Strategic Options for Urban Solid Waste Management in Enugu, Nigeria[1]

Anthony N. Ezemerihe

Enugu State University of Science and Technology (ESUT)

Enugu, Nigeria

ABSTRACT

The study examined the strategic options for Municipal Solid Waste Management (MSWM) in Enugu Urban. The aim is to identify the problems that result to challenges in Municipal Solid Waste Planning and Management in Enugu. The objective is to review the existing MSWM practices and determine the necessary measures to improve the planning and management of solid wastes in the study area. The Methodology involved the use of personal interview and questionnaires to sample the opinion of respondents from three selected local government area in Enugu Urban based on their level of urbanization using five (5) point likert scale. The result shows that there is a strong positive coefficient of correlation (r) = 0.9932 and the coefficient of determination of (r^2 or R) = 0.948 or 94.8% from the responses of project workers at the selected location and staff of Enugu State Waste Management Authority (ESWAMA). The work recommends an integrated solid waste management with proper planning and management of waste generated, disposal and treatment options, source reduction, waste recycling, use of more compression vehicles, reuse and exploitation of the potentials of solid waste to maximize its economic benefits. This will lead to sustainable solid waste management practices.

Keywords: solid waste management, sustainable solid waste practices, Enugu State Waste Management Authority (ESWAMA).

1.0 Introduction

In some cities of developing countries, bulk of solid waste, are seen on streets and in open spaces. This waste to say the least disfigures the city, creates an eyesore and also poses tremendous health hazards to the public. Investigation from Enugu State Waste Management Authority (ESWAMA) charged with planning and management of solid waste in Enugu urban indicates that, there is no effective and efficient solid waste management programme. Majority of the inhabitants in the area do not know what is expected of them as regards solid waste management. Out of the need to get rid of the solid waste from their domains and relieve themselves of its nuisance, the inhabitants dump the refuse behind their houses and indiscriminately in nearby open dumps. Some of the solid waste is dumped in the water channels, gullies, riverside and any available spaces. In most cases, the refuse accumulates, encroaching on roads and streets. Open burning has become the practice

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of reducing the volume of solid waste in some locations leading to air pollution in Enugu. In fact, solid waste disposal/management is said to be the highest environmental problem because at the moment, there is no effective existing solid waste management/disposal technology for the area.

(i) Urbanization and industrialization resulted to progressive increase of solid waste generation rates with increase in disposal costs and associated activities. There is also corresponding increase in disposal cost, environmental and health concerns, limited landfill, composting and dump sites which affect the Enugu urban waste management.
(ii) There are insufficient dumpsters at dump sites for collection of waste generated prior to arrival of collection vehicles and transportation to disposal landfill sites.
(iii) Substantial quantity of Municipal Solid Wastes (MSW) is disposed of unhygienically in open dumps, thereby creating problems to public health and environment.
(iv) The frequency of solid waste collection in some areas is inadequate so the collection of solid wastes is delayed which in turn pollutes the environment.
(v) There are no solid waste treatment facilities in Enugu, so waste is not treated before disposal.
(vi) The solid wastes handlers and managers are not adequately equipped technically with adequate plant/machinery to face the challenges of wastes generation and disposal in Enugu.
(vii) The majority of disposal vehicles used is not designed for waste disposal and are open vehicles without good facilities which led to littering of streets as solid waste are transported to disposal sites.
(viii) There is not enough public enlightenment to educate the inhabitants of Enugu urban on environmental control measures, protection of environment and human lives, and other pollution menace for effective waste management.
(ix) There is insufficient disposal site for solid waste management in Enugu.
(x) Lack of reliable database has affected the planning and management of Solid Wastes in Enugu.
(xi) There is no Solid Waste recycling plant or the like in Enugu.
(xii) The capacity of Enugu Waste Management Authority (ESWAMA) to collect and dispose of used tyres and large construction wastes are lacking which makes these wastes stay too long without collection from dumpsites.
(xiii) Inconsistent government policy on Solid Waste Planning and Management have adversely affected the development of a master plan for solid waste in Enugu.

2.0 Literature Review

The "Waste management" refers to the collection, transport, recovery, and disposal of waste, including the supervision of such operations and after-care of disposal sites. It concerns itself with the existing amount of waste, trying to minimize the human-waste or environment-waste interface and to minimize potential impact. Waste management should concern itself not only with final disposal of waste but also with the whole cycle of waste creation, transport, storage, treatment, and recovery and does so to minimize pollution (Chukwuemeka, Ugwu and Igwegbe, 2012). According to the waste management pyramid, the waste management strategies need to be based

on prevention measures and measures such as recovery and disposal are secondary. (Chime, 2009). Waste minimization measures include waste prevention, internal recycling of production waste, and source-oriented improvement of waste quality and reuse of products for the same purpose. Also, external recycling, sorting of waste, reuse for another purpose, and energy recovery are included as waste management measures. Waste management is also viewed as the control of waste-related activities with the aim of protecting human health and the environment and resources conservation. Waste-related activities include waste-creating processes, waste handling processes, and waste utilization.

The cost of collection has been estimated to represent about 50 to 70% of the total cost of solid waste management, depending on the disposal method (Tchobanoglous, Theisen and Vigil, 1993). Refuse collection is a difficult and expensive aspect of solid waste management in developing countries and accounts for 70% to 90% of costs in developing countries. However, in most developing country, cities such as Addis Ababa (Ethiopia) and Ibadan (Nigeria), efficient refuse collection is complicated by poor roads and perennial access problems which make house-to-house collection difficult and expensive. Even in those areas where house-to-house collection is practicable, lack of collection vehicles makes the process irregular and unreliable. Refuse character and availability of trucks affect frequency of collection. The solid waste generated in African cities is largely organic and exhibits relatively high moisture content. Its odor attracts flies and rodents, and this is why collection should be frequent and regular. Separating urban solid waste into classes such as paper, glass, plastics and metals at the source is a very efficient way of collecting waste because it makes recycling, reutilization or energy recovery a lot easier. It is important to have an appropriate system of selective collection at source. Selective collection is the point of contact between generators and disposal operators. Therefore, the model of collection must strike a balance that satisfies both parties.

The available sites identification and methods of waste disposal is one of the major challenges facing many urban authorities today. This is exacerbated by the NIMBY (not in my backyard) syndrome whereby no one wants the dumpsite in his or her backyard, but all the same want the waste removed and dumped somewhere else (Nzeadibe and Anyadike, 2012). Landfills represent the dominant alternative for municipal solid waste disposal in most parts of the world. In many emerging economies, municipal solid waste disposal by sanitary landfill is regarded as the most cost-effective method to protect human health and the environment. In South Africa, almost all collected municipal solid waste is land-filled. Similarly, over 80% of municipal solid waste generated in China is landfilled. Landfilling provides the cheapest and most convenient method of waste disposal today when operated efficiently.

Cointreau-levine (1994) posited that the management of waste in many developing countries is ideal for conversion into organic fertilizer, and economic factors favour composting in those countries where food production is of great importance. Refuse composting converts the fermentable organic content of refuse into a soil conditioner. In the poorest countries very simple screening and manuring can produce good results considering the economic realities which the populations face. The Harare City Council in Zambia at one time operated a composting plant just less than one kilometre from the former Mabel reign drive-in-cinema. This converted refuse free

from non-biodegradable material into organic manure. Operations at the plant slowed down largely due to costs, as manure is bulky and hence expensive to transport. As in composting, modern incineration is not common in the developing countries because the refuse has a low calorific value. The operation of huge urban incineration without coupling them with heating and power generation is too expensive for most developing counties (Omuta, 1988).

Tchobanoglous and Kreith (2002) stated that waste generation involves any activities associated in identifying materials that are no longer usable and are either gathered for systematic disposal or thrown away.

i. **Onsite handling, storage, and processing:** These include activities at the point of waste generation, which facilitate easier collection. For example, waste bins are placed at sites that generate sufficient waste.
ii. **Waste collection:** This is a crucial phase of waste management, and includes activities such as placing waste collection bins, collecting waste from those bins, and accumulating trash in the location where the collection vehicles are emptied. Although the collection phase involves transportation, this is typically not the main stage of waste transportation.
iii. **Waste transfer and transport:** These encompass all activities involved in moving waste from the local waste collection locations to the regional waste disposal site in large waste transport vehicles.
iv. **Waste processing and recovery:** These include the facilities, equipment, and techniques employed to recover reusable or recyclable materials from the waste stream and to improve the effectiveness of other functional elements of waste management.
v. **Disposal:** This is the final stage of waste management. Which refers to the activities aimed at the systematic disposal of waste materials in locations such as landfills or waste-to-energy facilities.

2.1 Integrated Solid Waste Management (ISWM)

The advancement in the field of solid waste management made it possible for solutions to be looked at more systematically and holistically. ISWM, for example, is an increasingly important term in the field of waste management. It is referred to as the selection and use of appropriate management programs, technologies, and techniques to achieve particular waste management goals and objectives. The U.S. Environmental Protection Agency (EPA) (2015a) states that ISWM is composed of waste source reduction, recycling, waste combustion, and landfills. These activities can be done in either an interactive or hierarchical way.

It is important to stress that better solid waste management programs are urgently needed in some countries. Only about half of the waste generated in cities and one-quarter of what is produced in rural areas is collected. Internationally, the World Bank warns that global waste could increase by 70% by 2050 in a business-as-usual scenario. Ongoing efforts to improve the waste management

3.0 Methodology

For this study, purposive sampling techniques were adopted using survey design method to select three (3) local government areas out of the 17 local government areas (LGAs) in Enugu state. The 3 selected LGAs were selected based on level of urbanization. They are Enugu East, Enugu North and Enugu South local government areas. A sample size of 300 respondents was determined from the population of 722664 drawn from both male and female population of the three LGAs as published by National Population Commission (NPC Census, 2006). The analysis of methodology was focused to ascertain from respondents the issues on:

i. Inadequate environmental policies and legislation
ii. Low level of environmental awareness and public enlightenments
iii. Poor funding because of the capital-intensive nature of waste management
iv. Inadequate technology and inadequate facilities
v. Polities and corruption
vi. Unplanned developments and population increase.

3.1 Method of Data Analysis for Questionnaire Responses

In analyzing the data, the mean scores were used to answer the research questions which guided the study. A cut-off mean score of 3.25 and above was regarded as constituting a problem, while a mean score of less than 3.25 was regarded as not constituting a problem. In calculating the mean, the five point rating scale was given the following values;

(i)	Strongly Agree	(SA)	5 values
(ii)	Agree	(AG)	4 values
(iii)	Undecided	(UD)	3 values
(iv)	Disagree	(DA)	2 values
(v)	Strongly Disagree	(SD)	1 value.

The formula for the mean, $\bar{X} = \frac{\sum fx}{N}$ were used to calculate the average score, where

Σ = summation or sum of
f = frequency of observation
X = individual
N = number of sample

Pearson Product Moment Correlation Coefficient (PMCC) denoted by (r) was used to determine the strength of the correlation between the two variables X which represents responses from sample of sixty (60) respondents selected from the six sample locations and Y which represents the responses from sample of forty (40) respondents from workers of Enugu State Waste

Management Authority (ESWAMA). The PMCC or r has values $-1 \leq r \leq +1$. As the value approaches +1, the stronger the correlation. The simple linear correlation having positive correlation shows that both x and y increase or decrease together while negative correlation is when X increases as Y decreases i.e. change in opposite direction. The value of r = 1 shows a perfect positive correlation.

Decision Rule: the mean score of above 3.25 from the respondents indicates that the problem exists from the responses while below 3.25 shows the problems are regarded as disagreed.

4.0 Results and Discussion

4.1 Results Obtained from Questionnaire Responses of Public and Civil Servants

a. To what extent have urbanization and industrialization contributed to solid waste generation in Enugu urban?

Table 1: Scored/Graded Responses of the Respondents in Question No.1 above

Item No.	Description	Score ($\bar{X}$)	Score ($\bar{Y}$)
1	Urbanization has increased the quantity/volume of solid waste generated in Enugu Urban.	4.85	4.51
2	Industrialization has resulted to increase in solid waste generated in Enugu.	4.50	4.32
3	Increase in population of migrants from rural communities to squatter settlements in Enugu urban have contributed to increased volume of solid waste generation.	4.75	4.34
	Grand mean score	**4.70**	**4.39**

The grand mean scores of 4.70 for X and 4.39 for Y indicate that urbanization and industrialization contributed to increase in solid waste generation in Enugu urban. So, it is a problem.

b. Are there sufficient dumpsters for collection of solid waste at dumpsites?

Table 2: Scored/Graded Responses of the Respondents for Question No.2 above

Item No.	Description	Score ($\bar{X}$)	Score ($\bar{Y}$)
1	The number of dumpsters at dumpsites are inadequate.	4.32	4.45
2	Some of the dumpsters at dumpsites for solid waste collection are damaged which not be used for the purpose.	4.0	4.15
3	Overflow of solid waste in dumpsters make inhabitants of the area to burn the waste at dumpsites by fire	4.82	4.42
	Grand mean score	**4.38**	**4.34**

The grand mean scores of 4.38 for X and 4.34 for Y show that there is insufficient dumpsters for collection of solid waste at dumpsites thus a problem.

c. To what extent has unhygienic disposal of solid waste in open dumpsters affected public health and environment?

Table 3: Scored/Graded Responses of the Respondents for Question No.3 above

Item No.	Description	Score ($\bar{X}$)	Score ($\bar{Y}$)
1	Open dumping of solid wastes in Enugu urban pollutes the environment.	4.75	4.61
2	Open dumping of solid wastes in Enugu urban deface the aesthetics of the environment.	4.45	4.51
3	Open dumping of solid wastes in some areas of Enugu has resulted to blocking of some access roads, increase in rodents and diseases which affect the health of residents in the area.	4.42	4.44
	Grand mean score	**4.54**	**4.52**

The grand mean scores of 4.54 for X and 4.52 for Y show that there is problem of unhygienic disposal of solid wastes in open dumpsites which affects public health and environment?

d. To what extent is the frequency of solid waste collection from dumpsites location maintained?

Table 4: Scored/Graded Responses of the Respondents for Question No.4 above

Item No.	Description	Score ($\bar{X}$)	Score ($\bar{Y}$)
1	There is no regular collection of solid waste generated in some dumpsites location in Enugu urban	4.57	4.62
2	Lack of access motorable roads have made the collection of solid waste in some areas difficult	4.47	4.37
3	Delay in collection of solid waste has resulted to littering of the wastes at dumpsites location.	4.46	4.45
	Grand mean score	**4.50**	**4.48**

The grand mean scores of 4.50 for X and 4.48 for Y show that the frequency of solid waste collection from dumpsite location are not maintained, which constitutes a problem.

e. Are the municipal solid wastes in Enugu urban treated before disposal?

Table 5: Scored/Graded Responses of the Respondents for Question No.5 above

Item No.	Description	Score ($\bar{X}$)	Score ($\bar{Y}$)
1	The solid wastes in Enugu are not treated before disposal.	4.84	4.82
2	Inhabitants in some areas in Enugu burn their wastes before disposal.	4.02	4.04
3	Some people bury their wastes without disposal to dumpsites.	3.65	3.44
	Grand mean score	**4.17**	**4.10**

The grand mean scores of 4.17 for X and 4.10 for Y show that municipal solid wastes in Enugu urban are not treated before disposal is a problem.

f. To what extent are the solid waste handlers and managers equipped to handle the challenges of planning and management of solid waste in Enugu?

Table 6: Scored/Graded Responses of the Respondents for Question No.6 above

Item No.	Description	Score ($\bar{X}$)	Score ($\bar{Y}$)
1	Enugu State Waste Management Authority (ESWAMA) do not have enough trained personnel to handle the planning and management of solid wastes in Enugu.	4.25	3.84
2	There is no regular periodic training of ESWAMA staff to update them on how to cope with the increasing waste generated in the area.	4.06	3.88
3	There is inadequate number of staff in ESWAMA to handle the challenges of solid waste planning and management of in Enugu.	3.78	4.22
	Grand mean score	**4.05**	**3.98**

The grand mean scores of 4.05 for X and 3.98 for Y show that there is problem of solid waste handlers and managers not equipped to handle the challenges of planning and management of solid wastes in Enugu.

g. Do the disposal vehicles used in solid waste disposal have adequate facilities to prevent pollution of the environment as solid waste is transported to disposal site?

Table 7: Scored/Graded Responses of the Respondents for Question No.7 above

Item No.	Description	Score ($\bar{X}$)	Score ($\bar{Y}$)
1	Some of the vehicles used in the collection of solid wastes at dumpsites are open tippers which litter the streets as wastes are transported to disposal site.	4.01	4.29
2	The odour of solid wastes in open vehicles pollute the environment as they are transported to disposal site.	4.10	3.90
3	Most of the disposal vehicles do not meet the global standard vehicles for transport of solid wastes to disposal or treatment sites.	4.31	4.17
	Grand mean score	**4.14**	**4.12**

The grand mean scores of 4.14 for X and 4.12 for Y show that the vehicles ESWAMA used for solid waste disposal is substandard and subjects the workers to very high risk of infection and other hazards is a problem.

h. Is there enough environmental education and public enlightenment to educate inhabitants of Enugu on environmental issues for effective waste management?

Table 8: Scored/Graded Responses of the Respondents for Question No.8 above

Item No.	Description	Score ($\bar{X}$)	Score ($\bar{Y}$)
1	The occupants of most residential, commercial, industrial and health institutions are not informed on waste characteristics to encourage sorting and disposal	3.75	3.80
2	There is no adequate budget for public enlightenment and education on hazards associated with solid waste handling and disposal.	4.36	4.24
3	The residents of Enugu are not properly educated on how to manage and dispose waste, and implications to protect human lives and environment	4.34	4.32
	Grand mean score	**4.15**	**4.12**

The grand mean scores of 4.15 for X and 4.12 for Y show that there is problem of inadequate environmental education and public enlightenment to educate residents of Enugu on environmental issues for effective waste management.

i. Is the existing disposal site enough to accommodate the processing and management of solid waste generated in Enugu?

Table 9: Scored/Graded Responses of the Respondents for Question No.9 above

Item No.	Description	Score ($\bar{X}$)	Score ($\bar{Y}$)
1	There is not enough disposal site for management and treatment of solid waste generated in Enugu	4.07	4.05
2	The solid wastes are disposed in open disposal site without facilities for landfill or treatment.	4.26	4.28
3	The disposal sites lack the facilities for effective solid waste management.	4.00	3.94
	Grand mean score	**4.11**	**4.09**

The grand mean scores of 4.11 for X and 4.09 for Y show that the respondents are of the opinion that the existing disposal site is not enough to accommodate the processing and management of solid waste generated in Enugu so constituted a problem.

j. Are there any data base for proper planning and management of solid waste available in Enugu?

Table 10: Scored/Graded Responses of the Respondents for Question No.10 above

Item No.	Description	Score ($\bar{X}$)	Score ($\bar{Y}$)
1	There is no available data base for planning and management of municipal solid waste in Enugu.	4.33	4.28
2	The inhabitants are not aware of any data base for ESWAMA to manage waste in Enugu urban.	4.42	4.06
3	The information on quantity of solid waste collection and disposal are not available at ESWAMA office in Enugu.	3.94	4.41
	Grand mean score	**4.23**	**4.25**

The grand mean scores of 4.23 for X and 4.25 for Y shows that there is problem of data base for proper planning and management of solid waste not available at ESWAMA office Enugu

k. Are there any waste recycling plants in Enugu?

Table 11: Scored/Graded Responses of the Respondents for Question No.11 above

Item No.	Description	Score ($\bar{X}$)	Score ($\bar{Y}$)
1	Lack of waste recycling plant in Enugu resulted in poor management of solid waste in Enugu.	3.66	3.42
2	Inability of Enugu state government and ESWAMA to provide waste recycling plant has led to huge piles of waste at their disposal site.	3.92	4.24
3	Non availability of solid waste recycling plant has resulted to pollution and environmental hazards from waste collection in Enugu.	3.58	3.38
	Grand mean score	**3.72**	**3.68**

The grand mean scores of 3.72 for X and 3.46 for Y show that there is problem of no waste recycling plant in Enugu.

L. To what extent is the capacity of ESWAMA able to collect and transport used tyres, the like and some construction wastes deposited at various dumpsites in Enugu?

Table 12: Scored/Graded Responses of the Respondents for Question No.12 above

Item No.	Description	Score ($\bar{X}$)	Score ($\bar{Y}$)
1	There is inadequate plant and equipment for lifting of used tyres, construction wastes and the like at designated dumpsites in Enugu.	4.07	4.38
2	Most of construction wastes are collected with vehicles/plant from the place of generation and transported to disposal sites without depositing them at dumpsites.	4.23	3.96
3	The dumpsters provided at dumpsites do not have capacity to carry large construction wastes and used tyres of vehicles.	4.09	3.99
	Grand mean score	**4.13**	**4.11**

The grand mean scores of 4.13 for X and 4.11 for Y show that ESWAMA does not have the capacity to collect and transport used tyres, the like and some construction wastes deposited at various dumpsites in Enugu which is a problem.

m. Has changes in government policies on solid waste affected the developments of a comprehensive master plan for solid waste management in Enugu?

Table 13: Scored/Graded Responses of the Respondents for Question No.13 above

Item No.	Description	Score ($\bar{X}$)	Score ($\bar{Y}$)
1	There are inconsistent government policies on solid waste planning and management which has hampered the development of a comprehensive master plan for solid waste generation in Enugu.	3.53	3.48
2	The change in government which also results to changes in ESWAMA management and board of directors have made it difficult for the authority to achieve all her mandate since inception in 2004.	3.34	3.22
3	Enugu state government interference in the ESWAMA administration has affected them in living up to all their mandate at inception.	3.21	3.26
	Grand mean score	**3.36**	**3.32**

The grand mean scores of 3.36 for X and 3.32 for Y shows that government policy changes have affected the developments of a comprehensive master plan for solid waste management in Enugu constitutes a problem.

4.2 Calculation of the Product Moment Correlation Coefficient PMCC

Table 14: PMCC Computed Values

Sample No.	X	Y	XY	X2	Y2
1.	4.70	4.39	20.63	22.09	19.27
2.	4.38	4.34	19.01	19.18	18.84
3.	4.54	4.52	20.52	20.61	20.43
4.	4.50	4.48	20.16	20.25	20.07
5.	4.17	4.10	17.10	17.39	16.81
6.	4.03	3.98	16.04	16.24	15.84
7.	4.14	4.12	17.06	17.14	16.97
8.	4.15	4.12	17.10	17.22	16.97
9.	4.11	4.09	16.81	16.89	16.72
10.	4.23	4.25	17.98	17.89	18.06
11.	3.72	3.68	13.69	13.84	13.54
12.	4.13	4.11	16.97	17.06	16.89
13.	3.36	3.32	11.16	11.29	11.02
Total	**54.16**	**53.50**	**224.23**	**227.09**	**221.43**

THE Pearson's Product Moment Correlation Coefficient (r) is given by the formula,

$$r = \frac{n\sum XY - \sum X \sum Y}{\sqrt{[n\sum X^2 - (\sum X)^2][n\sum Y^2 - (\sum Y)^2]}}$$

$$r = \frac{13(224.23) - (54.15)(53.50)}{\sqrt{[13(227.09) - (54.16)^2][13(221.43) - (53.50)^2]}}$$

$$r = \frac{2914.99 - 2897.56}{\sqrt{18.86 \times 16.34}} = \frac{17.43}{\sqrt{308.1724}} = \frac{17.43}{17.55} = 0.99316 \approx 0.9932$$

$$\therefore \text{ r} = 0.9932$$

Pearman's Product Moment Coefficient of Correlation, r = 0.9932 shows a very strong positive linear relationship between the responses from sample of sixty (60) respondents from six sample locations (X) and the responses from respondents of forty (40) workers of ESWAMA.

Using another measure, the coefficient of determination, which is the square of coefficient of correlation, we have,

$$r^2 = (0.9932)^2 = 0.9864 \text{ or } 98.6 \text{ percent.}$$

The computed coefficient of determination $r^2 = (0.9932)^2 = 0.9864$ shows that 98.6% of the total variation in the dependent variable (i.e. responses of workers, Y) is explained by the variation of responses in the six-sample location, X as indicated in Table 14 while 1.4% of the variations is attributable to the influence of other factors not explained by the regression function.

5.0 Conclusion and Recommendations

It is a clear fact that the waste management practice in Enugu urban is unsatisfactory and good strategies / measures need to be employed to salvage the situation. The two different waste management options that must be combined intelligently in a way as to reduce the environmental and social impact of waste are improving the aesthetic of the city and living conditions of residents within the area. The combined option of integrated solid waste management and system approach should be used for the assessment of the competing options.

The integrated solid waste management above will solve the problem of solid waste through;

(i) **Compaction of solid waste:** there is compaction vehicle already in use by ESWAMA but some of the trucks have broken down due to lack of maintenance so increasing the number of compaction vehicles will reduce the number of trips of delivery vehicles.

(ii) **Estimation of methane gas from waste generation:** the recovery products from landfills is methane which is produced by degradable wastes. It is useful in estimating the recovery value of methane from landfill emission. Methane production from landfills is estimated on chemical composition of solid wastes from Enugu urban. This product if harnessed will be another source of revenue.

(iii) **The biogas recovery value:** $1m^3$ of biogas can generate 1.2 Kw/hr of electricity or $200m^3$ of biogas can generate $1.25 \times 180 = 225$ Kw/hr of electricity. This will generate a lot of revenue from biodegradable wastes for the government.

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About the Author

Anthony Nnamdi Ezemerihe

Enugu, Nigeria

Anthony Nnamdi Ezemerihe, PhD holds a bachelor's degree in Building from Enugu University of Science and Technology Enugu, Nigeria, Higher National Diploma in Building Technology and Quantity Surveying from Institute of Management and Technology (IMT) Enugu, Nigeria. Postgraduate Diploma (PGD) and Master of Business Administration (MBA) in Banking and Finance from Anambra State University of Technology (ASUTECH) Enugu. A master of Science (M.Sc) degree in Construction Management from Nnamdi Azikiwe University (NAU) Awka, Nigeria. He has Master in Engineering (M.Eng.), Philosophy Degree (PhD) in Civil Engineering (Water Resources and Environmental Engineering) from Chukwuemeka Odumegwu Ojukwu University Uli, Anambra State Nigeria. He has also obtained PhD in Construction Management at NAU, Awka.

Dr. Ezemerihe is a registered Engineer with Council for Regulation of Engineering in Nigeria (COREN) and a member of Nigerian Society of Engineers (MNSE). He is a registered Builder and Corporate member Nigerian Institute of Building (MNIOB), Nigerian Institute of Quantity Surveyors, Nigerian Institute of Management (MNIM), Nigerian Environmental Society (MNES) and passed with overall result A in Public Service Examination (PSE) from the Administrative Staff college of Nigeria (ASCON). He also obtained Doctor of philosophy (Critical and Creative Thinking) Ph.D. (CACT) (Honouris Causa) from Montclair State University, Upper Montclair New Jersey, United States of America (USA). He can be contacted at ecatonia2008@yahoo.com