Journal of Science, Innovation and Creativity
Vol. 3 No. 1 (2023): ISSN (Online): 2958-454X
DOI: https://doi.org/10.58721/jsic.v3i1.641
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Article History
Received: 2024.04.04
Revised: 2024.07.14
Accepted: 2024.07.19
Published: 2024.07.22

Keywords
Attributes
Causal factors
Green spaces
Silverdure
Urban

How to cite:
Mbugua, M., W., Kamiri, H. & Kamau, P. (2024). Causal Factors Responsible for Changes in the Attributes of Urban Green Spaces in Nairobi City County, Kenya. *Journal of Science, Innovation and Creativity, 3*(1), 1-10.

Abstract
Urban green spaces are an important part of public open spaces and a common service provided by a city, town, or municipal council. In Nairobi City County, green spaces have been increasingly threatened by overcrowding, poor planning, weak management structures and illegal alienation thus denying city residents access to the much-needed recreation and leisure facilities. As the population increases in urban areas, their activities impact the environment and therefore the ecosystem services. This study was done with the Principle of Intelligent Urbanism in mind, as the most prolific urban development theory developed by the International Congress of Modern Architecture. Quantitative and qualitative methods were used to collect data while a cross-sectional survey designs and stratified random sampling of the green spaces was employed, based on the location within the urban core and peri-urban of Nairobi County. Four green spaces (Karura Forest, Ngong Road Forest, Nairobi Arboretum, and City Park) with diverse characteristics and attributes were selected. A sample population of 384 visitors to the green spaces was surveyed for their perceptions of the functions, uses, and benefits of the green spaces. Our findings showed that management structures and population growth are the main causal factors responsible for changes in the attributes of urban green spaces.

Introduction
Social, economic and urban situations influence the state of urban green spaces (UGS). However, population growth in cities combined with urban planning policies of infrastructure development can drive the value of green spaces (Bush, 2020). In Kenya, the 1948 Nairobi City Master Plan reserved 27.5% of Nairobi's total land area for urban green spaces (Makworo & Mireri, 2011). After independence in 1963, the country operated without a national land policy until 2009, when Kenya's National Land Policy was passed. During this period (1963-2009), leaders informally converted the available green spaces into private facilities and allowed new neighbourhoods to be constructed without green spaces. For example, City Park lost 50 acres to private developers through illegal alienation (Makworo & Mireri, 2011). The park survived further land use change when it was declared a national monument through gazette notice number 6313 of 1997 but was already irreparably changed and reduced to just 29.74 hectares (The Kenya Gazette, 1997). This justifies the perception that Nairobi's urban green spaces available today only exist because they were and still are resilient to land use change (Makworo & Mireri, 2011).

According to Katyambo et al., (2017), Nairobi is experiencing a radial-axial urban expansion along roads into farms and forests. This has seen built-up areas encroach into other land uses by about 1.5 km^2 per year. Between 1995 and 2015, a growth rate between 8.4% and 17.2% was experienced, compared to 4.6% between 1948 and 1962 and 12% in 1969.

Urban green spaces are associated with environmental and social benefits relevant to residents' higher quality of life and contribute to enhanced productivity and improved health, well-being, and physical and psychological benefits of the communities living around them.

De la Barrera et al., (2016) and The United Nations (2020) show a positive correlation between the quantity of green spaces and household incomes in developed and developing countries. Thus, the higher the incomes, the larger the area covered by green spaces, the better the quality of these spaces and the higher the area under private green spaces. The total green spaces averaged only about 16 per cent of total urban land globally. In comparison, only 46.7 per cent of the urban population can access green spaces within 400 metres of walking distance globally. There are disparities in access to green spaces across regions, ranging from 26.8 per cent in Eastern and Southeast Asia to 78 per cent in Australia and New Zealand (The United Nations, 2020).

Factors causing changes in the attributes of urban green spaces

The rapid population growth of Nairobi City has contributed to the pressure on available open and green spaces. Residents' perceptions of the value, vulnerability and management of green spaces may vary from conservative to liberal. However, every human structure erected around a green space hinders the accessibility of the biotic and abiotic elements (Basu & Nagendra, 2021).

Out of the 826 public open spaces in Nairobi City County, there are only two urban forests, two nature reserves and 34 parks and gardens, with a total land area of 2,154 hectares (United Nations Human Settlements Programme, 2020). According to the ANGSt model by Handley et al., (2003), formalising important issues like policies on entrance points to green spaces and maintaining high standards of maintenance, including removal of litter, are critical to enhancing the utilisation of green spaces by the community. The human population will always produce waste but choose to exploit clean, tidy environment instead of dirty litter-strewn areas, which pose health risks. Pollution in green spaces occurs in air, water and land. Air pollution comes from machines and vehicular exhaust. Water pollution results from raw sewerage discharge into rivers, while land pollution is from solid waste disposal.

Literature Review

Poor management of urban green spaces has seen them deteriorate and deplete fast worldwide. Besides, rapid urbanisation shifts funding to support settlement, lowering the priority on green spaces. Poor attitude of the local people and political instability deprive green spaces of their status to survive irrespective of their value. For example, a study conducted on land-use changes in 25 European cities found that between 7.3% and 41% of green spaces were lost to different land uses (Mensah, 2014). A study on land-use change in 274 metropolitan areas in the USA revealed a loss of over 1.4 million hectares of green spaces to various land developments (Mensah, 2014).

The rapid depletion of green spaces in Africa has resulted in green spaces covering a tiny per cent of the total urban land space of many urban areas. For example, it has been found that several towns in the Republic of South Africa have less than 10 per cent of their total urban lands occupied by green spaces (Adegun et al., 2021). The situation in Lagos City (Nigeria) is even more frightening. Green spaces now occupy less than 3 per cent of the city's landmass. In Kumasi city in Ghana, once the Garden city of West Africa, statistics show that several of the green spaces in the city have been depleted, and only a small fraction, together with other public spaces, constitute less than 11 per cent of the total land area (Mensah, 2014).

In Kenya, about 6,600 hectares (ha) of forest land and 720 ha of urban green spaces were lost between 2000 and 2019, representing an 11% loss in 20 years (Oloo et al., 2020). In Nairobi's City Parkland, parkland has been lost due to grabbing and questionable land allocations to private institutions (Mwanzu et al., 2023).

Safety in urban areas is key, as targeted by Sustainable Development Goal (SDG) #11—sustainable cities and communities (The United Nations, 2020). Since urban population is expected to rise to 70% by 2050, green spaces are supposed to remain safe, resilient, and sustainable. They should be able to serve all the deserving population and retain their silver due.

In parks where safety is not guaranteed, the number of park users drops among the children, the elderly and women (Mensah, 2014). By 2030, UN member states are intended to provide unrestricted access to safe, inclusive and accessible green spaces, especially for women and children, older persons and persons with disabilities. SDG #15 (life on land) requires UN member states to manage green spaces sustainably, halt and reverse land and natural habitat degradation, combat desertification and stop biodiversity loss.

Theoretical Framework

The Principle of Intelligent Urbanism (PIU) by Josep Lluis Sert (1902-1983) was developed at the Graduate School of Design of Harvard University. PIU is the most prolific urban development theory, and it was developed from ten city planning guidelines proposed by the International Congress of Modern Architecture. Some of these principles would address the causal factors responsible for changes in the attributes of green spaces in Nairobi City County: congestion of human population should be within a balance with nature, preservation of cultural heritage and traditions to override land use change, appropriate technology to reduce vegetation clearing during extension of infrastructure, institutional integrity for effective management of urban green spaces and their waste disposal, and a balanced movement of human population in respect to corridors for fauna and flora. The theory is used in city planning and urban design to focus on developing a harmonic and comfortable social environment for residents. It conceives urbanisation as a balance with nature (Bugadze, 2018; Makworo & Mireri, 2011).

Research Design

The study adopted a mixed research design to evaluate the impact of anthropogenic activities on attributes of green spaces in Nairobi City County. A cross-section survey coupled with stratification and random sampling were applied in this study. The study used the triangulation method, which adopted qualitative and quantitative techniques to collect data. Structured questionnaires were administered to park users, Focus Group Discussions (FGDs) and in-depth interviews were administered to key informants. The researcher applied visual observations of green space attributes to validate the primary data collected. Historical data, including the park's age, usage and functions, were acquired from the County offices and Kenya Forest Services for the gazetted forests.

A multi-stage cluster sampling was applied, stratifying the study area into different clusters based on a selection of variables considered relevant for evaluating the influence of human activities, such as total area, vegetation cover, age (number in years since opening to the public), dominant function, space characteristics, and proximity to urban dwellings.

Selection of study area and sites

The study area was purposively selected to include green spaces of diverse sizes, functions and attributes within Nairobi City County. Nairobi City County is located at the south-central region of Kenya. The geographical coordinates of the study area are 1° 17' 0" South, 36° 49' 0" East, and elevated at 1,795masl. The county covers a land area of 703.9 km² with a population of 4,397,073 people. According to KNBS (2019), Nairobi City County has the highest population density in Kenya at 6,247 per km².

Target population

According to KNBS (2019) population statistics, the population of Nairobi City County was approximately 4,397,073, with an average household size of 2.9 members per family. The sample size

thus calculated following Mugenda & Mugenda (2019) to determine the sample size when the target population is more than 10,000:

Where n = the desired sample size

z = standard normal deviation at the required confidence level (1.96)

p = proportion in the target population (0.5)

q = 1-p

d = level of statistical significance set (0.05)

Hence: n = (1.96)2 (0.5) (1-0.5) / (0.05)2

= 3.8416 x 0.25 /0.0025

= 0.9604 / 0.0025

= 384.16

Thus, a sample size of 384 respondents was obtained from a population of 4,397,073 persons.

Research and sampling design

Key informants included county officials in charge of the environment and Kenya Forest Service (KFS) conservators, foresters and rangers. Purposive sampling was used to choose the key informants in each stratum so that it didn't end up with gender or age bias. The target population was the total population of Nairobi City County, 4,397,073, while the sample population was 384, from which the county government's deputy urban planner, the officer in charge of parks and gardens and one in charge of forests were interviewed as key informants. The 51 KFS officers interviewed included Karura Forest (3), Ngong Road Forest (29), City Park (5) and Arboretum Nature Reserve (14). Forty-seven rangers filled out questionnaires, while four forest managers, two county forest conservators and seven CFA staff were also interviewed. Three hundred and thirty (330) park users responded to the questionnaires. According to Mugenda and Mugenda (2019), 30% of the population is enough for sampling. However, all 53 KFS officers were subjected to either an interview or a questionnaire.

Data Collection Methods

The study collected data through interviews, observations, and documentary data review. Public green spaces were often too numerous to allow a detailed study of all of them. Due to their high heterogeneity, concise selection or stratification was important, as this would have affected the statistical validity of the data collected and subsequent analysis (Farinha-Marques et al. 2016).

Data analysis and presentation

Data collection used statistical analysis and GIS-based techniques, while data quality was ensured by piloting questionnaires and interview schedules before they were administered. Field assistants were inducted into data collection to provide them with sufficient skills in data collection using questionnaires, key informant interview guides, and GPS receivers.

Ethical dimension

For ethical reasons, each respondent was enlightened on the study's objectives, the need for them to participate, the associated risks, the envisioned benefits, and the confidentiality measure. The relevant institutions at the national, county, unit forest/park administration, and university levels sought and granted permission to undertake research.

Changes in the green spaces in the last ten years

The visitors were asked to indicate the changes they have witnessed in the park in the past ten years. The results are shown in Table 1.

Table 1: Changes Witnessed in the Greenspaces

Changes Witnessed in the Green spaces	Karura Forest	City Park Forest	Ngong Road Forest	Arboretum
	F(%)	F(%)	F(%)	F(%)
Increased sitting places such as benches	57(72.2)	38(34.5)	33(59.0)	35(77.8)
Improved waste management	68(86.1)	22(20.0)	38(67.8)	40(89.0)
Increased tree cover	74(93.7)	18(16.4)	48(85.7)	32(71.1)
Increased vegetation cover	70(88.6)	22 (20.0)	50(89.2)	39(86.7)
Increased tracks and trails	55(69.6)	82(74.5)	42(75.0)	28(62.2)
Increased buildings	21(26.6)	64(58.2)	28(50.0)	30(66.7)
Declining vegetation cover	16(20.2)	76(69.1)	14(25.0)	15(33.3)
Increased size	8(10.1)	21(19.1)	9(16.1)	5(11.1)
Deforestation	22(27.8)	71(64.5)	11(19.6)	8(17.8)
Littering	30(37.8)	88(80.0)	14(25.0)	10(22.2)
N = 290	**79**	**110**	**56**	**45**

As shown in Table 1, findings show that in Karura forest, 72.2% of visitors have noted increased sitting places such as benches, 86.1% improved waste management, 93.7% increased tree cover, and 88.6% increased vegetation cover. The findings further reveal that 69.6% increased tracks and trails, 26.6% increased buildings, 20.2% declining vegetation cover, 10.1% increased size, 27.8% deforestation, and 37.8% of the visitors have noted changes in littering.

In addition, the findings show that in City Park, 34.5% of the visitors have noted increased sitting places such as benches, 20% improved waste management, 16.4% increased tree cover, 20% increased vegetation cover, 74.5% increased tracks and trails, 58.2% increased buildings, 69.1% declining vegetation cover, 19.1% increased size, 64.5% deforestation, and 80% of the visitors have noted changes in littering.

Findings show that in Ngong Road Sanctuary, 59% of the visitors have noted increased sitting places such as benches, 67.8% improved waste management, 85.7% increased tree cover, 89.2% increased vegetation cover, 75% increased tracks and trails, 50% increased buildings, 25% declining vegetation cover, 16.1% increased size, 19.6% deforestation, and 25% of the visitors have noted changes in littering.

Results from Arboretum show that 77.8% of the visitors have noted increased sitting places such as benches, 89% improved waste management, 71.1% increased tree cover, 86.7% increased vegetation cover, 62.2% increased tracks and trails, 66.7% increased buildings, 33.3% declining vegetation cover, 11.1% increased size, 17.8% deforestation, and 22.2% of the visitors have noted changes in littering.

The findings imply that there have been several changes in the green spaces. The changes are mainly aimed at improving the comfort of the green spaces to encourage more visitors and also the ambience and physical appearance of the green spaces. However, human activities have led to the shrinking of

the park sizes as they encroach on the green spaces. Mbiti, (2022) found that urban green spaces in Nairobi City have decreased from 1989-2019. The loss of urban green spaces was associated with urban growth. Regarding tree cover, respondents were asked about the dangers associated with this green space, which might affect its quality. Results are shown in Table 2.

Table 2: Dangers in the Green spaces

Dangers in the Green space	Karura	City park	Ngong	Arboretum
	F(%)	F(%)	F(%)	F(%)
Expansion of build-up structures	56(71.0)	98(89.1)	28(50.0)	34(75.6)
Over population/congestion	45(57.0)	82(74.5)	40(71.4)	38(84.4)
Vegetation clearing	14(17.7)	28(25.4)	16(28.6)	12(26.7)
Land-use change	68(86.1)	94 (58.4)	51(91.1)	41(91.1)
Waste disposal and management	10(12.6)	80(72.7)	15(26.8)	12(26.7)
Noise	6(7.6)	102(92.7)	14(25.0)	9(20.0)
N = 290	**79**	**110**	**56**	**45**

Results in Table 2 show that 71% of visitors indicated that the expansion of build-up structures is dangerous to Karura Forest, 57% overpopulation, 17.7% vegetation clearing, 86.1% land use change, 12.6% waste disposal and management, and 7.6% noise.

Findings indicate that the dangers of the Karura forest are mainly an expansion of build-up structures, changes in land use and overpopulation. This implies that the structures near the forest are a threat to the size of the forest. The management has effective waste disposal measures; hence, waste disposal is not challenging for Karura Forest. The encroachment has led to the destruction of habitats as people build houses. The management has erected posts to notify the public that the land is not for sale. This is to sensitise innocent Kenyans who are duped into buying public land.

The construction of a house along Peponi Road, next to Karura Forest, was halted after reliable evidence showed that the developer had encroached on riparian land along the Karura River. The building was marked for demolition, but the developer ignored the warning and construction continued. The developer was later charged with developing a project without approved plans. Developers and people in power who feel privileged continue to encroach on green spaces in Nairobi County. There are many residential estates built along the forest or on its edges. Their sewerages are directed into rivers that flow into green spaces like Karura forest. These neighbourhoods include Runda, Rosslyn, Spring Valley, and Muthaiga. Rosslyn Mall was constructed along a river that flows into Karura forest. Two Rivers Development was built beside the Ruaka River at the forest's edge. The mall includes residential homes, a five-star hotel, and office blocks. It is being built on a 40-hectare (100-acre) parcel carved from the forest. There is also a house on the Gitathuru River in Karura forest. Some greedy individuals are trying to claim ten acres of Karura forest as their property. They have taken the authorities preserving Karura (on behalf of Kenyans) to court, accusing them of blocking "access to their property" by fencing Karura. They want the fence removed to build high-rise apartments in the forest for sale and make a profit. They are also under the illusion that the absence of Wangari Maathai provides a fantastic opportunity to get away with the ploy.

Results show that 89.1% of visitors indicated that expansion of build-up structures is a danger to City Park, 74.5% overpopulation, 25.4% vegetation clearing, 58.4% land use change, 72.7% waste disposal

and management, and 92.7% noise. The findings also imply that, like in the Karura forest, a high expansion of built-up structures near City Park threatens its existence.

"*High population of visitors threatens the park since it hinders grass growth due to frequent stepping on the vegetation. The County management also constantly cuts down trees in the park and takes up space during market and road upgrading, reducing the park's size. There are changes in land use in the city centre to accommodate the high population, threatening City Park. The park has waste management challenges, which are challenges to its existence since they may be a health hazard to visitors. There is also very high noise pollution, which could be due to the free entry, which allows every willing person to enter the park. Sometimes, a public address and business people advertise their merchandise simultaneously.*" (Respondent, 7).

Concerning Ngong Road forest, results show that 50% of visitors indicated that expansion of build-up structures is a danger to the Forest, 71.4% overpopulation, 28.6% vegetation clearing, 91.1% land use change, 26.8% waste disposal and management, and 25% noise.

Findings imply that the expansion of the build-up structure threatens the existence of Ngong Road Sanctuary. The population increase around the forest has led to the sprouting of buildings, threatening the sanctuary's existence. Land use has also changed around the sanctuary, which poses a danger to it. Effective waste management practices have resulted in the eradication of threats that may be posed by waste generated in the sanctuary. There is, however, less noise; hence, noise pollution is a non-issue.

Findings on the Nairobi Arboretum show that 75.6% of visitors indicated that the expansion of build-up structures is a danger to the space, 84.4% overpopulation, 26.7% vegetation clearing, 91.1% land use change, 26.7% waste disposal and management, and 9% noise. These results imply that the main threats to the existence of the Nairobi Arboretum are expansion of build-up structures, overpopulation, and land use change.

Findings imply that green spaces face diverse challenges. The challenges are mainly human-induced and controlling them would enhance the conservation and sustainability of green spaces.

Wildlife Direct, (2020) reported that Nairobi's green spaces face increasing development pressure due to the expanding urban population. Nairobi City County lost 22% of its green spaces from 1990 to 2016 due to infrastructure development, illegal encroachment by government mega projects, and real estate development.

Findings agree with Debebe et al., (2023) that expanding residential areas has reduced urban green spaces. Girma et al., (2019) found that the increase in rural-urban migration has led to the conversion of green environment, parks and green spaces to residential buildings to accommodate the ever-increasing population in the city centre. According to Ghosh (2019), physical expansion greatly affects land cover and leads to the conversion of agricultural and forest lands into urban dwellings. As the built-up area increases, the urban green spaces also reduce. Haaland & van den Bosch, (2015) found that a decrease in urban green spaces is attributable to urban growth and whose increase has led to the conversion of lands reserved for green spaces to other uses.

The researcher further sought respondents' opinions on improving green spaces. The findings are presented in Table 3.

Table 3: Greenspaces Improvement

Greenspaces Improvement	Karura Forest	City Park	Ngong Road Forest	Arboretum
(1=yes, 2=no, 3=don't know)	**M/Std**	**M/Std**	**M/Std**	**M/Std**
Has the green space been improved to include more uses	1.26(0.691)	1.18(0.510)	1.14(0.401)	1.28(0.704)
Do you feel the presence of site management monitoring the activities on the green space	1.24(0.880)	2.22(0.596)	1.38(0.752)	1.44(0.802)
Is the county government of Nairobi doing enough to sustain this green space	1.18(0.474)	2.48(0.596)	2.05(0.297)	1.16(0.367)
N = 290	**79**	**110**	**56**	**45**

Results show that most Karura forest visitors responded in the affirmative that the green space had been improved to include more uses (m=1.26, std=0.691). They feel the presence of site management monitoring the activities in the green space (m=1.24, std=0.880), the county government of Nairobi is doing enough to sustain the green space (m=1.18, std=0.474). The findings imply that several changes in the forest have led to improvement of the Forest.

The findings regarding the City park show that the majority of the Park's visitors responded in the affirmative that the green space has been improved to include more uses (m=1.18, std=0.510). Respondents opined that they do not feel the presence of site management monitoring the activities on the green space (m=2.22, std=0.596), and the county government of Nairobi has not done enough to sustain the City Park (m=2.48, std=0.596).

Results show that the majority of Ngong Road Forest visitors responded in the affirmative that the green space has been improved to include more uses (m=1.14, std=0.401). Visitors feel the presence of site management monitoring the activities on the green space (m=1.38, std=0.752), and the county government of Nairobi has not done enough to sustain the Ngong Road Sanctuary (m=2.05, std=0.297).

Results show that most Nairobi Arboretum visitors responded in the affirmative that the green space has been improved to include more uses (m=1.28, std=0.704). Respondents feel the presence of site management monitoring the activities on the green space (m=1.44, std=0.802), the county government of Nairobi is doing enough to sustain Nairobi Arboretum (m=1.16, std=0.367).

According to an item observed in the Nairobi National Museum, the problem of population influx in Nairobi city began when Kenya became independent in 1963. Africans enjoyed the freedom of movement and wanted to liberate themselves from the colonial villages. They moved to the urban area hoping to improve their livelihoods, even when ill-prepared for urban life. They, therefore, settled where they could afford: in shanty informal settlements. With no government regulation, green spaces and other public spaces were ignored, resulting in an ever-dwindling green space compared to population growth.

Conclusion

There have been notable changes in the green spaces, which include increased sitting places such as benches, improved waste management, tree cover, vegetation cover, tracks and trails, and buildings, and increased changes in the removal of litter. Other observable changes include expansion of build-up structures around green spaces, land-use change, overpopulation/congestion, vegetation clearing,

waste disposal and management, and noise. In addition, the green space has been improved to include more uses, and there is a presence of site management monitoring the activities on the green space. The county government of Nairobi has not done enough to sustain the green spaces, with City Park having the highest insecurity issues in Nairobi City County. The main reason cited is insufficient funding since the park doesn't charge an entrance fee. The management depends on the funding from the government and donations from well-wishers, which is not adequate to meet the financial requirements of managing a park.

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