IMPACTS OF KAYOLE-SOWETO INFORMAL SETTLEMENT ON NGONG RIVER AND ITS ENVIRONS, NAIROBI KENYA

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Abstract: Informal settlements presets one of the greatest challenges that face humanity in the contemporary world. These settlements are characterized by lack of basic social amenities and unplanned urban expansion which leads to a myriad of environmental concerns. The phenomena of informal settlement is more widespread in the developing countries. In Africa, informal settlement scenario is more extensive due to high poverty levels and sporadic human population growth rates. This paper examines the impact of Kayole-Soweto slum on Ngong River in Nairobi. The study was based on the following specific objectives; to assess the extent and proximity of human settlement along Ngong River, to establish how human activities within Kayole-Soweto affect Ngong River and to establish waste disposal techniques employed by residents of the study area and their impacts on the Ngong River. *Ex post factor* research design was adopted and qualitative data was collected using semi structured questionnaires administered to 36 residents picked by simple random sampling. Pearson correlation established that there was a significant negative correlation between the waste disposal techniques in use and the state of the river Ngong (r=-0.648, Sig. value <0.05); further, there was also a significant negative correlation between activities carried out in the locality and the state of the river Ngong environs (r=-0.582, p value <0.05) and a significant negative correlation between informal river line settlements in the Kayole-Soweto slum and the state of the river Ngong environs (r=-0.514, p value <0.05). This implied that an increase in the disposal of solid and liquid wastes into the river Ngong, an increase in informal settlements along the river and an increase in activities along the river would be associated with poorer state of the river Ngong environs.

Key Words: *Ngong, Informal settlements, solid waste, human activities, poverty, environmental concerns*

1.0 Introduction:

Globally, large populations of people have historically inhabited places with ready access to fresh water, and a large part of it is directly dependent on natural freshwater bodies (Rivers, lakes and swamps). The past century has seen the human population increase from 1.6 billion in 1900 to 6.9 billion in 2010 (United Nations, 2004). This sporadic population overshoot was and continues to be more pronounced in the developing countries, causing a strained relationship between human populations and freshwater bodies. Connor, R. (2015). According to Bonaiuto, M., et al, (2015), over 50% of the global population live closer than 3 km to a surface freshwater body and only 10% of the population lives further than 10 km away. This has led to high levels of fresh water pollution and it can be attributed to physical (e.g. pollution of water bodies), socioeconomic (e.g. increased population, urbanization, and economic development), and cultural (e.g. aesthetic preferences and traditional habits) factors.

In Africa, the edges of Juksekei River in Alexandra, South Africa is home to the Stjwetla which is an informal settlement with an estimated population of 7500 households (Council, G. J. M. (2000). notes that this population, is not only affected by floods during the rainy season, but also other adverse health effects that arise from a lack of proper sewer systems. He further records that the living conditions of Stjwetla community are unhygienic and highly dangerous due to the floods which drown at least 20 people each rainy season. Airborne and waterborne diseases have become a part and parcel of the people living in the area due to lack of proper sanitary techniques. Further, Njogu, K. (Ed.). (2011) notes that in Kenya it is barely a century ago, when Nairobi City was a just tented camp for the Kenyan-Uganda railway workers. It had cool weather and clean drinking water from river Ngong, Mathare and Mbagathi, creating a bubbling ecosystem for many wild plants and animals that freely roamed there. The then human population of Nairobi was less than 12, 000 and the fringes of the three rivers (Ngong, Mathare and Mbagathi) which are main subsets of the Nairobi River, were somehow pristine (Roger S. G. and Timothy M., 1989). Since then, completion of Nairobi railway terminus of the then Kenya- Uganda railways and the subsequent change of the British protectorate headquarters from Mombasa to Nairobi in 1905 enhanced growth of the town in terms of other infrastructure (roads, hotels, schools and administrative offices). This has now seen the growth of human population in Nairobi to what it is today and the projection of the same by 2025 shall stand at 5 million as projected by Omwenga, M. (2011). According to the Amnesty international, (2013), approximately 2 million people in Nairobi live in informal settlements and slums. Pamoja Trust, (2009) in their unpublished report also indicated

that slum dwellers in Nairobi make up to over half the capital's population and yet they are jam-packed into only 5 per cent of the city's residential area and just 1 per cent of all land in the city. They are forced to live in inadequate housing and have little access to clean water, sanitation, healthcare, schools and other essential public services. They also live under the constant threat of forced eviction from the makeshift structures they have made their homes. Due to the current scenario, the once pristine river banks are now punctuated with informal settlements and theirs waters now characterized with heavy pollution loads. There has also been a major loss of riparian lands, aquatic biodiversity and aquatic aesthetics as a result of various anthropogenic activities along the river banks. Consequently, the once sources of clean, cool and refreshing waters, are now major sources of diseases and deaths due to raw sewage disposal into the rivers by slum dwellers (Erick, K. M, 2016). This situation prompted the interest of the researchers to carry out this study with particular interest of evaluating the impacts of Kayole-Soweto slums on river Ngong in Nairobi.

1.1 Economy of Kayole

Gallaher, C. M et al, (2013) observed that in the slum, what one does, does not matter so long as it leads to passing the day, and how amorphous one has to be, to accept any shape life came in. it's all about finding a way to put food on the table. Ehebrecht, D. (2015) Slum residents cut a living by collecting garbage, separating it and reselling plastics and metals. The plastics and metals savaged from the dump site are resold and earn money. Food waste is fed to pigs that are later sold to butchers. The Kayole Soweto residents have found an avenue of earning money via that way. Vending illegal alcohol is mainly done by women while others are out servicing men escaping reproach from their homes during the day and sometimes at night. Life is all about living for the day. According to Mwania, J. M., & Muola, J. M. (2013).The alcohol is made using the heavily polluted Ngong river waters. This possess a great health risk to the illicit brew consumers. In the Soweto informal settlement at the heart of Kayole in Nairobi is a school community called sheep care community. Its members testify that the sky is the limit for those who aspire to succeed. Sheep care Community Centre is impacting on the students and the community through the practice of aquaponics. The project combines fish and crop farming.

1.2 Sources and Nature of River Ngong Pollutants

Riverside farming is common among the residents of the Kayole Soweto slum and the three most common vegetables grown on the banks of the river are amaranthus, spinach and arrowroot. There is small-scale farming where chemical fertilizers are used and when it rains, some of the fertilizer and dangerous chemicals are washed into the rivers, Njuguna, S. M., et al, (2017). Using the fertilizers maybe harmful to the river especially during the rainy season because the fertilizers which contain sulphates and nitrates are washed into the river and this may cause eutrophication. It is important to note that the biggest percentage of population in the Kayole Soweto slums has no formal employment and therefore they are always in search of casual labor on a daily basis to meet their daily needs. Women are mostly involved in casual labor of washing clothes in the surrounding households. The water used for washing the clothes is disposed out into the open drains which end up into the river Ngong. They also do small businesses of selling groceries, charcoal and other basic commodities. These small businesses are not sustainable because the little money they get goes to food and shelter and they end up not taking their children to school because they cannot afford education. Men involve themselves basically with casual labor at construction sites and they have to wake up very early in the morning. There is no guarantee of getting this job because there are thousands of unemployed youths and grown-ups who are in search of these casual labors on a daily basis explains. Zimmermann, L. (2012). Economically, the river bank are used for irrigation, cultivation, car washing, beer brewing, and 'Juakali' industries within the slum. Irrigation is most common for the vegetables that the area residents grow (spinach and kales). Car washing and illegal bear brewing is done in the area as a means of livelihood amongst the Kayole Soweto residents. Macharia, K. (1992)

2.0 Methodology and Research Approach
2.1 Study Area

This study was conducted in Kayole- Soweto slum in Nairobi, Kenya. The main focus was on the influence of human settlements along Ngong River which originates from Kibiku forest, south of Ngong Hills. The river traverses through in Nairobi city and the Kayole-soweto slum before emptying into Athi-River in the outskirts of Nairobi city. This study focused in Matopeni and Mitoni areas.

2.2 Research design

ex post facto as a research design as described by Kothari, C. R. (2005) ; Kerlinger, F. N., & Lee, H. B. (2000) was used for data collection. The independent variable of informal river settlements was studied in relation to the river environs. A sample size of 36 out of a population of 747 people living within 100m from the river bank and along the 1 km stretch of the river in the study area was established using the Slovin's formula - n = N/1-N(e)^2 at 95% confidence interval. Where N= Population size, n= the sample size and e is margin of error. Simple random sampling was further used to identify the respondents to whom semi- structured questionnaires and interviews were administered and conducted respectively.

2.3 Data Analysis

Data collected was analyzed through descriptive statistics in the form of frequencies and percentages while Pearson correlation analysis was used to determine the relationship between the independent and dependent variables and their significance. The computer software used for data analysis was the Statistical Package for Social Sciences (SPSS) version 22. Data was presented using tables.

3.0 Results
Table 1: Respondents' responses in relation to proximity to the river bank in terms of meters

Proximity to the river (in meters)	Frequency	Percent
0-25 m	19	52.8
26-50 m	8	22.2
76-100 m	9	25.0
Total	**36**	**100.0**

The results indicated that all the respondents sampled lived close to the river Ngong with 52.8% living less than 25 meters from the river, 25% living within a distance of between 75-100 meters from the river and 22.2% living less than 50 meters from the river. This implied that the Kayole-Soweto slum settlements were in close proximity to the Ngong River.

Table 2: Respondents' economic activities within the study area

	Frequency	Percent
Residential (un-employed)	19	52.8
Commercial	8	22.2
Educational	3	8.3
Agriculture	5	13.9
Public utility services	1	2.8
Total	**36**	**100.0**

On analysis of economic activities carried out by the respondents, it was found out that majority of the respondents -52.8% were residents of the study area and had temporary structures which they used as shelters. These had no any formal employment. From the sampled population it was also established that 22.2% run small commercial businesses such as shops, bars, motor vehicle and motor cycle garages and hotels. Further, 13.9% of the respondents also indicated that they carry out agricultural activities in the area and especially

along the riverbanks and 8.3% run education facilities while 2.8% run public utility services in the area. This showed that the river Ngong environs consisted mainly of residential activities together with both commercial and agricultural activities though to a lesser extent.

Table 3: Respondents' general views, perceptions and impacts of waste disposal in River Ngong

		Frequency	Percentage
Colour of the water	Black	33	91.7
	Grey	3	8.3
Condition of the river	Very poor	28	77.8
	Poor	7	19.4
	Good	1	2.8
Whether the river breaks its bank	Yes	33	91.7
	No	3	8.3
Frequency of flooding	Frequent	33	91.7
	Not applicable	3	8.3

Majority (91.7%) of the respondents reported that the colour of the water in river Ngong was black while 8.3% reported it to be grey. Further,77.8% of the respondents were of the view that the condition of the river was very poor in terms of overall hygiene including bad smell, 19.4% were of the view that the river's condition was poor while only 2.8% of the respondents were of the view that the condition of the river was good. In addition, 91.7% of the respondents claimed that the river frequently broke its banks especially during the rainy season while 8.3% claimed that the river never broke its banks. This showed that river Ngong posed a serious health risk to the residents of the Kayole-Soweto slum.

Table 4:

	State of the river Ngong environs	Solid and liquid waste disposal techniques	Informal river line settlements	Activities carried out in the locality
State of the river Ngong environs (r) (p) Sig. (2 tailed)	1			
Solid and liquid waste disposal techniques (r)	.⁻648*	1		
Sig. (2 tailed)	.000			
Informal river line settlements (r)	.⁻514*	.016	1	
Sig. (2 tailed)	.000	.114		
Activities carried out in the locality (r)	.⁻582*	.161	.233	1
Sig. (2 tailed)	.000	.229	.464	

Pearson's product moment correlation analysis　　* Significant at 5%

Results of the Pearson correlation as shown on Table 4.10 above indicates that there is a significant negative correlation between the solid and liquid waste disposal techniques in use and the state of the river Ngong environs (r=-0.648, Sig. value <0.05); a significant negative correlation between activities carried out in the locality and the state of the river Ngong environs (r=-0.582, p value <0.05) and a significant negative correlation between informal river line settlements in the Kayole-Soweto slum and the state of the river Ngong environs (r=-0.514, p value <0.05). This implied that an increase in the disposal of solid and liquid wastes into the river Ngong, an increase in informal settlements along the river and an increase in activities along the river would be associated with poorer state of the river Ngong environs.

4.0 Discussion and Conclusions

The results of this study indicated that most of the respondents lacked formal employment and therefore could not afford various basic amenities such as proper shelter, toilets and safe waste disposal systems and land resource for settlement. This is what prompted a huge population of residents to settle closer to the river as with the findings in the table 1 and 2 above. As a result River Ngong and roads became the only waste disposal sites for this category of people. Furthermore, only few public toilets were available in the area and were mostly found within the few schools and other public areas, these were mostly being used by people who operated businesses in the area since they could afford to pay the Kshs.10 charged by the toilet operators. However, most of them had underground pipes that emptied into river Ngong hence dumping raw sewage into the river. Similarly those who operated businesses with solid or liquid waste production agreed that most of their wastes such as motor vehicle oils, grease and hotels wastes (both biodegradables and non-biodegradable) found their way into river Ngong. This accounted for the Black-grey colour and the poor condition of the water as reported by the respondents in table 3. Analysis of contribution of various economic activities, proximity of settlements to the river bank and waste disposal techniques in towards the current condition of Ngong River in relation to pollution indicated medium level of significance.

In conclusion, human settlements along the riparian zone aggravates river bank erosion which leads to; sedimentation, increased turbidity, hence low light penetration for primary production as evident in the pearson's correlation in table 4. These adverse effects have left the river as a mere shadow of the past, which was a bubbling ecosystem that once used to support vast biodiversity. If this situation persists, the whole river will die and affect the river Athi which is its effluent and in the long run affect the Indian Ocean where Athi River discharges its waters. Finally, as a recommendation, urgent attention to clean up the river is required. Furthermore, an extension /or a follow up of this research with an aim of establishing the physical and biochemical parameters of this river is paramount.

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