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A Review of the Health Implications of Solid Waste Disposal Systems

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Abstract
This paper reviews the health implications of solid waste disposal systems in Trans Amadi Industrial Layout, Port Harcourt, Rivers State, Nigeria. A survey research design was adopted in the study. 400 questionnaires were administered through stratified random sampling but only 381 respondents in the study area completed their questionnaires. Chi square statistical method was used to test the null hypothesis (H_0) which states that the level of health problems together with the poor conditions of water is not significantly related to the solid waste disposal system in Trans Amadi area. Secondary and primary sources of data were used as means of getting information used for the purpose of the research work. Questionnaire administration, personal interview and physical observation were used for gathering of primary data. The result of the test showed a calculated value of 1.66 while the Chi square table read 0.103 at a 0.95 level of significance. From the calculation, the calculated value was greater than the table value. It was deduced from the findings that the level of health problems together with the poor conditions of water is significantly related to the solid waste disposal system in Trans Amadi area. It is recommended that Government should provide refuse receptacles in large quantity and place them at interval of not more than 200m apart in both residential and commercial area. Government should establish waste recovery facility for effective management of solid waste. Solid waste management should be an integral part of government's business in order to convert waste to wealth through recycling, recovery and re-use. Effective public education on waste disposal should be introduced through mass media, seminar, workshop and mobile awareness programme. Mobile courts should also be established to try offenders of indiscriminate refuse dumping and if found guilty, the offender should be fined a relatively substantial amount and, monthly environmental sanitation should be re-introduced and enforced.
Keywords: Disposal system, Environmental education, Public health, Sustainable development, Waste management

1. Introduction

Waste management means all the activities necessary to manage waste from its generation to the final disposal and this includes collection, transport, treatment and disposal of waste together with monitoring and regulation. It also encompasses the legal and regulatory framework that relates to waste management encompassing guidance on recycling (United Nations Environmental Statistics Division, 2017).

Waste has been generated by humans throughout the history. In areas with low population density, waste generation may have been negligible. In higher population areas even largely biodegradable waste had to be dealt with. Sometimes this was released back into the ground water with environmental impact. The Maya of Central America had a fixed monthly ritual, in which the people of the village would gather together and burn their rubbish in large dumps (Hensel George 2016).

1.1 Brief historical background of solid waste management

The first occurrence of organised solid waste management system appeared in London in the late 18th century. A waste collection and resource recovery system was established around the 'dust-yards'. Main constituent of municipal waste was the coal ash ('dust') which had a market value for brick-making and as a soil improver. Such gains encouraged dust-contractors to recover effectively all the residual wastes remaining after readily saleable items and materials had been removed by the informal sector in the streets. The dust-yard system had been working successfully up to middle 1850s, when the market value of 'dust' collapsed. It was important in facilitating a relatively smooth transition to an institutionalised, municipally-run solid waste management system in England (Laura Del, 2009).

In Africa, wastes are generated from industries such as food, textile, furniture, clothing, iron and steels, chemicals, and printing industry. Institutional wastes are wastes generated by institutional sectors such as school while construction and demolition wastes are produced from construction wastes that arise from streets cleaning, park, beach and wastewater treatment sites all fall under the municipal services wastes (Nebiyeleul G. 2006).
One of the major problems in urban centres in African countries nowadays is the collection, treatment,

transportation, storage, and eventual disposal of waste. Consequently, people have witnessed a relatively poor waste management practices characterized by indiscriminate dumping of refuse in water bodies and isolated places which further exacerbates the already low sanitation level in most African countries. The prevailing increase in the level of urbanization in Africa is expected to continue in the future. However, a major concern is that there are no adequate infrastructural facilities and appropriate land use planning to match up with the demands posed by the urban growth rate especially the slums and ghettos in Africa (Kaseva M, and Mbuligwe S. (2005), Okot-Okumu J. (2012) and Pichtel J (2005) .

In Nigeria, the increase in population, urbanization and industrialization including globalization, the challenge of Solid Waste Management in the Country has increased and even now complex. Contributory factors to the challenge include inadequate regulatory framework that has manifested in lack of interest of private sector investment in service delivery (infrastructure); uncoordinated institutional functions; low political will, low capacity to discharges duties, poor data information for planning, wrong attitude of waste generator amongst others. Yet on the increase is the demand for good waste management service for public health and environmental protection (World Bank, 2011).

1.2 Statement of the research problems

Trans-Amadi industrial layout presents pictures of the neglect of filled refuse bins in recent times. Many areas around the homes are littered with domestic, refuse sewage waste, garbage and other wastes from industrial operations. Industries operations from Trans-Amadi layout are characterized by the generation of large volume of waste in the form of solid, liquids and gases. Some of these wastes are toxic to our environment. There are emissions of repugnant odour from the drainage system filled with solid wastes and in the air. Stagnant pools of water are seen in most areas of Trans-Amadi layout and these are breeding sites for mosquitoes. Water and excreta-related diseases such as malaria, fever, typhoid fever, dysentery and cholera are prevalent in this area.

1.3 Aim and Objectives of the study

The aim of the research is to review the solid waste disposal in Trans Amadi industrial layout Port Harcourt with the objectives of:

i) determining the level of severity of sanitation-related health issues in Trans Amadi, Port Harcourt, Nigeria
ii) examining the extent of public environmental education programmes in creating awareness of sustainable solid waste management in Trans Amadi area
iii) understanding the relationship of solid waste disposal system with that the level of health problems together with the poor conditions of water sources in Trans Amadi area.

1.4 Research Questions

The following research questions are structured for the purpose of this study.

i) How do you assess the level of severity of sanitation-related health issues in Trans Amadi, Port Harcourt, Nigeria
ii) What is the extent of public environmental education programmes in creating awareness of sustainable solid waste management in Trans Amadi area
iii) Is there any relationship of solid waste disposal system with that the level of sanitation-related health problems together with the poor conditions of water sources in Trans Amadi area?

1.5 Research Hypothesis

The following null hypothesis has been formulated to guide the study.

H_0: The level of health problems together with the poor conditions of water is not significantly related to the solid waste disposal system in Trans Amadi area.

1.6 Justification of the study

The study was embarked upon to understand the level of health problems posed by solid waste disposal systems and the efforts in ensuring sustainability in the management of solid waste in the study area.

1.7 Significance of the study

The study will be relevant to policy makers, urban and regional planners, environmental groups and associations, waste management authorities, academics, local communities and government. The study will also be beneficial to the local communities as it will increase their environmental education and eventually acquaint the public with the environmental consequence of indiscriminate waste disposal.

2. Literature Review

This chapter gives the review of the existing literature associated with waste disposal system in Trans Amadi area. Port Harcourt, Nigeria.

2.1 The Conceptual framework

The concept of waste management arose as a result of environmental hazards posed by waste generation. It is not only because Solid Waste Management impact on the environment or health, but poor implementation of Solid Waste Management hinders the nation's progress towards Sustainable Development. There is a need for a comprehensive strategies for Solid Waste Management within development processes. It is important to improve Solid Waste Management for Sustainable Development through environmental conservation. The conceptual issues of this study include the Sustainable Waste Management practices to mitigate its impact on environmental and socio economic development, the assessment of the impact of solid waste management on the environment and sustainable development. Figure 2.1 shows the conceptual framework for solid waste management (Asiri D Vitharana, 2013).

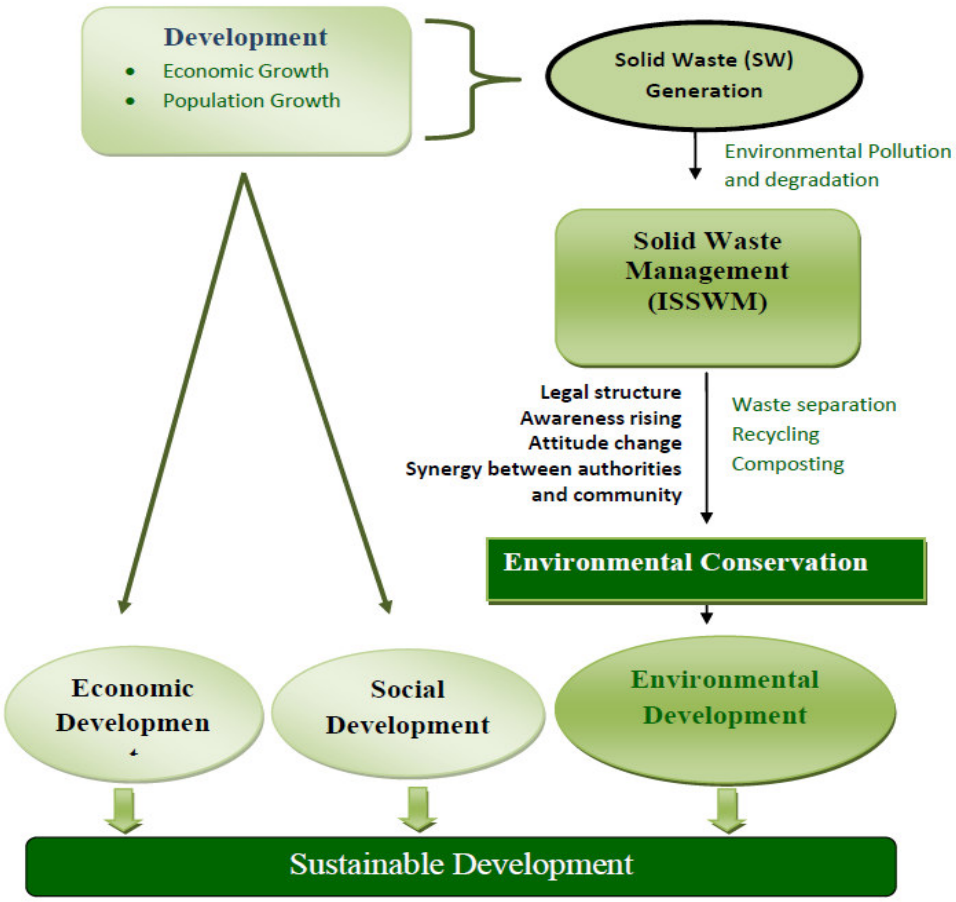

Figure 2.1: Conceptual framework for Solid Waste Management
Source: Asiri D. Vitharana, (2013).

2.2 Theoretical framework for Solid Waste Management

A Municipal Solid Waste Management System comprises a combination of various functional elements associated with the management of solid wastes (Ramachandra, T.V. 2006). According to Ramachandra, T.V. (2006) and Oni, M.C. and Opara, .J.A. (2001), Municipal Solid Waste Management (MSWM) is the control of waste generation, its storage, collection, transfer and transport, processing and disposal in a manner that is in accordance with the best principles of public health, economics, engineering, conservation, aesthetics, public attitude and other environmental considerations.

Waste management should include the collection, transportation, treatment and disposal of solid wastes in the community at minimal costs, with minimum harm to public health and environment (Oni, M.C.H and Opara, .J.A (2001). Figure 2.2 shows the theoretical framework for Solid Waste Management .

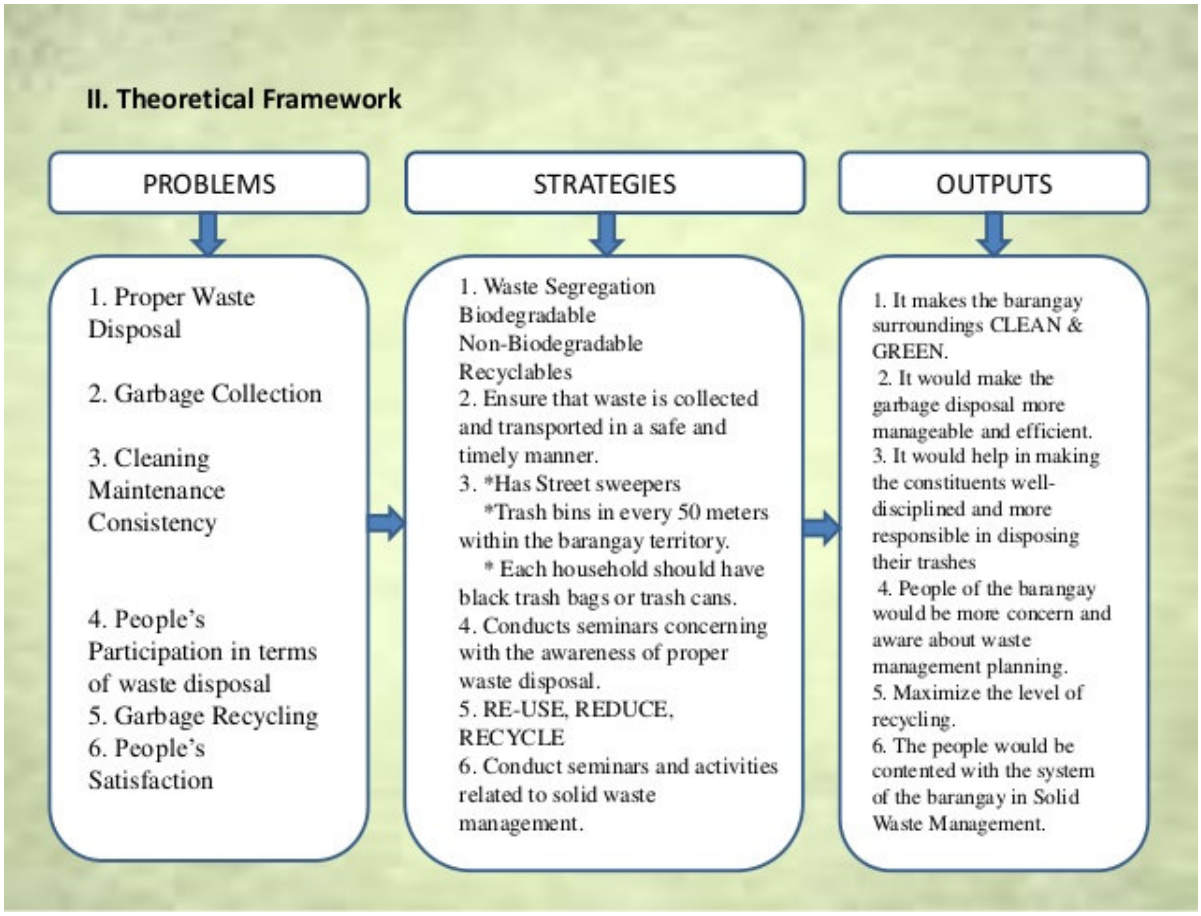

Figure 2.2: Theoretical Framework for Solid Waste Management
Source: Ramachandra, T. V. (2006)

3.0 Study area

Trans Amadi is one of the industrial areas in Port Harcourt metropolis, Rivers State, Nigeria. Trans Amadi is a thousand-hectare (2,500-acre) industrial area, as well as a diverse residential neighborhood in the city of Port Harcourt. It is Situated at 4°48'53" N latitude and 7°2'14" E longitude. The neighborhood supports a strong manufacturing sector and is considered to be a major industrial zone in Port Harcourt. Materials such as glass bottles, tires, aluminium and paper have production plants in the area. Trans Amadi lies in the north and is bordered by D/line in the south west, Woji township to the east and Rumuola to the north west. The main abattoir of the city is located along Trans Amadi. As of June 2003, there are 248 new and completed residential units existing with previous estimates of the total number of dwellings in the neighbourhood (AllAfrica Global Media, 2003).

4. Research methodology

This chapter shows the research design which includes the data needs, the procedure adopted for data collection and analyses, the types and sources of data, the research population, the sampling frame, determination of sample size and the method of data analyses.

4.1 Research design

It describes the data utilized in the testing of the hypothesis, explains how such data were obtained, and describes the methods of analyses applied in determining whether the hypothesis is true or false.

4.2 Data needs of the study

The data needed for this research includes age, sex, occupation, educational qualification, demographic data, environmental and health data.

4.3 Sample Size Determination

According to National Population Commission (2011), the population of Trans Amadi at 2011 was about 50,000

and the projected population at 2016 was 124,416. The sampling population was selected from the population of 124,416 residents using Taro Yamane's (1967) formula stated below as:

$$Sn = \frac{N}{N + 1\,(e)^2}$$

Where; Sn = Sample size, N = total population, e = error factor (0.05)

$$S_n = \frac{124{,}416}{124{,}416 \times 1\,(0.05)^2} \qquad S_n = \frac{124{,}416}{124{,}416 \times 1\,(0.05)^2}$$

$S_n = 400$

Therefore, a total of 400 were represented as the sample size.

4.4 Sampling techniques

Six streets in Trans Amadi Industrial layout were considered. These streets are Ijere street, Socawari street, Amadi street, Fimeye street, Industrial Layout, Chief Gbakagbaka street. Four hundred questionnaires were administered to selected prospective respondents. Three hundred and eighty one (381) questionnaires were duly completed and utilized for analytical purpose. Nineteen (19) questionnaires were not used for analytical purpose, due to improper completion and were not returned. Table 4.1 shows the distribution of questionnaires.

Table 4:1: Distribution of Questionnaires

S/N	Street	Sample Size	Questionnaires completed
1	Ijere street	67	64
2	Socawari street	66	62
3	Amadi street	66	63
4	Fimeye street	67	62
5	Industrial layout	67	62
6	Chief Gbakagaka	67	68
	Total	400	381

Source: Researchers field survey (2017)

5. Data Presentation and Analyses

This section presents and analyses the data from the Researchers field surveys.

5.1: Profile of the respondents

The personal details of the respondents are presented in the tables below.

Table 5.1: Sex of the respondents of the study area

Sex	**Frequency**	**Percentage**
Male	233	61.1
Female	148	38.9
Total	381	100

Source: Researchers field survey (2017)

From the above table, 233 respondents were male while 148 respondents were female.

Table 5.2: Marital status of the respondents of the study area

Marital Status	**Frequency**	**Percentage (%)**
Single	102	26.8
Married	279	73.2
Total	381	100

Source: Researchers field Survey (2017)

From the above table, 26.8% of the respondents was single while 73.2% of the respondents was married.

Table 5.3: The age range of the respondents of the study area

Age ranges	**Frequency**	**Percentage (%)**
25 - 40 yrs	232	60.9
41- 60 yrs	149	39.1
Total	381	100.00

Source: Researchers field survey (2017)

From the above table, respondents within the age range of 25 – 40 years were 60.9% while the respondents within the age range of 41 – 60 years were 39.1%.

Table 5.4: Occupation of the respondents of the study area

Occupation	**Frequency**	**Percentage (%)**
Company workers and civil servants	294	77.2
Students	87	22.8
Total	381	100

Source: Researchers field survey (2017).

From the above table, 77.2% of the respondents was company workers and civil servants while 22.8% of the respondents was students.

Table 5.5: The academic level of the respondents of the study area

Academic level	Frequency	Percentage (%)
First Degree	258	67.7
MSc. and PhD.	123	32.3
Total	381	100

Source: Researchers field survey (2017)

From the above table, 67.7% of the respondents was first degree holders while 32.3% of the respondents was MSc. and PhD holders.

5.2 Environmental issues in the study area

Table 5.6: Where is waste disposed in the area?

Option	**Frequency**	**Percentage (%)**
Designated	11	2.9
Undesignated	149	39.1
No disposal facility	221	58.0
Total	381	100.00

Source: Researchers field survey (2017)

From the above table, 2.9% of the population agreed that waste are disposed at the designated facilities, 39.1% agrees that wastes are disposed at undesignated facilities while 58.0% agrees that there is no facility for waste disposal.

Table 5.7: What is the extent of public environmental education programmes in creating awareness of sustainable solid waste management?

Option	**Frequency**	**Percentage (%)**
Adequate	129	33.9
Not adequate	252	66.1
Total	381	100

Source: Researchers field survey (2017)

From the table above, it will be observed that 66.1% of the sampled population believes that there is no adequate publicity on creating awareness on solid waste management, while 33.9% believes that there is an adequate publicity on creating awareness on solid waste management in the study area.

Table 5.8: How do you assess the severity of health issues in the study area?

Health issues/Level of severity	**Very Severe**	**Quite Severe**	**Not Severe**	**Total**
Poor condition of water sources	209	123	49	381
Sanitation-related health problems	224	117	40	381
Total	433	240	87	762

Source: Researchers field survey (2017)

From the table above, 209 respondents believe that the poor condition of water sources is very severe, 123 respondents believe that the poor condition of water sources is quite severe while 49 respondents believed that the poor condition of water sources is not severe. 224 respondents believe that the sanitation-related health problems is very severe, 117 respondents believe that the sanitation-related health problems is quite severe while 40 respondents believe that the sanitation-related problems is not severe.

5.3 Test of Hypothesis

Table 5.9 shows the expected frequency formulated from table 5.8.

Table 5.9: Formulation of the expected frequency table

Health issues/Level of severity	**Very Severe**	**Quite Severe**	**Not Severe**	**Total**
Poor condition of water sources	209	123	49	381
Sanitation-related health problems	224	117	40	381
Total	433	240	87	762

Source: Researchers field survey (2017)

Expected Frequency (FE) = $\frac{\text{Row total x column total}}{\text{Grand total}}$

Very severe = $\frac{381 \times 433}{762}$ = 216.5

Quite severe = $\frac{381 \times 240}{762}$ = 120

Not severe = $\frac{381 \times 87}{762}$ = 43.5

5.4. Formulation of the expected frequency using Chi-square (x^2)

$X^2 = \frac{(FO - FE)^2}{FE}$

Where FO = Observed frequency
FE = Expected frequency

Table 5.10: Formulation of the expected frequency table from the poor condition of water sources

OPTIONS	FO	FE	FO - FE	$(FO-FE)^2$	$\frac{(FO-FE)^2}{FE}$
Very severe	209	216.5	-7	56.2	0.26
Quite severe	123	120	3	9	0.08
Not severe	49	43.5	5.5	30.25	0.70
Total	381				1.04

Source: Researchers statistical analysis (2017)

Table 5.11: Formulation of the expected frequency table from the level of sanitation-related health problems

OPTIONS	FO	FE	FO-FE	$(FO-FE)^2$	$\frac{(FO-FE)^2}{FE}$
Very severe	224	216.5	7.5	56.25	0.26
Quite severe	117	120	-3	9	0.08
Not severe	40	43.5	-3.5	12.25	0.28
Total	381				0.62

Source: Researchers statistical analysis (2017)

Grand total value of x^2 from the tables = 1.04 + 0.62 = 1.66
Thus, 1.66 is the calculated value.
For the table value of x^2 (a, df), where a = level of significance = 0.95,
Degree of freedom (df) = (R -1) (C - 1)
R = Rows
C = Columns
Degree of freedom = (R - l) (C - 1) = (2 -1) (3 - 1)
= 1 X 2 = 2

At degrees of freedom of 2, $x^2 = 0.103$ (from the Chi-square distribution table) at 95% level of significance. The result of the test showed a calculated value of 1.66 against a table value of 0.103 at a 0.95 level of significance. The null hypothesis (H_0) was rejected in favour of the alternative hypothesis (H_1) which infers that the level of health problems together with the poor conditions of water sources is significantly related to the solid waste disposal system in Trans Amadi area.

6. Conclusion and Recommendations

This chapter presents the conclusion drawn from study and recommendations for further studies.

6.1 Conclusion

It is concluded that poor waste disposal systems are the causes of poor conditions of water sources and high severity of sanitation-related health problems in the study area

6.2 Recommendations

From the research, the following recommendations were made:

- Government should provide refuse receptacles in large quantity and place them at interval of not more than 200m apart in both residential and commercial area.
- Government should establish waste recovery facility for effective management of solid waste

- Solid waste management should form an integral part of government's business in order to convert waste to wealth through recycling, recovery and re-use.
- Effective public education on waste disposal should be introduced through mass media, seminar, workshop and mobile awareness programme.
- Mobile courts should also be established to try offenders of indiscriminate refuse dumping and if found guilty, the offender should be fined a relatively substantial amount and,
- monthly environmental sanitation should be re-introduced and enforced.

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