PER CAPITA WASTE GENERATION AND VARIATION IN KARU LOCAL GOVERNMENT AREA, NASARAWA STATE, NIGERIA

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ABSTRACT
Increasing amount of waste is clearly an issue of concern within the satellite towns of the Federal Capital City of Abuja. In the last decade, these satellite towns have witnessed tremendous influx of immigrants resulting in the overstretching of the basic infrastructural facilities, one of which is waste collection and disposal facility. This study examined per capita waste generation and its variation in Karu Local Government Area, Nasarawa State. The objectives of this research were achieved using 300 copies of questionnaire administered to heads of households and weighing of waste. Solid wastes generated within twenty four hours were weighed and recorded. Data derived from field were subjected to statistical analysis using descriptive statistics to determine the per capita wet and dry season's waste generation for the various sampling locations across the study area, student's t-test was used in assessing the significance of the difference in average per capita waste generation. Results obtained shows that the rate of per capita waste generation for the three sites is 0.537kg and 0.92kg for dry and wet seasons respectively. There is no significant variation in the amount or rates of waste generated among the three study sites in the two seasons at 5% probability level (.090 > 0.05). Therefore, it is concluded that average per capita waste generation for the three areas are almost the same, and waste generated during the dry and wet seasons varied. Recommendations include the encouragement of recycling, re-use and sorting of households waste, among others.

Keywords: Per-capita, Waste Generation, Variation.

INTRODUCTION
Solid waste is any material which comes from domestic, commercial and industrial sources arising from human activities which has no value to people who possess it and is discarded as useless or unwanted (Beede and Bloom, 1995). In the early days, waste disposal do not pose difficulties as habitations were sparse and land was plentiful. During the last decade of the 20th Century, environmental issues received an unprecedented attention at the international level. The global waste crisis, among other environmental issues, confronting mankind in both developed and developing countries threatens the assimilative and carrying capacity of the earth which is our life support system. It is an indisputable fact that waste is the most visible and serious environmental problem facing Nigeria's urban and semi urban centres (Oyediran, 1994; Gentry and Fernandez, 1997; DETR, 1999; EIONET, 1999).

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Waste disposal became serious problem when towns and cities continued to increase in size, where large number of people started to congregate in relatively small areas in pursuit of livelihoods (Beukering and Sehker, 1999; Shafiul and Mansoor, 2003). While the population densities in urban areas and per capita waste generation increased, the available land for waste disposal decreased proportionately, thus solid waste management emerged as an essential specialized sector for keeping cities healthy and livable. Waste characterization and generation rates are the force of any waste management systems (Buenrostro and Gerardo, 2001). Selection of handling and treatment and disposal systems solely depends on waste characteristics and volume. Analysis of solid waste generation rates can help to forecast the future generation rates and characteristic of solid waste.

Study Area

The study area for this research is made up of Masaka, Karu and Mararaba, areas in Karu Local Government area of Nasarawa State. The study area lies between latitudes 8° 30′ and 9° 30' N and between longitudes 7° 30' and 8° 10' E of Greenwich meridian (Figure 1). Karu Local Government Area is situated at the eastern part of the Federal Capital Territory Abuja and occupies a land area of about 27,116.8 square kilometres. The area is located in the North-Central Geo-political Zone of Nigeria and bounded to the west by FCT Abuja, to the north by Kaduna State, to the east by Kokona Local Government Area and to the south by Nassarawa Local Government Area.

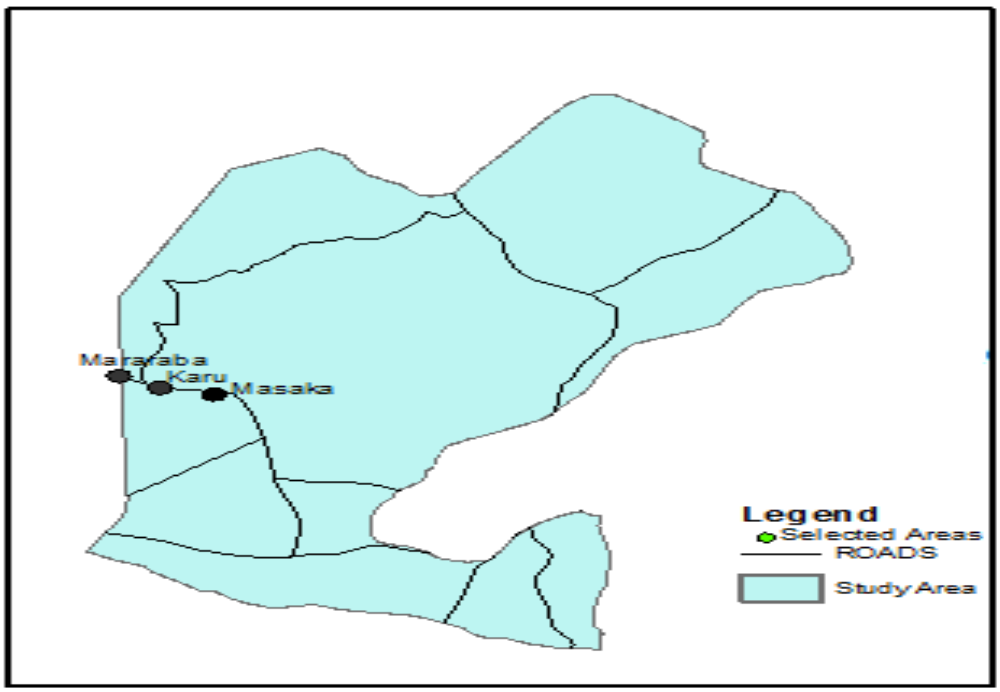

Figure 1: Karu Showing the Study Areas

MATERIAL AND METHODS

Primary data were collected through the use of structured questionnaire and weighing the amount of waste generated by sampled households. One set of questionnaire was designed and administered to heads of households. The population of the entire Karu Local Government Area was two hundred and five thousand, four hundred and forty-five (205,445) people, according to 2006 National Population Census. Based on the 2006 National Population Census, the estimated population of the study sites was 100,000 out of which Masaka has 25,000 (25%), Karu 36,000 (36%), and Mararraba 39,000 (39%) respectively. A total of 300 household heads were sampled and questionnaires administered to them in the three areas where seventy-five respondents were sampled in Masaka, one hundred and eight respondents were sampled in Karu, and one hundred and seventeen respondents were sampled in Mararraba.

Sampling Methods

Within a systematically sampled plot of land, one household was randomly sampled. The household within a sampled plot of land was numbered and the household numbered one (1) was sampled to be representative of all the households within the sampled plot of land. Furthermore, the household sampled within a sampled plot was administered with a copy of questionnaire during the dry season fieldwork and the same household was maintained during the wet season fieldwork. If a sampled land plot was found to be empty, or the residents of sampled land plot were not present for interview, the plot after the sampled land plot was selected as a replacement. Similarly, when it was also discovered that the sampled plot was an uncompleted building, a plot after the sampled plot was also selected as a replacement. Furthermore, when the occupants were not present during the first interview and were present during the second interview the same procedure above was applied or maintained.

Measurement of Solid Wastes

Each household sampled, was visited twice in the dry and wet seasons. The selection of these periods assisted in determining or ascertaining variation in the amount and types of solid wastes generated with seasons.

Field assistants visited sampled households in the three study sites to empty their dustbins and placed black cellophane bags in each of the dustbins for members of the household to throw their waste for the next one day (twenty-four hour). On this first day, a copy of the questionnaire was administered to the head of the household. On the following day, the field assistants went back to the same sampled households, remove the household waste dumped in a black cellophane bag, weigh the waste using weighing scale and record the weight against the tag of the sampled household. This procedure was repeated for each of the sampled land plot. The household survey allows for the derivation of per capita waste generation rates, which also served as a basis for computing volumes and determination of seasonal variation. Student's t-test was used in assessing the significance of the difference in average per capita waste generation between dry and rainy seasons for each sampling location.

RESULTS AND DISCUSSION

Per Capita Waste Generation Rate

The data shows that the rate of per capita waste generation for the three areas is almost the same. Average waste generation for the three areas during the dry and wet season is 0.537kg and 0.92kg, which shows that there is significant variation in the amount of waste generated in the two seasons within the study areas.

Waste generation in sub-Saharan Africa is approximately 62 million tons per year. Per capita waste generation is generally low in this region, but increase from 0.09kg to 3.0 kg per person per day, with an average of 0.65 kg per capita per day. Per capita waste generation in East Asia ranged from 0.44kg to 4.3 kg per person per day for the region, with an average of 0.95 kg/capita/day (Hoorweg *et al* 2005). In Eastern and central Asia the rate of per capita waste generation is 0.29kg to 2.1 kg per person per day, with an average of 1.1 kg/capita/day. The rate of per capita waste generation in Latin America and the Caribbean ranged from 0.1 to 14 kg/person/day, and an average of 1.1 kg/person/day. In the Middle East and North Africa, solid waste generation is 63 million tons per year. Per capita generation is 0.16kg to 5.7 kg per person per day, and an average of 1.1 kg/capita/day. The OECD countries generate an average of 2.2 kg/capita/day, and these countries generate almost half of the world's waste, while Africa and South Asia produce the least waste (Urban Development Series 2010).

There is variation in the amount of per capita waste generation between the Developed and Developing countries where income is high and food are processed and Developing countries with low income and food not processed. Developed Nations generate more waste than the Developing Nations because of high income and the level of industrialization.

Table 1: Waste Generated Per Person

Area	Dry Season (kg)	Wet Season (kg)
Masaka	0.53	0.85
Karu	0.54	0.95
Mararraba	0.54	0.95
Average waste generated	0.537	0.92

Source: Fieldwork 2011

Variation in Solid Waste Generation Rates

The Table shows that the variation in per capita waste generation for the three areas is significant at probability level, which is equal to 257.803,> p- value =0.000 i. e there is variation in the amount of wastes generated in the three study areas within the two seasons (dry and wet seasons).

Furthermore, the data on Table 2 reveals that there is variation on per capita waste generation for the three areas. This variation is significant at 5% probability level of 20.049,> p-value=0.000. This clearly shows that the per capita waste generation varies in the three study areas in Karu both during the dry and wet seasons. Though

the value for the rate of waste generated both in the dry and wet seasons for Masaka is higher than the value for Karu and Mararraba, results of the study have shown that the rate of variation is significant particularly for Masaka and the other two areas Karu and Mararraba respectively.

Table 2: Variation per Capita for the 3 Study Sites.

Area	Dry	Wet
Masaka	0.5291	0.8412
Karu	0.544	0.9528
Mararaba	0.544	0.9497

Source: Fieldwork 2011

The information shows that the rate of per capita waste generation for the three study sites are almost the same, average waste generation for the three sites during dry and wet seasons is 0.537kg and 0.92kg respectively. This indicated that there is significant variation in the amount of waste generated in the two seasons within the study areas. Variation on per capita waste generation for the three study sites is significant at 5% probability level of 20.049 > p- value of 0.000. This therefore shows that the per capita waste generation varies in the three areas in Karu both in the dry and wet seasons. Thus, that of Masaka seems to be higher than the other two areas.

CONCLUSIONS

The results of the research findings are in support of the following conclusions:

- There is significant variation in the per capita waste generated in the three study areas within the two seasons, though the value for Masaka both in the dry and wet seasons is higher than for Karu and Mararaba;
- There is significant variation in the amount of household waste generated in the three study sites within the two seasons;
- There is significant variation in the rate of waste generated for both the wet and dry seasons in the study area.

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