Journal of Public Administration and Social Welfare Research E-ISSN 2756-5475 P-ISSN 2695-2440
Vol. 10 No. 2 2025 jpaswr www.iiardjournals.org Online Version

Seasonality of Polythene Waste Generation in Enugu Metropolis, South East, Nigeria

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DOI: 10.56201/jpaswr.v10.no2.2025.pg93.109

Abstracts

Seasonal variation seems to plays key role in determining the quantity and characteristics of municipal solid waste generation. Furthermore, there have been the arguments rising speculative of the quantity of polythene waste generation during the various weather season at home in various cities including Enugu urban, Nigeria. . This study examines seasonal variation in household polythene waste generation in Enugu metropolis, South east Nigeria with a view to evolving a guided and more efficient waste disposal policy in the study area. Data was collected through observation and measurement of 400 systematically selected households from 12 neighborhoods of the three different residential densities (High, medium and Low) that make up Enugu metropolis, and data generated was summarized using descriptive statistical measures and Analysis of variance. Results show that the mean polythene waste generation rate of a household is 60.5kg in wet season and 32.7kg in dry season. Result of the hypothesis using ANOVA suggests that there was significant difference from that polythene waste generated in homes in the same weather season in Enugu metropolis. ($F= 9.417$, $P = 0.026$, $P <0.05$ significant value). This variation can be attributed to greater agricultural resource utilization resulting from crop harvest with on-set of the dry season with reciprocal waste generation, as well as the increase in the purchasing power of residents due from proceeds of crop sales at that time among others factors. The study recommends the use of the data base created by Enugu State Waste Management Agency (ESWAMA) for effective planning for municipal solid waste management in the area. An increase in the provision of waste collection, storage and disposal facilities particularly in the wet season by waste management agencies should be imminent.

Keywords: Polythene, Seasonal, Waste, Enugu

1. Introduction

Polythene materials are used widely in many consumer products and its consumption has increased exponentially in the past decades. In most urban and rural areas in Nigeria, polythene bags litter the landscape, presenting an ugly and unhygienic scene. Improper disposal of polythene creates environmental pollution and space problem because they are not easily biodegraded (Maxwell, 2022). The wastes also clog drainages leading to flooding as witnessed in many cities of Nigeria (Enete, 2022). The blocked drains are difficult and costly to maintain. Hence, there is need to adopt effective waste management approaches in order to resolve environmental pollution caused by polythene wastes. Recycling has been advocated as an effective approach to managing polythene wastes in Nigeria. The reuse of the waste polythene products such as the conversion from sachet water bags into candle products has been reported by (Jerie & Tevera, 2014) and other reuse product such as fuel oil (Oguntosin, 2020).

Rapidly increasing population, rising living standards, development of the way of consumerism, developments in the fields of science and technology have caused areas of more growing waste. These factors cause continuously increase in the quantity and variety of domestic waste. Increasing domestic waste and consequences of its degradation in the environment can cause serious damage on environment and population (Kamran, et al, 2015). Agricultural waste in the rural areas, especially animal husbandry, has cascading consequences for the environment and human health, including degradation of air and water quality (Karbassi and Pazoki, 2015). Waste is the materials generated by human activities and the producer considers them useless. These materials include agricultural, commercial, construction, demolition, hazardous, industrial, and household and food wastes (Azizi, 2021; Shitu, 2015).

Informal waste collection is an economic venture which involves using unorthodox means of waste collection and transportation such as cart, wheelbarrow, head pan or basket, to collect, transport and dispose of household waste for a fee. Studies have shown the effectiveness of informal waste collectors (IWCs) in waste management despite the rudimentary nature of their operation (Ola, 2016). There is need to fully integrate the informal sector into the solid waste management system of the city of Gweru and also priorities the waste management strategies following the order presented in the waste management hierarchy. This means educating the informal sector enterprise operators on the merits of waste prevention, waste reduction, reuse, and recycling as well as composting and energy production from waste.

Polyethylene (cellophane) papers are currently being used in all forms and shades in Nigeria as wrappers ranging from biscuit, ice cream, table water, salt, and tapes (audio and video) to mention but a few. Cellophane bags are used virtually in all shopping centers, homes, markets, restaurants and farms in Nigeria (Ogunna, 1999). Polyethylene materials, which are derived from ethylene polymers, are products of the polymers industry at present, they possess certain qualities and properties which make them readily usable. These include high tensile, stiffness, compressive strength and impact resistance. They also retain their physical and chemical properties over a wide range of environmental conditions such as heat, cold and chemicals. They can resist mechanical stress for a very long period of time. Flame retarders are not an essential requirement but it has become an added asset lately. They are not biodegradable since they are unaffected by heat, cold and chemicals (Obadiah, 2019). This is a pointer to the fact that the world will, in due course,

have more of cellophane and plastics to contend with environmentally. Polyethylene is found within the entire markets and homes streets, nooks and crannies of Enugu metropolis. They therefore pose serious environmental problems to inhabitants especially where solid wastes are deposited in towns (urban areas) and villages (rural areas). Urban waste disposal is the responsibility of various municipalities, local government and/or city co-operations (Tanko. 2019). The continuous increase in the quantity and heaps of solid waste in Enugu urban of Enugu state has remained alarming and disturbing to policy makers and waste managers in the state. One of the major problems confronting Nigerian town or cities today is poor solid waste management. Enugu is not different from what is obtained in other towns/cities in Nigeria. The waste management strategies are inefficient to effectively solve the problem of waste. According to Afon, (2007), large quantities of solid waste have persistent accumulation in Enugu metropolis which the agency responsible has failed to effectively evacuate. Along Okpara Avenue, Nike Road, Agbani Road and even Nike road, there is always the presence of odorous waste which has attracted the attention of environmentalist especially because of its health implication.
Seasonal variation seems to plays key role in determining the quantity and characteristics of municipal solid waste generation. The presence of some agricultural and organic product during the wet season which makes the use of polythene bags to cover or weep these products has the ability to generate much polythene waste (Urban development bank, 1992). Again, the dry season always comes with its attendant dusts. This has indirectly caused for the use of polythene to cover production (Bogoro, & Babanyara, 2018). Furthermore, there have been the arguments rising speculative of the quantity of polythene waste generation during the various weather season at home in various cities of the world. To the best of the knowledge of the researcher no study has been done to ascertain the weather season (dry or wet) of the year that generates more of polythene waste in any city, let alone Enugu urban. Therefore, this empirical study targets to assess the seasonal polythene waste generation rate in Enugu metropolis since this has been lacking in the body of literature, hence, the essence of this study. This study examines seasonal variation in household polythene waste generation in Enugu metropolis, South east Nigeria with a view to evolving a guided and more efficient waste disposal policy in the study area. The study hypothesized that there is no variation in the quantity or rate of homes polyethylene waste generation in wet and dry seasons in the study area. Specific quantification and characterization of polyethylene waste generated assumes great significance which will enable accurate assessment of waste load and encourage proper planning of waste management system. This would help in achieving proper waste management and utilization of reusable resources in the study areas

2. Theoretical Framework

2.1 *Theory of Waste Management*

The traditional waste management view is centered on assurance compliance, risks management, health and environmental protection that are short term tactical. The same authors reshaped traditional waste management view into new value creation that can raise productivity, enhance relations, support eco-innovations, and enable growth for long term endeavors. But the focal point of practical waste management lies on three vital objectives;

i. Waste quantification

ii. Waste characterization and
iii. Waste management methods or practices.

And the three waste management practices classification include:

i. Prevention practices comprising strategies on waste minimization,
ii. end-of-pipe strategies involves recovering the economic value on waste through waste separation, recycling, proper land filling, incineration and
iii. Environmental restoration practices, aimed at repairing leakages and damages to the environment.

Cooper correspondingly classified improving resident's awareness and legislation as preventive practices. In the same context, end-of-pipe strategies cover waste segregation methods that are either origin-separated collection or destination-separated collection. These end-of-pipe strategies are classified as eco-innovations. And shredding their shadows on the light of economic boundaries, the prevention practices are less costly but offer the highest effectiveness rate, while environmental restorations are the most expensive yet the least effective.

i. Eco-Innovation

The initial scope of eco-innovation includes in part the productions and processes, then on the improvement of the management system, the creation of new markets, material flows and social eco-innovation. Eco-innovation is well-defined as "all measures of relevant actors which develop new behavior, new ideas, process and products, to apply or introduce them in the attainment of ecologically specified sustainability targets that contributes to lessen environmental burdens". Simply stated, eco-innovation is innovation in "any form", which is beneficial to the environment. Eco-sustainability innovation includes also a social aspect that emphasizes one of the elements in the TBL which extends its scope to include institutions, markets and social actors. Innovations include but not limited to the use of renewable energy technologies, green products, and pollution prevention schemes. Cross-disciplinary technological trials related to eco-innovations are the furthermost precarious and problematic issues when a city or organization moves toward sustainability. Effective eco-innovations lead the way towards sustainable development based on the Triple Bottom Line Sustainability.

The benefits of eco-innovation other than complying environmental regulations will also improve economic aspect, the competitiveness of companies and countries by supporting the creation of a new market for green growth products and processes, corresponding employment effects and so on. Hence, the execution of multidisciplinary systems and technologies concerning eco-innovation is the road toward sustainability.

ii. Triple Bottom-Line Concept

The term Triple Bottom Line (TBL) was coined in 2017s by business consultant John Elkington to describe the economic, environmental, and social value of an investment that may accrue outside a firm's financial bottom line. TBL or sustainable economic development was defined as activities, programs or policies designed to provide or retain jobs and wealth in ways that contribute to economic, social, and environmental well-being over time. It is distinct from economic growth or development, which may or may not contribute to overall well-being including fiscal health, quality of life, resource stewardship, and resilience.

This line of thinking suggests that economic systems exist to serve human well-being, that human and economic well-being is inextricably linked to environmental well-being, and thus, human, environmental, and economic well-being must be considered in the design and evaluation of economic development efforts. By considering social, environmental, and economic factors, TBL, or sustainable economic development, provides a more meaningful, productive framework for achieving and measuring economic development. Specific programs with regard to trainings, incentives, assessment, and research that can advance theory and practice are central to the success of the TBL approach.

2.2 Factors that Influence Waste Generation and Disposal in Seasonal Variation

Population growth, rural and urban development, lifestyle changes and the consequent change in consumption patterns have created problems in modern societies. The change of household consumption pattern has changed the waste volume and the waste characteristics composition (Widyaningsih et al, 2015; Aziz, 2018). Little attention has been paid to rural domestic waste DW in most of the developing countries. For this reason, one of the most challenging problems in this countries in production of waste (Zeng et al, 2016). In fact, waste management is one of the new issues in developing countries which urges them to develop and implement effective, necessary and integrated management plans for waste generation prediction. Thus, the quantity of waste produced and collected is one of the most important application of waste management (Tchobanoglous, et al, 1993).The rate of economic growth and living standards improvement in recent decades have led to changes in some phenomena such as mass production, mass consumption and mass disposal(Weng and Fujiawra,2018).Along with the quantitative growth in waste generation, the nature of domestic waste has also changed and share of synthetic waste with complex compounds especially plastic, glass and hazardous materials is increasingly larger (Karbassi and Pazoki, 2015; Vergara and Tchobanoglous, 2021).

Rapidly increasing population, rising living standards, development of the way of consumerism, development in the fields of science and technology have caused areas of more growing waste, these factors cause continuously increase in the quantity and variety of domestic waste. Increase domestic waste and consequences of its degradation in the environment can cause serious damage on environment and population (Palmer, 1998). Agricultural waste in the rural areas, especially animal husbandry, has cascading consequences for the environment and human health including degradation of air and water quality (Karbassi and Pazoki, 2015). Waste is the materials generated by human activities and the produced considers them useless. This material includes agricultural, commercial, construction, demolition, hazardous, industrial, and household and food waste (Azizi, 2021). In addition, systematic sets of rules controlling the production, storage, collection, transportation, processing and disposal are called waste management. This kind of management includes all administrative, financial, legal, design and engineering issues and considers the most optimal principles of public health, aesthetic, economic, resource conservation and environmental consideration (Movari and Amin share, 2007). The factors affecting waste generation are different in each area, because in each region, local conditions such as climate, standard of living, technology, customs and culture, economic issue and other factors are different.

According to Ross, (1982), the rate of waste generation is affected by various factors such as geographical location, season, cycle of using kitchen food waste, collection repetition, features regional services, on site processing, peoples food habits, economic conditions, recovery and reuse, laws on waste management, local culture and beliefs, population growth, weather conditions and size of households (Stevens, 2019). It seems that the rate of solid waste generation is very different in socio economic groups and the proportion of household income and the number of household members is important. Much of the weight changes in socio cultural and economic factors including cultural tradition household income, prices of goods and services consumed, the number of employed people, the size of the household, human awareness in particulars their attitude and behavior towards waste management, housing typology, floor area of the residence, lifestyle of the family etc (Zeng et al, 2008). Such factors affect waste generation in long term period. Thus, these factors must be carefully analyzed in the models prepared for long term forecasting

3. Case study area

The selected case study is Enugu, the capital of Enugu State and is located in the South-Eastern geopolitical region of the Federal Republic of Nigeria as shown in Figure 1. Enugu City is located between $06^{0}21^{0}$N and 06^{0} 30^{0} latitude and between longitude 07^{0} 26^{0} E and 07^{0} 37^{0} E. The land area of the city is estimated at about 72.8 square kilometers. Enugu Urban consists of three local government areas, namely: Enugu North, Enugu South and Enugu East as shown in Figure 2. Enugu is the foremost headquarter of the former south east region of Nigeria. It has 24 prominent residential neighbourhoods. Enugu urban registered a population of 62,764 in 1952; the 1991 Census shows the population count of Enugu to be 462, 514, accommodated in 28 residential patterns. This increased to 722,664 in 2006 and is estimated to be 1,414,785 in 2022. The spatial scope of this study is limited to the neighbourhood in the Enugu metropolis, Enugu south, Enugu north and Enugu East Local government areas.

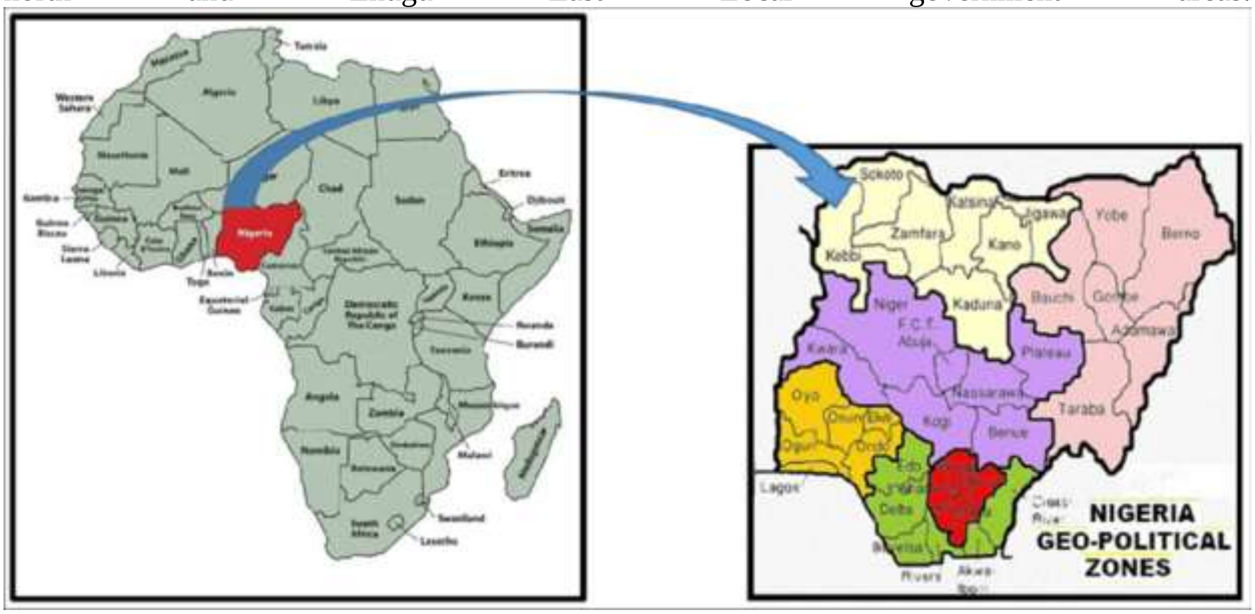

Figure 1: Map of Africa showing Nigeria
Source: Ministry of Lands Survey, Enugu State, 2018.

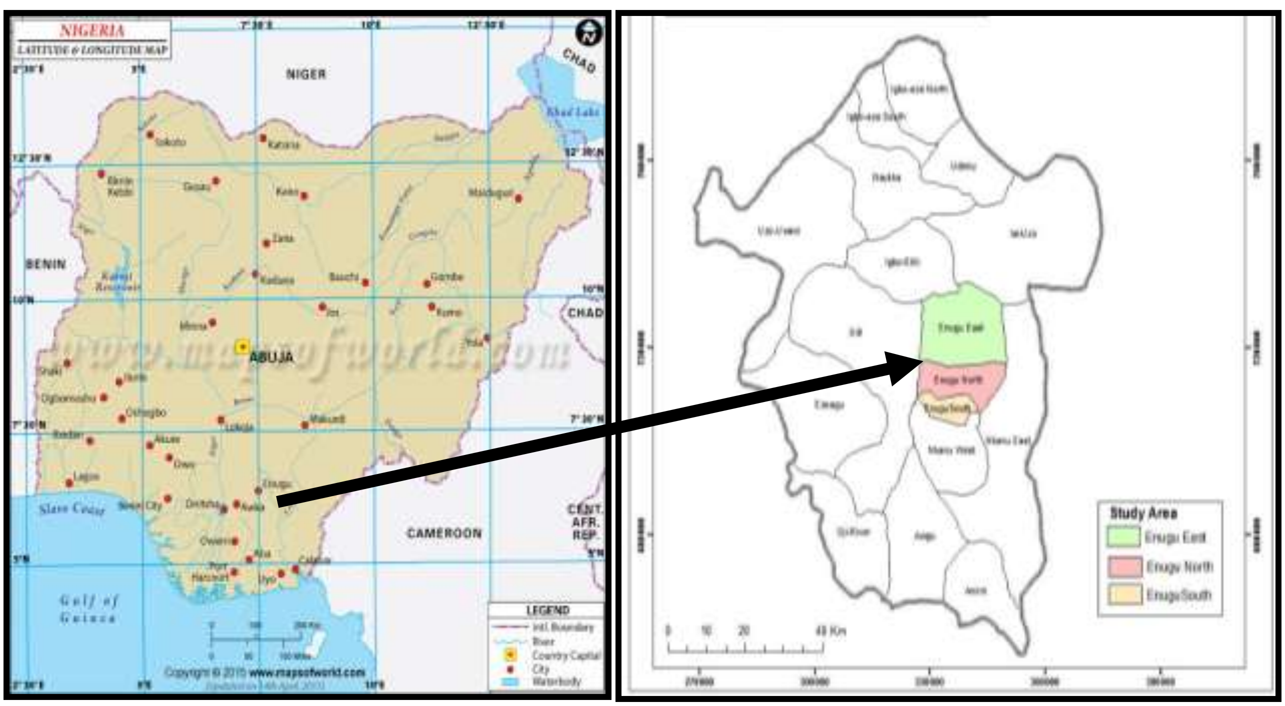

Figure 2. Map of Nigeria showing Enugu and that of Enugu State showing Enugu urban
Source: Ministry of Lands Survey, Enugu State, 2018.

Residential land- use account for the highest land use comprising about 54.3% of total urban area in Enugu. Enugu has about twenty four (24) distinct neighborhoods that may be broadly categorized as low, medium and high density areas. It is pertinent to note the housing types are typical of density areas. For example, tenements buildings dominate and are characterized of high-density areas such as Ogui New Layout, while block of flats are prevalent in New Heaven and Achara Layouts, a medium density area. In the low-density areas, bungalows and duplexes are common.

Due to the influences of spread effects, mixed densities exist. Planned and unplanned areas sprang alongside Enugu metropolis as a result of a high demand in residential accommodations. That is to say that the urban residential space in Enugu metropolis is not necessary a continuous zone but an arbitrarily defined circumscribing area of about sixteen neighborhoods and some intervening open spaces. Many informal business sectors grow alongside with the residential units as noticed in areas like Kenyetta- Edozie streets axis, Agbani- Ziks Avenue Road, Ogui Road, Obiagu Road, Abakpa Road, Emene Road, Chime Avenue e.t.c. Rapid urbanization has increased the population of the city

4. Methodology

Survey research design was adopted in the study. The primary sources of data used in this work were collected through interviews, direct observations, questionnaire, measurements/ weighing and others. The polythene waste (garbage) produced daily from the selected households in the areas were collected biweekly from the bins and the bulk weighed gravimetrically beforehand sorting the various components that made up the waste.. The following are equipments/tools used to collect wet and dry season data for the study, regarding municipal solid waste generation;

i) Improvised data recording sheet (ii) Tri Cycle, (iii) Polythene waste receptacle. (iv) Surgical Mask, (v) Hand gloves, (vi) Metal Cart (push-push), (vii) Still camera and (viii) Salter scale

The sample frame was the household from all the different residential density in Enugu metropolis. The sample size for this research was determined through application of Williams (1978) formula as was adopted by Kerlinger and Lee (2000). This formula is concerned with the application of the normal approximation with a level of confidence at 95%. An error margin of 0.05 was assumed while determining the sample size for the study.

The sample size was determined using Williams (1978) formula as was adopted by Kerlinger and Lee (2000). The formula is given as:

$$S = \frac{n}{1 + n/N}$$

Where:

S = Sample size

n = The proportion of households population that was sampled which was 2.5 percent. 2.5% was used because of its aptness in calculating proportions that relates to household. (Osuala, 2009)

N = The total number of households

A sample of four hundred households was obtained for Enugu.

Stratified, systematic and simple random sampling techniques were used to proportionately select the residential densities and respondents used in the study.

Simple random sampling technique was used to select streets/roads in the neighbourhoods.Systematic sampling technique was used to select the houses from each of the selected streets to be sampled. The 5th building was always selected, this was to ensure proper representativeness in the streets sampled. Proportionate allocation strategy was used to get the sample size for each of the neighbourhoods using their various household sizes .Enugu urban had 24 neighbourhoods.However, there were pockets of slums like Ugbo odogwu, Agu abor, Ugbo Obed. Stratified random sampling was used to divide these 24 neighborhoods into residential densities- high, medium and low densities. Table 1 shows the various residential densities that were stratified into residential densities.

Table 1: Residential density and neighbourhoods in Enugu.

High-Density	Medium Density	Low-Density
Abakpa	Achara Layout	Aria
Asata	Awkunanaw	City Layout
Obiagu	Idaw River	G.R.A
Iva Valley	Maryland	Independence Layout
Ogbete/Coal Camp	New Era	Republic
Ogui	New Haven	Riverside
Ogui New Layout	Secretariate Qtrs	Thinkers Corner
Uwani	Udi siding	Trans-Ekulu

Source: Researcher's field study, 2024

Three neighborhoods was randomly chosen from each of the densities, however, the study considered those three that over the years had influx of residents. This revelation was made during the pilot survey. This was done through a pilot survey. Thus, a total of nine neighborhoods were selected in the study. Below is table 2 that shows selected neighborhoods, and their residential densities

Table 2: Selected neighbourhoods and residential densities.

S/N	HIGH DENSITY	MEDIUM DENSITY	LOW DENSITY
1	Abakpa	Maryland	Trans Ekulu
2	Asata	Uwani	G.R.A
3	Ogui	New haven	Independence Layout

Based on 2006 census, the selected neighborhoods had a population of 373,664. At an annual growth rate of 2.8%, the population of the selected neighborhoods was projected to 710,522 in 2024. The 2024 population of the selected neighborhoods was projected using the Thomas. R Malthus Exponent projection model:

$P_t + n \quad = \quad Pt\,(1 + r)^n$

where

$P_t + n$ = Projection Population (2024)

P_t = Population of base year (2006)

n = Number of year (13 year)

r = Growth rate (2.8%) = $\frac{2.8\%}{100}$

The table 3 shows the selected neighbourhoods and their population.

Table 4.3: Sampled neighbourhoods and their population

NEIGHBOURHOODS	**DENSITY**	**2024 PROJECTED POPULATION**
Abakpa	HIGH	182,836
Asata		60,887
Ogui		91,189
Maryland	MEDIUM	46,925
New haven		85,022
Uwani		83,491
Independence layout	LOW	68,733
G.R.A		52,049
Trans Ekulu		39, 390
Total		**710, 522**

Source: 2006 NPC data projected to 2024 by the researcher.

The number of households for each of the selected neighbourhoods were obtained by dividing the projected population of the neighbourhoods by six (6) which is the average household size in Nigeria.(NPC, 2005). The study using the proportionate allocation strategy ensured that the households with greater numbers had more sample size. Table 4 showed the household population and number of questionnaires that was administered:

Table 4 : The sampled neighbourhoods and the sample sizes for Enugu

NEIGHBOURHOOD	PROJECTED POPULATION (2015)	HOUSEHOLD POPULATION	SAMPLE SIZE
Abakpa	182,836	30472	**102**
Asata	60,887	10147	**35**
Ogui	91,189	15198	**52**
Maryland	46,925	7820	**25**
New haven	85,022	14170	**48**
Uwani	83,491	13871	**46**
Independence layout	68,733	11455	**38**
G.R.A	52,049	8674	**29**
Trans Ekulu	39, 390	6565	**25**
TOTAL	**710, 522**	**118,372**	**400**

Source: Researcher's Survey, (2024).

Stratified, systematic and simple random sampling techniques were employed in the study. The study area- Enugu urban- was stratified into three residential strata (high, medium and low residential density). Three neighborhoods were selected from each of these three residential densities. Systematic random sampling was employed in the selection of the streets for sampling. Out of the 66,846 estimated households in the selected 9 neighbourhoods which formed the population frame, 0.20% of the population was used. Hence, samples size of four hundred (400) households was used. The principle of proportional allocation was adopted in distributing the 400 copies of questionnaire in the nine selected neighbourhoods. On the method employed to generate data, the sampled residents on daily basis segregate and collect each category/class of waste they generate into the nine (9) sets of polythene bags issued. The polythene wastes were collected biweekly by two (2) research assistants in all the selected neighbourhoods and each class is observed and weighed using the salter scale. This is done to determine the proportion or weight of each class of waste generated in every ward. The procedure is repeated biweekly from January to march for dry season and August to October for rainy season, 2024 respectively. This is to reflect daily and seasonal variations. Equally, the choice of these particular times in the season is because January is the peak of dry season and August is the peak of wet season in the study area. Thus the average wet and dry season field data for the metropolis is computed. It is worthy of note that some of the polythene waste collected from households for this exercise were returned after observation and weighing because some of the materials generated as waste are sold by residents to commercial waste collectors or recycled to usable products.

5. Result

5.1: Quantity of Polyethylene Waste Generated and Dispose in the high density residential area in Dry Season

Table 5 shows the average generation and disposal of polyethylene waste generated various neighbourhoods in the high density residential area in Enugu urban from January to march in the dry season. The table shows that there was seasonal variation of cellophane generation and disposal which recorded high generation and disposal during the dry season month of January to march with the highest generation of 23.8kg and disposal peak of 15.6kg in the month of March.

Table 5. Quantity Generated and Dispose in the high density residential area in Dry Season

Monthly	**Quantity generated**	**Quantity dispose**
January	18.5 kg	13.7 kg
February	20.6 kg	14.9 kg
March	23.8 kg	15.6 kg

Source: Field work, 2024

5.2: Quantity of Polyethylene Waste Generated in the high density residential area in Wet season

This table 6 showed that, there is an average gradual declining trend of polyethylene waste in the wet season in the high density residential neighbourhoods which experienced the least generation and disposal from the month of July and trend continue to rise in the month of September with 15.5kg cellophane generation and 11.6kg cellophane disposal.

Table 5.6: Quantity Generated and Dispose in the high density residential area in Wet Season

Monthly	**Quantity Generated**	**Quantity Dispose**
July	17.4 kg	9.7 kg
August	16.7 kg	9.5 kg
September	15.5 kg	11.6 kg

Source: Field work 2024

5.3: Quantity of Polyethylene Waste Generated and Dispose in the medium density residential areas in the Dry Season

The average quantity of polyethylene waste generated and disposes at the homes of the medium density residential areas in dry season shows in Table 7 that cellophane generation was generally high during the dry season months of January to march which recorded 55.7kg generation at home and 38.8kg disposal at home in the month of march.

Table 7: Quantity Generated and Dispose at Household in the medium density residential areas in the Dry Season

Monthly	Quantity generated	Quantity dispose
January	17.5 kg	10.8 kg
February	18.0 kg	13.5 kg
March	20.2 kg	14.5 kg

Source: Field work, 2024

5.4: Quantity of polyethylene Waste Generated and Dispose at households from medium density residential areas in the Wet Season

There was a decline in the amount of polyethylene waste generated in the wet season at home month of July to September with lowest recorded peak generation of 16.1kg and 13.2kg disposal.

Table 5.8: Quantity Generated and Dispose at household in in the medium density residential areas Wet Season

Monthly	Quantity generated	Quantity dispose
July	15.6 kg	11.4 kg
August	14.5 kg	12.0 kg
September	16.1 kg	13.2 kg

Source: Field work, 2024

5.5: Quantity Generated and Dispose at low density residential areas in Dry Season

The study shows the generation and disposal of polyethylene waste generated in the household at low density residential areas from January to march in the dry season. The table 9 shows that, there is seasonal variation of cellophane generation and disposal which recorded high generation and disposal during the dry season month of January to march with the highest generation of 23.8kg and disposal peak of 15.6kg in the month of March

Table 9: Quantity Generated and Dispose at household in at low density residential areas in Dry Season

Monthly	Quantity generated	Quantity dispose
January	18.5 kg	13.7 kg
February	20.6 kg	14.9 kg
March	23.8 kg	15.6 kg

Source: Field work, 2024

5.6: Quantity of Polyethylene Waste Generated in the at low density residential areas in Wet season

This table 10 showed that, there is a gradual declining trend of polyethylene waste in the wet season at market which experienced the least generation and disposal from the month of July and trend continue to rise in the month of September with 15.5kg cellophane generation and 11.6kg cellophane disposal.

Table 10: Quantity Generated and Dispose at household in at low density residential areas in Wet Season

Monthly	Quantity Generated	Quantity Dispose
July	17.4 kg	9.7 kg
August	16.7 kg	9.5 kg
September	15.5 kg	11.6 kg

Source: Field work 2024

6. Discussions

The finding of this study posited that polyethylene waste generation was found to be higher during the dry season months (January-march) (average of 60.5kg) than the wet season months (July-September) (average of 32.7kg) with the least in the month of June. This is in agreement with the works of Kamran, et al (2015) where he observed that solid waste generation is higher during the dry season than in the wet season. On the residential density basis, the high and low density residential areas has the highest total cellophane generation of 112.5kg, medium density areas are next with (101.9kg). The study also show that table water sachets topped the list and following that order of descending magnitude is ice cream and biscuit wrappers. Table water sachet topped the list because; it is consumed throughout the year with very little seasonal variation. Majority of the residents depend on the sachet water on a daily basis. Ice cream wrappers exhibited the highest variation in this study. Their generation and disposal are readily compared both during the dry months and the heart of the wet season. Polyethylene for assorted items also exhibited high seasonal variation. This implies that its demand and consumption is almost uniform throughout the year (Ubani et al, 2014). Jimoh, (2002) reported similar findings for Ibadan. She noted that among the non-biodegradable solid wastes generated cell phone is mostly affected by seasonality. This kind of seasonality impact was reported for sachet water, newspaper and recreational participation in Warri (Hammed, et al 2016). The result of the hypothesis using ANOVA suggests that there was significant different from that generated in homes in the same weather season in Enugu metropolis. ($F= 9.417$, $P = 0.026$, $P <0.05$ significant value). Hence, the null hypothesis was accepted. In summary, the results from finding shows that Seasonal variation of Polyethylene waste generated and dispose was found in the markets and at homes to be higher during the dry season months (January-march) than the wet season months (July-September) with the least in the month of June and the quantity dispose in dry season is more than the wet season.

7. Conclusions

Polyethylene waste generation was found to be higher during the dry season months (January-march) than the wet season months (July-September) with the least in the month of June. Generally, respondents use polyethylene for shopping, raising young seedlings, flowers and as, traveling bags. Some of the reasons given for improper disposal of polyethylene include environmental care free attitude of Nigerians, non-availability of refuse bins in public and private places, as well as no punishment abusers and violators. Polyethylene is a source of environmental degradation in Nigeria, and this form of environmental abuse is worst in the urban areas. The water held by cellophane serves as breeding ground for mosquitoes thereby increasing the incidence of malaria, which is the leading killer disease in Nigeria today. For a clear and sustainable environment therefore, awareness campaign and enlightenment should be vigorously carried out. Government should provide public waste bins in strategic positions for the collection of wastes. The Enugu State environmental protection agency under ministry of environment should employ more personnel. The government and individuals should look at recycling option of polyethylene.

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