AN ASSESSMENT OF THE EFFECTS OF HOUSING DEVELOPMENT ON WATER QUALITY IN ENUGU URBAN

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ABSTRACT

A biophysical environment is seen as a biotic and abiotic surrounding of an organism or population, and consequently includes the factors that have an influence in their survival, development, and evolution. Specifically, this study is aimed at carrying out an examination of the effect of housing development on surface water quality in Enugu urban. The research design used for this study was the experimental design. The major findings of the study were that housing development in Enugu state has a negative and significant impact on water quality. Compared with the WHO standard, water quality deteriorates as housing development progresses. It is therefore the recommendation of the study that the housing authorities in Enugu state should institute measures to ensure that housing development does not compromise environmental quality and house owners and indeed all residents should be properly sensitized through environmental education on the dangers of abusing environmental standards.

KEYWORDS: *Water Quality, Housing Development, Biophysical Environment*

1.1 Introduction

In an ordinary parlance, a biophysical environment is seen as a biotic and abiotic surrounding of an organism or population, and consequently includes the factors that have an influence in their survival, development, and evolution (Deng and Wilson, 2006). A biophysical environment can vary in scale from microscopic to global in extent. A conducive biophysical environment is necessary for land fertility, environmental equilibrium and other miscellaneous benefits.Housing is the second most essential human need after food. It is an integral part of human settlement that has a profound impact on the quality of life, health, welfare, productivity of man as well as economic development and environmental sustainability. This implies that housing has multiplier effect on the human society and economic development. In spite of this essential nature of housing, a large proportion of the population in most developing countries does not have access to decent housing at affordable cost (Sengupta and Sharma, 2016).

However, there is an adverse relationship between housing construction and environmental sustainability. These two variables tend to move in an indirect proportional relationship. An increase in housing construction and development, the lower the level of environmental

sustainability (Vanclay, 2015). Environmental effects of housing construction activities may vary from country to country. Major environmental impacts of housing construction projects are such as pollution,waste disposal, resource use and habitat destruction, desertification, soil erosion and material wastage etc. Housing construction activity use resources like timber and non- fuel materials' cement, water and a range of other resources including energy in the production of various types of housing works and structures. Housing construction project leads to habitat destruction, loss of arable land, and loss of biodiversity etc. (Janjic, 2016).

The rate of public housing development in Enugu is on a progressive path like other counterpart states. This is informed and encouraged by the need for shelter, welfare and economic gains that accrue from letting it out to prospective tenants and occupants (Attamah, 2016). However, the biophysical impact and effect of such public housing development activities and housing development in the state is not receiving due attention and this is considered an environmental risk. Though it is a known fact that housing development creates jobs to truck drivers, accountants, engineers, contractors, managers and business owners, just to name a few, one has to also know they have negative effect on the biophysical environment (Attamah, 2016). But not everyone realizes that when we build, use and demolish houses, we disturb and erode soil, disrupt habitats, deplete natural resources, pollute air and water and use upland (Janjic, 2016). The construction industry has a significant irreversible impact on the environment across a broad spectrum of its activities during the off-site, on site and operational activities, which alter ecological integrity of the environment. This is because buildings are very large contributors to environmental deterioration.

In this paper, one variable was used to measure biophysical environment namely; water quality. The paper evaluated the reactions of this variable (water quality) based on progressive housing development in Enugu state. The rate of housing development in Enugu state calls for an empirical study to estimate the reactions of the biophysical environment. Existing literature shows that there is paucity of studies on the relationship between housing development and biophysical environment sustainability in Enugu state. Related studies were not within the scope of this study. For instance, Iloeje et al (2013) carried out a study on housing deficit and environmental challenges in Enugu Urbanand found out that there is a straight line and positive relationship between housing deficit and environmental challenges in the state. Ononugbo, Akpan and Osho (2010) investigated on an assessment of housing needs for the low-income people of Enugu Metropolitan areas of Nigeria and found out that

the degree of housing needs is mounting an undue pressure on the biophysical environment. A study that is quite close to the present study is the paper written by Emeka (2017) on environmental degradations, strategies and effective management practices in Enugu, Nigeria and the work noted that the management of environmental degradations in the state has not been optimal. The deviating point being that he did not analyze the effect of housing development on the environment, rather focused on causative factors like solid waste management, the menace of deforestation, and development of slums as well as water and air pollutions in the area. The essence of this paper is therefore to ascertain the extent of biophysical reaction based on increased housing development in Enugu metropolis.

Aim and Objectives of the Study

The aim of this work is to examine the effect of housing development on surface water quality in Enugu urban.

2. Literature Review

2.1 Water Quality Parameters

2.1.1 Temperature

Water temperature plays a significant role in affecting physical, chemical and biological processes in water bodies (including the flowing waters like rivers), and thus theconcentration of many variables (ANZECC 1992). High water temperature activates the rate of chemical reactions with effect on evaporation and volatilization of substances from water. As water temperature increases, the solubility rate of gases in water such as Oxygen (O2) decreases. Moreover, the respiration rates of aquatic organisms increase in warm water which lead to greater consumption of O2 and increase the rate of decomposition (Chapman and Kimstach2018). An abrupt change in water temperature can lead to greater destruction of aquatic life. On the other hand, excessively high water temperature may lead to the problem of unwanted growth of water plants and wastewater fungus (Metcalf and Eddy, 2018).

2.2.2 pH

The pH is used to read the acid balance of a solution and it is defined as ‘the negative of the logarithm to the base 10 of the hydrogen ion concentration’ (Chapman and Kimstach, 2018). The pH scale ranges from 0 to 14 (i.e., very acidic to very alkaline), and pH 7 indicates a neutral condition. The pH of natural water stays in between 6.0 and 8.5 but could be affected by chemicals entering the waterways (Chapman and Kimstach, 2018).

2.2.3 Dissolved Oxygen

The analysis of dissolved oxygen (DO) is used to measure the amount of gaseous oxygen dissolved in the water, which is crucial for all forms of aquatic life. DO in water mainly appear by diffusion from the atmosphere and also from the photosynthesis of aquatic plants. Determination of this parameter is an integral measure of assessing water quality as O2 plays an influential role in 'nearly all chemical and biological processes within water bodies' (Anderson, 2015).

2.3.4 Electrical Conductivity

Electrical conductivity in water (ECw) is a measure of salinity and the extent to which water is able to conduct an electric current. It is expressed as micro Siemens per centimetre (µS/cm) and, relates to the concentrations of total dissolved solids (TDS) or salts in a specific water body (Taylor 1993; Liston and Maher 1997).

2.3 Empirical Studies

Dasi and Heidi (2014) examined the water quality impacts of housing project involving the culverting of a creek to allow for the construction of a runway at an airport in Cleveland, Ohio. Sampling parameters included total suspended solids (TSS), dissolved oxygen (DO), pH, conductivity, and temperature. To assess the effects of the construction project conducted using appropriate BMPs, weekly water quality samples were taken upstream and downstream from the construction site. The samples were categorized as baseline, active construction, and post-construction to isolate the effects of the construction activities. t tests were used to compare upstream and downstream data for each of the parameters and ANOVA was used to compare the individual water quality parameters in the three sampling periods to see if there were significant increases or decreases of the water quality parameters within the phases. Results of ANOVA indicate there were no statistically significant differences between upstream and downstream in the mean sample results for TSS, conductivity, and pH when comparing the three phases. While the descriptive statistics conducted on the data illustrated minor variation in the upstream, downstream, and between phase comparisons, the results of the t tests helped to strengthen the theory that construction projects utilizing appropriate BMPs can yield minimal impact on overall water quality of surrounding water bodies.

Roger and Ronald (2016) carried out a study on the impact of during and after highway construction on 15 water quality parameters and macroinvertebrate condition using the West Virginia stream condition index (WVSCI). Principal components analysis (PCA) identified regional primary water quality variances, and paired t-tests and time series analysis detected seven highway construction-impacted water quality parameters which were mainly associated with the second principal component. In particular, impacts on turbidity, total suspended solids, and total iron during construction, impacts on chloride and sulfate during and after construction, and impacts on acidity and nitrate after construction were observed at the downstream sites. The construction had statistically significant impacts on macro-invertebrate index scores (i.e., WVSCI) after construction, but did not change the overall good biological condition. Implementing BMPs that address those construction-impacted water quality parameters can be an effective mitigation strategy for future highway construction in this highlands region.

3.0 METHODOLOGY

3.1 Research Design

The research design used for this study is experimental based. The laboratory experimental approach was adopted in the course of the study.

3.2 Source and Method of Data Collection

Data for the study was collected through water samples subjected to experimental tests.

3.3 Method of Data Analysis

Data for this study was experimentally analyzedthrough the laboratory mechanisms.

4.0 DATA ANALYSIS AND INTERPRETATION OF RESULTS

In the course of the study, water samples were collected and analyzed experimentally through laboratory mechanisms. This is reported in the table below.

Experimental Results

Table 1: Results of Physic-Chemical Analysis of Collected Water Samples

Sample ID	Total Organic Carbon (%)	Ph	Organic Matter (%)	Fixed Carbon
Okwuosa	1.40	3.65	4.15	17.55
Coal City, Emene	0.92	4.16	2.73	11.55
Maryland	1.14	4.23	3.38	14.30
Mmiriocha, Abakpa	0.93	6.10	2.76	11.68
Ebeano Tunnel	0.89	7.07	2.64	11.17
Riverside Abakpa	1.07	4.20	3.17	13.41
W.H.O	6.5ug/I	No limit Listed	2.9	17.9

Source: Project Development Institute(Federal Ministry of Science & Technology)

Water samples of the sampled housing estates were collected and analyzed objectively through a laboratory process. These are displayed on table 1 while raw data analysis reported in the appendix. It can be clearly seen from table 5.5 that Okwuosa has the highest percentage of Total Carbon at the Magnitude of 1.40%, which was followed closely by Maryland which yielded 1.14%. The table further shows that Riverside Abakpa yielded a total Organic Carbon of 1.07%, Ebeano Tunnel yielded 0.89%, Mmiroicha Abakpa yielded 0.93% and Coal City Emene yielded 0.92%.

From the dimension of Ph which is another physic-chemical characteristic, Ebeano Tunnel yielded the highest outcome at the magnitude of 7.07%, followed closely by Mmiriocha Abakpa (6.10%), Okwuosa yielded 3.65%, Coal City (4.16%), Maryland (4.23%) and Riverside Abakpa yielded a Ph of 4.20%.

From the dimension of Organic Matter which was recorded in relative percentage, table 5.5 yielded 4.15%, for Okwuosa, the table further reveals that Coal City Emene yielded 2.73%, Maryland yielded 3.38% which is the second highest to Okwuosa, Mmiriocha Abakpa yielded 2.76%, Ebeano Tunnel yielded 2.64% and finally, Riverside Abakpa an organic matter of 3.17%.

Fixed Carbon as one of the physic-chemical characteristics of the collected water sample was extracted and analyzed. Table 5.5 reveals that Okwuosa yielded a fixed Carbon of 17.55%,

Coal City Emene yielded a fixed Carbon of 11.5%, Mmiriocha Abakpa yielded 11.68%, Ebeano Tunnel yielded 11.17% and Riverside Abakpa gave an output of 13.41%. This clearly shows that Okwuosa has the highest level of soil total fixed carbon, and Ebeano Tunnel has the least level of soil total carbon.

On the average, the water quality parameters are below the WHO standard for safety. The WHO standard for total organic carbon is 6.5ug/I, 2.9 for organic matter and 17.9 for fixed carbon.

4.2 Discussion of Findings

The objective of the study was to ascertain the impact of housing development on water quality in Enugu urban. Findings indicate that housing development has significant impact on surface water quality in Enugu. The experimental analysis confirmed that housing development deteriorates the water quality in Enugu urban as reflected in the values of the Ph, organic matter, organic carbon and fixed carbon in table 4.1 earlier discussed. The implication of this finding is that if not well controlled, water deterioration in Enugu urban will remain an environmental challenge given the high rate of housing development in Enugu urban. This finding is in line with the findings of Mohammad, Malik and Suktar (2017) who carried out an empirical investigation on housing development and its effects on water resources and found out that housing development adversely affects water quality. The study is further in line with the findings of Chen (2012) who reported that in the State of Ohio, USA, there is a significant and negative relationship between housing development, land use and in-stream water quality at a regional scale. The response of surface water quality to urbanization in Xi'n, China, was further investigated by He et al. (2018). Another study by Liu et al. (2019) has defined the application of the impact of new housing developments on river water quality in the integrated wastewater system context.

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This study has been able to assess the effect of housing development on the water quality of Enugu urban. In the course of the study, one element was used to measure biophysical environment in this study, namely; water quality. Based on the experimental analysis, it was concluded that housing development deteriorates the water quality in Enugu urban.

5.2 Recommendation

Based on the findings, the following recommendations were suggested:

- That the housing authorities in Enugu state should institute measures to ensure that housing development does not compromise environmental quality;
- That house owners and indeed all residents should be properly sensitized through environmental education about the dangers of abusing environmental standards.
- That strict enforcement of building and environmental bye-laws to punish those landlords who fail to provide the basic housing development standards.

APPENDIX I

Results of Heavy Metal Contaminants for Water Samples

Values in (Mg/g)								
Sample ID	**CU**	**Pb**	**Cd**	**Cr**	**Ars**	**Co**	**Ni**	**Hg**
Okwuosa	0.09	Nil	0.004	Nil	0.30	0.01	Nil	Nil
Coal City, Emene	Nil	0.09	0.02	Nil	0.08	0.14	0.01	Nil
Maryland	Nil	Nil	0.02	Nil	0.64	0.20	Nil	Nil
MmiriochaAbakpa	0.007	Nil	0.02	Nil	Nil	0.04	Nil	0.002
Ebeano Tunnel	0.003	0.08	Nil	0.02	0.01	0.11	0.003	Nil
W.H.O	1.98	0.009	3.2	1.91	2.78	2.54	4.21	1.2

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