an African City found out that land tenure systems had a negative effect on land values. They were specifically influenced by owner or seller-type. Hence attributes such as tenure system are important in determining land value.

Humavindu and Stage (2003) applied the hedonic pricing model to property sales in the township areas in Windhoek, the capital city of Namibia. Their study found out that apart from house quality, access to the central business district, access to marketplaces and access to transportation, environmental quality also has a large impact on property prices. Properties located close to a garbage dump sell at considerable discounts; while properties located close to a combined conservation and recreation area sell at premium prices. The results thus suggest that the hedonic pricing method can be useful for studying townships in developing countries, and that this can help to clarify the importance of environmental factors which are otherwise frequently neglected in town planning for township settlements.

3.0 Methodology

3.1 A brief analytical framework

The fact that organized markets for environmental amenities and disamenities do not exist requires the application of a non-market valuation technique in order to measure environmental impacts. Approaches that analyze the relationship between certain environmental quality characteristics and prices of private goods are variously termed “Property Value”, “Land Value”, or “Hedonic Price” techniques. According to Rosen (1974) hedonic prices are defined as the implicit prices of the characteristics of a property (e.g. size, location, quality and neighbourhood characteristics of a particular property) and are revealed to economic agents from observed prices of differentiated prices and the specific amounts of characteristics associated with them.

According to Hufschmidt et al., (1983), the underlying assumptions of this technique are that there is a large continuum of different individuals located in homogenous communities, that the price of land is based on expectations about future environmental quality, that people can perceive differences in environmental quality, that people are willing to pay for environmental quality improvements in their neighbourhood, that perfect information on real estate prices exist, that households continually re-evaluate their locational decisions, and that people do not cluster in areas with the same level of environmental quality for social reasons or transportation purposes.

Noting these and other caveats, Freeman (1979) argued that the hedonic price technique, while involving substantial simplifications and abstraction from a complex reality, still has a logical and consistent theoretical basis. He examined the theory, criticisms and results of more than a dozen studies that used the technique and concluded that the hedonic price model has substantial explanatory power and can provide a useful way to relate changes in environmental quality and property values. Hedonic Price Model (HPM) is a revealed preference method which allows us to impute the value people attach to environmental amenities or disamenities by observing the prices of marketed goods while the Contingent Valuation Method (CVM) is a stated preference approach where individuals are asked to state how much they would be willing to pay for a given environmental change.

3.2 Empirical Model and Justification

Most studies that have researched the impact of proximity to landfill of property have used HPM since the impact of this disamenity can be imputed from prices people pay for the marketed goods. Specifically, this study estimated the land – value equation with distance from the landfill as one of the attributes.

In the present study, the Hedonic Price Function (HPF) represents the locus of equilibria of all the individual buyers and sellers in the land market and as such, economic theory, suggests no a priori assumptions on the form it takes (Hite et al., 2001). The study used the log-log or double log functional form in this research (see also Harrison and Rubinfeld, 1978). The log-log specification of the empirical model is as follows:

$$\ln(LPRICE) = \alpha_0 + \alpha_1 \ln DIST + \alpha_2 \ln DIST^2 + \alpha_3 SMELL + \alpha_4 SEEN + \alpha_5 \ln SIZE + \alpha_6 \ln SIZE^2 + \alpha_7 LOCATE1 + \alpha_8 TENURE + \alpha_9 USE + \alpha_{10} WATER + \alpha_{11} ELECT + \alpha_{12} \ln ACCESS + \alpha_{13} \ln CITY + \alpha_{14} \ln EDU + \alpha_{15} \ln INCOME + \alpha_{16} DUMMY2006 + \alpha_{17} DUMMY2007 + \alpha_{18} LOCATE3 + \varepsilon \quad (1)$$

Where;

$\ln LPRICE$ = Dependent variable is log of land price per hectare in Ushs.

The explanatory (independent) variables are:

lnDIST= Log of Distance from landfill in metres

$lnDIST^2$ = Log of Distance from land fill squared

SMELL= Dummy for whether the landfill smells (1= smells, 0= Otherwise)

SEEN= Dummy for whether the landfill is visible from the property (1= seen, 0= Otherwise)

lnSIZE = Log of Size of land in hectares

$lnSIZE^2$ = Log of Size of land in hectares squared

LOCATE1 = Dummy for location of property (1=Hilltop, 0=Otherwise)

LOCATE3 = Dummy for location of property (1= Valley, 0= Otherwise)

TENURE = Tenure status of the property (1= Kibanja, 0=Otherwise)

USE = Dummy for current usage of property (1= agriculture, 0= Otherwise)

WATER = Dummy for connection of property to city water (1= connected, 0= otherwise)

ELECT= Dummy for connection of property to electricity (1= connected, 0= otherwise)

lnACCESS= log of Distance of property in metres from nearest public transport stage i.e bodaboda.

lnCITY= Log of Distance of property in metres from central point (city centre) in Kampala

lnEDU= Log of Education level of household head in terms of years of schooling

lnINCOME= Log of Approximate annual income of the household head in Uganda Shillings.

DUMMY2006 = Dummy variable for "if the parcel of land was sold in 2006"

DUMMY2007 = Dummy variable for "if the parcel of land was sold in 2007"

α = Coefficient

In this study, the characteristic of interest is the distance or proximity of the property to the landfill. Given that we specified and estimated a double log function, the implicit price for proximity to the land fill is derived as follows:

$$\frac{\partial \log(P)}{\partial \log(D)} = ..\frac{D\partial(P)}{P\partial(D)} = elasticityofPwrtD..(2)$$
$$= \alpha_1 + 2\alpha_2 LogD$$

3.3 Data type and sources

The study was implemented using actual sales data. These data were extracted from real property (estate) agents and land sale agreements that the local council chairpersons retain every time a transaction takes place. A total of 121 land sales were found to be available. These land sales were for the period 2006 to 2008. The other information regarding the name of the seller, name of buyer, date when the transaction took place, size of the land, and amount paid were extracted from the land sales records. While the sample size was 121 respondents, some of them were dropped when the model was run. This is because they contained values of improvements on the land at the time of sale which were insignificant to the buyer who planned to effectively improve that land. Distances from the property (land) to the land fill were located using the Global Positioning System (GPS) and then plotted on Google earth so that they can be seen and appreciated. The other variables that appear in the model were then obtained by interviewing the buyer who was identified in the sales records.

The other information on the model variables that were obtained include, whether the landfill is visible from the property or not, where the property is located (i.e. hilltop, slope, flat surface or valley), current usage of property, whether the property is connected to city water and electricity or not, and the distance of property from public transport and the city centre. The land prices used were purged of inflation (converted from nominal into real prices) using the Consumer Price Index (UBOS, 2009). Dummies were also employed for years 2006 and 2007 using 2008 as a base year.

These helped to test for changes in real market conditions over the three years for which sales were collected.

3.4 Data Analysis

Data analysis involved generation of descriptive statistics and conducting multivariate analysis using STATA 9.1 econometric programme. Descriptive analysis was used to describe the land and other property located in the areas surrounding the landfill. Econometric analysis involved estimation of the Hedonic Price function using STATA econometrics program.

To ensure valid analysis, regression diagnostics preceded the analysis. Multicollinearity was checked using the Variance Inflation Factor (VIF). It was found that there was no serious multicollinearity problem associated with the variables. Unusual and influential observations that had a significant impact on the regression results were identified and eliminated using the basic diagnostic statistics such as studentised residuals for regression outliers, leverages and Cooks D for leverage and influential data points, respectively. The Breusch-Pagan test indicated presence of heteroscedasticity that was corrected by using the robust standard errors. The model was then estimated using the Generalised Least Squares (GLS) estimation method.

4.0 RESULTS AND DISCUSSION

4.1 Introduction

This section presents the results of the impact of an environmental disamenity on the value of land estimated using the hedonic price method. Table 2 presents the socio-economic characteristics of the survey respondents together with descriptive statistics of variables used in the model.

Table 2: Descriptive Statistics of household characteristics

Characteristic	Mean (n=118)	SD	Min	Max
Age of the households head in years	40	8.43	23	71
Education level of households head in years	11	3.73	0	18
Household size (number of persons)	5.50	2.39	1	15
Annual Income of the household head in Ush	568220.30	429055.1	0	2500000
Time the household has lived on this property in years.	2.20	9.28	0.5	2.50
Mean size of land owned by the household in hectares	0.11	0.52	0.006	5.65
Land price in Uganda shillings/ha (Land price)	4342332.00	2887340.00	150000	1.50e+07
Distance from the property to the landfill in meters (Distance)	803.11	404.73	0.26	2.70
Distance from the property to the nearest public transport stage in meters (Access)	619.55	560.20	0.03	2.42
Distance from the property to the city centre in meters (City)	10,460.87	423.45	9.66	11.54
Percentage of male headed households	71%			
Location – Kitetika	13%			
Location - Lusanja	87%			

Source: Researcher estimates from the survey data

The overall mean age of the respondents was 40 years while the mean age of the respondents in Kitetika was 44 years and that in Lusanja was 40 years. There was a statistically significant difference between these mean ages. This could be because Lusanja is closer to the main road and to the landfill than Kitetika, therefore younger people tend to live near these places for ease of access and also they are able to exploit the opportunity of ravaging the landfill for still usable and saleable items. The overall mean household size was approximately 5.5 persons. The average household size is higher in Kitetika standing at 6.6 persons and lower in Lusanja 5.8 persons. This is higher than the national average of 4.7 persons reported in the 2002 Census (UBOS, 2002). The mean household sizes were not significantly different at 5 % (t-value =1.041) between the Lusanja and Kitetika local councils. The overall mean number of years of education of the household head was 11 for the entire sample, while the overall mean land size was 0.11 hectares. The average size of land in Kitetika was 0.040 hectares while that of Lusanja was 0.123 hectares. This difference was not statistically different at 5% level of significance (t =-0.571).

Table 2 also presents the descriptive statistics of the dependent and selected explanatory variables. For example, the average distance from the property to the nearest public transport stage is 619.55metres while the mean distance from the property to the landfill is 803.11meters. These results show that majority of the properties are small in size and closely located to both the landfill and the public transport system. The mean education level of the household is at the secondary school level with low annual incomes of US$ 258 per year or about US$ 20 per month.

4.2 Characteristics of Land and other property

Land is one of the most valuable resources and plays a significant role in sustainable economic development. Of particular importance, however, is the fact that the value of land is a function of different external factors and its attributes. As such, it is important to understand the different characteristics of land and other properties in order to achieve a better insight into the value of that land. Table 3 shows the descriptive statistics of land and other property located in the Kiteezi area.

Table 3: Characterisation of Land and other Property in Kiteezi

Characteristic/Distance from Landfill	0- 800 m	801 – 1600 m
Land Ownership		
Customary	0.053 ± 0.26	0.024 ± 0.024
Freehold	0.013 ± 0.013	0.024 ± 0.024
Kibanja	0.934 ± 0.029	0.952 ± 0.033
Land Use		
Agriculture	0.079 ± 0.031	0.143 ± 0.055
Residential	0.908 ± 0.033	0.851 ± 0.055

Source: Researcher estimates obtained from survey

As can be seen in table 3, the proportion of those respondents whose land is under the Kibanja tenure system constituted 93% of the land between 0 to 800m away from the landfill and 95% of the land between 801 and 1600m away from the landfill. This was significant at 1%.

The land in Lusanja has more agriculture going on since it is located at a higher altitude compared to the landfill while most of the crops and animals in the Kitetika area had died due to the fact that it is located at the valley and hence this area receives contaminated water, among other problems, resulting from the presence of the landfill in their vicinity.

4.3 Econometric Results

Table 4 presents the estimated coefficients for the double log form of the Hedonic price Function. Most of the results are consistent with standard expectations.

Table 4: Econometric regression results for the Double log functional form

Explanatory variables	Coefficient	Robust S.E	P>t
Intercept	8.581	19.880	0.667
DIST	6.830	3.081	0.030
DISTSQUARED	-0.543	0.229	0.021
SIZE	-1.011	0.127	0.000
SIZE SQUARED	-0.049	0.025	0.051
SMELL	-0.311	0.166	0.064
SEEN	-0.571	0.198	0.005
LOCATE1(hilltop)	0.188	0.178	0.296
LOCATE3(valley)	-0.540	0.198	0.008
TENURE(Kibanja)	0.032	0.275	0.908
USE(Agric.land)	0.486	0.284	0.091
ACCESS(bodaboda)	-0.425	0.105	0.000
CITY	-2.553	1.512	0.095
EDUCATION	0.233	0.113	0.042
INCOME	0.204	0.091	0.028
WATER	0.018	0.137	0.895
ELECTRICITY	0.065	0.140	0.644
DUMMY2006	0.145	0.164	0.381
DUMMY2007	0.298	0.112	0.010
Adjusted R2			0.762
Sample Size			94.000

As can be seen in Table 4, the coefficient for distance to the landfill from the parcel of land is positive and significant. This implies that land values increase with increased distance away from the landfill. The coefficient is also statistically different from zero at the 5% level of significance.

Since elasticity is non constant in this model because we used distance squared variable, we then used the following formula to calculate the actual elasticity of proximity to the landfill on the value of land.

Coefficient on Distance-(2*coefficient on distance squared*logDistance)

Table 5: below shows the results. It shows that there is a big disamenity to being very close to the landfill (for example 100 metres but then no effect further away.

Table 5: Elasticity due to proximity to the land fill.

Distance	Value	Elasticities
ln100	4.605	1.829
ln200	5.298	1.076
ln300	5.704	0.635
ln400	5.991	0.324
ln500	6.215	0.081
ln600	6.397	-0.117
ln700	6.551	-0.284
ln800	6.685	-0.430
ln900	6.802	-0.557
ln1000	6.908	-0.672

Source: Calculated from table 4 results and formula specified

The above results are consistent with the hypothesis that land values are negatively impacted by proximity to the landfill. The use of the quadratic function (squared distance) is based on the notion that the effect of disamenities from a landfill does not decrease linearly with distance all through, but after a certain distance, the effect vanishes. It is a location expense that decreases with distance at a diminishing rate, allowing the function to have a maximum point. The coefficient on the squared term is negative, implying that the effect of the landfill is highly localized, beyond which the landfill is perceived to have little or no effect on land values (Ihlanfeldt and Taylor, 2004).

The above result is consistent with findings of similar studies. For instance Nelson et al., (1992) who examined the price effects of landfill sites on house values using a sample of 708 single-family homes in Ramsey Minnesota, located near a landfill site. Their results indicate that proximity adversely affected home values - ‘house value rises by nearly $5000 for each mile away from the landfill. On a percentage basis, house value rises by about 6.2 percent per mile from the landfill.

The estimated coefficients of the other variables in the hedonic price function were generally consistent with a priori expectations. Variables on accessibility to amenities were found to be important factors in explaining variation in land values. For example, the coefficient for accessibility to the main road coefficient was found to be negative suggesting that 1% increase in the distance away from the main road decreases land values by 0.425% and this value was significant at 1%. Accessibility to the city centre was also found to have a negative effect implying that a 1% increase in distance away from the city centre causes 2.553% decrease in the land price and it was significant at 10% level. These findings are consistent with those of Grass (1992) who found that average property values increased near metro rail stations in Washington D.C. in 1980, and Benjamin and Sirmans (1996) who found that apartments near Washington D.C. metro rail stations experienced a decline in rents of 2.4% to 2.6% for each one-tenth mile increase in distance from the stations.

Accessibility to electricity and water positively influenced land values of parcels of land that had power and water although both coefficients were not statistically significant.

With regard to the land use, the parcels of land that were for agricultural purposes only, had their values increase by 0.486%. This means that people would pay more to obtain land that was closer to the landfill and use it for agricultural purposes than for other uses. This could be attributed to the problems associated with the landfill such as bad sights, smell, flies and dogs that they would face if they used it for other purposes like residential.

Both the income and education of the household head positively influenced land values. For example 1%increase in income of the household led to a 0.204% increase in the land values and this was statistically significant at 5% level. A 1% increase in the years of schooling of the household head led to 0.233% increase in the value of the property ceteris paribus and this coefficient was statistically significant at 5% level of significance. These results are consistent with the findings of Kain and Quigley's (1970) who further demonstrated that higher income households with more education prefer to live in relatively high quality dwelling units located further away from the environmental disamenities.

Parcels of land that were located at the hilltop had their values increase by 0.188% compared to those on a flat area. Parcels of land in the valleys had their values decrease by 0.540% compared to those in the flat area and this was statistically significant at 1%. This is probably because of the difficulty in managing land in the valley whether for residential or agricultural purposes. This land tends to be waterlogged and prone to flooding during the rainy season.

Although there was a general increase in the real price of land from 2006 to 2007, it was not significant compared to 2008. There was an increase in the price of land from 2007 to 2008 that was significant at 5%. This could be attributed to the high growth trend in the number of real estate firms that are bidding up property for housing estates.

Variables such as income and education of the household head were used as proxies against self selection. However these may be incomplete in explaining differences in the taste for disamenity causing households to self select therefore the authors would like to acknowledge the presence of heterogeneity.

Since distance and distance squared are both significant, the price of land is not constant, but a function of distance.

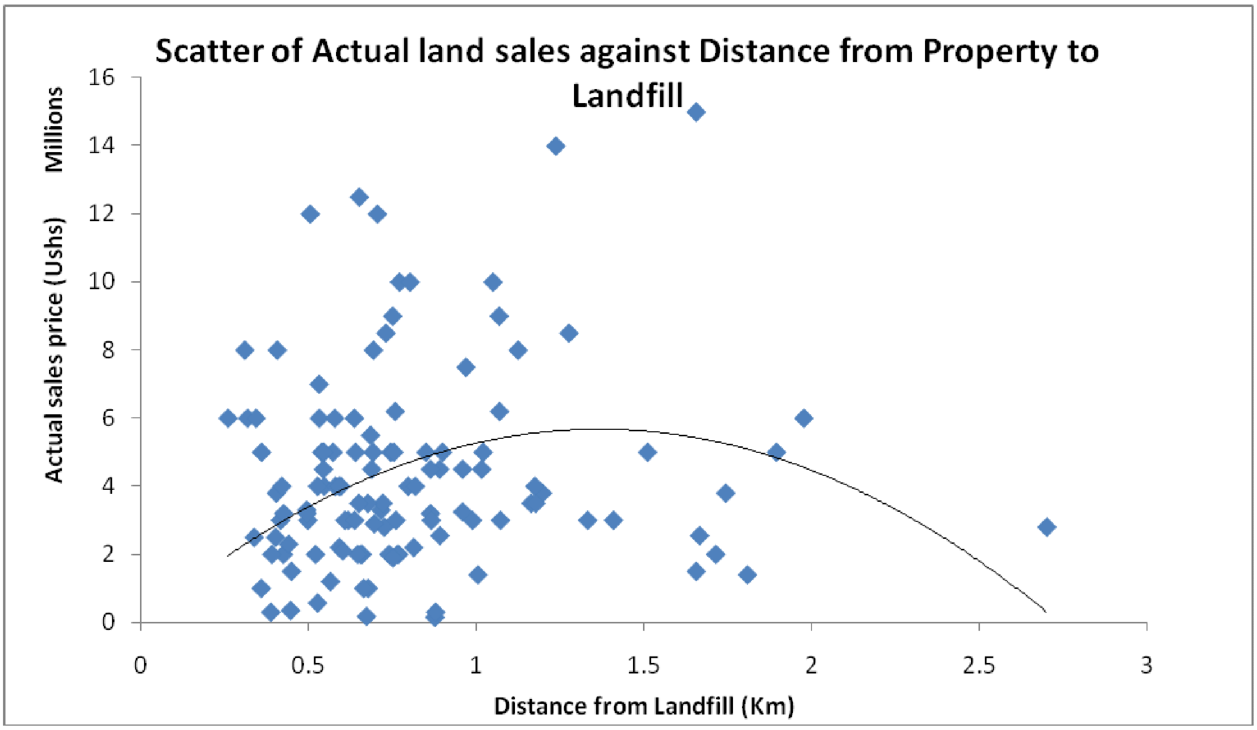

Figure 1: Scatter of actual land sales against distance from the property to landfill

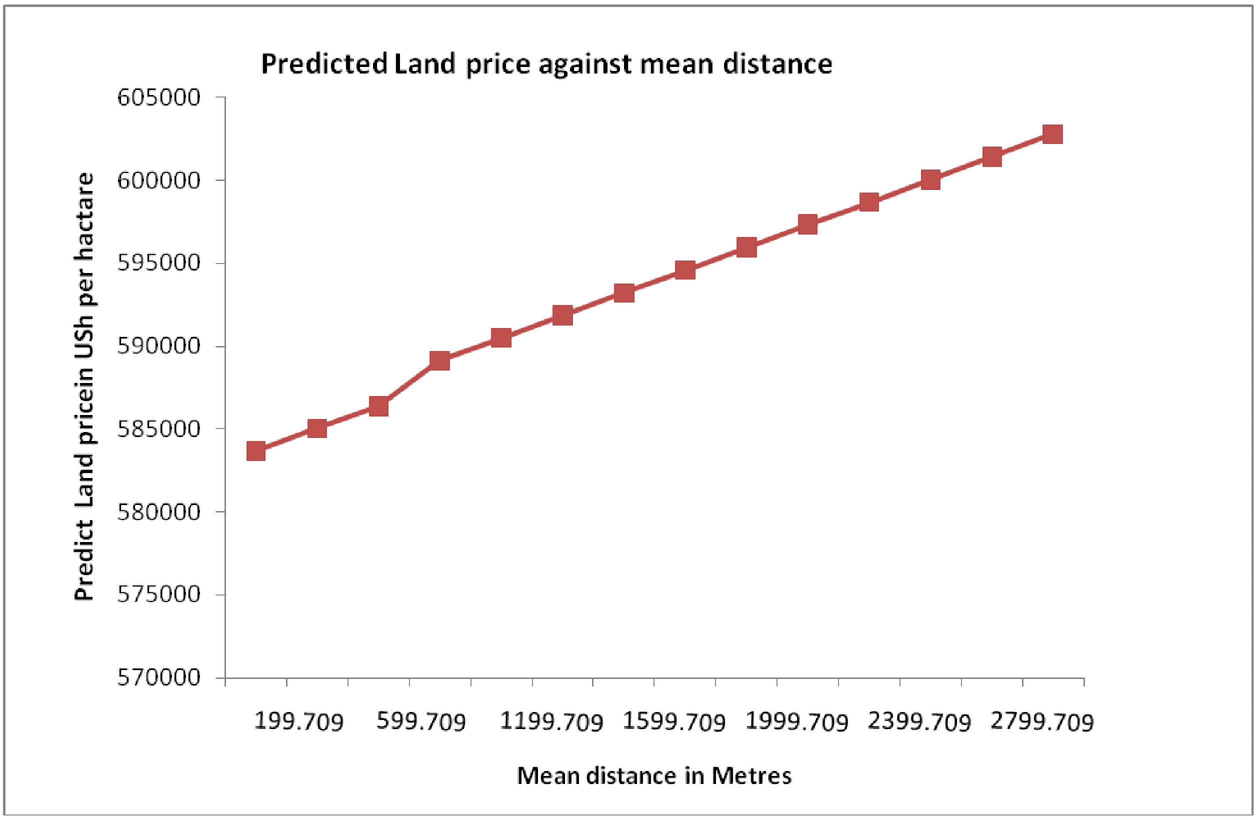

Figure 2: Predicted Land price against mean distance

The plot of land price against distance from the land fill confirms that indeed this is the case; figure 1. The trend line is parabolic confirming our earlier hypothesis that the effect of the landfill disamenity diminishes with distance away from the landfill.

To gain further insights into the relationship between the price of the land and distance from the landfill, we used the estimated model and calibrated it using variable means to predict this relationship. The results presented in figure 2 show the same diminishing relationship. It is expected that the graph should attain a maximum and then levl off at higher values of distance from the landfill and land price.

One earlier key objective of this research was to estimate the marginal willingness to pay (MWTP) for an extra unit of distance away from the landfill. This was achieved using equation 2 earlier presented (see appendix 1 for computations). The implicit price for proximity to the landfill was computed as Ush. 31057.211. This means that people are willing to pay Ush. 31057.211 or about US $ 15.529 for an extra unit of distance away from the landfill. The fact that households are willing to pay about 78 percent of their monthly income for a one metre distance away from the landfill confirms that the landfill has a negative impact on people and property in the Kiteezi area.

Furthermore the distance to the landfill was disaggregated to test for distance break points at which the impact of the landfill leveled out or became zero. The results are presented in table 6 below.

Table 6: Distance disaggregated to see the effect of landfill

Distance category	Mean Distance	Effect of the landfill
0-600	468.603	53227.049
601-1200	819.522	30435.248
1200-1800	1519.596	16413.807
>1800	2094.408	11909.024

Results on table 6 show that the existing impact is largely localized to residences within the first 2 distance categories from the landfill where there is an average decrease in price of Ush 53,227.049 for every metre away from the landfill for the first distance category. The second distance category had a total decrease in value of a parcel of land by Ush 30,435.248 while the 3rd distance break category had a price decrease of Ush 16,413.807. It was not possible to establish at what distance the effect of the landfill vanishes. This price distance gradient (i.e., properties that are closer to hazardous sites experience greater losses than properties further away) has also been demonstrated in other hedonic studies. The loss in property values could also be attributed to the overall presence of the landfill and not to any one characteristic.

4.4 Qualitative variables and proximity to the landfill

4.4.1 Problems associated with proximity to the landfill

The presence of a landfill in an area masks a lot of problems to the community as earlier noted in the literature. This study therefore observed a number of variables associated with proximity to the landfill. Figure 3 shows a summary of the stated problems:

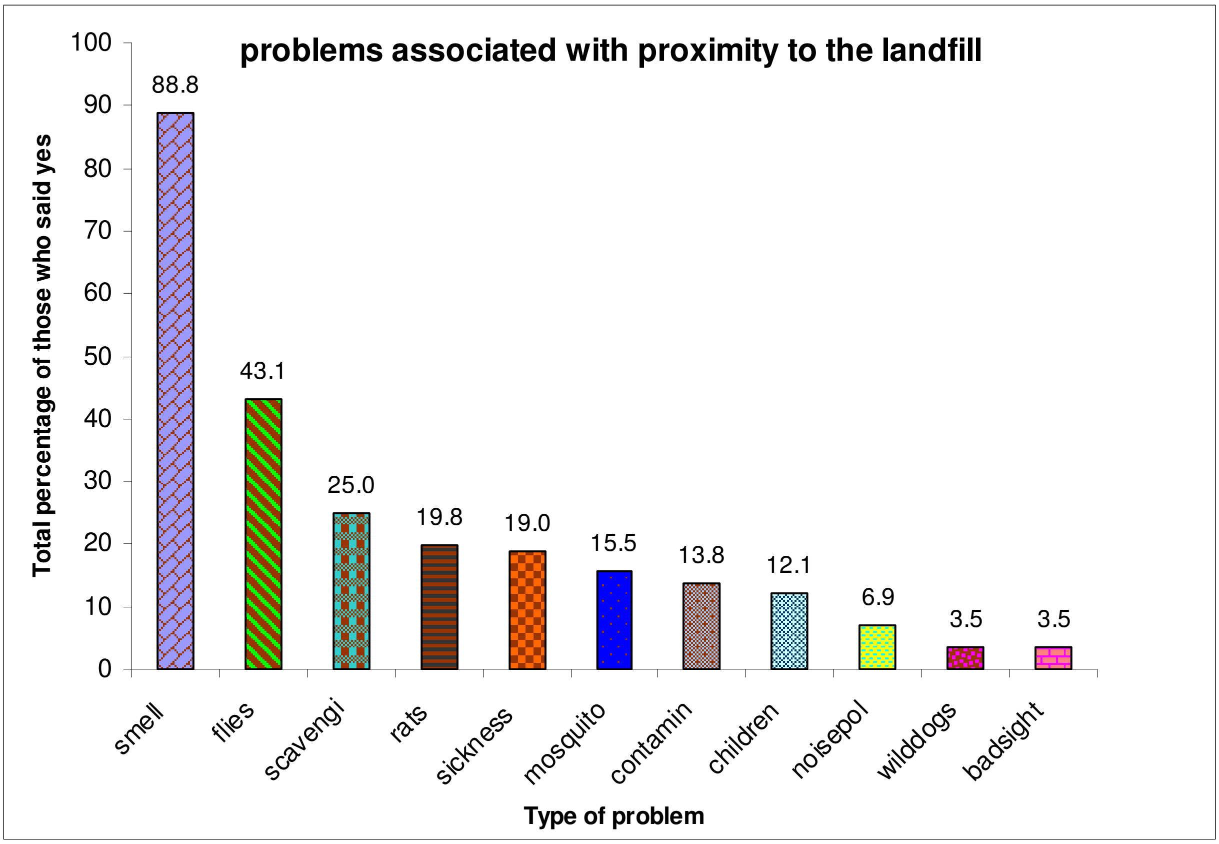

Figure 3: Problems associated with Proximity to a landfill

Source: Researcher estimates from the survey data

The most frequently mentioned problem was the bad smell that was common (88.8%). This was due to the fact that the waste is not properly covered with soil as it should be. Other problems associated with the landfill are flies (43%), scavenging birds (25%), rats (19.8%), various illnesses (19%), mosquitoes (15.5%), contaminated water (13.9%), noise pollution (6.9%), wild dogs (3.5%), and bad sights (5.5%), among others. These problems would clearly influence one's decision to acquire property in the area.

Given a choice between two parcels of land offered for the same price and identical in every other respect, except that one is closer to a landfill site, property buyers will choose the parcel of land that is further away. Only when the closer parcel is offered for less money will buyers consider it a suitable alternative. At some lower market price of the closer parcel of land, property buyers will become indifferent in choosing between that site and the higher-priced one further away from the landfill site. In this way, then, people are implicitly revealing their willingness to pay for avoiding the nuisances associated with a landfill by paying higher prices for parcels of land located further away from such a site.

4.4.2 Suggestions on how the problem of the landfill can be solved

A number of solutions were suggested by the respondents as a means of getting around this problem. Figure 4 presents these solutions as suggested by the respondents. The majority of the respondents (45%) said the landfill should be relocated while 41% said the authorities should at least stop dumping more garbage in the landfill. Others (8%) suggested that some form of recycling be done on the waste to reduce on the amount that ends up in the damping site. About 4% of the respondents suggested that the waste should be properly covered whereas 2% said, as a means of compensating the affected parties the authorities should build a clinic and provide everyone with running water, since the spring and borehole water they have been using is now contaminated.

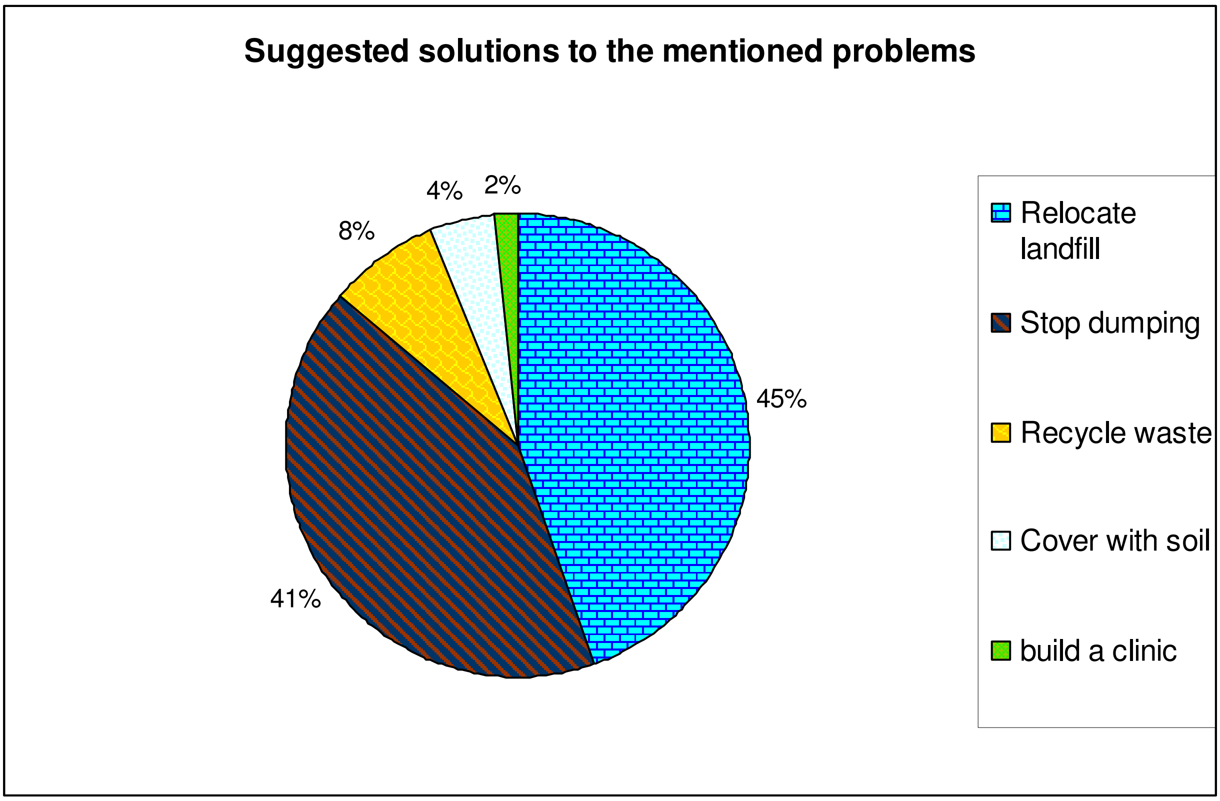

Figure 4: Suggested Solutions to the Stated Problems

Source: Researcher estimates from the survey data

5.1 Recommendation and Policy implications of the findings of the study

The study has established that land value in central Uganda is affected by the presence of a landfill and therefore a clear policy on location and management of landfills needs to be enacted as well as other types of legislation that encourage waste recycling since this would greatly reduce on the amount of waste that is taken to the landfill.

There is need for sensitization programmes aimed, particularly, at minimizing waste generation and this should target households and other institutions like schools and hospitals which generate large quantities of biodegradable wastes.

More explicitly, the information on the loss in property values can now be used in a cost-benefit analysis to support decisions with respect to site remediation (i.e. remediation should proceed if there is an acceptable return when costs of cleanup are compared to total social benefits of disposal and management. When a cost benefit analysis is undertaken, it will ensure that property values are not affected by poor location of the landfill.

Kampala City authorities need to ensure proper management of the landfill in terms of covering the garbage with soil and undertaking proper compaction. It's important that the waste be properly deposited in the right place since most of the trucks that take the waste end up spilling and pouring it by the road side.

Kampala City authorities should monitor the activities of the private sector and set up standards to be achieved in managing the disposal sites such as the land fill at Kiteezi. This could be done by setting up KCC offices close to the landfill.

This study has also demonstrated that the hedonic price model is applicable in a developing country like Uganda.

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Appendix 1:

$$\frac{\partial \log(LPRICE)}{\partial \log(DIST)} = \frac{\%\Delta LPRICE}{\%\Delta DIST} \text{...} (2)$$

$$\frac{\partial (LPRICE)}{\partial (DISTANCE)} = \alpha_1 \frac{\overline{LPRICE}}{\overline{\overline{DIST}}} + 2\alpha_2 \frac{\overline{LPRICE}}{\overline{\overline{DIST}}}$$

$$= (\alpha + 2\alpha_2)\frac{LRICE}{\overline{\overline{DIST}}}$$

$$= (6.830 + (2 * -0.543)\frac{4342332.00}{803.11}$$

$$= (6.830 + -1.086)5406.896$$

$$= 5.744 * 5406.896$$

$$= 31057.211$$