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ANALYSES OF SOLID WASTE GENERATION IN JIMETA TOWN, ADAMAWA STATE

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ABSTRACT

This research focuses on quantity of solid waste generated in Jimeta town (Adamawa State, Nigeria). The assumption of the study was that strong relationship exists between the social status of the respondents and the nature (including types and quantity) of solid wastes generated. Hence, collected from the sampled respondents were relevant data including the types and quantity of waste generated by each selected households; and socio-demographic information of the respondents using the combination of both direct field observation, measurements and questionnaire-based interview methods. Thereafter, processing and analyses of the collected data was done by using tables, percentages and chi-square statistical technique. Findings from the study revealed the strength of influence of the respondent's social status on solid waste generation in the study area. Also, animal dung was discovered to be the mostly generated waste. Therefore, amongst others, recommendations made included the need to turn some of the generated wastes, especially animal dung, to a source of income either to the government or to the private investors.

KEYWORDS: Household, Solid waste, Generation, Metropolis, Environment.

INTRODUCTION

In most urban centers, particularly in developing countries, accumulation of all forms of wastes constitute a major problem, thereby making the environment less conducive for human healthy living and as well, less attractive for recreation and other uses. While it is true that the provision of adequate solid waste management facilities is a great challenge facing all nations of the world (Afon, 2006), more so, maintaining clean urban centers of the developing world has always been a problem of great complexity and concern (Afon, 2006). However, developed countries generate waste components that are less degradable, because of the high level of industrialization

(Cointreau, 1982; Filani and Abumere 1986;
Afon, 2006). The quantity and composition of solid waste generation in an area is known to be affected by the resident's socio-economic, cultural and demographic attributes and climatic factors (Cargo, 1978; Adedibu 1988; Van Beukering *et al.,* 1999; Afon, 2006). Collins and Downes (1977) established that higher income households generate more quantity of solid waste than their low-income counterparts. On the contrary, Cargo (1978) found that there is a direct variation between the quantities of waste generation in high population density area occupied by low income groups. But then, Adedibu (1983) countered these by concluding that there was no existence of any direct significant relationship between waste generation and income in Ilorin. Another study on waste generation in Yola showed no significant variation in income and the quantity of 'pure water' polythene sachet waste generated by people (Tanko, 2008). So also was the report on Lagos by Adedibu and Okekunle (1989). In advanced countries, the quantity of waste generation is usually estimated through the waste evacuated from the individual homes by private or Government agencies. This is possible since almost all households are accessible. The product of per capital information derived and population size gives the estimated quantity of waste generated (Cargo, 1978). Unfortunately, not much reliable house-to-house services exist in Nigeria in general and especially in the study area. Hence, the thrust of this study is to provide quantitative empirical information on the type and quantity of solid waste generated by the residents of Jimeta-Yola (Adamawa State); especially by:

- Examining the socio-economic characteristic of the respondents.

- Identifying the type and quantity (in Kg) of waste generated by the residents in the study area.

- Evaluating the association between the respondent's socio-economic characteristics and the type of wastes generated.

- Making related recommendations on waste generation and/or management.

Jimeta town (also doubles as a Local Government Headquarter) is located on latitudes $09^{o}14'N$ & $09^{o}18'N$ and longitude $06^{O}22'E$ & $06^{O}30'E$ (Fig. 1) and has a total population of 198,247 (National Population Commission, 2006) with a total household size of 21,180 (National Immunization Report, 2010). It is bordered to the north and north-east by river benue,

while Yola South and Lake Gerio are to the south and west respectively. Jimeta is in the Sudan savannah vegetation zone and within the tropical continental climate with an average monthly temperature of 27^0C, annual rainfall of 50cm - 100cm and 4 – 8 months of dry seasons (Anjorin, 2012). The Laka, Vere, Bata, Fulani and the Hausa people are the indigenous population in the area. However, other ethnic groups from all over Nigeria (including the Yoruba, Ibo, Efik, amongst others) also resides in Jimeta. Most of the residents are civil servants while few are into farming (fishing and cattle/animal rearing inclusive), trading, transportation, and furniture-making, etc. There are social facilities in the area includes domestic airport, electricity, pipe borne water, parks and gardens, medical centers, schools (public and private), amongst others.

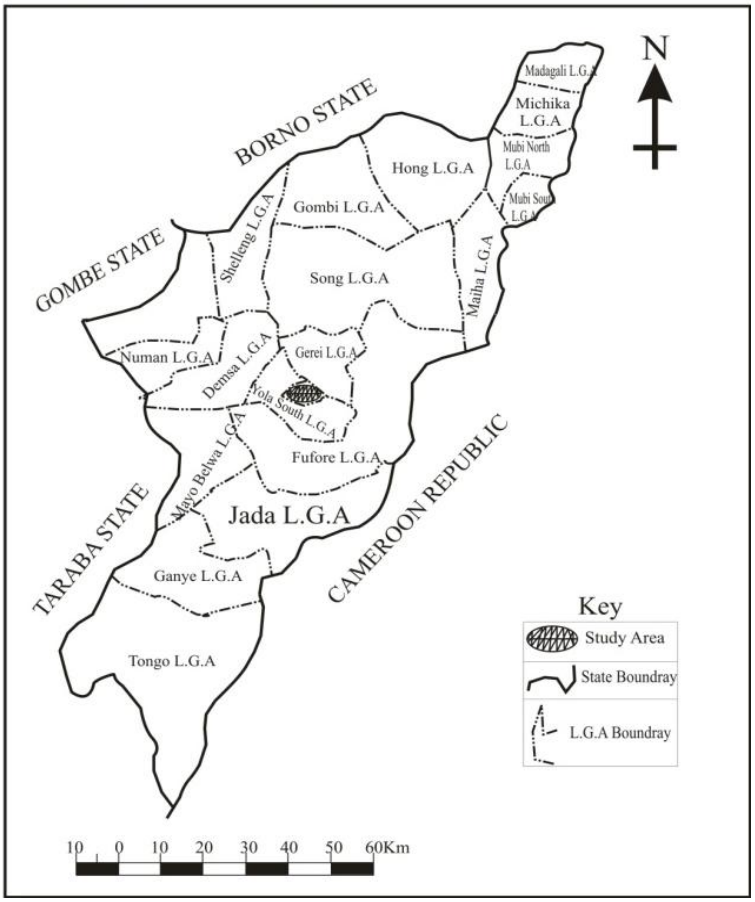

Figure 1. Map of Adamawa State Showing the study area.

MATERIALS AND METHODS

Collected and used for this study is the socio-economic information of the respondents, particularly the household's level of education, occupation, monthly income; and data on the types and quantity of waste generated by the sampled households. Data was collected by the researchers and 4 other well trained field assistants through direct field observations and measurements, oral and questionnaire-based interviews (with comments and observations well noted in the researcher's observatory note) and literature review. Also, 1417 waste collection bags (a bag per household) and 5 scales (with maximum reading of 100kg) were used to collect data. The process of data collection was in phases with the identification of the potential respondents, validation of the data collection instruments, and the actual field data collection in phase 1 (preliminary), phase 2 (pilot), and phase 3 (data collection) respectively. Thereafter, with availability sampling method, 15% of the total households (3177) were initially selected for the study. However, due to inconsistencies of many respondents in the provision of waste data, 1417 of the 21,180 households in Jimeta (representing approximately 7%) were consequently used for the study as these were those households that could provide the required waste data throughout the research period of one year. In addition, those respondents included all the households that resided in each of the systematically selected102 houses). Reason for these was to avoid mix-up of the waste of those sampled respondents and those not selected for the study.

Consequently, the weight of each of the waste collection bags was determined every morning before given them to each household. In the following morning (between 7am – 9am), each bag with its waste content was examined and re-weighted to determine the type(s) and weight of the waste generated in the previous day and weight recordings were accordingly made in the researcher's record (observatory note), against the sampled household. Also, all the generated waste were sorted into 3 categories with the sole aim of establishing empirically proven association, or otherwise, between 3 main socio-economic attributes of the respondents (monthly income, qualifications and occupation) and the types of waste generated. The categories were as follows:

Category A
Nylon & Polythene, Ashes, Rags, Animal Dung, and food shafts

Category B
Broken Bottles & Metals, Rubber Materials, and old or spoilt bags.

Category C
Cans, Papers, Food Wastes, Fruit Peels & Perishables.

The survey lasted for a year and it was carried out in every second week of the month for a period of one week simply because salary earners would have been paid for the month and can afford to buy series of consumer goods. All the entire questionnaires that were properly filled and returned were carefully analyzed. The collected data were tabulated, summarized and percentages calculated on daily, weekly and monthly basis. Also, the level of association between the type of waste generated by the respondents and their socio-economic status was tested using chi-square statistical technique (stated below):

$$x^2 = r\sum K\sum \frac{(O - E)^2}{E}$$

Where, $r\sum$ = roll total $k\sum$ = Colum total

O = observed E = excepted

RESULTS AND DISCUSSION

Respondents' Demographic Characteristics

Table 1 reported on the information of 3 important socio-economic characteristics of all the sampled respondents. This includes their data on academic and/or trade qualifications, type(s) of occupation they engaged in and consequently, their estimated total monthly income. Revealed accordingly therefore, is that almost half of the respondents (49%) had tertiary qualification. This was followed by those respondents who were holders of either primary or secondary school certificates (42%). However, the non–educated group was the least with just a little over 8%. Further analysis revealed that most of the respondents in the study area were either self-employed (54.9%) or salary earners (39.6%). This is against a handful of them (5.5%) that was unemployed. Consequently, their monthly income level varies as most of them (over 45%) reportedly earn between twenty and fifty thousand naira. The group with the highest earnings earns over fifty thousand naira per month, whereas, the least category with monthly income below twenty thousand naira was shown to be a little over 22% of the total respondents.

Types and Quantity of Waste Generated by Households

Quantity of Wastes Generated on Weekdays in Jimeta-Town

Views of the respondents on the type(s) and quantity of waste generated by the sampled households, both on a daily and weekly basis, were sought and their claims are presented in Table 2. According to the respondents, varieties of solid wastes including Nylon & Polythene, Rags, Animal Dung, Broken Bottles, Rubber Materials, Papers, Food Wastes

and Fruit Peels, etc were reportedly generated by households but differs in quantity.

Table 1: Socio-Economic features of Respondents

Social Characteristics	Total Respondents	Percentage (%)
INCOME/MONTH		
Below #20,000	319	22.5
#20,000 - #50,000	649	45.8
Over #50,000	449	31.6
TOTAL	1417	100
QUALIFICATION		
None	124	8.8
Primary/Secondary	598	42.2
Tertiary	695	49
TOTAL	1417	100
OCUPPATION		
Unemployed	78	5.5
Salary Earners	561	39.6
Self-Employed	778	54.9
TOTAL	1417	100

Source: Field work (2012)

Therefore, the 3 most commonly generated types of wastes in the area on a weekly basis, in descending order of quantity, includes animal dung weighing more than 3,223kg (representing over half of the total quantity of weekly generated wastes), Nylon & polythene totaling 1,630.86kg per week (one-fourth of the total weekly generated wastes) and wasted papers that was just 5.2% (334.64kg) of the total kilogram of waste generated every week. Further analyses reveals that ashes, broken bottles & metals were the 3 least generated types and quantity of wastes totaling only 6.2% (413.01kg) of the total waste (6326.462 kg). According to the data, the quantity of the total ashes generated (84.72 kg) was just slightly over 1%, that of cans was 2% (127.08kg) and broken bottles & metals was 201.21kg (3.2%) of the total quantity of weekly generated wastes. Observation shows that Animal dung and nylon & polythene appeared the most daily generated waste (548.562kg, 385.476kg respectively); also the highest quantity of wastes generation was recorded both on Saturdays 17% (1135.244, which is a ceremonial day) and Mondays 16% (1052.646kg) while the least was made on Tuesdays 10.244% (648.108kg).

These findings agree with some other research findings. Afon (2006) reported that animal and poultry husbandry were part of people's custom in Oyo (Nigeria); and that quantity of waste generation was highest on Saturdays than in any other days of the week. However, according to Afon (2006), the daily amount of waste generation, in Oyo town, was least on Thursdays. This is contrary to the situation in Jimeta-Yola where it was least on Tuesdays.

Quantity of Wastes Generated in the Months of the year in Jimeta Town

Analyses of the type(s) and quantity of waste generated by the respondents on a monthly/yearly basis were also computed and presented in Table 3. According to the data, it was revealed that a total of over 25,371kg of wastes was produced by all the sampled households during the period of study. Detail analyses indicates that the quantity of the total waste generation was highest in Nov (11.92%), April (10.7%), August (8.29%) and in January (8.25%). However, the quantity varies from 7.14% to 7.99% in other months. Interestingly, animal dung was mostly generated in the study area (60.37% of the total wastes) especially in the month of November when a total of 2104.023kg was recorded. This was much more than any other waste type and even with a wide margin from the closest type of waste which is Nylon & polythene (12.04% of the total wastes) within the period of the research. It also triples the quantity of animal dung produced in Oyo town in 2005 (Afon, 2005). Other types of waste were far behind ranging from 1.45% to 5.16% of the total wastes.

It is further shown that while wastes of rubber materials were more in only April (186.380kg), that (waste) of food, fruit peels & perishables were mostly generated in 4 months of the year (January 131.074kg, April 104.018kg, October 104.391kg, and November 131.074kg); so also was that of paper wastes. As shown in table 3, the quantity of waste papers was remarkably highest from January to May ranging from 152.038kg - 134.084kg. However, Nylon & Polythene which was recorded as the second largest quantity of wastes generated in a year was observed to be least produced in January (only 09.234kg).

Socio-Economic Factors Contributing to Households Waste Generation.

Three important socio-economic parameters of household heads (namely monthly income, qualification and nature of occupation) were related with the data of household's waste generation in order to establish an association or otherwise.

Table 2: Quantity of Waste Generation on Weekdays in Jimeta-Yola Metropolis

Types of Waste	MON	TUE	WED	THU	FRI	SAT	SUN	TOTAL (KG)	%
Nylon & polythene	385.476	38.124	247.806	230.862	224.508	139.788	364.296	1630.86	25.778
Rubber materials	14.826	16.944	23.298	48.298	38.124	19.062	14.826	175.794	2.778
Ashes	16.944	10.59	16.944	6.354	8.472	16.944	8.472	84.72	1.339
Rags	38.124	16.944	8.472	4.236	29.652	137.67	21.18	256.278	4.050
Broken bottles & Metals	40.242	23.298	38.124	23.298	27.534	27.534	21.18	201.21	3.180
Cans	21.18	4.236	2.118	6.354	61.422	8.472	23.298	127.08	2.008
Papers	23.298	25.416	25.416	27.534	21.18	186.38	25.416	334.64	5.289
Animal dung	468.078	463.842	444.78	451.134	463.842	548.562	383.358	3223.596	50.594
Food waste, fruit peels & perishables	33.888	46.596	25.416	44,478	38.124	46.596	25.416	260.54	4.117
Others	10.59	2.118	2.118	2.118	6.354	4.236	4.236	31.77	0.502
TOTAL (KG)	1052.646	648.108	834.492	845.082	919.212	1135.244	891.678	6326.462	
Percentage (%)	16.638	10.244	13.190	13.357	14.529	17.944	14.094		100

Source: Fieldwork, March 2011 - February, 2012

Hence, data were sought for, collected, and tested using chi-square statistical technique. Each of these variables was analyzed. The results of chi-square analysis presented in Table 4 therefore indicates the existence of strong association between respondents' monthly income (X^2cal. of 353.58 > X^2 crit. of 09.488), academic qualification(s) (X^2cal. of 147.3 > X^2 crit. of 09.488) and nature of occupation (X^2cal. of 131.67> X^2 crit. of 09.488) and their household's waste generation pattern at a constant level of significance of 0.05 (P > 0.05). Hence, a very scientifically tested finding proves that type(s) of waste generated by households in Jimeta town (Adamawa State, Nigeria) significantly vary in line with the variations in the level of monthly income, academic qualification(s), and type of occupation(s) of the household heads. The reported situation in the study area is however, not different from that of other parts of Nigeria as reported in the research findings of the other scholars. Afon (2005) concluded and reported that almost 90% of the type(s) of wastes generated in Oyo (Oyo State, Nigeria) were influenced by the social standing of the respondents. Appasamy (1994) also said that both the composition and quantity of wastes generated were linkable to people's cultural, socio-economic and demographic characteristics.

Table 3: Quantity of Waste Generation in the Months of the year in Jimeta-Yola Metropolis Fieldwork, March 2010 - February, 2012

Types of Waste	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL (KG)	%
Nylon & Polythene	09.23	284.01	278.01	283.25	208.21	226.01	278.02	219.02	214.21	201.05	291.03	282.04	3055.09	12.04
Rubber materials	92.43	86.02	81.19	186.38	79.38	88.92	74.41	98.39	89.04	72.38	84.23	78.12	1110.90	4.38
Ashes	98.35	59.28	79.21	61.84	98.81	74.08	87.43	82.46	83.41	89.23	98.12	94.33	1006.57	3.97
Rags	40.53	28.02	37.43	49.12	31.44	39.08	48.38	31.41	31.42	33.94	41.31	39.39	451.48	1.78
Broken bottles & metals	88.12	61.54	84.62	91.35	73.24	83.49	78.83	87.55	79.09	79.99	88.30	81.79	977.90	3.85
Cans	49.13	43.15	39.03	44.13	47.34	43.82	41.74	48.38	42.41	48.12	51.24	41.32	539.81	2.13
Paper	152.04	141.23	111.24	121.023	134.08	94.74	96.23	98.14	97.37	82.21	91.32	89.22	1308.86	5.16
Animal dung	1119.04	1211.18	918.09	1738.11	1208.11	1107.00	1019.24	1314.08	1214.06	1119.09	2104.02	1181.22	15316.30	60.37
Food waste, fruit peel & perishables	131.07	92.23	90.38	104.02	96.34	94.74	97.52	98.91	99.00	104.39	131.07	97.07	1236.76	4.87
Others	31.35	21.12	29.91	37.07	30.08	29.22	31.45	25.08	28.31	28.91	44.38	31.21	368.10	1.45
TOTAL (KG)	2092.33	2027.80	1812.12	2716.28	2007.04	1881.12	1853.25	2103.43	1978.33	1859.31	3025.03	2015.72	25371.77	
%	8.25	7.99	7.14	10.7	7.91	7.41	7.30	8.29	7.80	7.32	11.92	7.94		100

Table 4: Association between the Respondent's Socio-Economic Characteristics and wastes generation

Factors	Significance level	Df	X^2Cal.	X^2 crit.	Remark
Income/Month	0.05	04	353.58	9.488	Highly Significant. Hence, alternate hypothesis are accepted as null hypothesis are rejected
Qualification			147.3		
Occupation			131.67		

CONCLUSION

It is evident from the analyzed data that much solid wastes, of divers' composition, are generated and needed to be evacuated on a daily and/or weekly basis in the study area. The most important of these wastes was animal dung which can be transformed to fertilizer that can be used by the farmers. However, if these wastes are haphazardly managed, the environment will be unhealthy for the residents to leave in. Therefore, effective waste management procedure, including standard collection points and dumpsite, must be urgently put in place by both the local government, Adamawa State Urban Development Board and the private sectors.

In view of the significance of the findings of this study especially on the management of the generated solid wastes in our environment, the researcher therefore recommendation that:

- Further studies should be made on the best waste management procedure(s), including provision of standard dump sites and waste recycling factory (ies), to be adopted in the study area.

- Since the bulk of the waste generated in the study areas is animal dung, government and private investors should invest in the conversion of these into refined fertilizer to be sold to farmers at subsidized rate.

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