The impact of an environmental disamenity on land values: case of Kiteezi landfill in Uganda

Rosemary Emegu Isoto* and Bernard Bashaasha

Department of Agricultural Economics and Agribusiness,
Makerere University,
P.O. Box 7062, Kampala, Uganda
Fax: +256-414-531641
E-mail: emegur@yahoo.com
E-mail: bashaasha@agric.mak.ac.ug
*Corresponding author

Ateenyi Twaha Ali Basamba

Department of Soil Science,
Makerere University,
P.O. Box 7062, Kampala, Uganda
E-mail: ateenyitwaha@hotmail.com

John Mburu

International Research Institute (ILRI),
University of Nairobi,
P.O. Box 30709-00100, Nairobi, Kenya
E-mail: j.mburu@cgiar.org

Abstract: The discourse on waste management is increasingly becoming important especially in developing countries. Landfill use is one of the most preferred methods of waste management yet it has various negative effects on people's welfare and livelihoods. This study uses hedonic price model to quantify impacts of proximity to a landfill. It uses primary data on property characteristics and other factors as explanatory variables. Land-price is used as a dependent variable. The results indicated that proximity to the landfill negatively affects land value whereas amenity variables positively influence land values. The study recommends appropriate policy on location and management of landfills.

Keywords: hedonic price model; disamenity; property value; Uganda.

Reference to this paper should be made as follows: Isoto, R.E., Bashaasha, B., Basamba, A.T.A. and Mburu, J. (2011) 'The impact of an environmental disamenity on land values: case of Kiteezi landfill in Uganda', *Int. J. Environmental Engineering*, Vol. 3, Nos. 3/4, pp.371–387.

Biographical notes: Rosemary Emegu Isoto has her MSc in Agricultural and Applied Economics from Makerere University. She lectures in the Department of Agricultural Economics and Agribusiness, Faculty of Agriculture, Makerere University. Some of the courses she teaches are: introductory microeconomics,

environmental economics and firm management case study theory. Her research interests are environmental and natural resource management, poverty aspects, food security issues among others.

Bernard Bashaasha is currently an Associate Professor of Agricultural Economics. He holds a PhD in Agricultural and Development Economics from the Ohio State University, USA. He teaches both graduate- and undergraduate-level courses and has been a Guest Lecturer at the African Economic Research Consortium in Nairobi. He has widely published and has supervised close to 40 MSc and 3 PhD students to completion. He is currently an Adviser on Agriculture and Markets to the World Food Program (WFP) Country Director in Uganda. He has served on various government committees and NGO Boards.

Ateenyi Twaha Ali Basamba received his PhD in Environmental Sciences from the Department of Plant and Environmental Sciences, Norwegian University of Life Sciences (UMB), Norway. He is a Senior Lecturer in the Department of Soil Science, Faculty of Agriculture, Makerere University, Uganda. He has wide professional experiences in agroforestry and environmental soil science. He has published papers in environmental science journals.

John Mburu is an Agricultural/Resource Economist at the International Livestock Research Institute (ILRI) and a Senior Lecturer at the Department of Agricultural Economics, University of Nairobi (UoN). He holds a PhD in Agricultural Economics (2002) from the University of Goettingen, Germany, with specialisation in Environmental and Resource Economics. Prior to joining ILRI and UoN in June 2007, he worked at the Center for Development Research (ZEF), Bonn, Germany, as a Senior Research Fellow for almost five years. He has published widely on agricultural and environmental economics, and has acquired extensive experience of working in developing countries such as Brazil, Ethiopia, India, Kenya, Malawi, Uganda and Zambia.

1 Introduction

Land is one of the most valuable natural resources and it 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 acquire and economically utilise a piece of land. Households, in particular, take into consideration environmental factors such as disamenities existing on a given parcel of land to attach value to that land. A disamenity is usually associated with localised impacts of a site activity that generate negative reactions from those located in the immediate vicinity of that site. Ostenfeld and Wriborg (2000) refer to a disamenity as the “nuisance caused locally as a result of the presence of a landfill, airports and high traffic roadways, among others”. It can be characterised by noise, dust, litter, odour, presence of vermin, visual intrusion and enhanced perceptions of risk. 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. 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 incoming wastes, practise extensive compaction of waste and control the tipping front and the application of soil cover. Operated dumps, however, bring only limited measures to mitigate other environmental impacts. Operated dumps still practise unmanaged contaminant release and do not take into account environmental cautionary measures such as leachate and landfill gas management (Lars and Boyer, 1999). 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 in avoiding future costs from present mismanagement.

A disamenity problem exists in areas surrounding Kampala city since it operates a landfill located at Kiteezi, which is 13 km from Kampala City. The city of Kampala is Uganda's capital and one of the 80 districts of Uganda. It is the only urban district in Uganda and it covers an area of approximately 176 km^2. It is surrounded by Wakiso District. The population of Kampala was 774,241 at the 1991 census. Provisional results of the 2002 census put the nighttime population of Kampala at 1,208,544 million, indicating a growth rate of 4.13% per annum over the past 11 years (UBOS, 2002). Kampala city is administered by Kampala City Council (KCC). The average household size in Kampala city is four persons and the per-capita income is estimated at US$ 300 per annum (UBOS, 2002). A significant part of Kampala's daytime population does not reside in the city but in the surrounding Wakiso District and beyond. Naturally, such a high urban population generates a significant amount of solid waste. Solid waste (also referred to as refuse) includes waste from households, non-hazardous solid waste from industrial activities, commercial construction and institutional establishments (including hospitals and schools), market waste and street sweepings. The daily generation of solid waste in Kampala City is approximately 1 kg per capita (Sikyajula, 2003). 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 and construction and demolition disposal. The percentage composition of each component is as follows: vegetable matter 73.8%, tree cuttings 8.0%, street debris 5.5%, paper 5.4%, metal 3.1%, saw dust 1.7%, plastic 1.6% and glass 0.6%. About 10% of the collected waste could be recycled but, currently, no waste recycling is done by KCC. Just like in other cities in developing countries, waste management in Kampala is fast becoming a necessity rather than a luxury owing to the potential threats that improper waste disposal imposes on human health and the natural resource base.

Waste is collected in skips placed at selected locations within the district. Apart from that, there are also about 10 small private collectors that provide a door-to-door waste collection service at a fee. They normally provide their clients with waste bags that are collected at agreed frequencies. This privately collected waste together with the skip waste is then transported and dumped in Kiteezi landfill site. Kampala city generates over 48,000 tonnes of waste annually. Currently, about 16,724 tonnes or 65% of the generated waste is collected and transported to the landfill site. Landfill disposals, such as the one being operated by KCC, have immediate and long-term negative effects on the environment as well as property value in its proximity. As such, families searching for residential houses tend to equate landfill proximity with diminished environmental quality or quality of life (Arthur et al., 1992). Studies by Boyle and Kiel (2001) have shown 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 localised negative effects on property values like houses and land, among others. On the basis of the experiences gained through visits to over 50 final disposal landfills in Asia, Latin America and Africa, Lars and Boyer (1999) observed that medium and long-term environmental effects of solid waste management are not well known in the three regions. In most Sub-Sahara African (SSA) countries, in particular, there is little information regarding the impact of landfills on the value of the surrounding land. Therefore, this paper contributes to the body of knowledge on how a landfill, as an environmental disamenity, affects the value of land in urban areas of SSA cities. The goal of this paper is to use the hedonic price model to investigate the impact of the Kiteezi landfill on the value of properties located in the surrounding area. The study specifically wanted to profile and characterise properties and households located in the Kiteezi area; to quantify the influence of a disamenity and other factors on property values in the Kiteezi area; to estimate the MWP for an extra unit of distance away from the landfill and finally generate policy recommendations to guide the future location of landfills by KCC authorities.

The hypotheses that this study tested include: property value is negatively impacted by proximity to the landfill; accessibility to amenities such as water, electricity and city centre has a positive and significant influence on property value, other things held constant and MWP for an extra unit of distance away from the landfill is positive and significant.

2 Theoretical framework

This study draws heavily on the hedonic pricing framework. 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. Etymologically, the term 'hedonics' is derived from the Greek word *hedonics*, which simply means pleasure. In the economic context, it refers to the utility or satisfaction one derives through the consumption of goods and services.

Approaches that analyse the relationship between certain environmental quality characteristics and prices of private goods are commonly based on hedonic price techniques. There are two main approaches, which 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.

Lancaster's (1966) approach was based on consumer good characteristics. He used this model to analyse consumer choices based on the attributes of a good rather than the supply of goods and services. Therefore, a shortcoming of Lancaster's model is the sole focus on consumer demand for characteristics. Rosen (1974) extended Lancaster's approach to include the supply of consumer goods as a function of their implicit prices and established a competitive equilibrium theory of hedonic functions. According to Rosen (1974), hedonic prices are defined as the implicit prices of the characteristics (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. We apply this approach in this paper.

According to Hufschmidt et al. (1983), the underlying assumptions of this technique are that price of land is based on expectations about future environmental quality; people can perceive differences in environmental quality and that people are willing to pay for environmental quality improvements. These are not unrealistic in the Ugandan situation.

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.

3 Methodology

3.1 Theory of economic valuation of environmental resources

According to the theory of economic valuation of environmental resources (MEA, 2005), the Hedonic Price Method (HPM) is a revealed preference method, which allows us to impute the value individuals attach to environmental amenities or disamenities by observing the prices of marketed goods such as houses and land. Unlike with stated preference methods such as Contingent Valuation Method (CVM) where individuals are asked to state how much they are willing to pay for a given environmental change, HPM uses appropriate statistical techniques to infer the willingness to pay for a change in environmental quality. This study employed HPM as used by Linneman (1981), Parsons (1986) and Quigley (1984).

Approaches that analyse the relationship between certain environmental quality characteristics and prices of private goods are commonly based on hedonic price techniques. There are two main approaches, which 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.

Given the assumptions and theoretical aspects discussed in the theoretical framework, the price of a property can be taken to be a function of its characteristics, neighbourhood attributes, accessibility and environmental quality characteristics (Pearce and Turner, 1990). If P is assumed to be the price of a particular piece of land, this function can be written in its general form as:

$$Pi = f(Si\ldots, Ni\ldots, Ai\ldots, Ei\ldots) \tag{1}$$

where

Si: various characteristics of the ith piece of land, such as size and location

Ni: characteristics of the property owner such as income and education

Ai: accessibility characteristics such as accessibility to city centre, water source and electricity

Ei: Environmental quality characteristics proxied by variables such as the distance of the property from the landfill.

This function is the hedonic or property value function. If observations on prices and characteristics are available, the hedonic function can be specified and estimated by multivariate analysis.

3.2 Empirical model

Most studies that have researched on the impact of proximity property to a landfill have used HPM since the impact of this disamenity can be imputed from prices people pay for the marketed goods. Specifically, the study estimated the land-value equation with distance from the landfill as one of the attributes. In this 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). An important issue in estimating proximity to landfill coefficients involves proper specification of the determinants of land value. Misspecification can certainly lead to biases in estimated coefficients.

As noted by Hufschmidt et al. (1983), the HPF as specified in equation (2) is estimated using multivariate regression techniques. The estimation of hedonic analysis requires three considerations (Boxall et al., 2005). Two of these considerations are functional form and model specification, which are common to all hedonic analyses. The third consideration is the treatment of spatial dependencies and whether spatial considerations should be formally considered in model specification. Each of these considerations is addressed in turn. This study examined both semi-log and log-log or double log functional forms. Post-estimation tests, for example the link test and the Ovtests, were then carried out on both methods and the log-log functional form was chosen on the basis that it passed both tests. Hence, only the results of the double log model are presented and discussed.

The log-log specification of the empirical model is as follows:

$$\begin{aligned}\ln(\text{LANDPRICE}) = \alpha_0 &+ \alpha_1 \ln \text{DIST} + \alpha_2 \ln \text{DIST}^2 + \alpha_3\text{SMELL} + \alpha_4\text{SEEN} \\ &+ \alpha_5 \ln \text{SIZE} + \alpha_6\text{WATERELECT} + \alpha_7\text{LOCATE} \\ &+ \alpha_8\text{TENURE} + \alpha_9\text{USE} + \alpha_{10}\text{WATER} + \alpha_{11}\text{ELECT} \\ &+ \alpha_{12} \ln \text{ACCESS} + \alpha_{13} \ln \text{CITY} + \alpha_{14} \ln \text{EDU} \\ &+ \alpha_{15} \ln \text{INCOME} + \varepsilon\end{aligned} \tag{2}$$

where

LANDPRICE: Dependent variable (land price in Uganda shillings)

The explanatory (independent) variables are:

DIST: Distance from landfill in kilometres

DIST^2: Distance from landfill 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)

SIZE: Size of land in hectares

LOCATE: Dummy for location of property (1 = Hill top, 0 = Otherwise)

TENURE: Tenure status of the property (1 = Freehold, 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)

ACCESS: Distance of property in kilometres from nearest public transport stage

CITY: Distance of property in kilometres from central point (city centre) in Kampala

EDU: Education level of household head in terms of years of schooling

INCOME: The income of the head of the household in Uganda shillings

ln: Natural logarithm α = Coefficient and ε is the random error term.

An interaction variable for water and electricity was also included in the model.

3.3 Data and sources

This study was carried out in Lusanja and Kitetika local councils of Wakiso district. Through pilot and preliminary visits, these areas were established to be affected most by the presence of Kiteezi landfill. Preliminary data collection commenced with a preliminary visit undertaken in 2007. The study was implemented using primary data obtained using a semi-structured household questionnaire implemented during the period April–May 2008. The questionnaire was first pre-tested before actual implementation was done. With the help of local council (LC1) chairperson of the villages surrounding the landfill, a sampling frame was constructed. A random sample of 200 households/plots was drawn for the study. The survey asked each owner to estimate the value of his or her property in Uganda shillings and also provide information on distance from landfill in kilometres, whether the landfill is visible from the property, size of land in hectares, whether the land has a permanent structure such as a permanent house or not, where the property is located (i.e., hilltop, midslope or valley), current usage of property, whether the property is connected to city water and electricity or not and the distance of the property from the nearest public transport stage and the city centre. Since the researcher had no information on actual market prices of individual plots/properties, the approach used here is similar to that used by the United States Census of Population and Housing in its property value and air pollution studies.

Field questionnaires were examined for consistency. Data were entered in an SPSS spreadsheet and cleaned before commencement of 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 HPF. 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 the presence of heteroskedasticity that was corrected by using the robust standard errors. The model was estimated using the Generalised Least Squares (GLS) econometric method.

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

$$\frac{\partial(\text{LANDPRICE})}{\partial(\text{DIST})} = \alpha_1 * \frac{\overline{\text{LANDPRICE}}}{\overline{\text{DIST}}}. \tag{3}$$

4 Results and discussion

4.1 Household characteristics

As can be seen from Table 1, the mean age of the respondents was 50 years, which is an indication that most of the respondents were of middle age. There was no significant difference between the age of respondents in Kitetika and Lusanja local councils. The overall mean household size was approximately 6.9 persons. The average household size is higher in Lusanja standing at 7.5 persons and lower in Kitetika at 6.4 persons. This is higher than the average of 4.7 persons reported in the 2002 Census (UBOS, 2002). The mean household sizes were significantly different at 5% (*t* value = –2.33) between the Lusanja and Kitetika local councils. The overall mean number of years of education of the household head was 10 for the entire sample, while the overall mean land size was 0.93 ha. The average size of land in Kitetika was 0.868 while that of Lusanja was 0.997 ha. This difference was not statistically different at 5% level of significance (*t* = 0.478). Over half (68%) of the respondents said they were household heads.

Table 1 Descriptive statistics of household characteristics

Characteristics		*Mean* (*n = 200*)	*SD*	*Min*	*Max*
Age of the households head in years		50	14.18	26	105
Education level of household head in years		10	4.25	0	18
Household size		6.9	3.42	1	20
Mean size of land owned by the household in hectares		0.93	1.84	0.002	20.3
Percentage of those who said they were household head?		68%			
Percentage of male-headed households		66.5%			
Location	Kitetika LC	50%			
	Lusanja LC	50%			

4.2 Characteristics of land and other property

The Chi-square tests were carried out to obtain the descriptive statistics, since it is important to understand the different characteristics of land and other properties to achieve a better insight into the value of that land. Table 2 shows the descriptive statistics of land and other property located in Kiteezi area.

Table 2 Characterisation of land and land use

Characteristic	*0–1.5* km	*1.51–4* km	*Chi^2 value*	*p value*
Proportion owning land	97.94	91.18	4.353	0.037
Land ownership				
Customary	20.00	24.47	0.546	0.460
Freehold	17.89	7.45	4.652	0.031
Kibanja	61.05	65.96	0.490	0.484
Land acquisition				
Inherited	36.84	26.60	2.289	0.013
Bought	57.89	68.09	2.104	0.147
Given	4.21	5.32	0.128	0.720
Land use				
Agriculture	52.13	51.09	0.020	0.887
Residential	46.81	48.91	0.083	0.774

As can be seen in Table 2, the proportion of those respondents owning land within 0–1.5 km away from the landfill was 97.94% compared with 91.18% of those who owned land within 1.51–4 km away from the landfill and this proportion was significant at 5%. The rest (2.06% who did not own land between 0 and 1.5 km and 8.82% who did not own land between 1.51 and 4 km) were either renting the houses they lived in or hiring the land for some use like agriculture. Under land ownership, the freehold tenure system constituted 17.89% of the land between 0 and 1.5 km away from the landfill and 7.45% of the land between 1.51 and 4 km away from the landfill. This was significant at 5%. A majority of the respondents, i.e., 61.05% between 0 and 1.5 km and 65.96% between 1.5 and 4 km, had a Kibanja form of land tenure system. Under land acquisition, 36.84% of the respondents inherited land between 0 and 1.5 km away from the landfill while 26.60% inherited land between 1.51 and 4 km and this difference was significant at 5%. The land in Lusanja has more agriculture going on since it is located at a higher altitude compared with the landfill while most of the crops and animals in the Kitetika area had died because 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.

Table 3 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 0.84 km while the mean distance from the property to the landfill is 1.44 km. The approximate mean annual income of the household head was 550,186.5 Uganda shillings.

Table 3 Descriptive statistics of variables used in the model

Variable	*Description*	*Mean*	*SD*
Land price	Land price in Uganda shillings	2,510,436	2,448,386
Distance	Distance from the property to the landfill	1.44	0.88
Size	The size of the land in hectares	0.93	1.84
Access	Distance from the property to the nearest public transport stage in km	0.84	0.68
City	Distance from the property to the city centre in km	9.36	2.35
Education	Education of the household head in years	10.0	4.24
Income	Approximate mean annual income of the household head in Uganda shillings	550,186.5	65,609.34

4.3 Econometric results

Land is one of the most valuable resources and has 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. Hence, a double log functional form was estimated using GLS and the results are presented in Table 4.

From the above-mentioned post-estimation results, using the Ovtest, we do not reject the null hypothesis that the model has no omitted variables whereas the link test also using the hat squared shows that the model is well specified (Table 5). On the basis of the above-mentioned results, this study then adopted the double log functional form for further analysis.

The coefficient for distance to the landfill from the parcel of land is positive. This implies that land values increase with increased distance away. The coefficient is also statistically different from zero at the 1% level of significance. The coefficient indicates that a 10% increase in distance from the landfill increases land values by 6.14%, holding all other factors constant. The above-mentioned 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 effects of environmental disamenity from a landfill do not decrease linearly with distance all through, but after a certain distance, the effects vanish. 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 localised, beyond which the landfill is perceived to have little or no effect on land values (Ihlanfeldt and Taylor, 2004).

The above-mentioned results are consistent with studies by 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. Their results indicate that proximity adversely affected home values; a house value rises by nearly $5000 for each mile away from the landfill. On a percentage basis, house value rises by about 6.2% per mile from the landfill.

The estimated coefficients of the other variables in the HPF 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, accessibility to the main road (nearest public transport stage) coefficient was found to be negative, suggesting that 10% increase in distance away from the main road decreases land values by 9.9% and this value was significant at 5%.

Table 4 Econometric regression results for the double log functional form

Explanatory variables	*Coefficient*	*SE*	*P > |t|*
Intercept	12.810	0.788	0.000
DIST	0.614	0.107	0.000
DISTSQDD	–0.045	0.070	0.517
SIZE	0.249	0.067	0.000
SMELL	–0.819	0.373	0.030
SEEN	–0.370	0.185	0.049
LOCATE2	–0.355	0.188	0.060
TENURE1	0.388	0.186	0.038
USE1	0.475	0.173	0.007
ACCESS	–0.099	0.061	0.032
CITY	–0.384	0.202	0.000
EDU	0.516	0.214	0.017
INCOME	0.085	0.067	0.212
Waterelec2	0.475	0.393	0.228
Waterelec3	0.037	0.004	0.858
Waterelec4	0.215	0.197	0.278
Adjusted R^2	0.517		
Sample size (*n*)	171		

Ramsey RESET test using powers of the fitted values of lnLANDPRICE.

Ho: model has no omitted variables.

$F(3, 147) = 0.39$.

Prob > F = 0.7575.

Table 5 Link test

lnLANDPRICE	*Coefficient*	*SE*	*P > t*
_hat	1.359	1.442	0.348
_hatsq	–0.013	0.518	0.804
Constant	–2.488	10.029	0.804

Accessibility to the city centre was also found to be negative implying that a 10% increase in distance away from the city centre causes 3.84% decrease in the land price. This value was statistically significant at 1%. Accessibility to water and electricity positively influenced land values in that parcels of land that had water and power had higher land values although they were not significant. These findings are consistent with those of Grass (1992) who found that average property values increased near metro rail stations in Washington DC in 1980, and Benjamin and Sirmans (1996) who found that apartments near Washington DC metro rail stations experienced a decline in rents of 2.4–2.6% for each one-tenth mile increase in distance from the stations.

With regard to land use, the parcels of land that were for agricultural purposes only had their values increased. 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 uses like residential purposes.

Several studies on airport noise, which is also considered as a disamenity (Mieszkowski and Saper, 1978; O'Byrne et al., 1985), found large statistically significant negative impacts on house prices. In a study of the Vancouver Airport, Uyeno et al. (1993) found a negative impact on house prices, while controlling for a large number of house and neighbourhood characteristics.

The above-mentioned regression results showed that the coefficient on whether the landfill was visible from the property was negative and statistically significant at 5%. These results are in line with the findings of Graves et al. (1988) who included particulates and an index of visibility. They reported that the coefficients on visibility for the regressions estimated were negative and significant at the 5% level. These imply that there is a decline in value for those properties that can see the disamenity.

After the full model was run without disaggregating the distance, the study also tested for distance break points at which the impact of the landfill levelled out or became zero and estimated the model by including the distance categories as dummies. These are: 1 = less than 1 km, 2 = between 1 km and 2 km, and 3 = greater than 3 km.

Results showed that the existing impact is largely localised to residences within the first 1 km of the landfill where there is an average negative impact of approximately 0.65% on land value. From 1 to 2 km, the average impact is 0.282% on the land value. After about 2 km, the impact of the landfill was not significant. This indicated that the effects of the landfill are highly localised, beyond which the landfill is perceived to have little or no effect on property value. 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 for example Abeles-Allison and Connor (1990), in a study of property values near large hog operations in Michigan, found that house values decreased by \$1.74 for each additional hog within a 2 km radius of the house. They did not find significant impacts outside of 2 km. The loss in property values could also be attributed to the overall presence of the landfill and not to any one characteristic.

As explained in the methodology section, MWP of U.Sh 1,068,678.66 was then derived as follows:

$$\frac{\partial(\text{LANDPRICE})}{\partial(\text{DIST})} = \alpha_1 * \frac{\text{LANDPRICE}}{\text{DIST}}.$$

(0.613*2510436)/1.44 = U.Sh 1, 068,678.66

The implicit price for proximity to the landfill is U.Sh. 1,068,678.66. This means that people are willing to pay U.Sh 1,068,678.66 or US$ 534.34 for an extra unit of distance away from the landfill.

4.4 Problems associated with proximity to the landfill

Poorly managed landfills have various problems associated with them. This study established so many of these problems as enumerated by respondents as being experienced in areas surrounding Kiteezi landfill. The most frequently mentioned problem was the bad smell that was common (99.5%). This was due to the fact that the waste is not properly covered with soil as it should be, hence the smell is simply unbearable as one of the respondents quoted,

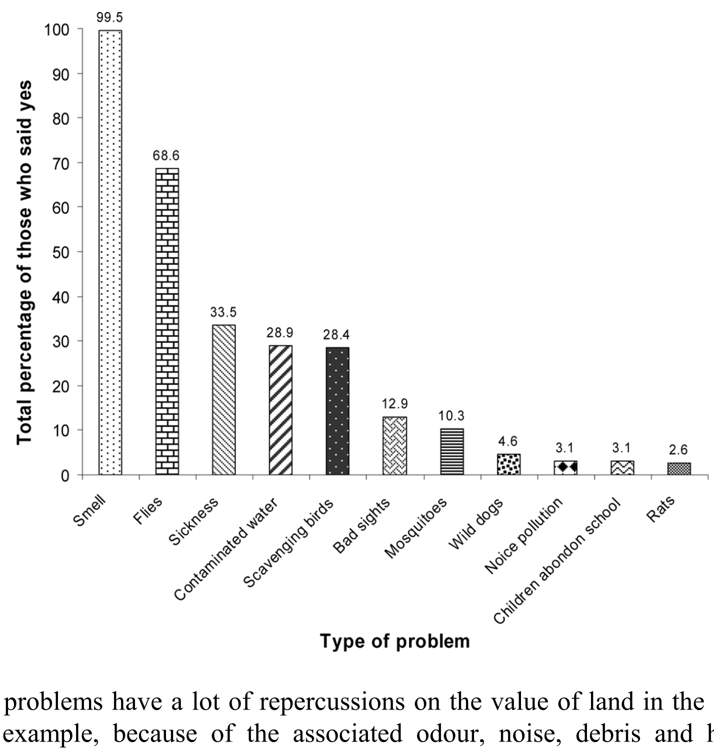
> "This damping site is a menace to us, the stench is unbearable, and we can no longer sit out or relax in the open air of our compounds."

One of the respondents also said,

> "My asthmatic child has had to relocate to her aunts home since every time she comes home she gets asthma attack due to the polluted air that we breathe in."

This quotation is in line with the findings of Lyons et al. (2009) that reported symptoms such as tiredness, sleepiness and headaches as being experienced by the people interviewed. According to Lyons et al. (2009), although these symptoms cannot be assumed to be an effect of toxic chemical action, they may indicate that sites can have an impact on stress and anxiety. Other problems faced were scavenging birds (68.6%), flies (68.6%), various illnesses (33.5%), contaminated water (28.9%), rats (28.4), bad sights (12.9%), mosquitoes (10.3%), wild dogs (4.6%), noise pollution (3.1%) and among others. Figure 1 shows a summary of these problems.

Figure 1 Problems associated with proximity to a landfill

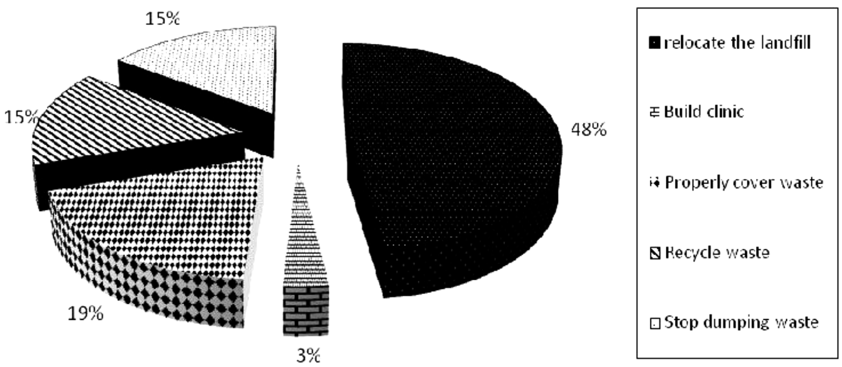


The stated problems have a lot of repercussions on the value of land in the surrounding areas, for example, because of the associated odour, noise, debris and health risks, people in search of housing sites would tend to equate landfill site's proximity with diminished environmental quality. Given a 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 families 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.

4.5 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 2 presents these solutions as suggested by the respondents. The majority of the respondents (67.1%) said the landfill should be relocated while 20.6% said the authorities should at least stop dumping more garbage in the landfill. Others (21.8%) suggested that some form of recycling be done on the waste to reduce on the amount that ends up in the damping site. 26.5% of the respondents suggested that the waste should be properly covered. 4.7% 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 2 Suggested solutions to the stated problems



5 Conclusions

This study has established that the presence of a disamenity such as a landfill in an area decreases property values and this affects the economic and social livelihoods of the people living in that vicinity. This implies that people's willingness to acquire and economically utilise a property such as land is heavily determined by the prevailing and expected environmental, political and social conditions. This study underscores the need to consider the effect of poor environmental management on marketed goods such as land and houses even in a situation of underdevelopment. This calls for a concrete policy on location and management of landfills and related legislation to encourage waste recycling as the latter would greatly reduce on the amount of waste that is taken to the landfill.

The findings of the study bring to the forefront the need for sensitisation programmes aimed, particularly, at minimising waste generation targeting households and other institutions like schools and hospitals, which generate large quantities of biodegradable waste.

There is need to strengthen environmental compliance review of potential landfill operators. Those who aspire to manage the landfill should have strict guidelines and regulations that they must follow to ensure that the negative impacts of the landfill are mitigated.

Standards need to be set for safe transportation of solid waste by trucks and thereafter proper disposal and management of the landfill. Containers used to transport solid waste should be leak-tested and covered. It would be a violation to allow open and obsolete trucks to transport waste to the damping site. Apart from that, proper coverage using soil should be done to minimise the smell.

There is need to authorise a local government with planning authority over a sanitary landfill. This local government officer would have authority to inspect the landfill and ensure that the set standards are adhered to.

There is need for strict zoning to ensure that homes are not built too close to the landfill to avoid the disamenities. These results could be used to determine the radius of distance in which residential houses should not be built. Evidence from this research regarding the effect of accessibility to amenities on property value is inconclusive and further investigation is recommended.

This study has demonstrated that property owners are able to attach correct near market and fairly rational values to their property bearing in mind the environment within which the property is located and the prevailing information. Hence, this study has showed that hedonic price model can also be used in a developing country like Uganda. However, an area of further research could be using actual land sales data to see if there would be any differences in the results. Therefore, further research is recommended.

Acknowledgements

We sincerely thank DAAD for funding this study to the end. We also like to acknowledge Makerere University for providing us with a conducive and enabling environment that helped us finish the study successfully.

References

Abeles-Allison, M. and Connor, L.J. (1990) *An Analysis of Local Benefits and Costs of Michigan Hog Operations Experiencing Environmental Conflicts*, Agricultural Economics Report #536, Department of Agricultural Economics, Michigan State University, East Lansing, Michigan.

Arthur, C., Nelson, J.G. and Genereux, M. (1992) 'Price effects of landfills on house values', Published by University of Wisconsin Press, *Land Economics*, Vol. 68, No. 4. November, pp.359–365.

Bartik, T.J. (1987) 'The estimation of demand parameters in hedonic price models', *Journal of Political Economy*, Vol. 95, No. 11, pp.81–88.

Benjamin, J.D. and Sirmans, G.S. (1996) 'Mass transportation, apartment rent and property values', *Journal of Real Estate Research*, Vol. 12, No. 1, pp.1–8.

Boxall, P.C., Chan, W.H. and McMillan, M.L. (2005) 'The impact of oil and natural gas facilities on rural residential property values: a spatial hedonic analysis', *Resource and Energy Economic*, Vol. 27, pp.248–269.

Boyle, M.A. and Kiel, K.A. (2001) 'A survey of house price hedonic studies on the impact of environmental externalities', *Journal of Real Estate Literature*, Vol. 9, No. 2, pp.117–144.

Brisson, I. and Pearce, D. (1995) *Benefits Transfer for Disamenity from Waste Disposal*, Working Paper, CSERGE, University College-London.

Court, A.T. (1941) *Hedonic Price Indexes with Automotive Examples, in the Dynamics of Automobile Demand*, General Motors, New York.

Freeman, A.M. (1979) 'Hedonic prices, property values and measuring environmental benefits: a survey of the issues', *Scandinavian Journal of Economics*, Vol. 81, pp.154–171.

Grass, R.G. (1992) 'The estimation of residential property values around transit station sites in Washington DC', *Journal of Economics and Finance*, Vol. 16, No. 2, pp.139–146.

Graves, P., Murdoch, J.C., Thayer, M.A. and Waldman, D. (1988) 'The robustness of hedonic price estimation: urban air quality', *Land Economics*, Vol. 64, No. 3, pp.220–233.

Hite, D., Chern, W., Hitzusen, F. and Randall, A. (2001) 'Property-value impacts of an environmental disamenity: the case of landfills', *Journal of Real Estate Finance and Economics*, Vol. 22, Nos. 2–3, pp.185–202.

Hufschmidt, M.M., James, D.E., Meister, A.D., Bower, B.T. and Dixon, J.A. (1983) *Environment, Natural Systems, and Development: An Economic Valuation Guide*, The Johns Hopkins University Press, Baltimore and Loudon.

Ihlanfeldt, K.R. and Taylor, L.O. (2004) 'Externality effects of small-scale hazardous waste sites: evidence from urban commercial property markets', *Environment Economic Management*, Vol. 47, pp.117–139.

Lancaster, K.J. (1966) 'A new approach to consumer theory', *Journal of Political Economy*, Vol. 74, pp.132–157.

Lars, M.J. and Boyer, G. (1999) *Observations of Solid Waste Landfills in Developing Countries Africa, Asia, and Latin America*, The International Bank for Reconstruction and Development/The World Bank 1818 H Street, N.W. Washington DC 20433, USA.

Linneman, P. (1981) 'Some empirical results on the nature of the hedonic price function for the urban housing market', *Journal of Urban Economics*, Vol. 8, No. 1, pp.47–68.

Lyons, M., Luria, P. and Harris, J. (2009) *Recycling and Public Health*, A Report by Environment Agency, on *Health Impact Assessment of Waste Management: Methodological Aspects and Information,* Liverpool John Moores University, Hatoon Garden, Liverpool L3 2AJ.

MEA (2005) *The Millennium Ecosystem Assessment*, Island Press, Washington DC.

Mieszkowski, P. and Saper, A.M. (1978) 'An estimate of the effects of airport noise on property values', *Journal of Urban Economics*, Vol. 5, No. 4, pp.425–440.

Nelson, A.C., Genereux, J. and Genereux, M. (1992) 'Price effects of landfills on house values', Published by University of Wisconsin Press, *Land Economics*, Vol. 68, No. 4, November, pp.359–365.

O'Byrne, P.H., Nelson, J.P. and Seneca1, J.J. (1985) 'Housing values, census estimates, disequilibrium, and the environmental costs of airport noise: a case study of Atlanta', *Journal of Environmental Economics and Management*, Vol. 12, No. 2, pp.169–178.

Ostenfeld, C. and Wriborg, J. (COWI) (2000) *A Study on the Economic Valuation of Environmental Externalities from Landfill and Incineration of Waste*, Final Main Report. European Commission, DG Environment, October.

Parsons, G.R. (1986) 'An almost ideal demand system for housing attributes', *Southern Economic Journal*, Vol. 53, pp.347–363.

Pearce, W.D. and Turner, K.R. (1990) *Economics of Natural Resources and the Environment*, Ashford Colour Press Ltd., Gosport, Hampshire.

Quigley, J.M. (1984) 'Non-linear budget constraints and consumer demand: an application to public programs for resident housing', *Journal of Urban Economics*, Vol. 12, pp.177–201.

Rosen, S. (1974) 'Hedonic prices and implicit markets: product differentiation in pure competition', *Journal of Political Economics*, Vol. 82, pp.34–55.

Sikyajula, E. (2003) *An Assessment of the Current Solid Waste Management Practices in Kampala with Respect to Sustainability*, Dissertation BSc, Civil Engineering, Makerere University, Kampala-Uganda.

Triplett, J.E. (1986) 'The economic interpretation of hedonic methods', *Survey of Current Business*, Vol. 66, pp.36–40.

Uganda Bureau of Statistics (UBOS) (2002) *Uganda Population and Housing Census-Provisional Results*, Uganda Bureau of Statistics, Kampala-Uganda.

Uyeno, D., Hamilton, S.W. and Biggs, A.J.G. (1993) 'Density of residential land use and the impact of airport noise', *Journal of Transport Economics and Policy*, Vol. 27, No. 1, pp.3–18.