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EMPIRICAL ANALYSIS OF THE EFFECTS OF HOUSEHOLD SOLID WASTE DISPOSAL ON THE RESIDENTIAL ENVIRONMENTAL QUALITY OF ENUGU METROPOLIS

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ABSTRACT

Managing Solid waste has always been a problem in most urban areas in Nigeria. Different Households employ different ways of disposing the wastes generated by them. This paper examines the major waste disposal methods adopted by the various households in Enugu Metropolis, and how they relate with the environmental quality of the area. Multiple regression model was used to establish a relationship between the environmental quality of the area and the major methods used by households in the area in disposing their household solid waste materials. Factor analysis was used to reduce the various environmental quality variables into a single factor score as the 'Y' (dependent) variable. The four major methods used in the area in disposing wastes served as X_1, X_2, X_3 and X_4 (independent) variables. In the result, the coefficient of determination showed that adjusted r^2 = 928 indicating that 92.8% variation in the environmental quality can be predicted from solid waste disposal methods. Dumping solid wastes in unauthorized areas negatively impacted more on the environmental quality of the area than any other variable. The situation induced flooding in the area, debasing the quality of the environment. Public education on environmental sanitation in general and waste disposal in particular, among other measures have been recommended to improve the situation.

Keywords: Sanitation, Refuse Disposal, Enugu, Environment, Nigeria.

1. INTRODUCTION

Inefficiency in solid waste management is one of the endemic environmental problems plaguing most urban areas in Nigeria. It has been a common practice to dispose refuse by the expedite method available without considering the negative effects on man and his environment. Just like in the rest of the world, rapid urbanization and population growth have brought about a proportional increase in the amount of waste generation in Nigeria. The inability to manage these wastes effectively in most urban areas with special reference to solid waste has become an issue or great concern with its attendant environmental implications.

In Enugu metropolis, the littered heaps of refuse dump as well as dumpsters overflowing with refuse at the nooks and crannies of the area do not only constitute obstruction to traffic flow, but also create health and environmental problems. Besides, it was equally observed that the various households within the metropolis engage themselves in different methods of disposing their household solid wastes. Despite the fact that Enugu State Waste Management Authority introduced the use of dumpsters as a solid waste management strategy few years ago, yet many households within the metropolis are not effectively appropriating this waste disposal method. This study is therefore directed towards examining the major ways by which the various households in the metropolis dispose their solid wastes in the area and how these have related with the environmental quality of the metropolis.

2. LITERATURE REVIEW

Cendrero and Fischer (1999) worked on the procedures for assessing the environmental quality of coastal areas for planning and management based on the identification of certain characteristics. They used certain indicators including number of storms per year, and thereby proposing numerical indices of the indicators. The indices could be used for monitoring environmental change with time. The method can help to determine whether existing management and policy trends move away or towards sustainability. Again, it can facilitate the integration of scientific assessment into the process of coastal planning and management through the application of indices which give the summary of environmental characteristics in terms that should be significant to planners and managers. However, because of the peculiarities of coastal areas, it could be seen as an irony of circumstance for the procedure for assessing environmental quality in a coastal area to be generalized to every other environment.

Also m United States of America Brasington (2005) estimated the relationship between housing price and environmental disamenities using spatial statistics to uphold the view that nearby point source pollutants depress house price. Applying the statistics, six spatial Hedonic regressions for Akron, Cincinnati, Cleveland, Columbus, Dayton and Toledo were determined. The highlight of the results showed that the implicit prices of environmental quality and related characteristics from the house price hedonics the estimate of a demand curve for environmental quality. It was also found that there was significant evidence in spatial effects in both the hedonic and demand estimations, and that environmental quality and house sizes are substitutes. Perz (2011), studying the environmental quality of Brazilian Amazon, emphasized that deforestation is not the only issue of importance concurring changes in environmental quality of the Amazon. Three dimensions of urban environmental quality were considered. Census data and health services statistics were used. The study compared enchanters of environmental quality in urban population of Amazon in 1980 and 1991 quantitatively. Thirty three environmental quality indicators were used. The results indicated that environmental quality in the region deteriorated during the 1980s as the production of and exposure to environmental hazards rose while resources to ward off hazards eroded, and that environmental quality was particularly poor in more rapidly growth urban centres. Consequently, this stands as a challenge for sustainable development in the Amazon.

Using Europe and America as case studies, Cendrero, Lopez et al (2003) worked on the procedure for sustainability assessment in Coastal areas based on a series of indicator and indices that reflect environmental quality. Three dimensions of environmental quality (functions, interaction and components) were taken into consideration. The procedure was developed within the ELANEM Euro-Latin American project. The procedure offered the possibility of expressing environmental quality of the coastal areas in numerical form through the use of indices based on clear and replicable method, using indicators that can be measured or objectively determined. This method could provide a useful tool for monitoring environmental quality, thus helping to assess sustainability of existing policies and practices.

Bernaver and Konbi (2004) in their study on the effect of various political variables on environmental quality, took into account the effects of economic variables. Air pollution (concentration of sulfur dioxide) was used as the dependent variable. Annual observations for the year 1971-1996 from 291 observation sites located in 107 major cities in 42 countries (2,555 observations) constituted the data for sulfur dioxide concentration. Combining the environmental, economic, political and site specific components a statistical model was obtained. Through regression of sulfur dioxide concentrations on the explanatory variables, they obtained their results. Emerging from the result, there was indication that higher income, higher intensity of economic activity and greater trade openness contribute to lower pollution levels. The study could be useful for environmental quality monitoring. However, being an issue specific in nature, it cannot be generalized to other forms of environmental quality.

Assessing the inequality in the spatial distribution of accessibility and environmental quality in Paris metropolitan region, Palma et al (2007) asserted that local amenities are generally capitalized into housing market. Data from IAURGP GIS data base and metropolitan computations were used. The empirical analysis of the study showed that considerable inequality existed in the spatial distribution of the local amenities and social indicators. Spatial representation and Lorenz curves were used to examine the degree of inequality in these amenities. These provided evidence that some amenities were much more inequitably distributed than others. The researchers therefore obtained new insight into, how households in the Paris region trade off amenities against each other and against housing cost by estimating models at both a commune and at a grid cell level. Hence, they found that residential location choice model filled the data moderately better at the smaller scale of the grids cell compared to the commune. Thus G.I.S/EMIS could be seen to be invaluable for modem environmental studies in most counties of the world.

Majunder, Hossain and Islam, (2007) in an interesting environmental quality mapping study of Chittagong metropolis in Bangladesh, endeavoured to analyse both factual statues and perceptual pattern of the environmental quality of Chittagong Metropolitan City. The factual data were collected from various sources while the perceptual data were based on questionnaire survey of opinions of 492 respondents at the household level by City ward. The City's 40 wards were surveyed in this study using ranks of the wards by environmental groups. Thus, the study's numerous variables were classified into three: physical environment, neighbourhood environment and social environment. To determine the limit of satisfaction and dissatisfaction of the various environmental variables by respondents, satisfaction index developed by Hall, Yen and Tan was applied. It was tested against three levels of household income - high, medium and low income groups-using Chi-Square. The study presented the crying need to address urban environmental quality resulting from high rate of urbanization and urban population in Chittagong Metropolitan City. They concluded that community people should be mobilized in such effort because people's participation is very much fruitful in improving their environmental situation.

In Turkey, Alkay (2009) carried out a study on the relationship between environmental quality level and housing sale prices in Istanbul metropolitan area. The study was carried out in two stages. In the first stage the environmental quality index was measured, using principal component analysis, after standardizing the different units of measurements with similar indicators. Relationship between the environmental quality index and housing sale prices were explored in the second stage. Correlation coefficient and square goodness of fit were used. The result indicated that the weights of dwelling indicators and satisfaction from housing environmental indicators were positive while the economic, social and accessibility indicators were negative for the casual factor that explained the environmental quality at district level in the metropolitan area. The study therefore concluded that the increasing environmental quality levels depend on the increasing quality of dwelling characteristics and satisfaction from the housing environment. The result is useful in that it can show the overview of the environmental quality index at the district level, used by both public and private decision makers in improving

the city. However, the study lacked time series data. Besides, some studies have also been carried out in Africa as they concern the environmental quality of the area.

Alem and Martinson (2011) investigated the importance of environmental quality to the poor and what the policy makers know about it in Addis Ababa, Ethiopia. The citizens and policy makers were asked to rank the areas that they think government should focus on. The ranking areas were:

a) Better health services, education and housing
b) Creating environmental opportunity
c) Controlling price rise
d) Improved solid waste disposal
e) Improved liquid waste disposal

In their finding, although standard determinants of subjective well being in western countries seemed to explain happiness in Addis Ababa, yet environmental quality equally played a very prominent role. Averagely, the policy makers had more long-term perspective by focusing on health, education and housing. The citizen on their part focused more on short-term issues such as controlling price rise. Hence, the government of the country went as far as introducing a strict control over prices of basic commodities, adopting the views of the citizens in this regard.

In Nigeria, different people have equally worked on environmental quality as it affects different cities or towns. Olorunfemi (2009) studied the willingness to pay for improved environmental quality among the residents living in close proximity to two landfills in Olushoshun and Abule Egba, all in Lagos metropolis. The main instrument used in the collection of primary data was structured questionnaire. In the survey, a contingent valuation method was used, which solicited the resident's preferences through survey technique to state their willingness to pay for the benefits gained from an improvement in environmental quality (an improvement in the quality of Landfill practices). From the results, there was an indication that the presence of the landfills and the associated environmental impact was an important factor contributing to respondent's willingness to pay for environmental improvement in their neighbourhood.

Examining the housing improvement of core residential environmental quality of Ogbomosho town, Afon (1998) made use of twenty variables and identified ten environmental quality indicators. Correlation matrix was compared to determine the relationship existing between pairs of the variables. Correlation of the ten proved positive. Expressing the importance of the study, Afon advocated that it was no use for planners to impose their ideas on the public because people are better planned for when they have input into policy and programmes that will affect their present and their future.

Ekurekong and Jacobs (1998) attempt to shed some light on compliance that ensure high attachment of environmental quality in housing estate in Uyo, AkwaIbom State. The study revealed that the housing estate by all indicators was deficient in facilities and service provision. The study also showed that more than 70% of the total area of the estate had been used for residential development, leaving less than 10% for the provision of facilities and services. These services were completely lacking in the estate. The analysis showed that the existing facilities were undoubtedly inadequate to support the huge population in the estate. An environmental quality unit was recommended to be established, to monitor and control quality of the environment in the estate.

Ede et al (2007) determined housing and neighbourhood quality for Yenegoa, Bayelsa State of Nigeria. The study sampled five neighbourhoods in the city to examine the problem, using questionnaires and physical observation as instruments. They looked at some of the variables that determine urban housing and neighbourhood quality as they relate to Yenegoa. The analysis made use of multiple Linear Regressions. The dependent variable (y) in the study was a composite value based on location. The statistical package for social sciences (SPSS)

was used to explain the variations in the dependent variable by the independent variables. The results showed that sanitary services among other independent variables have the greatest significance level (.99 confidence levels). The coefficient of determination was 0.1, and it was significant at 0.00 levels. Other independent variables of significance that could be taken serious included modem toilets, good drainage and open spaces. There was an indication that housing developers in Yenegoa did not comply with the existing regulatory measures to improve the housing and environmental quality. This, indeed, creates a gap between the present conditions and the target of various policy instruments for regulating the neighbourhood environmental quality in Nigeria. In order to address the situation, it was recommended that existing regulatory measures such as urban and regional laws, the National Housing Policy, the Urban Development Policy and the State sanitation Edict be vigorously enforced by the government. Although the study was empirically conducted, the independent variables shown were more of housing than environmental. In other words, it contained a limited number of environmental quality variables.

Others include, Olanrewaju and Fadairo (2003) who emphasized poor state of streets as a problem which does not give room for efficient evacuation of solid wastes. Okeke (2002) noted that the extensive use of temporary structures in the high density neighbourhoods of Nigerian urban centres has constituted the fore runner of squatter settlement development in these areas. Emodi (2013) pointed out that rapid population growth among other factors have compounded urban environmental management, thereby negatively impacting surrounding environment. Umeakuka and Mba (1999) observed that blockage of storm water drainage paths in Onitsha with solid wastes which in turn induced flooding can not enhance the quality of the area.

In 2005 Nwafor carried out a study on the recycling and re-use of urban solid waste in Enugu (Nwafor 2008). Certain studies have also been carried out and proposals advanced as to the improvement of solid waste management in Enugu metropolis. Wastlake (2008), noted the study carried out by Mequip Engineering services in 2006 "Towards integrated urban solid waste management". The project among other things was the supervision of the construction of a sanitary Landfill for Enugu metropolis located at Ugwuaji site, 1.5 km away from Enugu, along Port Harcourt Expressway. The study and the implementation of the sanitary landfill, however, had congenital weaknesses which were aggravated by operational inappropriateness. There was no Environmental Impact Assessment study and Monitoring Programme for the Landfill site, with the result that flooding made operations in the rainy season difficult. Also, the Waste management Authority granted Emenite Ltd (industrial outfit) access to the Landfill for the disposal of industrial waste which was not provided for by the study.

Nwafor (2008), examined the causes of urban solid waste management problems and the attendant economic, social and health costs, as well as environmental and aesthetic costs. He identified the inertia factor, the demographic factor, institutional factor as well as absence of public participation as being responsible. According to him the force of inertia operates from three angles; difficulty in enrolling public involvement for change, the perceptual aspect and the response aspect. Considering the demographic factor, rapid urban population increases the accelerated rate of urbanization, while lack of intersectoral communication and coordination to manage the environment are the major institutional constraints. Consequently, solid waste management problems have resulted in critical environmental, economic, social and human health crises in Enugu metropolis.

In his study on sustainable solid waste management practices in Enugu Metropolis, Emodi (2013) observed that no form of refuse disposal service is provided for some of the traditional core areas because of lack of easy access to these areas. Besides, houses are invariably located haphazardly, and most of the roads and pathways are too narrow to be motorable and are generally impassable during the rainy season. Hence, even where garbage trucks are available, they many not be able to pass through for the evacuation of refuge. He,

however, identified four major methods of solid waste disposal by various households in the metropolis to include; burying by households, burning, dumping refuge at unapproved dumpsite and the use of dumpsters in refuge disposal.

Although various authors have discussed or carried out researches on environmental quality, the review indicates some research gaps in this area of study. Environmental quality studies have so far primarily concentrated on the effects of economic and social demographic variables on environmental quality as observed by Bemauer and Loubi (2004). Besides, the available studies on measuring environmental quality focused mainly on peculiar areas as in the case of Cendrero and Fischer (1999). Again, a good number of the studies were on an aspect of environmental quality especially pollution such as in Olorunfemi (2009). Furthermore, public perception based studies were very common as exemplified in Afon (1998). It is therefore essential that a study of detailed environmental quality indicators is timely in Nigeria. This will aid in the measuring and ascertaining the environmental quality of an area, especially now that Nigeria and the rest of the world are gearing towards sustainable environment, which invariably will take centre stage in addressing the issue of sustainable development.

3. MATERIALS AND METHOD

3.1 The study Area

Enugu metropolis, the study area is located between latitudes $6^0$27'N and $7^0$28N and longitudes $7^0$30E and $8^0$19E. The urban land area is roughly 72.8 square Kilometers with the rural environs covering an additional area of about 200 square metres. It comprises three local government areas namely, Enugu North, Enugu East and Enugu South. Enugu metropolis is in Enugu State, located in the eastern part of Nigeria and embedded in the Guinea savanna belt, which is the broadest vegetation belt in Nigeria.

The metropolis which lies on an altitude of 232.6 metres above sea level exists natural domes in the South and undulating plains forming the foothills of Udi escarpment in the North. The population has been on the increase within the metropolis in the last few decades as a result of rapid urbanization and subsequent influx of people. In 1953 the population was 63,000. This rose to 482, 977 in 1991 and by 2006, the population was put at 7,22,664 (NPC, 2006).

Enugu started as a photo-urban settlement near the mines, following the discovery of coal in the Udi hills around 1909. Iva valley and Ogbete areas which were the first areas to develop functioned primarily as coal miners residences. With the discovery of deep sea harbor in Port Harcourt, construction of Enugu-Port Harcourt rail line commenced in Enugu in 1914. The first freight of coal was transported from Enugu to port-Harcourt in 1916. In 1917, Enugu, attained, township status and was then referred to as Enugu Ngwo. As a result of its rapid expansion towards areas owned by mixed indigenous communities rather than towards Ngwo highlands, it was renamed Enugu in 1928. By 1939 Enugu has become the headquarters of the then Southern province. It became a regional capital and the important administrative centre in the then Eastern Region with the creation of the three regions in Nigeria in 1961. Presently, it is the capital of Enugu state of Nigeria.

The annual rainfall in the metropolis is 1247.8mm and the rainfall is mostly during the months of April through October, having July as the peak period. The annual temperature of Enugu is about 30.8°C and the variation within the season is normally less than 10°C. The relative humidity fluctuates between 40 and 80 percent. The prevailing winds are the local monsoons; the North East Trade wind and the South West Trade wind. The North East Trade wind blows from across Sahara desert, with dry and dusty air over the area, hence resulting in dry season characterized by dusty harmattan weather. This season usually last from November

to March. The South West Trade wind blows from across the Atlantic Ocean, bringing about the raining season.

3.2 Methodology

Relationship between environmental quality of Enugu metropolis and methods of solid waste disposals by various households in the area was established. Environmental quality variables constituted the dependent variable while solid waste disposal methods made up the independent variables. 21 environmental quality variables were used in the study, made up of 11 dwelling unit quality variables, 5 parcel quality variables and 5 basic residential quality variables. The variables of solid waste disposal by the households include, households involved in burning of refuge they generate, households involved in burying the refuge they generate, households that dump their wastes at unapproved dumpsite and the households that use dumpsites in refuge disposal.

Survey design was adopted. The metropolis was classified into 30 neighbourhodds, stratified into high, medium and low density areas. From these areas samples were selected randomly. Primary data were mainly collected using questionnaires. Direct contact method of reaching the respondents was used. Closed form was mainly used in which choices of possible answers to open questions were provided. One thousand, four hundred and forty copies of the questionnaires were used in the analysis. Besides, field tests were equally carried cut to determine the air quality as well as the noise level of the area.

In the analysis of the data, factor Analysis (Principal Component Analysis) was first used to reduce the various environmental quality factors. Varimax rotation was introduced to get the aggregate factor score as the singular "Y" variable. Then multiple linear regression was used to establish the relationship between environmental quality of the study area and solid waste disposal methods by the households in the area. As the environmental quality variables formed the "Y" variable, households involved in burning of refuge, household involved in burying refuge households that dump their wastes at unapproved dump site and households that use dumpsites in refuge disposal made up the "X_1" "X_2" "X_3" and "X_4" variables respectively. Hypothesis was used to test the relationship between the environmental quality variables and solid waste disposal variables. The hypothesis was tested at 0.05 level of significance.

3.3 Data Presentation and Analysis

The environmental quality variables used in the study include, the eleven dwelling unit variables (Condition of floor, condition of wall, condition of window, condition of ceiling, condition of roof, condition of lighting, structural condition, landscaping, nuisance, poor condition, neighbourhood problem). The five parcel quality variables are (condition of drives, fair condition of units, sanitary condition, drainage, noise level) and five basic residential quality variables (crowdedness, good condition of units, air quality, waste disposal, and source of domestic water supply). Factor Analysis was initially used and varimax rotation further applied to reduce the environmental quality factors as could be seen in table 1. It also shows the rotated components of the environmental quality variables. After constant rotation, the result eventually turned out 3 factors, with 13.8.89, 1.434 and 32.040 as eigen values for factors 1, 2 and 3 respectively. Factor 1 is significantly loaded on 11 variables stressing primarily the variables of the environment which hinge squarely on the dwelling unit component. Hence, the underlying factors identified could be regarded as the dwelling unit impact on the environmental quality of the study area. Factor 2 has significant loading on 5 variables which constitute the most pronounced and conspicuous imprints on the adjacent structures and the parcel. This entails the extent to which quality of the units and surroundings within the same vicinity are affected. The common focus within these variables is that they

hinge on the parcels of the area. Consequently, the underlying factor could be identified as the parcel environmental quality. Factor 3 is loaded significantly on 5 variable, the index appearing to measure the overall quality of the exterior physical environment. For this reason, it is referred to as Basic residential Quality. The eigen value of each factor was used against the individual factor score. They were eventually combined to get aggregate factor score as the "Y" variable.

Table 1: Varimax Rotated Component Matrix Of Environmental Quality Variables

Variables	Components		
	1	2	3
Floor	.673	.435	.486
Wall	.808	-.427	-.185
Window	.768	.437	.364
Ceiling	.789	.295	-.435
Roof	.758	.249	-.435
Lighting	.867	.240	-.317
Structural condition	.835	.286	-.198
Landscape	.709	.249	-.310
Nuisance	.655	-.460	-.199
Drive condition	.574	-.660	-.952
Crowdedness	.176	.108	-.808
Poor condition	-.659	-.463	-.455
Fair condition	.216	-.786	.100
Good condition	.591	.184	.653
Sanitary condition	-.281	-.817	.106
Drainage	.494	.687	.178
Neighbourhood problem	.727	-.438	-.291
Air Quality	.336	.265	.512
Noise Quality	.339	.623	.504
Waste Disposal	.250	.491	.700
Domestic water	.375	.483	.593

****Extraction:** Principal component analysis;
***Rotation method:** Varimax with Kaiser normalization

For solid waste disposal variables, a survey of the distribution of regular households by the primary methods of solid waste disposal in the metropolis was carried out and the data is presented in table 2.

Table 2: Distribution of Regular Households by Method of Solid Waste Disposal in Enugu Metropolis

NEIGHBOURHOOD	SOLID WASTE DISPOSAL METHODS			
Low Density Areas	*Burning*	*Burying*	*Dumping at Unapproved side*	*Makes use of dump side*
Independence layout	102	106	1280	4462
Old G.R.A	114	112	1421	4340
Republic Layout	109	102	1566	3986
New G.R.A	96	98	980	4668
Golf	88	92	864	4676
MEDIUM DENSITY AREAS				
Trans Ekulu	286	292	2866	2682
Corridor Layout	302	278	2720	3644
Federal Housing	336	320	2966	2026
Thinkers Corner	268	274	2148	2414
City Layout	272	328	2441	2008
Maryland	298	348	3272	2956
Aria Road	276	209	1989	2287
New Era Layout	254	248	2088	2872
Second Avenue	262	250	2041	2004
HIGH DENSITY AREAS				
Ogui Layout	594	462	3648	1427
Asata Layout	642	634	3240	980
Real Estate	586	580	2962	1132
Ogbete	684	620	4831	720
Achara Layout	502	628	3928	862
Idaw River	551	554	3998	884
Uwani	450	462	3890	1824
Iva Valley	684	764	4994	241
Awkunanaw	662	688	4648	734
Abakpa Nike	374	731	3988	488
State Housing	610	622	3001	677
Emene	676	741	4978	328
Riverside	634	730	4486	582
New Haven East	490	486	3928	1983
New Haven West	492	508	3646	1880
Asata Camp	590	521	4024	841

Source: Researcher's Field work, 2014

Table 2 shows the distribution of the various households by their method of disposing the solid wastes they generate. In the analysis of the entire data, SPSS was used and the SPSS out outputs (regression outputs) are:

Table 3A: Results of OLS Regression (1)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.994	.987	.928	8.14648

Table 3B: Results of ANOVA Test

Model	Sum of Squares	df	Mean square	F	Sig
1 regression	237.925	4	59.481	1.896	0.031
Residual	1659.129	25	66.365		
Total	1897.053	29			

Tabl 3C: Results of Coefficient of variables

	Unstandardised Coefficients		Standardized Coefficients		
Model	*B*	*Std Error*	*Beta*	*t*	*Sig*
1 (constant)	30.774	16.143		4.906	068
Burning	-072	.2.422	-101	5.190	.038
Burrying	-3.552	2.300	-377	5.163	.037
Unapp dump site	-770	2.837	-121	5.714	.029
Use dump site	-1.256	2.718	-200	4.622	.048

4. RESULTS AND DISCUSSION

The results show that there is a strong significant relationship between residential environmental quality and the modes of solid waste disposals by households in the study area, R^2 = . 987. This is the coefficient of determination, which indicates that 98.7% of variation in the dependent variable (environmental quality) can be predicted from the independent variables (burning, burying, dumping at unapproved site, dumping at dump site). However, to generalize the findings to the population beyond the sample, the adjusted r^2 is employed. Adjusted r^2 = .928, indicating that the best coefficient of determination is 928%. Thus, 92.8% (explained variance) of the variables is capable of predicting the value of environmental quality in the area. This leaves 7.2% of the variation unexplained, suggesting that the explanatory variables could be regarded as being high.

Besides, P significance = .03 and P < 0.05 significance level. Interestingly, burning has P significance value of 0.038, burying has 0.037, dumping at unapproved sites has 0.029 and dumping at approved site has 0.048, all being significant at 0.05 significance level. The standard error of the estimation = 8.14684, which is the standard deviation of the error term. However, the explanation above is an overall measure of the strength of association, and does not reflect the extent to which any particular independent variable is associated with the dependent variable. Hence, the coefficients of the independent variables are employed, which measure the significant interactions in the relationship. The coefficients table indicates the relative impact of each variable on the dependent variable. It reveals the ability of each individual independent variable to predict the dependent variable. It is pertinent, however, to note here that dumping household solid waste at unapproved area variable negatively impacts more on the environmental quality of the area than any other variable. This suggests that most of the households in the study area dump their solid wastes in unapproved locations in Enugu metropolis.

Indeed, in most areas of the metropolis, particularly in high and medium density areas, household solid wastes are seen littered all over the areas. In places like Abakpa, Emene, Ogui, Maryland etc. these household wastes are dumped along the roads. During rainy season as it rains, some households dump their solid wastes into the running water. These wastes tend to block the drainages and the running water trying find its course moves into the nearby land areas to constitute the problem of flooding.

Besides, though Enugu State Government through the Waste Management Authority has provided designated places in most part of the metropolis where household solid wastes could be dumped for onward movement to the landfill at Ugwuaji, yet many people do not make use of these dumpsters. Even though the wastes are brought to the dump site, they are not dumped inside the dumpsters provided. Rather than dumping the wastes in the dumpsters, these wastes are always seen littered around the dumpsters. Also the attitude of the workers of the waste management authority who do not evacuate these wastes regularly is not encouraging. In some areas, the dumpsters are over filled with wastes without evacuation, and they remain so for days or even weeks, with the result that wastes are littered around such

dumpsters. As it rains, some of these wastes are carried into water drainages by running, blocking the drainages and also bringing about flooding. Furthermore, the odour emanating from the decayed and decomposed wastes that have not been evacuated for a long time from the dump site tends to impair the quality of the air in the surrounding environment.

Burning of household wastes is normally carried out not within the core of the metropolis. This method of waste disposal is noticed in places like Awkunanaw, Ogbete and Achara Layout all of the high density area of the metropolis. This, indeed pollutes the air. At the fringes of the metropolis like in Abakpa, Emene, Iva Valley and Idaw River, household solid wastes are usually buried within the nearby farmlands which in some cases serve as manure when decayed (for the degradable) for the agricultural operations in the area. The non degradable materials like plastic items are normally sorted out and burnt, thereby equally polluting the air.

5. CONCLUSION AND RECOMMENDATIONS

The study has shown that the issue of household solid waste management has become a monster in Enugu metropolis staring the authorities in the face while they look on rather helplessly. The problem largely results from the lack of political commitment to address the issue, which is reflected in government failure to resource authorities to deal with the rather complex issue of waste management in the area. Most households in the metropolis dump their solid wastes in unauthorized sites; along the roads, into running water as well as any site convenient to them. This, they do out of ignorance of proper way of disposal, and in some cases as a last resort since there are no other proper alternatives accessible to them. Even those households that make use of dumpsters do not appropriately utilize them as the wastes are not properly discarded into the dumpsters but are littered around them.

The situation has negatively impacted on the quality of the surrounding environment in the metropolis by eliciting flood, impairing the air quality as well as distorting the status of cleanliness by which the metropolis has been known for a long time. One can therefore deduce that there exists a significant impact of household solid wastes disposal practices in the metropolis on the environmental quality of the area. As the current practices are ineffective, the recommendations in this study, if considered will go a long way to bring in efficiency in household solid waste disposal in the area which invariably will strengthen the environmental quality of the metropolis.

It was observed that there is lack of data on the waste management situation in Enugu metropolis. This, is indeed, a constrain to the planning and organization of waste management operations in the area. There is, therefore the need to have accurate data on such issues as the quantities and types of wastes being generated by households, and the characteristics of the wastes. The state Government should create a data base on wastes. Accurate data on waste generation and composition, for example will be useful in determining appropriate strategies for waste management in the area. In situations where the state government lack the capacity to undertake the necessary research to generate waste data, qualified researchers can be engaged from universities and other research organizations to carry out the research and assist in the planning and implementation of waste management operations.

There is also need to identify all stakeholders in waste sector including waste producers, those who provide (formal and informal) waste collection services, waste pickers and recyclers. The contributions of these stakeholders must be recognized and their operations formalized and supported to improve waste management in the metropolis.

The poor waste disposal culture among households in the area can be addressed through public education in environmental sanitation in general and waste disposal in particular. This can be achieved through such avenues as schools, Churches/Mosques, and the media. Environmental sanitation should be made an integral part of the basic education curriculum. The media; the radio stations, television and newspapers should be used to raise

awareness among the general public on the importance of maintaining a clean and healthy environment. This could be done disseminating information in local languages, which will provide the opportunity to reach out to most of the households.

The study has show that most of the various households in the area have very poor waste handling culture which exacerbates waste disposal problem in the area. To curb this negative public attitude, the local authorities must strictly enforce existing by-laws on waste disposal, including littering and indiscriminate refuse dumping. To facilitate the enforcement of the waste disposal by laws, local authorities will have to be supported to recruit enough environmental sanitation guards to monitor waste handling by the public. They will also need the support of the court to help bring offenders to book. Prescribed penalties for waste disposal offences should include court fines, orders to clean up the streets, and imprisonment depending on the gravity of the offence committed.

It is also recommended that integrated solid waste management be adopted as a guiding framework within which to conduct the business of waste management in the area. Producers such as households should be enlightened on the merits of and encouraged to practice waste prevention. Waste reduction and re-use, while measures should be instituted to promote recycling and composting. Besides, since the bulk of solid waste generated in the metropolis consists of compostable organic materials, a successful composting project can greatly reduce the amount of solid waste going for landfilling. There is the need to move away from waste disposal in unmanaged dumps, and to the construction of modern landfills designed to control leachate flow and harvest landfill gas for energy production. These landfills can be supplemented with recycling and recomposing, all of which can generate additional revenue to fund waste management operations which eventually improves the quality of the environment.

It has been discovered that dumpsters are not available in some of the interior areas like Ogui neighbourhood and interior Obiagu. More dumpsters are therefore needed in addition to the existing stock. Also Enugu Environmental Waste Management Authority should adopt a distribution pattern of the available dumpsters to ensure a balance in dumpster accessibility to all neighbourhoods and households. This will help to make locations (drop-off points) accessible to household in all neighbourhoods, and reduce indiscriminate dumping of household wastes along the roads, Also the waste Management Authority should strengthen its activities by constantly removing the wastes from the dumpsters to avoid littering the surrounding environment with wastes, polluting the air.

Observing that dumping wastes at unauthorized areas and improper usage of the dumpsters in dumping wastes are the major methods through which households dispose of wastes generated by them, it is therefore pertinent that embarking on all programmes that will discourage household in the area from dumping their solid wastes indiscriminately along the road, and encouraging them in the proper use of the available dumpsters will go a long way to enhance the environmental quality of the metropolis.

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