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Original Article

Influence of Location Externalities on Residential Rental Values: Evidence from Nairobi City, Kenya

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ABSTRACT

Location externalities refer to the effects of a particular location on the value, desirability, or quality of neighbouring properties and the well-being of residents in the area. This study investigates the influence of significant location externalities on residential rental values in Nairobi City, Kenya. The methodology employed is a questionnaire survey on a sample of 347 residential tenants within 36 suburbs in Nairobi city. The data are analysed using quantitative methods and presented in tables. According to the study results, residential rental value is significantly influenced by clusters of factors related to the environment, social as well as economic aspects. Specifically, air pollution, crime and insecurity, anthropogenic noise pollution, access to internet connectivity, urban traffic congestion, and inappropriate domestic solid waste disposal are significant location externalities influencing residential rental values in Nairobi City, Kenya. The study recommends regulation and enforcement as well as pricing mechanisms as strategies for managing location externalities in urban areas in Kenya.

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INTRODUCTION

Location externalities, also referred to as spatial externalities or neighbourhood effects, refer to the impact that the location or spatial characteristics of a property or area have on its value, desirability, and the well-being of individuals or communities (Kauko, 2003; Epstein, 2017). These externalities arise from the presence or absence of certain features, amenities, or conditions in a specific location that affect the utility or costs experienced by individuals beyond the immediate participants in market transactions. They can be positive or negative and play a crucial role in shaping various aspects of the housing market and urban development (Jim & Chen, 2007; Rossi-Hansberg & Sarte, 2012; Rossi-Hansberg et al., 2010). Examples of positive location externalities include proximity to amenities, good access to transportation networks, employment opportunities, safety and security and good environmental quality. Negative location externalities include pollution and environmental hazards, noise and congestion, social disamenities and a general lack of amenities and services (Aluko, 2011; Jensen & Harris, 2008; Zheng et al., 2014)).

The concept of location externalities has a long history and has been studied across various disciplines, including economics, urban planning, geography, and sociology. The idea of externalities, in general, can be traced back to the works of classical economists such as Adam Smith and David Ricardo (Parker & Munroe, 2007; Dean & Mc Mullen, 2002). However, the specific focus on location externalities emerged more prominently in the twentieth century as scholars sought to understand the spatial aspects of economic and social phenomena (Correia & Roseland, 2022; Block, 2011). Thus, the study of location externalities has evolved over time, incorporating insights from various disciplines and addressing different dimensions of spatial impacts. It continues to be an essential area of research, providing valuable insights for policymakers, urban planners, and stakeholders in their efforts to create liveable, equitable, and sustainable communities (De Nicolo et al., 2012). Understanding location externalities is crucial for buyers, sellers, investors, urban planners, and policymakers as they influence property values and performance, market dynamics, neighbourhood quality, and the distribution of resources and opportunities within a city or region (Martinez, 2013; Boyack, 2010).

The objective of this study was to determine the influence of significant location externalities on rental values for residential properties in Nairobi City, Kenya.

LITERATURE REVIEW

As Anselin (2003) suggests, urbanisation, the mass movement of residents from rural areas to urban areas, does not in itself lead to negative consequences per se. Urbanisation becomes problematic when it takes place at a very rapid rate and when it is accompanied by uncontrolled urban expansion or urban growth. This situation is further compounded if, at the time of occurrence, the quantum (quality and quantity) of urban infrastructure and services are not adequate to support the influx of inhabitants who have since become urban dwellers (Rossi-Hansberg et al., 2010). The resulting situation is characterised by an imbalance between the available urban infrastructure and services (supply) and the required level of those infrastructure and services (demand).

Consequently, urban inhabitants may suffer from the intermittent supply of urban infrastructure and services and in some instances, complete lack of these services. Above and beyond this, whenever such services are in short supply, regardless of the factors responsible for the shortage, it is very likely that the prices of these commodities will escalate, further impeding their access by urban dwellers (Orford, 2004).

This results in the formation of informal markets since these services are considered a critical component of urban life. This urban inadequacy is manifested in dilapidated road networks arising from lack of maintenance, intermittent electricity supply, lack of telecommunication, information and communication technology, unreliable water

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supply and sewerage services, lack of solid waste management services, lack of drainage, inaccessibility to markets, and general deterioration of education, health and social services (Berliant et al., 2002).

The effects of locational externalities are more noticeable in cities, towns, and urban areas where the urban morphology is characterised by a mix of land types and, as a result, a range of various land uses (Devereux et al., 2007). Thus, a balanced approach to land development to ensure that the various land users within the urban setting coexist harmoniously and promote sustainable development practices is necessary. Unfortunately, ideal as it may seem, such a utopian urban setting is seldom achieved since land in urban areas is highly priced because naturally, it is in short supply and characteristically has a high rent-earning capacity (Tsou et al., 2005).

Consequently, urban land is prone to 'abuse' in the sense that the economic costs of any given land activity often supersede the associated environmental and social costs. The lack of reliable regulatory mechanisms to manage the phenomenon of locational externalities by employing both legal and institutional frameworks is a major impediment to improving the quality of urban life in most Least Developed Countries (LDCs). In essence, the profit motive often overrides the wider societal social costs (Van Soest et al., 2006).

Whereas locational externalities can result in either positive or negative effects within urban and rural areas, this study focuses on urban areas. This is not because urban areas are more important than rural areas; rather, it is because urban areas are naturally more populous, expand at a higher rate and act as hubs of development for the surrounding regions (del Mar Martinez-Bravo et al., 2019).

Influence of Location Externalities on Real Estate Values

Regarding the nexus between location and real estate values, literature is plentiful. Generally, the analysis of this relationship falls into two groups: the methods that involve prices and rents, commonly referred to as market approaches, and interactive approaches that utilise interviews and surveys within the context of property value modelling (Kauko, 2003).

Generally, in economics and law, externalities are considered a major cause of market failure. Market failure refers to a situation in which a free market, left to operate on its own, does not allocate resources efficiently and leads to suboptimal outcomes. In other words, market failure occurs when the equilibrium of supply and demand in a market does not result in the most socially desirable or economically efficient outcome. Thus, externalities arise whenever a given economic activity results in consequences (costs and benefits) on unrelated third parties (individuals or organisations). Depending on the nature of these consequences, externalities can either be positive or negative (Kestens et al., 2006).

Most externalities in the real estate market are spatial in nature, and as a result, their effect lessens with increasing distance from their point of origin (Cordera et al.., 2019). Externalities are one of the major reasons why governments intervene in markets. A significant number of externalities are considered to belong to the category of technical externalities, meaning that their indirect effects fall on the consumption as well as the production activities of other parties without affecting the prices of products. Consequently, differences emerge between private marginal benefit and private social cost (Jim & Chen, 2007).

It is important to note that housing externalities directly affect the decisions of agents with regard to housing investments. Moreover, understanding the nature of these effects has proven to be a challenging undertaking so far as housing markets are concerned. Two scenarios provide an explanation of precisely how investments are uniquely affected. Firstly, investments in housing are considered complements. This means that the marginal benefits accruing to a house occupant

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arising from such a house being painted results in higher utility to the house occupant only if the surrounding houses are also painted (Turnbull & Dombrow, 2006).

Likewise, it is possible for a small number of foreclosed properties to erode investor confidence in a particular neighbourhood, thereby moving it to a lower investment position with regard to market equilibrium. When this happens, it is said to have occurred as a result of the complementarity of investments. Secondly, housing investments in a neighbourhood can act as substitute goods. In this case, agents may be concerned about the consolidated effects of housing services, which in essence, are the totality of their own house characteristics and those of the neighbouring properties (Zabel, 2004).

METHODOLOGY

Research Design

Cross-sectional survey and case study designs were utilised in this study. Babbie (1994) postulates that survey design is probably the best method available for studying social phenomena because it allows researchers to collect original data for describing a population too large to be observed directly. Location externalities are a social phenomenon and a survey approach is appropriate. Thus, the choice of the study design is dependent upon the type of data required, with the main goal being addressing the study objectives effectively.

Target Population, Sample Size and Sampling Techniques

The target population in this study included residential real estate tenants in Nairobi County. Other respondents included valuers and estate agents/property managers. To estimate the population of the residential tenants in the study area, the study used the number of households in the study area according to Kenya's national housing and population census statistics of 2019. From the 2019 national census, Nairobi County had 1,506,888 households, and the number of rented residential properties was 1,354,882 (KNBS, 2020).

Generally, findings from large samples are more reliable than those based on smaller samples, and it is on this basis that this study was grounded. Kumar (2005) contends that a larger sample size will generally produce more accurate findings. In doing this, the sample should mirror the population in all respects. In this study, Yamane's (1967) simplified formula was used to determine a scientifically reliable sample size at the 95% confidence interval and 0.05 level of significance.

$$n = \frac{\mathrm{N}}{1+\mathrm{N}\,(e)^2} \qquad (1)$$

Where N = Total population size, n = Sample size, e = degree of precision (significance).

According to the Kenya Population and Housing Census (2019), Nairobi County had a total of 1,354,882 rented properties. Based on Yamane (1967), therefore;

$$n = \frac{1{,}354{,}882}{1+1{,}354{,}882\,(0.05)^2} = 399.99\ households$$

Hence, a total sample size of 400 households was found suitable for the selection of study respondents. Mugenda & Mugenda (2003) postulate that it is prudent to obtain as big a sample as is feasibly possible when determining the required sample size. Naturally, time and resource restrictions tend to be a major hindrance in this endeavour. The sample size is often a function of other factors, such as the type of research design used by the researcher, data analyses employed and the accessible target population. According to Gay (1981), as cited by Kieti (2015), Masu (2006) and Murigu (2005), a minimum of 30 cases will suffice for correlation studies with 10% of the accessible target population being adequate for descriptive studies. The study used a stratified random sampling technique to interview residential real estate tenants residing within the study area. Thus, a total of 36 suburbs were surveyed from the study area. From the target population of 400 tenants, 347 responded, resulting in a response rate of

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86.75%, which was considered adequate for purposes of analysis.

Data Collection

In this study, data collection was undertaken using quantitative methods to collect pertinent information on location externalities. The data sought was mainly primary data on the market rents for residential properties in the study area. This data was obtained from the survey respondents (residential tenants) and valuers. The following research instruments were used for data collection.

Semi-Structured Self-Administered Questionnaires

A questionnaire is a proforma with a set of well-sequenced questions relevant to the study objectives. Schedules/self-administered questionnaires are more appropriate where the respondents are not well educated than the use of questionnaires (Kothari, 2004). Schedules are faster and ensure that the data collected is complete without omissions/unanswered questions. They also enable high response rates and make the combination of different methods and personal contact possible (Babbie, 1994; Kumar, 2005). This study used schedules due to the above reasons to collect data from residential real estate tenants.

Data Analysis and Presentation

The influence of location externalities on residential rental value was analysed using Correlation Analysis (CA) and Multiple Regression Analysis (MRA) to relate the dependent variable (residential real rental value) against the independent variables (significant location externalities identified in literature and field survey). Residential rental value was used as a proxy for property performance (dependent variable). The location externalities (independent variables)/(predictors) are the environmental, social and economic factors that influence tenant locational decisions and include anthropogenic noise pollution, crime and insecurity, air pollution, proximity to shopping malls, urban traffic congestion, electricity disruptions, vehicular noise pollution, intermittent water supply, illegal dumping of domestic waste, proximity to nearest public primary school, proximity to transport terminus; and, availability of internet connection.

The general Multiple Regression Analysis (MRA) equation is expressed as;

$$Y = a_0 + b_1x_1 + b_2x_2 + b_3x_3 \ldots b_nx_n + \mathcal{E} \qquad (2)$$

Where: Y – is the dependent variable; a_0 – is the regression constant; x_1 – x_n – are the independent/predictor variables; b_1 – b_n – are the regression coefficients; $\mathcal{E}$ - is the error term

Using the 12 significant location externalities, the multiple regression equation can be hypothesised to be:

$$Rent = a_0 + b_1anthropogenic + b_2crime + b_3air + b_4shopping + b_5traffic + b_6E\_disruptions + b_7vehicle + b_8I\_water + b_9dumpsite + b_{10}school + b_{11}T\_terminus + b_{12}internet + \mathcal{E}$$

Where: Rent – Monthly Rent in Kenya Shillings Per Month (Dependent variable); a_0 – Regression constant; b_1 – b_{12} – regression coefficients; anthropogenic – anthropogenic noise pollution; crime – crime and insecurity; air – air pollution; shopping – proximity to shopping mall; traffic – urban traffic congestion; E_disruptions – electricity disruptions; Vehicle – vehicular noise pollution; I_water – intermittent water supply; Dumpsite – proximity to nearest illegal dumpsite; School - proximity to nearest public primary school; T_terminus – proximity to nearest public service vehicle transport terminus; Internet – availability of internet connection

Correlation analysis is used to determine the direction (positive or negative) and the strength (none, weak, moderate, and strong) of linear association/relationship between variables (Kingoriah, 2004). Correlation and regression analysis were performed using Statistical Package for Social Sciences (SPSS) software. Specifically, Pearson correlation (2-tailed) was performed to show how residential rental value (dependent variable) is related to location externalities

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(independent variables). This was necessary to demonstrate how the dependent and independent variables explain each other.

Multiple regression analysis (MRA) was performed by use of ENTER and STEPWISE methods of SPSS. This was necessary to check the relative contribution of location externalities to residential rental value and thus determine the influence of the significant location externalities on residential real estate performance.

RESULTS

Descriptive statistics was first performed on the data to summarise the variables influencing residential rental value to enhance understanding and further analysis. Murphy (1996), as cited in Kieti (2015), suggests that descriptive statistics should be performed on data before correlation and regression analysis to check for the completeness of data sets and whether data obeys the normal distribution curve. Data sets that obey normal distribution curves should have a small value of standard deviation, and the value of mean and median should be equal or almost equal (Kingoriah, 2004; Murphy, 1996, as cited in Kieti, 2015).

In *Table 1*, the descriptive statistics of the rental value (dependent variable) show that the values obey a normal distribution. The mean (70,816.14) and median (51,000.00) values are not too far apart, considering the range of rental values lies between 17,000 (minimum) and 320,000 (maximum). The mode (48,000) and median (51,000) are equally not far apart. In this study, the value for skewness is 1.873, indicating that the data resembles a normal distribution. On the other hand, the value for kurtosis in the study is 4.943, indicating that the data resembles a normal distribution. Kurtosis is a statistical measure that describes the shape of a probability distribution or frequency distribution. It quantifies the heaviness of the tails or the presence of outliers in a dataset compared to a normal distribution. (Westfall, 2014; Kim & White, 2004).

Table 1: Descriptive Statistics for the Dependent Variable

Valid	347
Mean	70,816.14
Median	51,000.00
Mode	48,000[a]
Std. Deviation	51,000.143
Skewness	1.873
Std. Error of Skewness	0.131
Kurtosis	4.943
Std. Error of Kurtosis	0.261
Minimum	17,000
Maximum	320,000

Source: Survey Results, 2023

In *Table 2,* the descriptive statistics for the independent variables are presented. Evidently, the mean and median values for every independent variable are close, an indication that the data obey a normal distribution. For example, the variable 'air pollution' has a mean of 1.81 and a median of 2.0. The variable 'anthropogenic noise pollution' has a mean of 93.75 and a median of 90.0. A value of 1.81 for the variable 'air pollution' means that out of the residential tenants sampled in the study, the average air quality is moderate. With respect to the variable 'anthropogenic noise pollution', a mode of 90 means that the majority of the residential tenants in the study viewed the anthropogenic noise level within their neighbourhoods to be 90 decibels.

A mean value of 16.39 for the variable 'urban traffic' means that on average, it takes a residential tenant 16 minutes using public transport to commute from their residence to the central business district of Nairobi City. Similarly, a mean value of 1.84 for the variable 'electricity disruptions' means that on average, residential tenants experience electricity supply disruptions

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twice a week. On the other hand, the standard deviation values for each of the independent variables indicate the degree of disparity among all the observations in the study. The figures for minimum and maximum values indicate the range between all the observations.

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Table 2: Descriptive Statistics for the Independent Variables

	Air pollution	Anthropogenic noise pollution	Crime & insecurity	Proximity to shopping mall	Urban traffic	Electricity disruptions	Vehicular noise pollution	Intermittent water supply	Illegal dumpsite	Proximity to public primary	Proximity to transport terminus	Availability of internet connection	Number of bedrooms
Valid	347	347	347	347	347	347	347	347	347	347	347	347	347
Mean	1.81	93.75	88.20	3.664	16.39	1.84	95.33	1.52	88.69	3.969	112.14	1.41	3.12
Median	2.00	90.00	85.00	3.500	16.00	2.00	100.00	2.00	74.00	3.800	76.00	1.00	3.00
Mode	2	90	85	2.5	16	2	100	1	94	4.2	51	1	3
Std. Deviation	.481	8.952	42.797	1.4588	5.836	.753	6.324	.544	68.003	1.4802	109.246	.492	.479
Skewness	-.473	.041	.720	.582	.299	.270	-.539	.335	3.772	.356	3.102	.383	2.063
Std. Error of Skewness	.131	.131	.131	.131	.131	.131	.131	.131	.131	.131	.131	.131	.131
Kurtosis	.303	-.671	.839	.103	-.123	-1.195	.302	-1.034	18.218	-.343	12.234	-1.864	6.673
Std. Error of Kurtosis	.261	.261	.261	.261	.261	.261	.261	.261	.261	.261	.261	.261	.261
Minimum	1	70	9	.7	3	1	70	1	17	1.1	19	1	2
Maximum	3	110	236	8.5	35	3	110	3	531	8.2	825	2	5

Source: Survey Results, 2023

Table 3: Correlation Matrix for the Dependent and Independent Variables

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Rent in kshs per month	P. Correlation	1	-.662**	-.546**	-.608**	-.046	-.267**	.001	-.219**	-.025	.481**	-.092	.220**	-.472**	.773**
	Sig. (2-tailed)		.000	.000	.000	.397	.000	.981	.000	.644	.000	.087	.000	.000	.000
	N	347	347	347	347	347	347	347	347	347	347	347	347	347	347
2. Air pollution	P. Correlation	-.662**	1	.484**	.441**	.117*	.255**	.019	.140**	-.009	-.346**	.112*	-.193**	.394**	-.518**
	Sig. (2-tailed)	.000		.000	.000	.029	.000	.724	.009	.860	.000	.037	.000	.000	.000
	N	347	347	347	347	347	347	347	347	347	347	347	347	347	347
3. Anthropogenic noise pollution	P. Correlation	-.546**	.484**	1	.568**	-.034	.052	.084	.310**	-.054	-.375**	.046	-.102	.165**	-.478**
	Sig. (2-tailed)	.000	.000		.000	.528	.334	.118	.000	.312	.000	.393	.058	.002	.000
	N	347	347	347	347	347	347	347	347	347	347	347	347	347	347
4. Crime & insecurity	P. Correlation	-.608**	.441**	.568**	1	-.094	.124*	.008	.301**	-.053	-.330**	-.052	-.108*	.265**	-.419**
	Sig. (2-tailed)	.000	.000	.000		.079	.021	.876	.000	.323	.000	.331	.044	.000	.000
	N	347	347	347	347	347	347	347	347	347	347	347	347	347	347
5. Proximity to shopping mall	P. Correlation	.046	.117*	-.034	-.094	1	.262**	-.081	-.095	-.038	.019	.151**	.015	.018	-.083
	Sig. (2-tailed)	.397	.029	.528	.079		.000	.132	.077	.484	.728	.005	.787	.736	.122
	N	347	347	347	347	347	347	347	347	347	347	347	347	347	347

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		1	2	3	4	5	6	7	8	9	10	11	12	13	14
6. Urban traffic	P. Correlation	-.267**	.255**	.052	.124*	.262**	1	.048	.032	-.103	-.045	.046	-.031	.282**	-.094
	Sig. (2-tailed)	.000	.000	.334	.021	.000		.369	.546	.055	.405	.397	.560	.000	.081
	N	347	347	347	347	347	347	347	347	347	347	347	347	347	347
7. Electricity	P. Correlation	-.001	.019	.084	.008	-.081	.048	1	.081	-.036	.048	-.026	-.071	-.005	.019
disruptions	Sig. (2-tailed)	.981	.724	.118	.876	.132	.369		.133	.500	.376	.626	.186	.925	.728
	N	347	347	347	347	347	347	347	347	347	347	347	347	347	347
8. Vehicular	P. Correlation	-.219**	.140**	.310**	.301**	-.095	.032	.081	1	-.076	-.234**	.023	-.032	.036	-.165**
noise pollution	Sig. (2-tailed)	.000	.009	.000	.000	.077	.546	.133		.159	.000	.674	.553	.509	.002
	N	347	347	347	347	347	347	347	347	347	347	347	347	347	347
9. Intermittent	P. Correlation	-.025	-.009	-.054	-.053	-.038	-.103	-.036	-.076	1	-.063	-.045	.009	.011	-.100
water supply	Sig. (2-tailed)	.644	.860	.312	.323	.484	.055	.500	.159		.245	.402	.862	.834	.064
	N	347	347	347	347	347	347	347	347	347	347	347	347	347	347
10. Illegal	P. Correlation	-.481**	-.346**	-.375**	-.330**	.019	-.045	.048	-.234**	-.063	1	-.052	.056	-.254**	.444**
dumpsite	Sig. (2-tailed)	.000	.000	.000	.000	.728	.405	.376	.000	.245		.331	.297	.000	.000
	N	347	347	347	347	347	347	347	347	347	347	347	347	347	347
11. Proximity to	P. Correlation	.092	.112*	.046	-.052	.151**	.046	-.026	.023	-.045	-.052	1	-.058	.051	-.088
public pri.	Sig. (2-tailed)	.087	.037	.393	.331	.005	.397	.626	.674	.402	.331		.282	.344	.103
school	N	347	347	347	347	347	347	347	347	347	347	347	347	347	347
12. Proximity to	P. Correlation	.220**	-.193**	-.102	-.108*	.015	-.031	-.071	-.032	.009	.056	-.058	1	-.076	.181**
transport	Sig. (2-tailed)	.000	.000	.058	.044	.787	.560	.186	.553	.862	.297	.282		.159	.001
terminus	N	347	347	347	347	347	347	347	347	347	347	347	347	347	347
13. Availability	P. Correlation	.472**	.394**	.165**	.265**	.018	.282**	-.005	.036	.011	-.254**	.051	-.076	1	-.236**
of internet	Sig. (2-tailed)	.000	.000	.002	.000	.736	.000	.925	.509	.834	.000	.344	.159		.000
connection	N	347	347	347	347	347	347	347	347	347	347	347	347	347	347
14. Number of	P. Correlation	.773**	-.518**	-.478**	-.419**	-.083	-.094	.019	-.165**	-.100	.444**	-.088	.181**	-.236**	1
bedrooms	Sig. (2-tailed)	.000	.000	.000	.000	.122	.081	.728	.002	.064	.000	.103	.001	.000	
	N	347	347	347	347	347	347	347	347	347	347	347	347	347	347

***. Correlation is significant at the 0.05 level (2-tailed).*
**. Correlation is significant at the 0.01 level (2-tailed).*
P. correlation = Pearson correlation

Source: Survey Results, 2023

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Correlation analysis was first performed on the twelve (12) location externalities to check the interrelationship between the independent variables. In *Table 3,* there is multicollinearity between number of bedrooms and rental value (r = +0.773). The variable 'number of bedrooms' was included as one of the independent variables despite it not being a location externality because, theoretically, residential rental value is a function of the location, neighbourhood, and structural factors (physical characteristics) of a house. Therefore, including the variable 'number of bedrooms' in the model takes into consideration the influence associated with a particular property's structural/physical elements in determining its contribution to rental value.

At a 95% confidence level ($\alpha = 0.05$ significance level), the correlation between two variables whose p-value is less than or equal to (0.05) would be statistically significantly correlated to each other, and vice versa. To avoid possible multicollinearity in our model, the variable 'number of bedrooms' was excluded in the foregoing statistical analysis. Thus, twelve (12) location externalities were subjected to regression analysis in the next stage. They included air pollution, crime and insecurity, anthropogenic noise pollution, illegal dumping of solid waste, access to internet connectivity, urban traffic congestion, proximity to transportation terminus, vehicular noise pollution, proximity to public primary school, proximity to shopping mall, intermittent water supply; and, electricity disruptions.

In order to determine the influence of the significant location externalities on residential rental values, multiple regression analysis was performed using SPSS (Statistical Package for the Social Sciences). The actual data analysis was performed sequentially using both the ENTER and STEPWISE methods in three stages. Whereas the ENTER method enables the researcher to analyse how all the independent variables (location externalities) performed, it is disadvantageous because it fails to show the extent to which each of the location externalities influenced the dependent variable (Petrocelli, 2003). The results are presented in *Tables 4, 5* & *6*.

In *Table 6,* the independent variables: 'anthropogenic noise pollution' (t = -1.260), 'proximity to a shopping mall' (t = -0.869), 'electricity supply disruptions' (t = -0.290), 'vehicular noise pollution' (t = -0.329), 'intermittent water supply' (t = -0.096), 'proximity to public primary school' (t = +0.924) and 'proximity to transportation terminus' (t = +1.996) are insignificant in the extent to which they predict residential rental value based on their t values which lie outside the +/- 2.0 range.

The remaining five (5) variables i.e., 'air pollution' (t = -4.959), 'crime and insecurity' (t = 6.653), 'urban traffic congestion' (t = -3.667), 'illegal dumpsite' (t = -2.200) and 'availability of internet connectivity' (t = +6.308) were regressed against the dependent variable (residential rental value) in the second stage using the ENTER method. The results are presented in *Tables 7, 8* and *9*. Application of multiple regression analysis to the remaining (5) location externalities to determine their influence on residential real estate performance produced a regression model with a correlation coefficient (R) of 0.798, a coefficient of determination (R^2) of 0.636 and an F-Value of 119.223. Therefore, the five location externalities are the most significant in determining residential rental value in Nairobi County.

In *Table 9,* all five (5) independent variables are significant in the extent to which they predict the dependent variable (residential rental value) because they all have values outside the +/-2.0 range. Their collective effect on residential rental value is indicated by an adjusted R^2 value of 0.631 (see *Table 7*), a slight decline from the R^2 value of 0.788 seen in the ENTER_1 regression model (see *Table 4*). As mentioned earlier, an adjusted R^2 above 0.50 will suffice for purposes of measuring the collective influence of the predictor variables.

The F-statistic has however improved from a value of 99.760 (see *Table 4*) to a value of 119.223 (see *Table 7*). This new F-value is highly significant (p = 0.000), an indication that the five

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(5) independent variables are reliable in their prediction of residential rental value (the dependent variable). The standard error of the estimate (SEE) has, however, declined slightly from the previous model's value of 23498.051 (see *Table 4*) to the current value of 30989.383 (see *Table 7*), possibly on account of excluding some of the independent variables which had insignificant t-values. Typically, lower SEE values are preferred to higher ones.

In the third stage, the STEPWISE method of regression is applied to establish the influence of the significant locational externalities on residential rental value. A major advantage of this method is that it enables a researcher to determine the contribution of every dependent variable in the model using the adjusted R^2 values. The regression results using the STEPWISE method are discussed below.

In *Table 10,* the location externality 'air pollution' was the first variable to be analysed. This variable was measured as the level of air quality as either being 'good quality', moderate quality' or 'poor quality'. Essentially, air quality measures tenants' comfort levels associated with a particular suburb since these levels determine a tenant's threshold in choosing to reside therein. In *Table 9*, it is evident that 'air pollution' is the most significant location externality influencing residential rental value in Nairobi County. With 'air pollution' as the only independent variable in the regression model, it determines 43.9% of the variation in residential rental value, as indicated by an R^2 value of 0.439.

The second variable to be analysed was 'crime and insecurity'. This variable was measured as the average annual number of criminal incidents reported within a particular suburb. From the results in *Table 10,* it is evident that this variable was the second most significant location externality influencing residential rental value in Nairobi County. With only two variables, namely, 'air pollution' and 'crime and insecurity', as the only dependent variables in the regression model, the two variables determine 56.2% of the variation in residential rental value as indicated by the R^2 value of 0.562.

The third variable to be analysed was 'illegal dumpsite'. This variable was measured as the distance in metres from a given residential property to the nearest illegal dumpsite within the vicinity of the property. From the results in *Table 10,* it is evident that this variable was the third most significant location externality influencing residential rental value in Nairobi County. With only three variables, namely; 'air pollution', 'crime and insecurity', and 'illegal dumpsite' as the only dependent variables in the regression model, the three variables determine 60.2% of the variation in residential rental value as indicated by the R^2 value of 0.602.

The fourth variable to be analysed was 'accessibility to internet connection'. This variable was measured as the availability of internet connectivity in each suburb either by means of cable internet or WIFI connection. From the results in *Table 10,* it is evident that this variable was the fourth most significant location externality influencing residential rental value in Nairobi County. With only four variables, namely; 'air pollution', 'crime and insecurity', 'illegal dumpsite' and 'accessibility to internet connection' in the regression model, the four variables determine 63.1% of the variation in residential rental value as indicated by the R^2 value of 0.631.

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Table 4: ENTER_1 Model Summary

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	Change Statistics				
					R^2 Change	F Change	df1	df2	Sig. F Change
1	.892[a]	.796	.788	23498.051	.796	99.760	13	333	.000

a. Predictors: (Constant), Number of Bedrooms, Electricity Disruptions, Proximity to Public Primary School, Urban Traffic, Intermittent Water Supply, Proximity to Transport Terminus, Vehicular Noise Pollution, Proximity to Shopping-Mall, Availability of Internet Connection, Illegal Dumpsite, Crime & Insecurity, Air Pollution, Anthropogenic Noise Pollution

Source: Survey Results, 2023

Table 5: Analysis of Variance (ANOVA[a])

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	716082277729.966	13	55083252133.074	99.760	.000[b]
	Residual	183868751895.394	333	552158414.100		
	Total	899951029625.361	346			

a. Dependent Variable: Rent in Kshs Per Month

b. Predictors: (Constant), Number of Bedrooms, Electricity Disruptions, Proximity to Public Primary School, Urban Traffic, Intermittent Water Supply, Proximity to Transport Terminus, Vehicular Noise Pollution, Proximity to Shopping-Mall, Availability of Internet Connection, Illegal Dumpsite, Crime & Insecurity, Air Pollution, Anthropogenic Noise Pollution

Source: Survey Results, 2023

Table 6: ENTER_1 Model Coefficients

Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.	95.0% CI		Collinearity Statistics	
		B	Std. Err	Beta			Lower	Upper	Tolerance	VIF
1	(Constant)	26739.802	30404.483		.879	.380	-33069.264	86548.869		
	Air Pollution	-17632.456	3555.976	-.166	-4.959	.000	-24627.464	-10637.449	.546	1.833
	Anthropogenic Noise Pollution	-242.496	192.495	-.043	-1.260	.209	-621.156	136.164	.538	1.860
	Crime & Insecurity	-258.617	38.873	-.217	-6.653	.000	-335.084	-182.149	.577	1.734
	Proximity to Shopping-Mall	811.234	933.529	.023	.869	.385	-1025.125	2647.592	.861	1.162
	Urban Traffic	-879.451	239.834	-.101	-3.667	.000	-1351.233	-407.670	.815	1.227
	Electricity Disruptions	-496.751	1711.344	.007	-.290	.772	-2869.656	3863.158	.961	1.041
	Vehicular Noise Pollution	-71.346	216.949	-.009	-.329	.742	-498.109	355.417	.848	1.179
	Intermittent Water Supply	-228.526	2381.028	.002	-.096	.924	-4455.227	4912.279	.950	1.052
	Illegal Dumpsite	-48.154	21.886	.064	-2.200	.028	-5.102	91.206	.721	1.387
	Proximity to Public Primary School	810.406	876.856	-.024	.924	.356	2535.281	914.469	.948	1.055
	Proximity to Transport Terminus	23.774	11.913	.051	1.996	.047	.340	47.208	.943	1.061
	Availability of Internet Connection	18449.428	2924.984	-.178	6.308	.000	24203.205	-12695.652	.771	1.296
	Number of Bedrooms	51581.030	3458.595	.484	14.914	.000	44777.581	58384.480	.582	1.719

a. *Dependent Variable: Rent in Kshs Per Month*

Source: Survey Results, 2023

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Table 7: ENTER_2 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.798[a]	.636	.631	30989.383	.636	119.223	5	341	.000

a. Predictors: (Constant), Availability of Internet Connection, Illegal Dumpsite, Urban Traffic, Crime & Insecurity, Air Pollution

Source: Survey Results, 2023

Table 8: Analysis of Variance (ANOVA[a])

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	572474461482.385	5	114494892296.477	119.223	.000[b]
	Residual	327476568142.976	341	960341842.062		
	Total	899951029625.361	346			

a. Dependent Variable: Rent in Kshs Per Month
b. Predictors: (Constant), Availability of Internet Connection, Illegal Dumpsite, Urban Traffic, Crime & Insecurity, Air Pollution

Source: Survey Results, 2023

Table 9: ENTER_2 Model Coefficients Results

Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Err	Beta			Lower	Upper	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	197025.381	9004.108		21.882	.000	179314.796	214735.967					
	Air Pollution	-38331.919	4209.177	-.362	-9.107	.000	-46611.139	-30052.698	-.662	-.442	-.297	.677	1.477
	Crime & Insecurity	-389.935	44.533	-.327	-8.756	.000	-477.530	-302.341	-.608	-.428	-.286	.764	1.309
	Urban Traffic	-679.651	302.493	-.078	-2.247	.025	-1274.637	-84.664	-.267	-.121	-.073	.891	1.123
	Illegal Dumpsite	-150.866	26.975	-.201	-5.593	.000	-97.807	203.925	-.481	-.290	-.183	.825	1.212
	Availability of Internet Connection	17630.259	3819.215	.170	4.616	.000	25142.446	-10118.072	.472	.243	.151	.787	1.271

a. Dependent Variable: Rent in Kshs Per Month

Source: Survey Results, 2023

Table 10: STEPWISE Regression Results (Model Coefficients)

Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower	Upper	Tolerance	VIF
1	(Constant)	197703.830	7995.433		24.727	.000	181977.901	213429.759		
	Air Pollution	-70223.332	4276.380	-.662	-16.421	.000	-78634.390	-61812.273	1.000	1.000

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Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower	Upper	Tolerance	VIF
2	(Constant)	205749.920	7118.074		28.905	.000	191749.494	219750.345		
	Air Pollution	-51889.975	4214.872	-.489	-12.311	.000	-60180.141	-43599.810	.805	1.242
	Crime & Insecurity	-466.819	47.375	-.392	-9.854	.000	-560.001	-373.638	.805	1.242
3	(Constant)	175988.900	8500.576		20.703	.000	159269.081	192708.719		
	Air Pollution	-46165.884	4143.908	-.435	-11.141	.000	-54316.554	-38015.214	.760	1.316
	Crime & Insecurity	-410.075	46.287	-.344	-8.859	.000	-501.117	-319.034	.770	1.299
	Illegal Dumpsite	-162.516	27.861	.217	-5.833	.000	-107.716	-217.315	.841	1.189
4	(Constant)	191755.568	8744.565		21.929	.000	174555.667	208955.469		
	Air Pollution	-39904.955	4175.037	-.376	-9.558	.000	-48116.938	-31692.973	.696	1.436
	Crime & Insecurity	-390.579	44.795	-.328	-8.719	.000	-478.688	-302.470	.764	1.309
	Illegal Dumpsite	-146.158	27.053	-.195	-5.403	.000	-92.947	-199.368	.830	1.205
	Availability of Internet Connection	19446.564	3754.710	.188	5.179	.000	26831.796	12061.333	.823	1.214
5	(Constant)	197025.381	9004.108		21.882	.000	179314.796	214735.967		
	Air Pollution	-38331.919	4209.177	-.362	-9.107	.000	-46611.139	-30052.698	.677	1.477
	Crime & Insecurity	-389.935	44.533	-.327	-8.756	.000	-477.530	-302.341	.764	1.309
	Illegal Dumpsite	-150.866	26.975	-.201	-5.593	.000	-97.807	-203.925	.825	1.212
	Availability of Internet Connection	17630.259	3819.215	.170	4.616	.000	25142.446	10118.072	.787	1.271
	Urban Traffic	-679.651	302.493	-.078	-2.247	.025	-1274.637	-84.664	.891	1.123

a. Dependent Variable: Rent in Kshs Per Month

Source: Survey Results, 2023

Table 11: STEPWISE Regression Results (Model Summary)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.662[a]	.439	.437	38264.263	.439	269.656	1	345	.000
2	.750[b]	.562	.560	33840.537	.124	97.094	1	344	.000
3	.776[c]	.602	.598	32324.445	.040	34.026	1	343	.000
4	.794[d]	.631	.626	31172.254	.029	26.825	1	342	.000
5	.798[e]	.636	.631	30989.383	.005	5.048	1	341	.025

a. Predictors: (Constant) Air Pollution
b. Predictors: (Constant), Air Pollution, Crime & Insecurity
c. Predictors: (Constant) Air Pollution, Crime & Insecurity, Illegal Dumpsite
d. Predictors: (Constant), Air Pollution, Crime & Insecurity, Illegal Dumpsite, Availability of Internet Connection
e. Predictors: (Constant), Air Pollution, Crime & Insecurity, Illegal Dumpsite, Availability of Internet Connection, Urban Traffic

Source: Survey Results, 2023

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The fifth and last variable to be analysed was 'urban traffic congestion'. This variable was measured as the average commute time in minutes from a particular suburb to the CBD of Nairobi City when using public transportation. From the results in *Table 10,* it is evident that this variable was the fifth most significant location externality influencing residential rental value in Nairobi County. With all the five independent variables in the regression model, they collectively determine 63.6% of the variation in residential rental value as indicated by the R^2 value of 0.602.

The analysis using the STEPWISE regression method has resulted in five (5) models, as shown in *Table 11*. Model 5, constituting the location externalities 'air pollution', 'crime and insecurity', 'urban traffic congestion', 'illegal dumping of domestic solid waste' and 'availability to internet connectivity', is the most accurate since it has the highest values for R, R^2 and adjusted R^2 at 0.798, 0.636 and 0.631 respectively. Additionally, it has the lowest standard error of the estimated value at 30989.383 among the five models, an indication that it is more reliable in predicting residential rental values.

For these reasons, Model 5 is adopted as the most suitable model. Based on its correlation coefficient (r = +0.798), a linear relationship is observed between the dependent variable (residential rental value) and the independent variables (significant location externalities). All the t-values for the predictor variables in model 5 are outside the +/-2.0 range, an indication that each of the independent variable's contribution to the model is significant. Further, the values for tolerance and variance inflation factor (VIF) are all below 1.0 and 10.0, respectively. This means that there was no multicollinearity detected between the independent variables.

DISCUSSION

The results of the Pearson correlation analysis (two-tailed) have shown that residential rental value has a strong negative correlation with 'air pollution' (r = -0.662, p =0.000), 'crime and insecurity' (r = -0.608, p =0.000) and 'anthropogenic noise pollution' (r = -0.546, p =0.000). Additionally, residential rental value has moderate positive and negative correlations with the following location externalities; 'availability of internet connectivity' (r = +0.472, p =0.000) and 'urban traffic congestion' (r = -0.267, p =0.000), respectively. These results confirm that 'air pollution', 'crime and insecurity', anthropogenic noise pollution, 'access to internet connectivity' and 'urban traffic congestion' are the most significant location externalities influencing residential tenants' locational decisions in Nairobi County.

The regression results have revealed that there is a significant marginal contribution between the following location externalities and residential rental value; 'air pollution' (B = -38331.919, t = -9.107, p = 0.000), 'crime and insecurity' (B = -389.935, t = -8.756, p = 0.000), 'availability of internet connection' (B = +17630.259, t = +4.616, p = 0.000), 'urban traffic congestion' (B = -679.651, t = -2.247, p = 0.025) and 'illegal dumpsite' (B = -150, t = -5.593, p = 0.000). Therefore, their respective contributions to residential rental values are as follows: air pollution = 43.9%, crime and insecurity = 12.3%, illegal dumping of domestic waste = 4.0%, availability of internet = 2.9% and urban traffic congestion = 0.5%.

These results are an indication that 'air pollution', 'crime and insecurity', 'availability of internet connection', 'urban traffic congestion' and 'illegal dumpsite' are the location externalities most likely to cause market failure in urban housing markets in Kenya unless urgent measures are put in place to manage their undesirous effects. Collectively, these correlations and unstandardised beta coefficients are an indication that, on average, there is a strong relationship between the significant location externalities and residential rental values in Nairobi County.

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CONCLUSION AND RECOMMENDATIONS

Out of the five location externalities that influence residential rental value, air pollution is the most significant since it determines 43.9% of the variability in residential rental value. The analysis has also revealed that the location externality 'air pollution' has the strongest correlation with residential rental value having a correlation coefficient ($r = -0.662$, $p = 0.000$). This implies that air pollution has the largest influence on residential rental value in Nairobi County.

The government of Kenya should develop and implement zoning regulations that separate incompatible land uses, such as industrial activities away from residential areas. This will help reduce negative externalities like pollution and noise that can impact nearby communities.

The government should also enforce environmental standards and regulations to control pollution and protect natural resources. These regulations include limits on emissions, waste disposal, and water usage, among other measures. By ensuring compliance with these standards, negative externalities associated with environmental degradation will be minimised.

In the context of location externalities, the government can apply Pigouvian taxes to businesses or industries that create adverse effects on nearby communities or the environment. By taxing the external costs, the price of goods or services produced in those locations will increase, reflecting the true social costs and incentivising businesses to reduce their negative impacts.

Although twelve (12) location externalities were found to be significant in influencing tenant locational decisions, whereas five (5) location externalities emerged as being significant predictors of residential rental value, it is critical that policy interventions for managing the undesirous effects of location externalities factor in all the thirty (30) externalities that were examined in this study. This is because adopting a holistic approach has proved to be the most effective and efficient way of managing the phenomenon of externalities in society.

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