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# Domestic Waste Composition and Pollution Status of Calabar City, Nigeria

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**ABSTRACT:** A 10-month inventory of solid waste in Calabar City, Cross River State of Nigeria showed that domestic wastes constituted the largest source of solid waste produced (53.1 thousand tons/year) followed by commercial waste (10.2 thousand tons/year). The household or domestic wastes comprised of organic matter such as peeling/soft stems, legumes, chaffs, plastics, grasses etc and inorganic matter such as broken glasses, metal tins and scraps, among others. The organic wastes (only biodegradables) showed the highest occurrence in Calabar Central (Mayne Avenue/Atakpa, 76.5% and Ekpo Abasi 85.7% respectively) while the lowest occurrence was obtained in Calabar North (Ikot Ekpo, 13.0%). The amount of domestic wastes changed with seasons, being higher in the dry season than the wet season. A classification scheme, the NB/BD (non-degradable/biodegradable) ratio have been developed and used as a pollution index. Based on these ratios, the Calabar Central (Akpa) was assigned a potentially impacted area (NB/BD > 0.5) while the suburbs were less impacted (NB/BD < 0.5). © JASEM, 2000

The production of waste is an inevitable consequence of creation, recreation and reproduction processes. Wastes can be generated by natural phenomena such as wind erosion (whirlwind), precipitation, volcanic eruptions, flooding of river banks, atmospheric fallouts, among others and by human activities including domestic, commercial (business shops, supermarkets, etc), industrial and agricultural practices (ACS 1969, Hipper 1970, Monerief 1970). The magnitude of waste generated from human activities alone may exceed 18,000 tons per year for a developing city (Habitat 1989, Onibokun 1989).

Solid wastes are generated during every process of production by households and industrial establishments. Environmental perturbation arising from solid waste have been a perennial problem even for the developed countries of United State and Europe. For example, Claus and Halasikun (1976) reported that United States alone produced more than 210 million tons of solid waste annually. A breakdown showed that the urban wastes (including domestic wastes) constituted only 7% while 93% originated from mining and agricultural activities. The 7% from urban wastes still posed a great disposal problem because of scarcity of available dump sites in highly developed areas. In a similar study, Adeniji et al., (1996) observed that large urban areas of Ibadan are characterised by higher population and higher degradation of the environment. In other words, the amount and concentrations of domestic wastes generated increased with urbanisation and the larger the household, the larger was the quantity of waste generated.

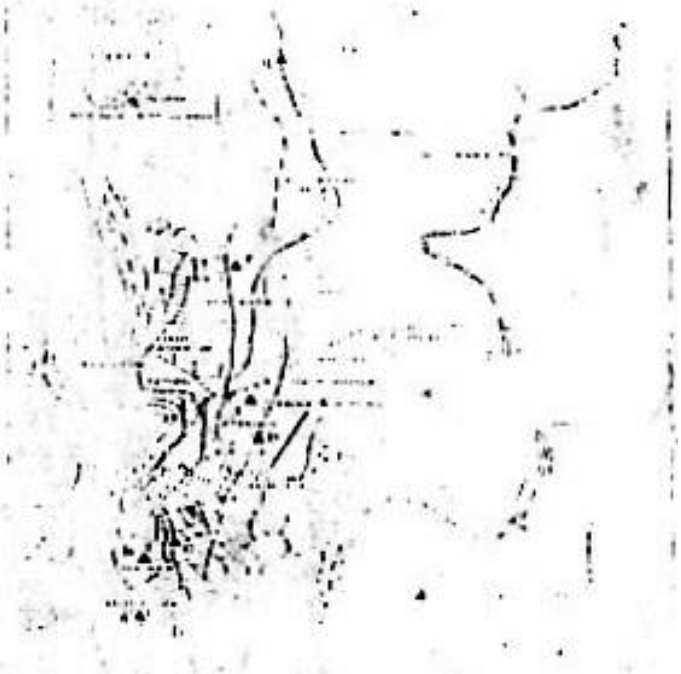

Fig. 1 Map of Calabar city showing the difference monitoring locations. A - Anantigha Area., B - Mbukpa Area., C - Ekpo Abasi/Mayne Avenue Area., D - Calabar Municipality., E- State Housing Estate., F - Federal Housing Estate., G -Ikot Ekpo Area.

Calabar is a coastal town in Cross River State, Nigeria located on latitude 4° 50' and 5° 00' N and longitude 8° 15'and 8° 50'E (Fig.1) It is about one quarter the size of Ibadan, the largest city in West Africa. It has a total population of about 0.3 million

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according to the 1991 National census figures (320,860 counts). The city is primarily a civil-service town with very few viable industries in operation. For effective monitoring, the city was divided into 3 zones: the northern zone comprising of Ikot Ekpo (11km ) and Federal Housing communities, the Central zone comprising the State Housing Estate/ Big Qua, Mayne Avenue/ Atakpa and Ekpo Abasi communities while the southern zone consist of Anantigha and Mbukpa communities. The inhabitants of Calabar Central are mainly industrialists, top Government personnel and businessmen whereas the northern and southern areas are primarily occupied by low income workers, peasant farmers and fishermen.

This report therefore highlights the basic components of domestic or household wastes generated in Calabar, the factors associated with waste dispersal, disposal and disappearance and also predicts the pollution status of the environment based on the proposed ND/BD (non-degradable/biodegradable) ratio.

## MATERIALS AND METHODS:

Twenty houses were selected as sampling points per residential area and the amount of domestic wastes determined by measuring "sorted out" waste in a sack suspended on a gallenkamp spring balance (precision ± 0.1 kg). The amount of waste was expressed as tons per month. Wastes were collected from refuse bins kept by each household or shop. Market wastes were collected and measured at the dump site as each carrier or depositor came with the wheel-barrow or basket of wastes for disposal. The quantity of wastes measured varied with location. The "sorting out" method involved spreading the unknown quantity of refuse on a clean polythene sheet (10 $m^2$) and separating the components into 5 groups: glasses designated as gl, plastics (pl), food peelings (fp), metal scraps and tins (mts) and trash papers (tp). Each component was quantified separately and recorded. The total quantity of wastes per location/month was obtained as the sum of the five individual components. The monitoring exercise was carried out weekly for 10 months (february to november 1996). In some residential areas especially state housing estate and parts of mayne avenue communities where refuse cans were evacuated by city scavengers (courtesy of calabar municipal government), waste quantification was done a day prior to evacuation. These services although very useful were rather irregular and not dependable despite the payment of refuse tariff and levies by the individual household.

## RESULTS AND DISCUSSION:

Analysis of major pollutants in Calabar city during this study gave about 81.1 thousand tons per year as the total amount of solid wastes produced (Table 1).

TABLE 1: Major Sources of Waste in Calabar City (Feb. - Nov. 1996)

| TYPE OF SOLID WASTE | ESTIMATED THOUSAND TONS/YEAR | % ABUNDANCE |
|---|---|---|
| Commercial waste | 10.2 | 12.6 |
| Domestic waste | 53.1 | 65.5 |
| * Industrial waste | 9.8 | 12.1 |
| Automobile scraps/Sundry waste | 6.0 | 7.44 |
| * Air-borne particulates | 2.0 | 2.46 |

* Industrial and Air-borne particulate estimates were obtained from production quota of Calcemco, Calabar Wood Company and Flour Mills Company.

domestic waste or refuse constituted 65.5% of the total estimated solid wastes. commercial wastes including shop refuse, market wastes, street litters, etc gave 12.6% and estimates of industrial wastes such as cement waste and saw dust from timber works and spilling from transportation of marble chips gave about 12.1%. the least contribution came from air borne particulate originating from chimneys, forest fires and incinerator, 2.46%. the fact that industrial waste contribute a very small amount of 9.8 thousand tons/year to the total amount of solid waste quantified, is a reflection of the low level of industrial activity in the city.

The levels of solid waste from domestic sources produced by households from the three zones in Calabar and their corresponding ND/BD ratios are presented in Table 2 while Table 3 shows the classification scheme for a potentially impacted environment wherever the available methods for solid waste disposal were not strictly adhered to.

vels of domestic wastes in Calabar and environs.

| Biodegradable waste (BD) tons/month | Non-Biodegradable waste (ND) tons/month | % Composition | | ND Ratio BD |
|---|---|---|---|---|
| | | BD | ND | |
| 10 - 15 | 80 - 100 | 13 | 87 | 6.7 |
| 95 - 100 | 100 - 120 | 45.5 | 55.5 | 1.2 |
| 150 - 200 | 50 - 80 | 71.4 | 28.6 | 0.4 |
| 120 - 260 | 50 - 80 | 76.5 | 23.5 | 0.31 |
| 250 - 300 | 30 - 50 | 85.7 | 14.3 | 0.2 |
| 5 - 15 | 30 - 36 | 29.4 | 70.6 | 2.4 |
| 10 - 15 | 30 - 40 | 27.3 | 72.7 | 2.7 |

bar North - No of Houses = 40
bar Central - " " " = 60
bar South - " " " = 40

ASSIFICATION SCHEME FOR A POTENTIALLY IMPACTED ENVIRONMENT BASED ON ND/BD TIO AND APPLICATION FOR ASSESSING THE POLLUTION STATUS OF CALABAR RESIDENTIAL EAS.

| Degree of Pollution | Residential Area |
|---|---|
| No impact | Ikot Ekpo, Anantigha and Mbukpa |
| Slightly impacted | |
| Moderately impacted | Federal Housing Estate |
| " " | |
| Heavily impacted | State Housing Estate |
| | Mayne Avenue |
| | Ekpo Abasi |

ratio as an index of solid waste as proposed is based on the fact e pollutants where the assimilative nvironment for self purification h the quantity of waste deposited. waste are persistent and resistant al degradation while BDs undergo decomposition within 3 - e to environmental factors such as: nisms etc. During the process of enerates obnoxious and unpleasant ironment since they are mostly of uch odours may linger for several stes are not quickly evacuated. ual environmental polluters are the stes and their values are used as the e proposed ND/BD ratio. In order e of pollution can be determined ture and abundance of BD wastes h household.

ND/BD ratio, Calabar City has been less impacted or no impact, acted and heavily impacted areas. When ND/BD > 1.5, it shows a less or slightly impacted environment where there is a surplus or abundance of non-degradable waste over biodegradable matter. Effective solid waste management in these areas if implemented can reduce environmental contamination caused by waste especially the BDs to a minimum. When NB/BD = 1.5, it reflects a potentially impacted environment. This is categorised as moderately impacted, ND/BD = 0.5 - 1.4 and heavily impacted areas, ND/BD < 0.5 (Table 3). The degree of impact reduces when the wastes are evacuated but builds up rapidly due to negligence on the part of waste collectors to evacuate waste promptly.

The densely populated areas particularly the suburbs comprising Ikot Ekpo, Anantigha and Mbukpa communities showed no contamination having NB/BD values of 6.7, 2.4 and 2.7 respectively. Federal Housing had a value of 1.2 depicting a moderately contaminated environment while the urban centres, Calabar Central (Mayne Avenue/Atakpa, Ekpo Abasi and State Housing/Big

Qua areas) with respective ND/BD values of 0.31, 0.2 and 0.4 are potentially heavily contaminated environments.

An analysis of the structure and composition of domestic wastes monitored revealed that, for a household of 5, waste generated consist of soft stems and peelings (mainly of carbohydrate origin), plastics, broken glasses, metal scraps, empty tins and trash papers. . The distribution of the separated components showed the following sequence:

FP > PL > TP > GL > MS

Wastes generated from carbohydrate sources such as soft pumpkin/water-leaf stems, cassava, yam and cocoyam peelings (FP) showed the highest abundance (75%) and the least abundant waste came from empty tins and discarded scrap metals (0.5%) (Fig. 2).

**Figure 2** Levels of Different Components of waste in Calabar City, Nigeria.

Both the ND and BD wastes can be a resource when they are converted into other useful forms either by households or industry. For instance, wastes such as empty cans and rubbers are converted and used for the storage of food stuff like rice, garri, cooking oil etc and kerosine. The ND items such as aluminium cans can also be sold in exchange for money to local scavengers. On the other hand, manufacturing industries can purchase scrap metals or broken glasses as raw materials and transform them into alloys (metal mixtures) and glass wares respectively. graphical analysis of the amount of waste monitored showed variation with seasons (fig. 3).

during the dry season (nov - march), higher quantity of waste were evident especially in the months of February and march. this period is characterised by low rainfall and the natural agents of waste dispersion and degradation principally water (precipitation or surface drainage) are scarce (except dew) and insufficient to facilitate the rapid disappearance of waste. in the wet season (April - Sept.), rapid disappearance of waste is enhanced by natural factors such as flood and storm water and households deposit or discharge their waste directly into gutters and drainage channels which convey such waste into nearby receiving waters. sometimes, these materials are littered on streets and highways hindering the free flow of traffic. direct (anthropogenic) and indirect (natural agents) dispersal of wastes during the wet season

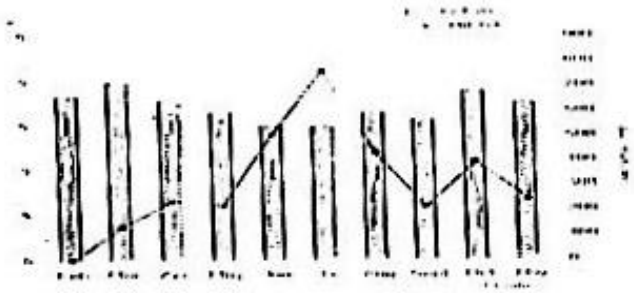

**Fig. 3.** Temporal variation of Domestic waste with monthly rainfall.(rainfall data were obtained from the Geog Department, University of Calabar, Calabar

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the low level of solid waste quantified when compared to the amount of waste matter in the dry season. Thus, precipitation is a major factor controlling the level of available waste in a developing tropical city as calabar.

Presently, domestic wastes that are not discarded or disposed off through the above processes are dumped at unauthorised disposal sites , or incinerated. Occupants of Calabar Central are at the moment, the

only beneficiaries of the scanty services of municipal scavengers. With increase in population pressure due to rural-urban migration for white collar jobs, the problem of solid waste management becomes more complicated for the coastal city. Secondly, when the proposed Export Processing Zone (EPZ) is fully operational, additional load from industrial production shall contribute to the problem of solid waste management in the city.

There is the need for intensified environmental awareness campaigns by the state and local government authorities in educating the citizenry on the modern methods of solid waste management. The observed difference with regards to solid waste management between the suburbs and the Calabar urban is attributed to laxity and inefficiency on the part of the municipal wastes carriers responsible for evacuating waste. On the other hand, while the urban dwellers appreciate the usefulness of depositing wastes into sacks or drums and by implication, the usefulness of scavengers, the majority of the suburb inhabitants are not well informed of the dangers of discharging waste indiscriminately. A cross section of the suburb dwellers, when interviewed, maintained that the Government should provide them with refuse cans and collect the waste as they want, since they cannot afford such additional expenditure with their meagre earnings. Presently, the technological approach whereby biodegradable waste (BD) can be transformed into useful forms such as organic manure and sold to farmers, to give a boost to agriculture is lacking.

Domestic waste in its various forms constitute a health hazard and a threat to a sustainable environment. While the non-degradable waste should be sorted out and recycled, the biodegradable waste can be transformed into organic manure for aqua-culture and agricultural purposes.

This study has shown that Calabar Central (urban) is potentially a polluted zone and so wastes should be evacuated promptly and as when due. Government functionaries should play a major role in the evacuation of wastes from the environment. Secondly, Government should make it a legitimate duty to encourage NGO's and private scavengers to participate in solid waste management by providing incentives for refuse collection. Finally, the pollution status of a particular settlement can be evaluated and assessed when the ratio of non-degradable and biodegradable wastes have been computed and known. Human activities alone contributed more than 80% of solid wastes found in the environment. Thus, an efficient management scheme for the disposal of waste can be ensured through a functional approach such as sorting out and recycling of wastes which is presently not available.

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