

# Household Hazardous Waste Generation and Management Patterns in Enugu Metropolis, Enugu State

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## Abstract

*The present study aims to examine household hazardous waste generation and Management patterns in Enugu metropolis. A total of Ten (10) layouts were randomly selected out of forty one (41) residential layouts that make up Enugu Metropolis. The layouts include, Abakpa, Achara, Asata, Awkunanaw, G.R.A., Independence layout, Iva-Valley, New Haven, Ogui, and Uwan. A total of 300 questionnaires were randomly administered for the analysis of the Management of Household Hazardous Waste in Enugu Metropolis. Results showed that home cleaning waste was the most frequently generated HHW in the study area, accounting for (19%), followed by glasses (17%) and batteries (14.8%). Others include garden chemicals (12.6%), medical waste (10.5%), E-waste (10.4%), motoring products (8.7%), and paints (7.1%). Government Residential Area generated the highest amount of HHW with percent value of 13.1%, followed by New Haven (12.7%), Iva-Valley (10.6%), Ogui (10.2%) and Independence layout (10%). Abakpa, Uwani, Asata, Awkunanaw and Achara recorded 9.9%, 9.4%, 8.4%, 8.3%, and 8% respectively. The study found very low awareness level among the residents of the study area concerning the environmental impact of hazardous waste. Thus there is need for sensitization as this will encourage waste sorting, as well as help in educating the public on the need to purchase fewer hazardous products and accept a greater amount of responsibility when using and discarding any products that are purchased.*

Keywords: Household Hazardous waste, Waste Management, Environment, Waste Generation

## INTRODUCTION

Household Hazardous Waste (HHW) has for many years been seen as a waste stream of low significance compared to other more problematic wastes. However, the changes that have been wrought on the management of waste in recent years have pushed HHW more into the foreground, exposing many issues that need to be resolved. In developed countries for example, the separate collection of individual waste streams that comprise municipal solid waste (MSW), principally paper/card, glass, tins/cans and putrescible waste categories, have highlighted the presence of potential hazardous wastes in the residual household

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waste stream. Similarly, the withdrawal of a number of chemicals from use in households (e.g. creosote, various pesticides including dichlorprop and resmethrin, CCA-treated timber, etc.) have raised the profile of the hazardous nature of certain household products and hence generated concern regarding their disposal (Slack, Gronow and Voulvoulis 2004, Slack, Gronow, Zerva, and Voulvoulis, 2005). The process of urbanization and improved consumption patterns in recent times have continued to enhance generation of HHW without corresponding management capacity. In a study by Koushki & Al-Humoud (2002) found that toilet cleaners, chlorine bleach, glass/window cleaners, roach killers, oven cleaners, and drain openers, are the top five most common consumed hazardous substances at homes in Kuwait. Similarly, Steinwachs (1989) listed automotive products, solvents and paints, pesticides, electronic wastes, certain cleaning products, batteries, cosmetics, ammunition, pharmaceuticals, fireworks, and other items found in almost every home as types of HHW.

A study by United States Environment Protection Agency (2007) observes that Americans generate 1.6 million tonnes of HHW per year. The average home can accommodate as much as 100 Kilogrammes of HHW in the basement and garage and in the storage of closets.

HHW, such as cleaning products, self-care products, medicines, home care products, automotive maintenance products, electronic equipment and general maintenance products for machinery are made from substances that, by themselves or when reacting with others, produce additional compounds that when attaining certain concentration levels might be capable of causing severe environmental and public health damage (Fatoki, 2000; NIEHS, 2004; Ebong, Etuk, & Johnson, 2008; Kadafa, Latifah, Sulaiman, and Abdullah, 2013; Moqsud 2014). Improper storage and handling of these materials has resulted in fires, explosions, accidental poisonings and other injuries (Conn, 1989). Pouring oil and other HHW onto the ground or thrown in regular trash could potentially harm the solid waste collectors, affect streams, lakes, wild life, and possibly even drinking water (Staples, Peterson, Parkerton & Adams, 1997). Letcher & Slack, (2019), reported that HHW which is 1% of total domestic waste may represent a disproportionate risk to human health and environment unless handled correctly. Moreover, in developing countries, the synergistic effect of mixtures of HHW in the environment occurs without the awareness of local authorities, since in general, legislation does not consider separate solid waste disposal (Ejlertsson, *et al.*, 2007). These wastes which are often littered around in huge, unsorted quantities, eventually find their way into nearby streams and rivers, which subsequently become polluted. Addressing the above problem does not seem to be in sight, especially with ever increasing rural-urban migration, which in sub-Saharan Africa currently stands at about 4% on the average (Beede & Bloom, 1995).

In Enugu Metropolis, HHW are usually stored in bins or cartons along with other wastes in individuals' homes and later deposited into public bins placed on the curbside or thrown inside built dumps for collection. In the past, the general attitude to HHW disposal in Enugu metropolis is open dumping of waste into the nearest open space, either on land or surface water without any environmental consideration. This attitude could explain why sometimes there are heaps of wastes at every corner of the environment and the reluctance of Waste Management Agency staff to clear the waste because of potential injury. Tammenagi (1999) recorded that the environmentally hazardous dumps are unlined, have no leachate control or drainage systems, and the underground water or surface water unmonitored. The co-disposal method of domestic, commercial, institutional, medical and industrial solid wastes may be cheap and convenient but not environmentally healthy. Effective management of household hazardous waste include, sorting of the waste at source, legislation on HHW, provisions of adequate and appropriate waste bins, and public enlightenment programmes.

However, a prerequisite step towards achieving the above will include identifying the type, properties and generation patterns of HHW. The present study therefore is aimed to examine household hazardous waste generation and management patterns in Enugu metropolis.

## MATERIALS AND METHODS

### *Description of Study area*

Enugu Metropolis is the capital of Enugu State. It is located approximately between latitude  $6^{\circ} 30' N$  and  $6^{\circ} 40' N$  of the equator and longitude  $7^{\circ} 20' E$  and  $7^{\circ} 35' E$  of the Greenwich meridian (Figure 1). It covers an area of about, 145.8 square kilometres. It is administered by three local authorities namely, Enugu North, Enugu South, and Enugu East local government authorities. The climate of the study area is the tropical wet and dry type according to the Koppen climatic classification system, and experiences two seasons (wet and dry) both of which are warm. Rainfall occurrence is high with mean annual totals of 1600mm. The rainy season generally lasts from April to October, while the dry season lasts from November to March. Due to its latitudinal location, the study area receives abundant and constant insolation. Temperatures are high, usually varying between  $25^{\circ}$ - $29^{\circ}C$ , reaching the maximum with the approach of the rainy season. The mean daily temperature is above  $27^{\circ} C$  all over the year. The topographical features of Enugu Metropolis can be classified into two: to the west is the escarpment which is erosional and is continually eroded backward by the east-flowing rivers and to the east are the Cross River Plains that are generally low and of monotonous relief. Enugu lies at the foot escarpment, of the Cross River Plains, (Mamman, Oyebanji, & Petters,2000)

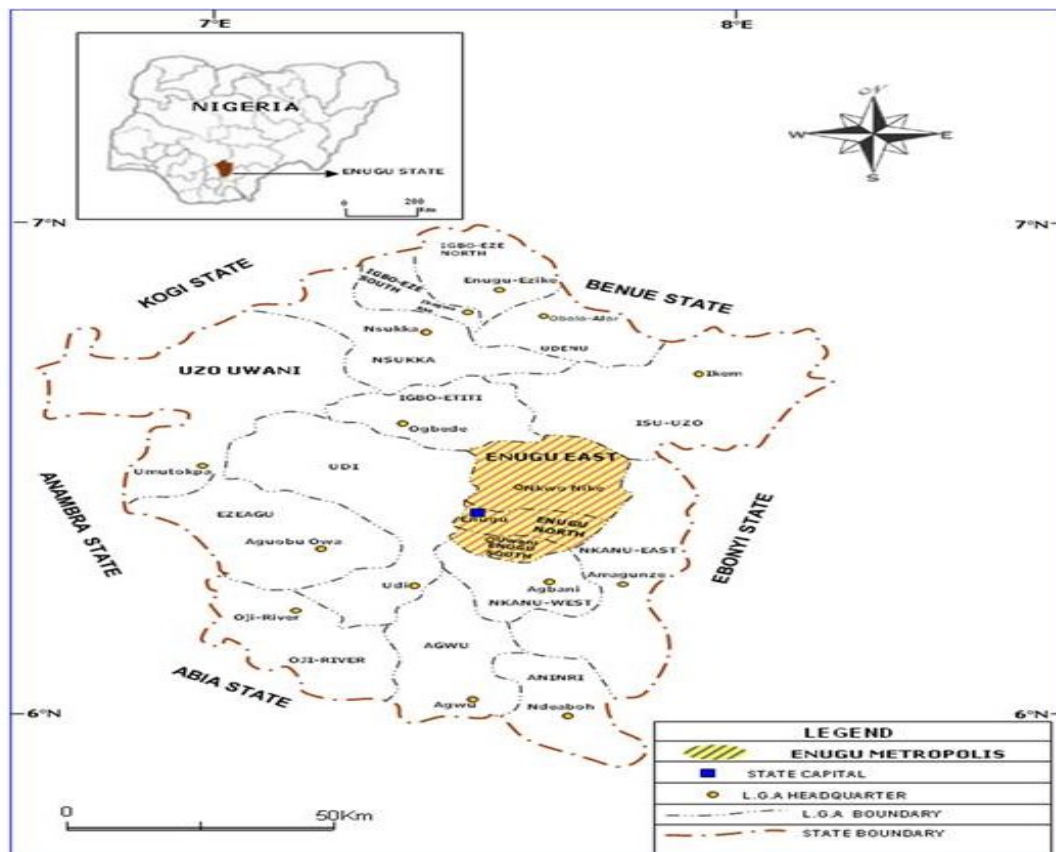


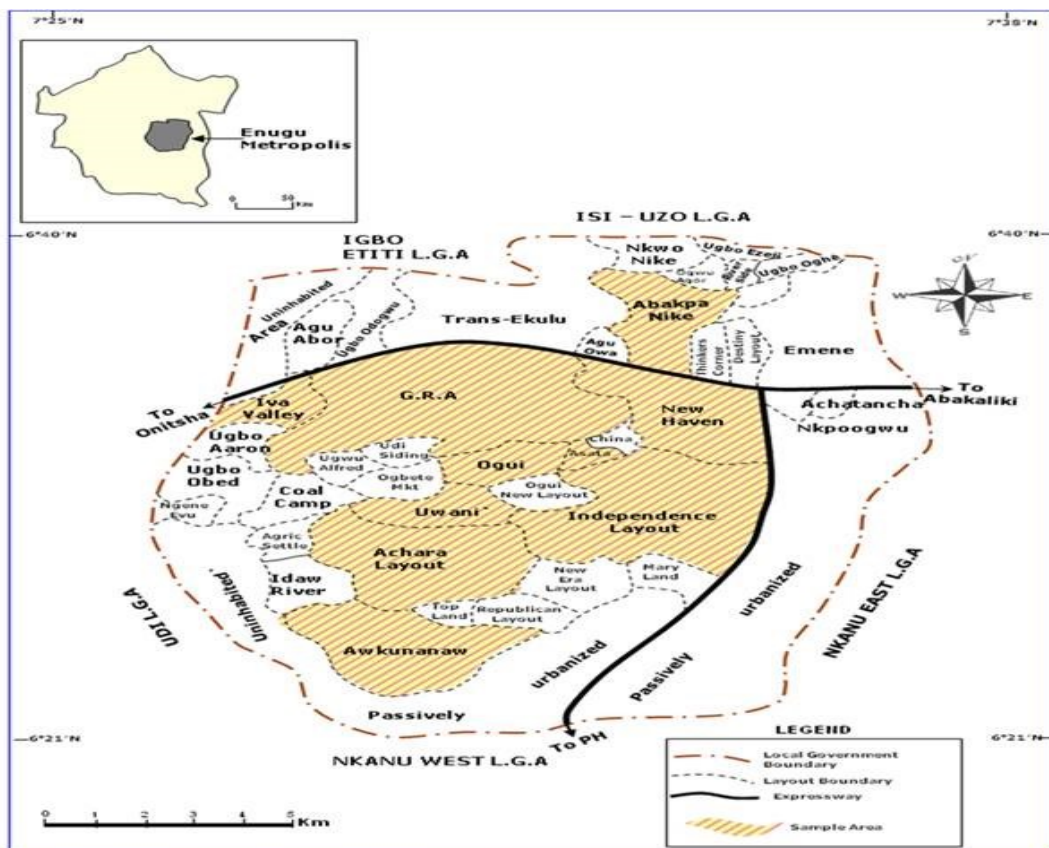
FIG. 1: MAP OF ENUGU STATE SHOWING ENUGU METROPOLIS

Source: Ministry of Survey, ENUGU, 2009

Enugu Metropolis is bounded in the north east by Isi-Uzo and northwest by Igbo-Etiti local Government Areas, in the east and south by Nkanu East and Nkanu West L.G.A respectively and in the west by Udi Local Government Area. (Figure 1). Enugu Metropolis has had a rapid growth. Its population rose from a handful of mineworkers in 1915 to 3,170 inhabitants in 1921. When the first census was taken in 1931, the population had increased fourfold to 13,000 and in 1953, Enugu Metropolis had a population of 62764 people. In 1963, the population had increased to 138,457 people. The population of Enugu Metropolis in 1991 was 369,373. In 2006, the population census figure for Enugu Metropolis was given as 722,665(Federal Republic of Nigeria Official Gazette, 2007).

**Data collection**

For the purpose of this work, 10 layouts were randomly selected from forty one (41) residential layouts in Enugu metropolis. The criteria for selection of these ten layouts were to include typologies of layouts, and the diversity of households among the selected layouts. The 10 layouts for this study include, Abakpa, Achara, Asata, Awkunanaw, G.R.A., Independence layout, Iva-Valley, New Haven, Ogui, and Uwani (see Fig.2). The sampling framework for this study was three hundred (300) households comprising thirty (30) households from each of the 10 layouts. The study is largely quantitative and utilized data collected through household questionnaire survey. A total of 300 questionnaires were randomly administered for the analysis of the management of HHW in Enugu Metropolis. The questionnaire was detailed and contained close ended questions. Interview was carried out with Municipal Solid Waste Management officials to provide information of the institutional framework for HHW management, officials’ attitude and efforts at HHW collection and management in Enugu Metropolis. The Enugu State Sanitary landfill site (ENSEPA) was visited and workers in the site were interviewed, and pictures were taken at the site.



## RESULTS AND DISCUSSION

From Table 1, home cleaning waste was the most frequently generated HHW in the study area, accounting for (19%). This was followed by glasses (17%) and batteries (14.8%). The others frequently generated include garden chemicals (12.6%), medical waste (10.5%), E-waste (10.4%), motoring products (8.7%), and paints (7.1%).

Table 1: Frequency of Quarterly Generation of HHW in Enugu Metropolis

| HHW                    | Abakpa | Achara | Asata | Iva-Valley | Awkunanaw | G.R.A | Independence | Lavout New haven | Ogui | Uwani | Total of HHW in the | Total % |
|------------------------|--------|--------|-------|------------|-----------|-------|--------------|------------------|------|-------|---------------------|---------|
| Paint Related Products | 5      | 2      | 12    | 9          | 9         | 12    | 10           | 12               | 18   | 15    | 104                 | 7.1     |
| Garden Chemicals       | 15     | 26     | 9     | 24         | 12        | 24    | 20           | 24               | 12   | 18    | 184                 | 12.6    |
| Motoring Products      | 10     | 10     | 9     | 9          | 9         | 21    | 20           | 15               | 12   | 12    | 127                 | 8.7     |
| Household Batteries    | 25     | 20     | 18    | 21         | 21        | 30    | 25           | 24               | 18   | 15    | 217                 | 14.8    |
| E-waste                | 15     | 5      | 12    | 21         | 17        | 24    | 10           | 21               | 12   | 15    | 152                 | 10.4    |
| Medical waste          | 20     | 7      | 6     | 21         | 6         | 21    | 7            | 24               | 18   | 24    | 154                 | 10.5    |
| Home Cleaning          | 30     | 27     | 27    | 27         | 27        | 30    | 30           | 30               | 30   | 21    | 279                 | 19.0    |
| Glasses                | 25     | 20     | 30    | 24         | 20        | 30    | 25           | 27               | 30   | 18    | 249                 | 17.0    |
| Total for each layout  | 145    | 117    | 123   | 156        | 121       | 192   | 147          | 177              | 150  | 138   | 1466                | %Total  |
| Total %                | 9.9    | 8.0    | 8.4   | 10.6       | 8.3       | 13.1  | 10.0         | 12.7             | 10.2 | 9.4   | %Total              | 100     |

In Figure 2, HHW generation was spatially distributed differently. Government Residential Area G.R.A generated the highest amount of 192(13.1%), followed by New Haven 177(12.7%), Iva-Valley 156(10.6%), Ogui 150(10.2%) and Independence layout 147(10%). HHW was also generated at Abakpa 145(9.9%), Uwani 138(9.4%), Asata 123(8.4%), Awkunanaw 121(8.3%), and Achara 117(8%).

Paints and other paints related products generally had a low frequency of generation among the study areas. They are least generated in Abakpa, Iva-Valley, Awkunanaw, Achara, and Independence Layout. They are moderately generated in Asata, Ogui, Uwani and New Haven. In all the layouts, paints contributed 7.1% of all the HHW generated in Enugu Metropolis, which makes it the least generated HHW in the study area. Garden chemicals were generated in all the layouts but contributed only 12.6% of all the HHW in the study area. In their spatial distribution, the least were generated in Asata. They were moderately generated in Abakpa, Ogui, Independence Layout, Awkunanaw, and Uwani and also highly generated in Iva-Valley, G.R.A, New Haven and Achara Layout respectively.

In the opinion of respondents, motoring products accounted for 8.7% of all the quarterly HHW generated in the study area. They are highly generated in G.R.A, moderately generated in Ogui, Independence Layout, and Uwani, and least generated in Awkunanaw, Abakpa, Iva-Valley, Asata, and Achara layout respectively. The study found that highest amount used batteries are generated in G.R.A, Abakpa, Iva-Valley, New Haven,

Awkunanaw, and Achara layout. They are moderately generated in Ogui, Asata and Uwani. Used batteries contributed 14.8% of HHW generated in the study area.

It can be observed that the highest amount of wastes were generated in G.R.A, Iva-Valley and New Haven. They are moderately generated in Asata, Awkunanaw, Uwani, and Abakpa respectively. They are least generated in Independence Layout, and Achara Layout. E-waste generated contributed 10.4% of HHW generated in the study area, within the period of study. Medical wastes were generated in all the layouts in the study area. G.R.A, Iva-Valley, New Haven, and Uwani however generated the highest, while in Ogui and Abakpa, they are moderately generated. They are least generated in Awkunanaw, Achara, Asata and Independence Layout respectively. Medical wastes accounted for 10.5% of the HHW generated in the study area. Home cleaning products were generated in all the study areas. It is the most generated HHW in the study area. It accounted for 19% of HHW generated in the study area. Glasses were also generated in all the layouts in the study area and accounted for 17% of HHW in the study area. It was observed that apart from Awkunanaw, Uwani, and Achara Layout where they were moderately generated; household glasses are highly generated in the other layouts in the study area. Analysis of variance (ANOVA), was used to determine if there was any significant difference in the extent of generation of the different types of sampled HHW among the different layouts in the study area and the results presented in Table 2.

Table 2: Analysis of Variance of the Extent of HHW Generated in Enugu Metropolis

| Source of Variation       | Sum of Squares | Degrees of Freedom (Df) | Mean sum Of squares | F     |
|---------------------------|----------------|-------------------------|---------------------|-------|
| Between the types Of HHW. | 2943.7         | 7                       | 420.5               | 148.1 |
| Within the types Of HHW   | -224.5         | 73                      | 2.8                 |       |
| Total                     | 276189.2       | 80                      |                     |       |

Since the calculated value of 148.1 is greater than the critical value or table value of 2.13,  $H_0$  is rejected. This implies that there is a significant difference in the extent of generation of the different types of sampled HHW in the study area. Table 3 shows the temporal frequency of HHW generation among the different layouts in the study area. From Table 3, it is observable that the amount of household wastes generated and disposed in less than three months was (79.3%) as against more than three months (13%), and unknown (6.7%). The frequency of disposal methods of HHW in Enugu Metropolis were also analysed and is as shown in Table 4.

Table 3: Temporal Frequency of HHW Generation in Enugu Metropolis

| Temporal frequency | Abakpa | Achara | Asata | Iva-Valley | Awkunanaw | G.R.A | Ind. Layout | New Haven | Ogui | Uwani | Total          |
|--------------------|--------|--------|-------|------------|-----------|-------|-------------|-----------|------|-------|----------------|
| < 3 months         | 14     | 24     | 30    | 22         | 22        | 24    | 30          | 26        | 20   | 26    | 238<br>(79.3%) |
| > 3 months         | 7      | 2      | 0     | 5          | 6         | 6     | 0           | 3         | 6    | 4     | 39<br>(13%)    |
| Unknown            | 9      | 3      | 0     | 3          | 2         | 1     | 1           | 1         | 2    | 1     | 23<br>(7.7%)   |

Table 4: Frequency of Disposal Methods in Enugu Metropolis

| Frequency of Disposal Methods | Abakpa | Achara | Asata | Iva-Valley | Awkunanana<br>w | G.R.A | Ind.<br>Lavout<br>New<br>Haven | Ogui | Uwani | Total |               |
|-------------------------------|--------|--------|-------|------------|-----------------|-------|--------------------------------|------|-------|-------|---------------|
| Never had any to dispose of   | 10     | 5      | 7     | 10         | 8               | 3     | 2                              | 10   | 5     | 8     | 68<br>(22.7%) |
| Keep Them                     | 0      | 0      | 0     | 2          | 5               | 0     | 1                              | 0    | 0     | 0     | 8<br>(2.7%)   |
| Throw in dust bin             | 15     | 20     | 20    | 18         | 15              | 25    | 26                             | 20   | 20    | 22    | 201<br>(67%)  |
| Pour down sink/drain          | 5      | 0      | 3     | 0          | 0               | 0     | 0                              | 0    | 0     | 0     | 8<br>(2.6%)   |
| Take to landfill site         | 0      | 5      | 0     | 0          | 2               | 2     | 1                              | 0    | 5     | 0     | 15<br>(5%)    |

From our analysis, 22.7% of the households indicated that they never had any HHW to dispose of, 2.7% indicated that they keep them and this can pose a problem to their health and the environment, 2.6% pour liquid HHW down their sinks or drains, 5% take them to landfill site, the remaining 67% dispose them in the dust bins

**CONCLUSION AND RECOMMENDATION**

The management of HHW in Enugu Metropolis with a view towards having a sustainable and friendly environment has been analyzed. The HHW generated in Enugu Metropolis were classified into eight, they include paints, garden chemicals, batteries, motoring products, medicines, home cleaning products, e-waste and household glasses. From the spatial distribution analysis, HHW was most frequently generated in G.R.A , followed by New Haven. While Asata (8.4%), Awkunanaw, and Achara Layout, generated the least frequently generated HHW in the study area. The most frequently generated HHW in the study area are home cleaning products (19%) and household glasses. The least frequently generated HHW are motoring products and paints and other paints related products. Similarly, it was found that HHW are frequently generated in less than three months in the study area. The study found that HHW are not properly managed in Enugu Metropolis because there are; no proper disposal methods for disposing HHW they are disposed alongside with other household wastes; no recycling of HHW is carried out in the study area; lack of trained personnel, and no facilities for managing HHW in Enugu Metropolis. In the light of the above the study recommends the need for formulation of enabling HHW laws and setting of policies. Also, there is need to develop and enforce regulations for the management of HHW to help enforce the HHW laws. Awareness creation is the key to sustainable management of HHW. This will encourage waste sorting, as well as help in educating the public on the need to purchase fewer hazardous products and accept a greater amount of responsibility when using and discarding any products that are purchased.

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