Predicting Residential Property Values Around Landfill Neighbourhoods in Lagos, Nigeria

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Abstract Some studies have proven landfills to negatively impact value of residential properties within kilometers of proximity while few others have generated mixed conclusions. This study establishes a predictive model for residential property values within 1 200m proximity to the four landfills in Lagos State by examining their varying sizes, operating status and history inclusive of diminution tendencies. The relationship between each landfill and property values were measured based on interval of 300 meters up to 1 200 meters in concentric rings.

The resultant model validates the findings of the study that across the four landfill sites, increases in property values were evident as distance away from the landfills increased indicating that residential houses in close proximity to the landfills suffered value loss. Property appreciation relative to distance averaged 5.75% within the concentric rings for all four landfills.

The study suggested the closure of all landfils within residential areas and a relocation of such to uninhabited areas in the city's outskirt in order to promote sustained value appreciation

Keywords: Landfill, Distance, Value, Residential Property Value & Model.

1. Introduction

The location of landfills within residential neighbourhoods has for long been confirmed to create negative externalities capable of eroding residential property values as identified in literature. The dumping and accumulation of wastes in landfills give rise to bad odours, vermin and flies, while litters may spread from the landfill if not properly kept and policed by the various agents of dispersion. In addition, air pollution caused by suspended loose dust particles due to the covering and compacting activities of landfills could prove hazardous to neighbouring residents and passer-by as well. Being ignorant of the economic impact of landfills on the value of proximal residential properties is to neglect the loss accrued to the property market of a society via landfill stigmatisation. Therefore, for a good number of reasons, it is important to ascertain the disparity in capital value / rents between similar properties different only in distance from a landfill in order to keep affected property owners abreast of the marketability of their assets. Also, in the event where a landfill project is subjected to cost-benefit analysis, estimates of property price effects can be incorporated into the cost-benefit profile.

Prior studies on the impact of sanitary landfills on residential properties have established negative relationship between residential house prices and proximity to landfills. Indications via these studies point out that values of residential properties situated within a six kilometre radius from any prominent landfill site rise by approximately 5 to 7% per 1.6 km distance away from the said site. Negative value effects have been rarely found for properties located in excess of six kilometres away from landfills. Property values, however, fall more dramatically (between 21 and 30 percent) the closer (within 400m to 800m radius) the properties are situated to a landfill site.

A few recent studies, however, have found no statistically significant relationship existing between house prices and proximity to modern landfills.

This present attempt employs a quantitative approach in establishing an appropriate model capable of determining the capital values of residential properties within 1 200m concentric circle distance to the sanitary landfills. the study is structured into seven sections with the first being the introductory. Section 2 discusses the study area and the subsequent section presents previous study on sanitary landfills and residential property values. Section 4 describes the data collection and research methods employed for the study with the data being analysed alongside operationalisation of variables discussed in section 5. The section also contained the findings of the study in detail. Section 6 dealt with the research findings with recommendations presented in section 6. Lastly, section 7 concludes the study.

2. The Study Area

Lagos State covers an area of about 3,577 square kilometers, representing 0.4% of Nigeria's territorial landmass according to Esubiyi (1994). The State shares boundary in the North with Ogun State, West with the Republic of Benin, and stretches for over 180 kilometers North of the Guinea Coast of the Atlantic Ocean. Politically, Lagos State according to Ogunba (1997) had expanded as a result of rural-urban drift and had become a metropolis enclosing settlements such as Mushin, Oshodi, Ikeja, Agege, Shomolu and Bariga.

Figure 1. Map of Metropolitan Lagos



Source: Lagos State Ministry of Information

Lagos State has 16 Local Government Councils as shown in Fig 1 and 57 Local Government Development Areas. Since the metropolis spans across many councils, municipal services are actually carried out by central bodies e.g. the Lagos State Water Corporation (LSWC), the Lagos State Transport Management Agency (LASTMA) and the Lagos State Waste Management Authority (LAWMA)

In 1977, the Lagos State Waste Disposal Board (LSWDB) was formed vide Edict No. 9 of April, 1977 with the mandate to collect and dispose solid waste from commercial and residential sources. In 1980, the refuse Disposal Board was renamed 'Waste Disposal Board' with additional responsibilities of commercial/industrial waste collections and drains cleaning. To ensure compliance by Lagosians of the tenets of environmental laws, Lagos State Environmental Protection Agency (LASEPA), Lagos State Waste Management Authority (LAWMA) and Kick against Indiscipline (KAI) were established.

The regulatory agencies comprised the Ministry of Environment and Planning and the Health Management Board (HMB). Amongst the agencies, LAWMA was particularly vested with the responsibility of monitoring municipal landfills and waste management. Lagos represents all the ideals of property development whether commercial, industrial, recreational or residential. There are four major landfills in Lagos namely Olusosun in Ojota (Ikeja Local Government Area), Abule-Egba, and Solous (Alimosho Local Government) and Gbagada (Kosofe Local Government) respectively under the control and management of Lagos State Waste Management Authority. For the purpose of this study, all four were selected based on their present functional status.

3. Previous Studies on Residential Property Value and Landfills

The various professionals within the real estate industry each have diferent perspectives to the concept of value. To the Architect, value is aesthetic, to the Quantity Surveyor, it is cost implicative, to the Urban and Regional Planner, it is social value, Ratcliff (1978) and to the Estate Surveyor and Valuer, it is market value, Thorncroft (1975). Value by the layman is often expressed in money or other appropriate medium of exchange that is thought to be a fair exchange for something. It indicates the power of a commodity to command other commodities in exchange. The worth of such exchange is its market value. This provides the principal yardstick for measuring the worth of properties and other similar commodities. Though this is a subjective process, the Open Market Value (OMV) of a with-held interest on land has from time been famously established via this method. In a valuation bid, an Estate Surveyor and Valuer estimates the value of a landed interest by assessing the possible monetary worth a potential buyer would place on a property with respect to its uniqueness, characteristics, finishes, immediate location and other environmental factors which could act as price facilitators or depressants.

Most importantly, locational features such as sanitary landfills have to an extent, played down on the expected Open Market Value of properties in its close proximity. In American literature sanitary landfills have been found to be diminutive on residential properties as far back as 1971. Gamble et al (1982) estimated hedonic pricing regressions for house sales near a landfill in Boyertown in Pennsylvania. The purpose was to determine the extent of impact the landfill had on surrounding property values. When the distance was split and separate regressions estimated by year of sales, the estimated coefficients for distance to the landfill were not statistically significant at the 5% level of confidence. One of the estimated implicit prices was even negative implying higher prices closer to the landfill. This result was later cited by Cartee (1989) and Parker (2003) as evidence that modern landfills need not have negative impacts on property values. Though it could be argued that the modern landfill in this context must have incorporated certain inherent qualities that helped lessen the environmental effects of the landfill. Also, the span of the distance split in the above study was not specified so as to show the magnitude of the impact. This present research would address the gap by adopting 1.2km radius of the concentric ring to measure the impact of the landfill on value. A linear regression model would be employed at 95% degree of confidence.

Havlicek et al (1985) analysed 182 single family house sales between 1962 and 1970 surrounding four landfills in the Fort Wayne, Indiana region. Their variables of interest were both the linear distance of residential properties from the nearest landfill and the deviation (in absolute degrees) from the prevailing downwind direction from the landfill. Both the distance and the wind variables were of the hypothesised sign and were significant at 5% confidence level. Their results indicated that for each degree away from downwind, the value of the house increased by about \$10.30 and for every thirty centimeter distance away from the site, price increased by about \$0.61 in a linear fashion. Residents signified their preparedness to pay more when asked how much more they would be willing to pay for an identical house located a

kilometer further away from the hazardious waste site. The above study is significant to the current study because the distance variable was a common factor central on both studies. A small sample size of 182 single family house sales was adopted for analysis whereas a larger sample size of 2 341 has been adopted in the current study. Also, the choice of residential properties as a focus of research introduced a degree of similarity. However, while Havlicek, Richardson and Davies (1985) adopted a linear distance of 1 mile or 1.6 kilometers in their study. The present study has adopted 1.2kilometers in view of the fact that in Lagos, the overall pattern of development does not exhibit a well laid out plan like developed countries. One major outstanding feature of their study was the rigour of not only splitting the distance into centimeters, but also ascribing values to residential properties near the landfill. The distance gradient relationship adopted in the current study was 300meters to a maximum of 1 200 meters both in linear form and concentric rings.

Cartee (1989) specifically embarked on a study to consider whether sanitary landfills had any adverse effect on community development and residental property values, and if so, measure their magnitudes in selected areas of Pennsylvania. Ten sanitary landfills operating under permits from the Department of Environmental Resources in Pennsylvania were selected for the study. The sanitary landfills were selected based on the presence of residential development in the surrounding communities. The objective was to measure the effects of the landfills on community developments and residential property values. "Study areas" were defined as delineated as those around one mile of the landfills. Four randomly selected areas, each one-half mile in diameter, located three miles away from each landfill site constituted the "control areas". Several types of data were collected for the landfill and control areas. These data included the number of properties by size, class, dates of new residential building and proximity of properties to the landfill with respect to three distance zones. For properties purchased from 1977 to 1981, several other house, lot and locational characteristics were also studied.

The study employed multiple regression technique to measure the effect of landfills on residential property values. Regression results showed that in 1977 and 1979, the landfill had no discernable effects on residential property values. In 1978, the "distance to the landfill" variable was significant at 5-10% level of confidence. This suggests that distance variable was strongly intercorrelated with some other variables. The outcome of the research showed that different sets of property characteristics and different functional forms led to the general conclusion that things other than proximity to the sanitary landfill were more relevant to explaining property values. It can be deduced from the study that the real estate markets are dynamic and local in many respects. Also, landfills are rather heterogeneous varying in size, visibility, accessibility and appearance and that these intervening variables could affect study conclusions.

Reichert et al (1991) examined the effects of proximity to five municipal landfills in Cleveland, Ohio in the United States. The semi-rural towns studied were Belchertown, Hudson, Ware, Clinton, Pepperrell and Leicester, all located in Central and Western Massachusetts, which had, landfills with varying sizes, operational staus and history of contamination. Using Ordinary Least Squares, inflation adjusted housing prices were regressed upon the series of variables derived from previous studies. Regression results indicated that only one landfill (Pepperell) had a significant negative impact on property values. Although this particular landfill was closed, it was unlined and uncapped, and the fact that the landfill was on the US EPA's "potential health risk" list might have contributed to its visibility in the community. Extrapolated results showed that a typical house located half a mile from the landfill experienced a 6% rise in property value, while the same increased in value by one percent when located two miles away. This six percent diferential for a house valued at \$120,000 (the average value for the study) was \$7,200. However, in respect of Hudson, Ware, Clinton, Pepperell and Leicester, no statistically significant effects were found. The reason coud be that these effects did exist but were not detected in the study or possibly of the small sample sizes drawn on each of the landfills. Overall, the study did not provide grounds for broad generalisation about the effects of rural landfills on property values. It cannot be said that large landfills affect property values more than small ones as Hudson was the largest landfill studied and its effect was statistically insignificant. Open landfills do not affect values more than closed, as Hudson and Ware were still operationing and show no significant effect. Landfills which seem to pose a threat to human health may affect property values more than others: Pepperell was on EPA's list as potentially posing a threat to human health. If the depreciation of local property values around the landfill was a concern of town officals, it seems that the best course of action would be to keep the landfill as clean and policied as possible.

In a more relevant study, Nelson et al (1992) studied the effect of a Ramsey, Minnesota landfill on 708 house sales between 1979 and 1989. Their dependent variable was residential property sales' prices, while distance from the landfill, age of house, number of bedrooms and bathrooms were also included as independent variables. The author found that the two landfills had a negative effect on single family house values for homes within 2 mile radius. The study showed that a home located at the boundary of the landfill could suffer a reduction in value of more than 12% while the value of a property located at one mile radius from the landfill could decrease by an estimated property gradient of 6.2%. The result of this study contrasts with Gamble et al (1982) who found no negative impact resulting from proximity of residential houses to landfill. Nelson, et al (1992) adopted 2 miles as the maximum distance.

Bouvier et al (2000) estimated hedonic regression for houses located near six landfills in Central and Western Massachussetts, two of which were open and active during the study period. The six landfills differed in size, operating status and history of accumulation. The effect of each landfill was estimated by the use of multiple regressions. In five of the landfills, no statistically significant evidence of an effect was found. In the remaining case, evidence of an effect was found, indicating that houses in close proximity to this landfill suffered an average loss of about 6% in value. Also, for two of the landfills, the estimated Marginal Implicit Price (MIP) of distance was positive for one distance and negative for the other, but statistically insignificant for both cases. It was observed from the study that the estimated negative coeficient had high sampling variability due to small sample size. The small sample size had thereby introduced some degree of unreliability in the result obtained. The study however established an empirical relationship between residential property values and and proximity to a landfill or set of landfills.

Cambridge Econometrics et al. (2003) conducted economic study of house prices around landfill sites in the United Kingdom that was undertaken as part of a landfill tax review for the Department of Environment, Food and Rural Authority (DEFRA). The study provided additional evidence of an association between proximity to landfill and wealth. The study looked at over half a million sales of houses situated near 11 300 U.K landfill sites and found that those properties sited within half a mile of a landfill site suffered statistically significant disadvantages. The value of houses situated less than a quarter of a mile away from the landfill site were an average of $f_{.5}$ 500 lower than the value of a similar house not situated near a landfill site. For those houses over a quarter of a mile from the site but under half a mile, the fall in the property value was an average of f_1 600 and less than a quater of a mile saw a fall of 40%. Even within the U.K, there were significant regional disparities with the most marked effects in Scotland, where areas in closest proximity to the landfill site (disadvantaged socio-economic groups) may migrate to areas near hazards to take advantage of lower housing prices. This development as shown in the study by Reichert et al (1991) is characteristic of landfill neighbourhoods because as vacancy ratio increases due to the flight of most residents, people of low class take advantage of this to pay lower rent. The distance-value gradient used in the above study would be employed in the current study using concentric rings with the maximum of 1 200 meters.

In another study, Adewusi and Onifade (2006) focused on the effect of urban solid waste on physical environment and property transactions in Surulere Local Government Area of Lagos State. The study administered questionnaires randomly on residents and firms of estate agents to gather data on the subject matter. Data obtained were analysed using frequency tables and percentage ratings. The study found that rents paid on properties adjoining waste dumpsites were lower compared to similar properties further away and also, property transaction rates were very slow and unattractive as one approaches a dumpsite.

In the same vein, Bello (2007) used multiple regression analysis to determine the effect of waste dumpsites on property values in Olusosun neighbourhood at Ojota, Lagos State. The study found that property values increase with distance away from dumpsites. Also, Bello and Bello (2008) conducted a research on the willingness to pay for environmental amenities in Akure Nigeria. The study included environmental amenities such as waste water disposal, water and electricity supplies, neighbourhood roads and other locational services. The study used a two-staged hedonic model to examine the willingness to pay for better environmental services by residents of two neighbourhoods in Akure, Nigeria. He combined multiple regressions and predictive model to determine property values as a function of housing attributes and logistic model as willingness to pay. The study identified households' income, distance away from the refuse dump site and regularity of electricity supply as the major factors that influenced household's willingness to pay for better environmental services. The study recommended economic empowerment of the people, diligent consideration in the location of dumpsites and adoption of Public-Private Initiative in the provision of public infrastructure. The study established that real estate values are readily influenced by residents williongness to pay for both structural as well as neighbourhood characteristics where the real estate is located. However, Bello and Bello (2008) failed to relate property values with distance from the waste dump site as a computable model. This present study fills this gap.

Bello (2009) carried out a study on the effects of waste dump sites on proximate property values in Lagos, Nigeria using three dump sites located at Olusosun, Abule Egba and Solous adopting 1km distance measurement to assess the effects of the dumpsite on the neighbourhoods. The research sampled 334 residents from the three waste dump sites and 107 Estate Surveying and Valuation firms in metropolitan Lagos. The study was in the main to measure the effect of waste dump on property values and to develop an appropriate valuation methodology to carry out valuation of properties affected by waste dump sites. A combination of valuation methodologies was adopted such as Paired Sales Analysis, Contingent Valuation Analysis, Option Pricing Model and Hedonic Approach. The study found that there was a weak linear relationship between rental value and satisfaction of occupants in the neighbourhood of the waste dumps.

In Akinjare et al. (2011), the impact of four operational sanitary landfills (Gbagada, Olusosun, Abule-Egba and Solous) on proximal residential properties in Lagos metropolis of Nigeria was studied using a sample size of 2 341 residents across four landfill sites. Also, 229 Estate Surveyors and 315 Lagos State Waste Management Agency (LAWMA) officials provided data for the study. Data analysis using a hedonically derived regression function in evaluation of data drawn from administered questionaires showed a slight evidence of statistical significance indicating that all residential property values increased with distances away from landfill sites at an average of 6% from landfills.

Several other studies have established empirical relationships between residential property values and proximity to sanitary landfills. Some of these studies have estimated a hedonic price function, where the price of a residential property is regressed on the characteristics and the proximity of the landfill to the house. Many of these studies also have identified that houses located proximal landfills command lower prices than similar houses located farther away. One of such widely-cited study is that of Nelson et al (1992), which found diminutions in residential property values within 2 miles of a particular landfill with an average property value gradient of 6.2% per mile.

Notably, many of these studies were based on relatively small samples of house sales, so that the sampling variability in the estimated relationship between proximity and house price was high. It is possible that the landfills studied had negative impacts on nearby property values but that the relationship could not be statistically identified due to small sample sizes. There is yet to

be a large-sample sized study that conclusively demonstrates small or non-existent property value impacts from a landfill. This current study again fills this gap in literature.

This study attempts to formulate a model capable of predicting prices of residential properties within the neighbourhood of landfills in Lagos State. Obtainable results will form a good basis for understanding property market behaviour and consequently the price effects of the landfills as properties get distant from it. Of paramount note is the simple fact that attributes of the present study are similar to most of the principal attributes of the aforementioned studies however, the use of a table of intercept, property mean values for different categories of property at different distances away from the landfill sites, tables for Housing Variables, neighbourhood attributes and year of sale were inclusively computed in a bid to derive a suitable and functional model. Results show that the four landfills differ in their impact on nearby property values. While two of the three landfills have statistically significant negative impacts on nearby property values, the smallest, least prominent landfill does not.

4. Data Collection and Research Methods

Primary data were collected through questionnaires distributed to Estate Surveyors and Valuers, residents within 1.2km to the four landfills as well as officials of the Lagos State Waste Management Authority (LAWMA). The study sampled every third houses within 1.2 km distances from the four landfill sites. The response is as follows; Gbagada –(848), Olusosun – (674), Abule-Egba –(422) and Solous –(397). In addition, 229 Estate Surveyors and 315 Lagos State Waste Management Agency officials returned questionnaires administered to them. The survey recorded an average response rate of 78% and collected data were analysed using descriptive and analytical statistics.

Since the impacts of a landfill on nearby residential property values are not expected to be uniform as ascertained from literature, values are expected to increase with distance away from the landfill, the concentric ring model was then used in analysing landfill impacts on residential property values.





Source: *Author's Construct, (2010)*

5. Data Analysis and Operationalisation of Variables.

In an attempt to articulate the model developed for predicting residential property values around landfill, a Table of intercept and property mean values for different categories of property at different distances away from the landfill sites was computed. In addition, Tables for Housing Variables, Neighbourhood attributes and year of sale were computed.

For each of the property type, there is a need to determine the intercept (α_{Li}) of percentage mean values as distances increase away from landfill.

Property	Tenement	2Bedroom	4No 3b/r Flat	4 b/r Duplex	4 b/r	5 b/r
Distance (m)	House	Bungalow		-	Detached	Detached
		_			House	House
0	αĹł	αĹł	αĹi	αĹi	αĹi	αĹi
300	2	2	3	3	3	3
600	3	3	5	6	5	6
900	5	6	7	8	8	9
1200	5	6	7	8	8	9

Table 1. Intercepts (a₁) of % of Property Mean Value (MV) in Relation to Distance

Source: Field Survey, 2010

Table 1 shows that the base value α_{Li} = mean value of property earlier discussed in table 2 below hence α_{Li} for 4 bedroom duplex was N13.11million. Table 3 showed the intercept of property mean value along the radius line, thus as the distance increases from the landfill location, the intercept (mean values) of residential properties change. The intercept in this case demonstrated the percentage (%) change in mean value along the intercept line. With the mean value of 4 bedroom duplex put at at 0 meter (base value), the percentage change in mean value at location 300 meters was 3%, 600 meters 6% and 900meters, 8 %. It could be observed that at adistance 1 200meters away from the landfill, the percentage change remained constant at 8%. This means that the impact of landfill on residential property values had disappeared completely, thus property values had rebounced back and hence assumed full market value. It could be observed that all categories of residential properties in table 2 had assumed full market value at a distance 1200 meters away from landfill sites.

Location	Abule Egba Non Landfill Residential Neighbourhood in (=N=000,000)				
Property Type	Landfill	Non landfill	Diff in Value	% Increase.	
4nos 3bdrm flats	8.6	10.5	1.9	22.09	
4bdrm duplex	10.4	12.8	2.4	23.08	
5bdrm Duplex+ b/q	13.04	15.7	2.3	17.64	
5bdrm Detached+ b/q	12.6	16.5	3.9	30.95	
4bdrm Detached+ b/q	10.2	13.4	3.2	31.37	
3bdrm Duplex+ b/q	9.21	10.7	1.49	16.18	
Tenement House	4.1	6.2	2.1	51.22	

Table 2. Residential Property Value Outside 1.2km Concentric Rings of Abule Egba Landfill Neighbourhoods

Source: Field Survey, 2010

5.1 Percentage Change of Property Values by House Characteristics

House characteristics are fundamental to the determination of property values. However, since house characteristics were not the only contributory factor of value, the level of percentage contribution can be easured across the four landfill sites. In another, it is also possible that the percentage change in value resulting from house variables would not be the same for the four landfill locations. Table 3 shows the tabulation for the four landfill sites.

Landfills	Gbagada	Abule- Egba	Solous	Olusosun
β _i H	0.68	3.66	4.13	1.34
% Change	12.4	8.33	9.5	7.1

Table 3. Percentage Change Due to Housing Variables (X_1, \dots, X_n) .

Source: Field Survey, 2010.

Table 3 showed the different levels of percentage change brought about by diferences in house variables which in Gbagada accounted for 0.68 translating to 12.4%. In the same vein, at Abule Egba, housing variables accounted for 3.66 leading to 8.33% change in value. Solous equally recorded 4.13 for house variables resulting in 9.5%. Olusosun had 1.34 for house characteristics and 7.1% change. It was apparent from the pattern of percentage change that Gbagada had the highest which could be attributed to its proximity from the Central Business District (CBD). Solous recorded 9.5% which could be adduced to newness of environment as many of the structures that were new and of modern architecture with adequate amenities provision. The pressue being mounted on inadequate stock of accommodation especially by Lagos State University (LASU) Students and staff was another consideration. This appeared to have compensated for proximity to the CBD at Ikeja.

Abule Egba with 8.33% could be attributed to its location along Abeokuta express road axis. The quest to locate very close to a CBD brought about undue pressure leading to demand for accommodation. Unfortunately, the issue of amenities provision could be a serious consideration but at the same time could be traded off for proximity and accessibility. The property market at Olusosun at Ojota recorded the least percentage change in house characteristics of 7.1%. The reason for this development might be due to the fact that the market there had become saturated such that it had become less sensitive to any addition or substraction to house variables. Property value there revolved around a focal point because the market was localised.

5.2 Percentage Change in Property Values by Neighbourhood Attributes.

The quality of a neighbourhood is a function of its accessibility, drainage, power supply, water provision, security and road network. Notwithstanding that the contributions of these neighbourhoods differ from one location to another and of course, the percentage change brought about on property values also differed.

Landfills	Gbagada	Abule- Egba	Solous	Olusosun
$\beta_i \mathbf{N}$	0.051	0.032	0.027	0.045
% Change	10.2	6.4	5.4	9

Table 4. Percentage Change in Property Values Due to Neighbourhood Attributes

Source: Field Survey, 2010

Table 4 shows that Gbagada had the highest rating of 0.051 translating to 10.2% enhancement on property values around there. Olusosun experienced a 9% property value appreciation while Abule Egba enjoyed a 6.4% and Solous a 5.4% property appreciation respectively. The high property appreciations in Gbagada and Olusosun landfill neighbourhoods canbe attributable to the Lagos State Government's presence in the two neighbourhoods going by the various housing schemes such as Gbagada Phase 1 and 11, Medina Estate, Atunrase Estate in Gbagada and the industrial plants of 7up bottling company, Phillips Electronics, Ogudu G.R.A, Alapere Housing Estate and Ikosi Residential Estate in Ojota axis of Olusosun landfill.

5.3 Percentage Change by Property Year of Sale.

Characteristically, property values appreciate overtime except where there is war, natural disaster and unforseen circumstances. Thus, it is logical to have property values increasing with time passing. Also, the period of sale therefore matters in the determination of property value. The percentage change in value due to year of sale was not expected to be uniform across the four landfill neighbourhoods. The differences in percentage change for each landfill had been computed as shown in table 5.

Landfills	Gbagada	Abule-Egba	Solous	Olusosun
Yi	12.2	24.7	38.3	14.02
% Change	13.04	15.9	21.9	12.3

Table 5. Percentage Change due to Property Year of Sale

Source: Field Survey, 2010.

Table 5 displays the progression of percentage change in the four landfill sites in relation to the very year of a particular property was disposed of. The calculation has 2003 as its base year. From the rable, it becomes clear that Solous has the highest percentage rating of 21.9%. the reason for this could be due to the relative newness of the neighbourhood coupled with the quest for acquisation of property for residential purposes. The simple fact that property values towards the Lagos Island were climbing sky high had made people to move towards the outskirts thus exerting undue pressure on the existing stock. The same reason could also be adduced to the pattern of change in Abule Egba with 15.9% recorded. It simply means that the further away a location is from the CBD, the higher the tendencies for property acquisition and development. The pattern of percentage change in Gbagada; 13.04 and Olusosun; 12.3% underscores the earlier arguement since these two locations were in close proximity to the CBD. Like earlier stated, these locations have attained full maturity in property development hence; the rate of property sales was not volatile like the developing neighbourhoods of Solous and Abule Egba.

In paraphrase, the interpolation of data collected as contained in the analysis of data was carried out to generate the values in Tables 3-5 above. The change or increase in values was based on simple percentages on the intercept values per landfill. The four landfill areas located in different parts of Lagos have some basic similarities in terms of nature of property values but at the same time had magnitude of impacts of other variables. This informed the differences in the pattern of change in the model from one landfill to the other as shown in the model table.

Variables	Landfills				
	Gbagada	Olusosun	Abule Egba	Solous	
House	12	7	8	10	
Characteristics					
Neighbourhood	10	9	6	5	
Characteristic					
Year of Sale	13	12	16	22	

Table 6. Composite Change In Attributes Of Property Values Across the Four Landfills.

Source: Field Survey, 2010.

Table 6 presents at a glance the level of percentage contributed to the overall property value in each of the four landfill sites. The result as shown in the table is illustrated in graphical form as shown in Fig 1.



Fig.1 Percentage Change in Variable Attributes Across Landfill Sites

5.4 Validation of the Landfill Model.

From the initial model: $\mathbf{PV}_{di} = \boldsymbol{\alpha}_{Li} + \boldsymbol{\beta}_i \mathbf{H} + \boldsymbol{\beta}_i \mathbf{N} + \mathbf{Y}_i + \mathbf{C}$, the value of a 4bedroom duplex located within the fringes of 0-300 meters radius at Olusosun in Ojota can be derived thus; $\boldsymbol{\alpha}_{fi} = = N = 12.52$ million, $\boldsymbol{\beta}_i \mathbf{H} = = N = 167,768$, $\boldsymbol{\beta}_i \mathbf{N} = = N = 5,634$, $\mathbf{Y}_i = = N = 1,755,304.00$, $\mathbf{C} = 0$.

Therefore: $PV_{d(0.300)m} = = N = (12.52 + 0.17 + 0.0056 + 1.76)m = = N = 14.46m.$

Similarly, a 4 bedroom duplex at Gbagada located between 0 and 300meters away from the landfill derived its value thus:

 $\alpha_{\text{Li}} = = N = 3.11 \text{ million}, \ \beta_i \mathbf{H} = = N = 89,148, \ \beta_i \mathbf{N} = = N = 66,861, \ \mathbf{y}_i = = N = 1,575,822.00, \ \mathbf{C} = 0.$ Therefore: $PV_{d(0-300)m} = = N = (13.11 + 0.89 + 0.066 + 1.56)m = = N = 14.84m.$

Adopting the same model in predicting the value of a 4 bedroom duplex at Abule Egba situated within the fringes of of 0-300meters radius can be derived thus;

 $\alpha_{\dot{L}i} = = N = 11.4 \text{ million}, \ \beta_i \mathbf{H} = = N = 417,240.00, \ \beta_i \mathbf{N} = = N = 36,480.00, \ \mathbf{y}_i = = N = 2,815,800.00, \ \mathbf{C} = 0.$ Therefore: $PV_{d(0-300)m} = = N = (11.4 + 0.42 + 0.036 + 2.82)m = = N = 14.67m.$

Similarly, the value of a 4 bedroom duplex at Solous located between 0 and 300meters away from the landfill can be derived thus:

 $\alpha_{\dot{L}i} = = N = 9.54 \text{ million}, \ \beta_i \mathbf{H} = = N = 394,002.00, \ \beta_i \mathbf{N} = = N = 25,785.00, \ \mathbf{y}_i = = N = 3,653,820.00, \ \mathbf{C} = 0.$ Therefore: $PV_{d(0-300)m} = = N = (9.54 + 0.39 + 0.026 + 3.65)m = = N = 13.6m.$

The above mathematical analysis has shown that a 4bedroom duplex house located between 0 meter and 300meters commanded a mean value of =N=12.52million as derived from the questionnaire survey. The advantage of the model was that it can be used to predict residential property value at a given distance and at any specified year. The application of the model to

establish the value of a 4bedroom duplex at the neighbourhoods of the four landfills at Gbagada, Olusosun, Abule Egba and Solous with different valuation figures further confirmed that the impacts of landfill on residential property values vary from one landfill to another.

The study established a model to predict residential property values based on distance from landfills in metropolitan lagos as $\mathbf{PV}_{di} = \alpha_{1i} + \beta_i \mathbf{H} + \beta_i \mathbf{N} + \mathbf{Y}_i + \mathbf{C}$. It was established that the changes brought about by differences in house variables in Gbagada accounted for 0.68 translating to (12.4%). Abule Egba, 3.66 leading to (8.33%). Solous equally recorded 4.13 for house variables resulting in (9.5%), while Olusosun had 1.34 for house characteristics resulting to (7.1%) change in residential property values along the intercept. Also, the level of neighbourhood quality provided in the four landfill locations varied with Gbagada and Olusosun having the higher property value appreciation of 10.2% and 9% respectively while Abule Egba and Solous enjoyed a 6.4% and 5.4% property value appreciation respectively.

6. Recommendations

The Lagos State Government should empower the its waste autority (Lagos State Waste Management Authority -LAWMA) in acquiring modern machinery for compacting landfills so as to reduce methane gas leading to air pollution that often constitute health hazards to residents. Solous, Abule Egba and Olusosun were not pleasant to sight therefore there is an urgent need for suitable action plans and education (via the media on proper handling of waste) by LAWMA in order to improve the monitoring, control and projection of solid waste expected in the nearest future. Expansion of the current recycling programmes through modernised methods with a view of turning waste to wealth in metropolitan Lagos is also expedient.

Despite the present government's enormous effort at attaining environmental sustainability, it is recommended that landfill within fully developed residential city centers be closed down and relocated to city outskirts/ urban fringe. Latest technology on landfill development and operation must be employed in a bid to abate landfill hazards and nuisance. This move would forestall and sustain value in its aesthetic and cost implicative approach, social perspective (Ratcliff 1978) inclusive of its market value orientation to the Estate Surveyor and Valuer (Thorncroft 1975).

Finally, the introduction of the private sector and NGOs is also required most especially in the area of organising waste management workshops and enlightenment programs which would concentrate on grassroots participation and input. The introduction of custom built vehicles for waste collection and disposal is highly commendable as this has drastically reduced the volume of trash thrown along truck routes. The same customised truck vehicles should be made mandatory for the private sector collaborating with Government's effort. Also, Government should improve on the control of truck traffic creating traffic jam along their routes.

7. Conclusions

This current study has established a model for predicting values of residential housing around landfill neighbourhoods. The study has also brought into focus those factors that hitherto might not have received much attention. It is therefore, hoped that if the Lagos State Government is able to look into most of the recommended solutions, appreciation in property values across the state would be sustained.

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