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Evaluation of solid waste management Awareness in Oyigbo housing estate using Kendall's non-parametric statistical tool

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ABSTRACT: This study assessed the current municipal solid waste management practice in a fast growing Oyigbo community in Rivers State. Questionnaires were designed and distributed to both individual households and the local waste management authority in Oyigbo. The questionnaires were designed to capture information on the solid waste practice. The study area was divided in to four zones A, B, C and D to ensure adequate coverage of questionnaires. A total of 600 questionnaires were distributed to individual households and 24 to the Local waste management authority. Kendall's W result for households (95.2% for zone A, 92.5% for zone B, 90.8% for zone C and 82.8% for zone D) indicated generally that there is very high level of agreement on awareness parameters among the respondents and from their response they have high level of awareness. The local waste management authority staffs had 73.3% which also indicate a high level of agreement among the respondents. The waste management capacity is low and among the problems facing waste management in Oyigbo, lack of funds, lack of environmental campaigns, limited technology, people's attitude towards waste management and laws and regulations being not strict enough were given highest rating by respondents. A properly managed integrated solid waste management facility, good policies and involvement of both government and stakeholder in management of solid waste was therefore recommended.

Keywords: Kendall's coefficient of concordance, institutional waste management, oyigbo.

I. INTRODUCTION

Solid waste management in several countries is not line with global best practice hence does not meet with the objectives of sustainable development. This raises the important issue of how to deliver quality service in the face of the financial and skill constraints of the public sector[1]. Solid waste collection is mainly a municipal function but in general poorly executed. Urbanization, poor program design and management as well as poor infrastructure contribute to waste generation rates exceeding collection capacity. It is estimated that less than 50% of generated waste are collected via official or unofficial collection systems and are often disposed of in open dumps [2]. UNEP places the average collection rate in the urban areas of the continent at only 31% [3]. A small percentage of sanitary landfills exist and most municipal solid waste (MSW) is disposed of in open dumps and unlined landfills. Solid waste management is usually not easy to handle especially in Nigeria. The country is a nation that exemplifies chronic solid waste management problems in conjunction with population growth.

It is the most populous country in Africa, with over 120 million residents, and over the past 50 years, has had the third largest urban growth rate in the world at 5.51% annually [4]. It is estimated that nearly ten percent of the population (21 million people) live below the national poverty line [4]. Since gaining independence from Great Britain in 1960, Nigeria's government has been controlled by a succession of military dictators. The federal government has very little control over environmental regulation as a whole. The Federal Environment Protection Agency (FEPA) was established in 1988 to control the growing problems of waste management and pollution in Nigeria [5]. Vision 2010 was FEPA's attempt to address environmental problems in the nation. The report proposed goals to be accomplished by the year 2010 that would lead toward sustainable development. In regard to solid waste management, the report says the goal is to "achieve not less than 80 percent effective management of the volume of municipal solid waste generated at all levels and ensure environmentally sound management in the vision 2020 Strategies to achieve this goal include

education and awareness programs, developing collaborative approaches to integrative management of MSW, strengthening existing laws and ensuring compliance, and encouraging local and private sector participation. Although this represents a positive, though somewhat undefined, approach to solid waste management, the reality of poverty and government corruption has prevented effective implementation of these plans. There is little to hold the government or the public accountable to the regulations developed by FEPA and Vision 2010 [6].

Reliable waste information is not readily available but the average waste generation rate per capita is estimated to range between 0.5 and 0.8 kg per day of which approximately 70% is organic [7]. Another estimate is a range between 0.3 kg and 1.9 kg per capita per day in selected African cities [8]. A generation rate per capita per year of 290 kg is generated of which 69% is disposed of to MSW dumps [9]. This report also indicated that food wastes accounts for between 40% and 55% of MSW in all regions except Southern Africa with only 23%. Paper and cardboard also represents significant portions of MSW in Northern, Central and Southern Africa with fractions in excess of 15%. The African Roundtable on Sustainable Consumption and Production (2009) confirms that waste characterization data are generally not available but that the available data suggests that MSW are high in putrescible organic matter with inadequate heating values for energy recovery. Furthermore very little recyclable material is present and recycling initiatives are thus not commercially viable and takes place in the informal sector. Electric and electronic wastes are on the increase as well as the amount of plastics, paper and cardboard, cans and glass [8].

II. METHODOLOGY

A. Area of study

Oyigbo is a local government in River State. With coordinates 4.8781°N and 7.1283°E. Oyigbo is made up of ten wards. There are seventeen villages and the most notable villages in Oyigbo include Obeakpu, Egberu, Umuebele, Ayama, Afa-nta and Afam-Ukwu. The Local Government Secretariat is situated in Afam. Oyigbo has an estimated population of about 222,687 people according to 2006 population census. Access roads are numerous in Oyigbo. Most noticeable is the Port Harcourt-Aba road.

Oyigbo is located within the lower delta plain reported to have been formed during the Holocene of the quatemary period by the accumulation of sedimentary deposits. The major geological characteristics are sedimentary alluvium. Oyigbo lies about 15-31 meters above sea level. The soil types are generally shallow, young, poorly drained soils and acid sulphate soils.

Source: Google maps

Fig. 1. Map of Oyigbo showing zone A, B, C and D.

Oyigbo has a vast portion interspersed with bush-fallow bushes and patches of mature forest. The prevalent vegetation types are the tropical rainforest and to a lesser portion, the fresh water swamp forest. The forest is characterized by abundant plant species. The mean temperature all year round in the region is about 30°C. The monthly rain fall in Oyigbo is almost predictable as it follows a temporal sequence of increase towards July-August before decreasing in the dry season months of November to February. Rainfall is usually at its peak in July and September [10].

B. Data Collection

Primary and secondary data were collected and used in this study. Primary data were collected by site visitation, personal interviews, visual observation and the use of well-structured questionnaires survey forms that were administered to respondents in Oyigbo. The questionnaires were pre-tested one week prior to the field data collection by testing it on randomly selected people from the sample population to get their input in order to know where improvements can be made. The questionnaires were subsequently revised based on the information and feedback of the test respondents. Secondary data were collected through literature review. The field survey which involved issuing of questionnaires, personal interviews and sight visits was done to assess the management of Municipal solid waste management in Oyigbo, Rivers State. 624 questionnaires were prepared and distributed for two sets of people, the local waste management authorities and individual households. 24 questionnaires were issued to the local waste management authorities in Oyigbo, while 600 questionnaires were distributed to individual households which were divided into four zones (A, B, C and D). 150 questionnaires were issued in each of the four zones.

C. Data Analysis

Descriptive statistics was used to analyze the data while Kendall's coefficient of concordance (W) was used to test for the degree of agreement between respondents on the questionnaire parameters. Kendall's coefficient is a non-parametric statistic and is used to assess agreement among raters [11]. Its value range from zero (non-agreement) to unity (complete agreement). Intermediate values signify low or high degree of unanimity among respondents. For easy analysis using Kendall's coefficient of concordance (W) the questionnaire were structured into a yes, no and undecided format (Oyigbo waste management authority) and strongly agree, agree, disagree and strongly disagree (household). The responses were appropriately ranked. The formula for calculating W is given in Equation (3) below:

$$W = \frac{12\sum(R_i - \bar{R})^2}{m^2 n(n^2-1)} \quad \ldots(3)$$

R_i is the total rank given by respondents. It is given by Equation (4)

$$R_i = \sum_{j=1}^{m} r_{i,j} \quad \ldots(4)$$

Where i is an object given a rank/rating r_{ij} by respondent j

m represent total number of respondents

n represents total number of objects (questions in the case of this study)

$\bar{R}$is mean value of the total ranks given by equation (5)

$$\bar{R} = \frac{1}{2}m(n+1) \quad \ldots(5)$$

III. RESULTS AND DISCUSSION

The Kendall's coefficient of concordance was used to check their level of agreement on waste management awareness parameters.

The result from Kendall's coefficient of concordance evaluation across the four zones indicated as shown in Tables 2,3,4 and 5 for individual household respondents in Zone A,B,C and D.

$\bar{R} = ½ \times m(n+1)$

$\bar{R} = ½ \times 138(10+1) = 759$

$W = \frac{12X1495844}{138^2X10(10^2-1)} = 0.952082$ (95.2%)

There is high degree of agreement among individual household respondents of zone A. their responses indicates a good level of environmental awareness. However the level of awareness does not reflect commensurately in their waste management practice

$\bar{R} = ½ \times m(n+1)$

$\bar{R} = ½ \times 142(10+1) = 781$

$W = \frac{12X1539558}{142^2X10(10^2-1)} = 0.925477$ (92.5%)

Table 2: Evaluation of Kendall's (W) for individual household in Zone A.

S/N	(WMAH-P)	Mean	Rank	R_i	$\bar{R}$	(Ri-R□)^2
1	WMAH-P1	2.673913	8	369	759	152100
2	WMAH-P2	2.65942	9	367	759	153664
3	WMAH-P3	2.73913	5	378	759	145161
4	WMAH-P4	2.775362	2	383	759	141376
5	WMAH-P5	2.702899	7	373	759	148996
6	WMAH-P6	2.492754	10	344	759	172225
7	WMAH-P7	2.753623	4	380	759	143641
8	WMAH-P8	2.666667	3	368	759	152881
9	WMAH-P9	2.789855	1	385	759	139876
10	WMAH-P10	2.731884	6	377	759	145924
					(Ri-R□)^2	1495844

Table 3: Evaluation of Kendall's (W) for individual household in Zone B.

S/N	(WMAH-P)	Mean	Rank	R_i	$\bar{R}$	(Ri-R□)^2
1	WMAH-P1	2.795775	3	397	781	147456
2	WMAH-P2	2.711268	8	385	781	156816
3	WMAH-P3	2.788732	4	396	781	148225
4	WMAH-P4	2.816901	1	400	781	145161
5	WMAH-P5	2.760563	5	392	781	151321
6	WMAH-P6	2.521127	10	358	781	178929
7	WMAH-P7	2.809859	2	399	781	145924
8	WMAH-P8	2.704225	9	384	781	157609
9	WMAH-P9	2.725352	7	387	781	155236
10	WMAH-P10	2.746479	6	390	781	152881
					(Ri-R□)^2=	1539558

There is high degree of agreement among individual household respondents of zone B and from their responses, it indicate a good level of environmental awareness but their waste management practice does not match their awareness level

Table 4: Evaluation of Kendall's (W) for individual household in Zone C.

S/N	(WMAHP)	Mean	Rank	R_i	$\bar{R}$	$(Ri-R)^2$
1	WMAH-P1	2.794118	4	380	748	135424
2	WMAH-P2	2.75	8	374	748	139876
3	WMAH-P3	2.764706	7	376	748	138384
4	WMAH-P4	2.860294	1	389	748	128881
5	WMAH-P5	2.808824	2	382	748	133956
6	WMAH-P6	2.617647	10	356	748	153664
7	WMAH-P7	2.779412	5	378	748	136900
8	WMAH-P8	2.691176	9	366	748	145924
9	WMAH-P9	2.801471	3	381	748	134689
10	WMAH-P10	2.772059	6	377	748	137641
					$(Ri-R)^2$	1385339

$\bar{R} = ½ \times m(n+1)$

$\bar{R} = ½ \times 136(10+1) \approx 748$

$W = \frac{12X1385339}{136^2X10(10^2-1)} \approx 0.907871$ (90.8%)

There is high degree of agreement among individual household respondents of zone C. their responses indicate good awareness level as regards the environment but this is not evident in their waste management practice.

$\bar{R} = ½ \times m(n+1)$

$\bar{R} = ½ \times 128(10+1) \approx 704$

$W = \frac{12X1119664}{128^2X10(10^2-1)} \approx 0.82835$ (82.8%)

There is high degree of agreement among individual household respondents of zone D and their responses imply that they have good level of awareness but their waste management practice does not reflect in their level of awareness

Table 5: Evaluation of Kendall's (W) for individual household in Zone D.

S/N	(WMAH-P)	Mean	Rank	R_i	$\bar{R}$	$(Ri-R)^2$
1	WMAH-P1	2.867188	8	367	704	113569
2	WMAH-P2	2.875	7	368	704	112896
3	WMAH-P3	2.859375	9	366	704	114244
4	WMAH-P4	2.914063	2	373	704	109561
5	WMAH-P5	2.898438	4	371	704	110889
6	WMAH-P6	2.921875	1	374	704	108900
7	WMAH-P7	2.84375	10	364	704	115600
8	WMAH-P8	2.890625	5	370	704	111556
9	WMAH-P9	2.90625	3	372	704	110224
10	WMAH-P10	2.882813	6	369	704	112225
					$(Ri-R)^2$	1119664

Institutional Waste Management

The local waste management in Oyigbo was assessed based on waste management practices, capacity and challenges they face in carrying out proper waste management. This section discusses the result of the survey done to assess the waste management authority in Oyigbo. Howe

Kendall's coefficient of concordance evaluation of challenges faced by local waste management authority in managing municipal waste in Oyigbo

Table 6: Evaluation of Kendall's (W) for local waste management authority.

S/N	(WMC-P)	Mean	Rank	R_i	$\bar{R}$	$(Ri-R)^2$
1	WMC-P1	2.684211	3	51	85.5	1190.25
2	WMC-P2	2.263158	8	43	85.5	1806.25
3	WMC-P3	2.368421	7	45	85.5	1640.25
4	WMC-P4	2.421053	6	46	85.5	1560.25
5	WMC-P5	2.736842	2	52	85.5	1122.25
6	WMC-P6	2.789474	1	53	85.5	1056.25
7	WMC-P7	2.578947	4	49	85.5	1332.25
8	WMC-P8	2.526316	5	48	85.5	1406.25
					$(Ri-R)^2$	11114

$\overline{R} = ½ \times m(n+1)$

$\overline{R} = ½ \times 19(8+1) = 85.5$

$W = \frac{12X11114}{19^2X8(8^2-1)} = 0.733017$ (73.3%)

There is a high level of agreement among the respondent and from the responses, it can be inferred that there are strong challenges been faced in managing the solid waste generated in Oyigbo.

IV. CONCLUSION

Municipal solid waste management in Oyigbo is far from global best practice. The increasing population and rapid urbanization presents a bigger challenge that needs to be addressed urgently. The waste management system in place is inefficient as solid waste is seen lying around the streets of Oyigbo. A total of 600 questionnaires were distributed to individual households and 24 to the Local waste management authority. The study revealed that waste collection is done at night. Result of analysis of questionnaire showed that 100% of the local waste management authority respondents responded that open dump is the final disposal point for collected waste and 94.7 % responded that the disposed waste is not covered by a covering material. The open dump is built close to residents and business centers. Kendall's W result for households (95.2% for zone A, 92.5% for zone B, 90.8% for zone C and 82.8% for zone D) indicated generally that there is very high level of agreement among the respondents and from their responses, they have high level of awareness but this does not reflect in their waste management practice. The local waste management authority staffs had 73.3% which also indicate a high level of agreement among the respondents. For an improved and efficient management of solid waste in Oyigbo, implementation of the following are therefore recommended;

(i) Adequate resourcing, financing, personnel training of the local waste management authority in Oyigbo

(ii) Periodic waste management awareness campaigns

(iii) Involvement of private sector, NGOs and other stakeholders in policy formulation regarding solid waste management

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