GLOBAL JOURNAL OF ENVIRONMENTAL SCIENCES VOL. 8, NO. 2, 2009: 71 - 77

 1SSN 1596 - 6194

ASSESSMENT OF SOLID WASTE MANAGEMENT IN GBOKO TOWN

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(Received 25 June, 2008; Revision Accepted 20 October, 2009)

ABSTRACT

Solid waste management appraisal for Gboko town is made. Questionnaires were administered with respect to demographic and waste management data in five zones of the town. The rate of waste generation was determined by using household approach, which involved sorting and weighing of wastes respectively. The data obtained were subjected to statistical analysis using ANOVA and Chi-Square tests. The results showed that there was significant variation in the composition of waste generated. The amount of waste generated per day was estimated at 23,841 kg. In general management of solid waste in Gboko town is not satisfactory calling for more concerted efforts in the areas of public enlightenment campaigns, regular collection and disposal of generated wastes and extension of services to cover more inhabitants of the town.

KEY WORDS: Solid wastes, Management, Problems, Gboko town

INTRODUCTION

Gboko town was founded in the 1920's as a traditional settlement of the Tiv people. The town therefore sprang up with no formal planning. The Nyambuan cult disturbance of 1939 and the series of riots, arson and killings of 1962-1965 drove many people from rural areas to the town for protection. Another factor that accelerated the growth of the town was the elevation of Gboko as the headquarters of the defunct Tiv division and Gboko division in 1952 and 1962, respectively. Presently, it is the headquarter of Gboko Local Government Area (LGA} as well as the seat of the Tor Tiv. These make Gboko a cultural and political focal point of the Tiv nation.

By 1978, Benue Cement Company and BENRO packaging company were established. There are also rice mills and juice company (YUTECO Nig. Ltd). These industrial establishments, commercial activities, health and educational institutions have duely increased the population of Gboko town. The increase in population is not without the attendant increase in domestic waste generation.

Hudson and David (1977) observed that in every human settlement, the microscopic unit of waste generation is the household. The rate of generation in the household is related to its size, lifestyle, type and quality of housing among other socio-economic characteristics. In Nigeria, urban generated solid waste crises is highly attributed to three factors: rapid increase in population, heavy consumption pattern of urban dwellers and inefficiency of the authorities whose statutory roles include efficient refuse management (Ajadike, 2001).

The Federal Ministry of Environment (2002) attributed the problem of solid waste in urban areas to the following:

i) Overgrowing urban population with its characteristic increase in the rate of solid waste generation;
ii) Inability of the local government councils to cope with the problem of solid waste management due to inadequate technical and financial resources;
iii) Peoples belief that solid waste management is a social service and hence their unwillingness to pay for disposal charges ;
iv) The inability of people to discern what constitute wastes, reusable wastes,

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recyclable wastes, biodegradable and non-biodegradable wastes; and

v) Investment in functional waste treatment and enforcement of anti-pollution laws are given low priority in developing countries.

The management of solid waste involves the processes that are undertaken to control and eliminate wastes from the environment. This essentially entails the processes of generation, onsite storage, collection, transfer and transport, processing and disposal of solid waste. (Adegoke, 1990).

MATERIALS AND METHOD

The study was carried out in five different parts of Gboko town, namely: Gboko North, Gboko South, Gboko West, Gboko East and Gboko Central. The method involved the administration of questionnaires to 2,060 respondents in these areas. The first part of the questionnaire sought to obtain demographic data such as age, sex, marital status, family size, educational level, occupation, income status and ethnic group. The second part was to obtain information on waste management as regards: cleanliness of the environment, disposal methods, and environmental effect of solid wastes among others. Of the 2,060 questionnaires administered 2,001 were received given 97% response.

Household approach was used in determining the rate of waste generation in the town. This involved sorting out and weighing wastes from selected households for three consecutive days. One household was selected from each zone. The rates were obtained by dividing the waste measured (in kg) by the number of people in the household. The average for the town was then obtained by adding individual rates for the different zones and dividing by the number of households used.

Variation in the composition of waste was tested using analysis of variance (ANOVA), while the Chi-Square (X^2) technique was used to test for relationships between household size and amount of waste generated, educational attitude to people's waste disposal methods and income versus peoples demand for improved solid waste management.

RESULTS AND DISCUSSION

Table 1 shows that 52.5% of the respondents are females while 47.5% are males. Also, majority (59%) of the respondents fall within the economically active group (20- 50 years). The interest here is that they have the purchasing power to consume and hence generate wastes. A good proportion of the respondents are married. But singles dominate by a narrow margin as shown in Table 2. Married life affects family size which in turn influences consumption patterns and waste generation and management. Married people encourage meals that are African in nature and minimum packaged food with attendant wastes like cellophane materials. Single people on the other hand consume more of packaged foods which generate cellophane materials as wastes.

Table 1: Age/Sex Composition of Respondents

Age of Respondents	Males	Females	Total	Percentage, %
Less than 20 years	110	440	550	27.5
20-50 years	670	510	1180	59.0
Above 50 years	170	101	271	13.5
Total	950	1051	2001	100

Table 2: Marital Status of Respondents

Marital Status	No. of Respondents	Percentage,%
Married	890	44.5
Single	919	45.9
Separated	52	2.6
Widow/widower	90	4.5
Celibate	50	2.5
Total	2001	100

With respect to the family size, most families have less than 5 members, or at most 6-10 persons as depicted in Table 3. Large families generate more waste than small size families.

Income status of a people is an instrumental factor in demanding for goods and services. The income status of the respondents is presented in Table 4.The table reveals that 39% of the respondents earn between □6,000.00 – □15,000.00 per month; while 38.4% of the respondents earn less than □5,000.00 per month. The rest earn above □15,000.00 per month. These figures were chosen because they represent the ranges within which peoples income fall. It is clear that low income earners (≤□ 15,000.00) dominate the sample surveyed (77.4%)

Table 3: Average Family Size and Amount of Wastes Generated

Average Size of Family	Total Respondents	Amount of Wastes (in kg)	Percentage (of total),%
Less than 5 persons	848	933	20.7
6-10 persons	792	2,781	61.7
More than 10 persons	361	792.1	17.6
Total	2,001	4,506.1	100%

Table 4: Income Status of Respondents (Per Month)

Income, Naira(□)	Number of Respondents	Percentage,%
Less than 5,000	769	38.4
6,000 -15,000	780	39
16,000 -30,000	291	14.5
31,000 -50,000	110	5.5
Above 50,000	51	2.6
Total	2,001	100%

Table 5: Gravity of Solid Waste Management Problem as Perceived by the Respondents.

Perception	Number of Respondents	Percentage,%
Not serious	390	19.5
Not very serious	269	13.4
Serious	411	20.6
Very serious	881	44.0
No opinion	50	2.5
Total	2,001	100%

Table 6: Cleanliness of the Area

Situation	Number of Responses	Percentage,%
Very dirty	592	29.6
Dirty	678	33.9
Okay	580	29.0
Clean	61	3.0
Very clean	90	4.5
Total	2,001	100%

The gravity of a problem is visualized by the perception of the people affected or concerned. In the study area, majority of the people considered the problem of managing solid wastes as very serious (44%) as indicated in Table 5. In terms of cleanliness of the area, about 64% of the people described the area as being either very dirty or dirty (see Table 6). The preference of educated people to adopt better methods of waste disposal could be higher than illiterates, see Table 7. It is obvious from the table that most of the people who throw refuse on open land and drains are uneducated. Those who keep waste bins or burn it are mostly those with higher education.

Table 7: Matching Educational Levels with Methods of Solid Waste Disposal.

Disposal methods	Respondents by Educational Level				
	No Education	Little Education	Higher Education	Row Total	%
Street bins	98	140	180	418	21
Throw on open land	301	219	21	541	27
Bury it	50	30	39	119	6
Feed to animals	30	21	20	71	3.5
In drains /street	199	150	31	380	19
Burn it	101	139	99	339	16.9
Burn/bury it	21	51	61	133	6.6
Total	800	750	451	2,001	100%

Table 8: Frequency of Solid Waste Removal by Government

Frequency	Number of Responses	Percentage,%
Daily	130	6.5
Weekly	288	14.4
Once a month (at most)	561	28.0
Not at all	1,022	51.1
Total	2,001	100%

In general 46% of the respondents either throw their waste on land or in drains/street. Only 21% of the respondents deposit their waste in bins where they can be transferred to the designated points for ultimate disposal. This is in consonance with the observations of Akpen, et al (2005) that solid waste management fall short of expectations in urban areas of Benue state because of use of unconventional and non-environmental friendly methods of disposal.

Table 8 shows the frequency of removal of solid wastes by government agencies. Majority (51.1%) of the respondents reported that wastes are not removed from their areas. While 28% said wastes are evacuated at most monthly. This delay in the removal of wastes from points of generation constitutes a potential source of pollution. For instance, pollution of groundwater by leaching and percolation and stream waters by surface runoff. Besides delay in evacuation, public enlightenment campaigns to sensitize the public on the need to preserve the quality of the environment have not being satisfactory as indicated in Table 9.

Table 9: Environmental Awareness Campaign

Awareness	Number of Responses	Percentage,%
Yes	660	33
No	1,341	67
Total	2,001	100%

Table 10: Household Solid Waste Composition in Gboko Town by Percentage

Sample Composition	Gboko North	Gboko South	Gboko East	Percentage,%
Putrescibles	21	15	16	17.3
Polythene/cellophane	20	22	15	19
Paper	14	10	14	12.7
Metal	10	11	9	10
Glass	7	10	9	8.7
Textiles	9	12	13	11.3
Fines (ash, dust and sand)	10	12	14	12
Miscellaneous	9	8	10	9
Total	100 %	100 %	100 %	100 %

The household solid waste composition in Gboko was studied by sorting and weighing (Aondoakaa, 2005). Three zones namely Gboko North, Gboko South and Gboko East were selected for this study. It is clear from Table 10 that the dominant materials are putrescibles (food remnants, fresh leaves and vegetation etc). The decomposable wastes could be reused as compost manures. Others such as papers and metals are recyclable.

Table 11 shows rate of solid waste generation in the study area. Gboko North generates 0.49 kg/p/day and is the highest for the area. While the least value of 0.41 kg/p/day was obtained in Gboko East. On average, the rate of generation of solid waste in Gboko town was calculated to be 0.44 kg/p/day.

Table 11: Rates of Household Solid Waste Generation in Gboko Town

Zone	Rate (in kg/p/day)
Gboko North	0.49
Gboko South	0.45
Gboko West	0.44
Gboko East	0.41
Gboko Central	0.44

STATISTICAL ANALYSIS

HYPOTHESIS I

H_o – There is no significant variation in the composition of household solid waste generated in Gboko.

The data in Table 10 was subjected to ANOVA F ratio test because of its reliability in testing variation among samples. The statistics is shown in Tables 12a and 12b. The computed ANOVA is summarized as follows:

i. Total Variance (Total Sum of Square, TSS) = $\sum X^2 - \frac{(\sum X)^2}{N} = 384$

ii. Total Degrees of Freedom (D/F total) = N – 1 = 24 -1 = 23

iii. Between Samples Sum of Squares (BSS) $= \frac{\sum X1}{nX_1} + \frac{(\sum X_2)^2}{nX_2} + \frac{(\sum X_3)^2}{nX_3} = 3750$

iv. Between Samples D/F = K – 1 = 8 – 1 = 7

v. Within Samples Sum of Squares, WSS = TSS – BSS = 384 -3750 = -3366

vi. WSS D/F = D/F total – BSS D/F = 23 – 7 = 16

F-calculated = 3.34(2.55), while the value of F from table is 2.49. Hence we reject H_o and H_1 because F calculated is greater than F-tabulated. This implies there is significant variation in the composition of the household solid wastes generated in Gboko town.

HYPOTHESIS II

H_o – There is no significant relationship between household size and amount of wastes generated. The Chi-Square statistics was employed for this analysis. It's appropriate in this case because it compares differences between observed and expected (theoretical) frequencies. The values in column three below (Table 13) are obtained from Table 3. The expected frequency for a unicolumn table is given by the mean as 150.2. While Chi-Square is given as $X^2 = \sum (0\text{-}E)^2/2$ and Degree of Freedom (D/F) = N – 1 = 3 - 1 = 2

Table 12a: ANOVA Statistic for H_oI

Composition	Gboko North (X_1)	Gboko South (X_2)	Gboko East (X_3)	X_1^2	X_2^2	X_3^2
Putrescibles	21	15	16	441	225	256
Polythene/cellophane	20	22	15	400	484	225
Paper	14	10	14	196	100	196
Metal	10	1	9	100	121	81
Glass	7	10	9	49	100	81
Textiles	9	13	13	81	144	169
Fines (ash, dust and sand)	10	12	14	100	144	196
Miscellaneous	9	8	10	81	64	100
	$\sum X_1$ = 100	$\sum X_2$ = 100	$\sum X_3$ = 100	$\sum X_1^2$ = 1448	$\sum X_2^2$ = 1382	$\sum X_3^2$ = 1304

The critical value of X^2 of 2 at 0.05 level is 5.99 from table (less than 164 calculated, see Table 13). Hence we reject H_o and accept H_1. This means there is significant relationship between household size and amount of wastes generated. The results of the Chi-Square test on the other parameters revealed that:

i. Education has significant effect on the people's disposal methods 21.03: 36.09.
ii. The effect of income on willingness to pay for solid waste management services is significant. (9.49: 127.45).

IMPLICATION OF POOR SOLID WASTE MANAGEMENT ON THE ENVIRONMENT.

Poor solid waste management has the potential of causing flooding. It also encourages the spread of diseases, pollution of ground and surface waters, air pollution, land pollution and can distort the beauty of a town. It could even result in road accident due to obstruction of traffic flow, for instance where refuse are dumped on streets and highways.

Table 12b: ANOVA F- Ratio Table for H_oI

	(a) Source of Variance, (SV)	(b) Sum of Squares, (SS)	(c) Degree of Freedom (D/F)	(d) Variance Estimate (V/E)
1	Between Samples	3750	2	535.71
2	Within Samples	-3366	21	160.29
3	Total Variance	384	23	

Table 13: Chi-Square Frequency Table for H_oII

Household Size	Number of Responses	Amount in Kg	Percentage,%
Less than 5 persons	848	933	20.7
6-10 persons	792	2781	61.7
More than 10 persons	361	792	17.6
Total	2001	4506.1	100

CONCLUSION AND RECOMMENDATIONS.

The processes of field survey, data collection, administration of questionnaires and data analysis has been presented in this report. Based on the findings, the following conclusions are drawn:

1. Demographic variables like occupancy rate, socio-economic class and education affect solid waste management. The greater the size of the household the greater the tendency to generate more wastes.
2. Many people (64% of the respondents) believe that it is the responsibility of the government to manage solid waste and hence have care free attitude towards the management of the environment.
3. Government's management of solid waste is inadequate. This manifests in delays in collection of wastes for disposal and near absence of service in some areas. Also, public enlightenment campaigns have not been satisfactory.
4. There is significant variation in the composition of household wastes; the dominant materials are putrescibles and polyphone/cellophane.
5. It is therefore recommended that:

(i) Government's effort should be intensified in the areas of awareness campaigns, provision of equipment and personnel in removing solid wastes as well as ensuring compliance with existing environmental laws.
(ii) Composting the putrescible part of the wastes will be a source of raw material in organic fertilizer blending plants.

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