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# Burden of Plastic Waste in Nsukka Metropolis

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**Abstract**
Plastic waste in the environment poses threats to the ecosystem, such as loss of aquatic life, blockage of drainage system, reduction in water and nutrient absorption into the soil, destruction of the aesthetic value of the environment, and destruction of the environment. Nsukka, Nigeria has an area of 1810km2 and a population of 309,633 at the 2006 census. The rapid rate of urbanization has brought with it, its accompanying side effects, such as the creation of urban slums and waste generation. This study evaluated the burden of plastic waste in Nsukka metropolis including the sources, impacts, and management measures of plastic waste in Nsukka metropolis. A survey research design was employed, and a total of 100 questionnaires were administered to residents in the area. The findings revealed that plastic bottles and nylons are the most abundant plastic waste, followed by food wrappers and containers. Plastic pollution was found to have severe impacts on the environment, wildlife, and human health. Recycling, prohibiting single-use plastics, and proper waste management systems were identified as essential measures to reduce plastic waste. The study recommends implementing recycling programs, enacting laws prohibiting single-use plastics, and educating the public on proper plastic waste management. The findings of this study contribute to the existing literature on plastic waste management and provide insights for policymakers and stakeholders to develop effective strategies for mitigating plastic pollution.
**Keywords**: plastic waste, recycling, plastic waste management, plastic pollution
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## 1.Introduction

Globally, over one million plastic products are purchased per second. Global plastic production increases annually thus plastic waste continues to grow rapidly due to urbanization and globalization; with 85% plastics products not recycled thereby contributing to a greater population of waste worldwide. Biomass and plastics are two common municipal solid waste globally that have continuously placed a burden on the environment (Adeniyi et al., 2024). According to the research report written by EA- Earth Action on July 28th, 2023, in commemoration of "Plastic over Shoot Day", 158,943,925 tons of plastic waste will be created in 2023 and 43% of global plastic wastes will be mismanaged at the end of its life amounting to 68,647,999 additional tones of plastic in nature thus, the amount of plastic waste generated by consumers is staggering and projected to increase unabatedly for the foreseeable future (Ong et al., 2024). The global average consumption of plastic per person per year is 20.9kgs. In 2019, global plastic production reached 368 million metric tons (Mt) but is predicted to double within 20 years (Lebreton & Andrady, 2019). A rise from an estimated 353 million metric tons per year of plastic waste in 2019 to 1,014 million metric tons per year in 2060 and is estimated to produce 19 percent of global greenhouse gases by 2040. According to Plastics Europe, the global production of plastic waste was estimated to be 299 million tons in 2013 and 311 million tons in 2014 (Duer, 2020).

Plastic is a word that originally meant "pliable and easily shaped". Along with the changing lifestyle of consumers, the consumption of plastic has been increasing due to its convenient usage (Alam et al., 2018). Many numbers of products in our daily life are made of plastic. The plastic waste includes most common single use plastic that includes: plastic bags, plastic bottles, disposal coffee/juice cups and lids, straws, plastic cutlery and food packaging (Johnston.2017). Its durability, other properties and its versatile uses makes plastic much more preferable over other materials like glass, ceramic etc. however, with the increase in production and disposal of plastic, there is a growing concern about its impact on the environment and human wellbeing. Presently, Plastic waste poses a big challenge to the world at large, with its impacts reaching far and wide. Plastic pollution threatens global social, environmental, and economic sustainability (Walker, 2021).

Plastic waste is the result of discarded plastic materials that have fulfilled their intended purpose or are no longer required. In particular, most developing countries have no advanced technological facilities and no proper rules and regulations on plastic production, use, and waste management (Eze et al., 2021). Since plastics pollute both

 

terrestrial and marine ecosystems, the United Nations added the statement, 'Plastic is one of the substantial environmental threats faced by the world' (Khan et al., 2019, Borrelle et al., 2020). At present, the transformation of plastics from useful 'objects' to bothersome 'waste' has become a trending topic in the world. The first discussion on plastic waste began in the 1980s and continued afterward (Kedzierski et al., 2020). Plastic waste has become a significant environmental issue in recent years, posing numerous challenges to ecosystems, human health, and sustainability. Plastic waste is primarily caused by human activities such as improper disposal, inadequate recycling infrastructure, and excessive consumption of single-use plastics.

According to Jambeck et al., (2015), an estimated 8 million metric tons of plastic waste enters the oceans annually, with the majority originating from land-based sources. This waste often accumulates in rivers and coastal areas due to inadequate waste management systems (Lebreton et al., 2017). Liang et al. (2021) calculated the plastic waste generation in 2016 to be around 242 million tons. The degradation rates of plastic range from 100 to 1000 years. Consequently, the first invented plastics may still exist in nature (Welden, 2020). Based on the prediction by Stubbins et al. (2021), plastic waste accumulation by 2035 would be equal to the number of fish in the oceans.

Moreover, plastic waste contributes to greenhouse gas emissions during its production and disposal, exacerbating climate change (Andrady, 2015). Plastic waste has emerged as a pressing environmental issue with severe consequences for ecosystems and human health. The causes of plastic waste are rooted in human behavior and consumption patterns, necessitating a collective effort to address the problem. Plastic waste pollution refers to the detrimental impact caused by the accumulation of discarded plastic materials in the environment. Plastic waste pollution has emerged as a significant environmental issue in recent years, posing serious threats to ecosystems, wildlife, and human health. According to (Chadar & Keerti, 2017), Wastes are the materials that are not economically useable with further processing. Plastic waste pollution is primarily caused by human activities, including improper waste management, excessive plastic production, and inadequate recycling practices. According to Jambeck et al., (2015), an estimated 8 million metric tons of plastic waste enters the oceans annually, with the majority originating from land-based sources. This waste often results from inadequate waste disposal systems, littering, and improper handling of plastic products. From the 1950s to 2018, an estimated 6.3 billion tons of plastic were processed worldwide, an estimated 9 percent of which was recycled and an additional 12 percent incinerated (Hester et al., 2011). This vast volume of plastic waste reaches the atmosphere, with reports indicating that 90 percent of seabirds contain plastic debris (Hester et al., 2011; Hermabessiere et al., 2017). Some marine pollution experts say that there might be more plastic than fish in the sea by 2050. A report indicates that about 100,000 aquatic animals are killed by plastic waste annually (BBC, 2020). Several researchers have documented the impact of plastic waste on human health (Revel et al., 2018; Galloway, 2015), the environment, ecosystem (Rochman et al., 2016; Law, 2017; Kühn et al., 2015), and wildlife (Gall & Thompson, 2015; Güven et al., 2017).

The consequences of plastic waste pollution are far-reaching and multifaceted. Marine ecosystems are particularly vulnerable, as plastic debris poses a significant threat to marine life. A study by Rochman et al. (2015) found that marine organisms, such as seabirds, turtles, and fish, can ingest or become entangled in plastic waste, leading to injury, suffocation, and death. Furthermore, plastic waste can break down into microplastics, which can accumulate in the food chain and potentially harm human health (Galloway, 2015). Addressing plastic waste pollution requires a comprehensive approach involving individuals, governments, and industries. One effective strategy is to reduce plastic consumption and promote the use of sustainable alternatives. For instance, reusable bags and bottles can replace single-use plastic items. Additionally, improving waste management systems, such as implementing recycling programs and establishing proper disposal facilities, is crucial in preventing plastic waste from entering the environment (Barnes et al., 2018).

In Engineering context, plastic waste is a problematic- environment related issue which affects all aspect of life and human health. Accumulation of plastic products in the environment adversely affects wildlife, wildlife habitat, marine organisms, marine habitat and humans. Borrelle et al., (2020) estimated that 19-23 metric tons of plastic waste generated globally in 2016 entered aquatic ecosystems but is predicted to reach up to 53 metric tons annually by 2030. Plastic waste affects our environment including but not limited to loss of aquatic life, blockage of drainage system resulting in flooding, reduction in water and nutrient absorption into the soil, destruction of the aesthetic value of the environment, pollution and damage to the human body.

Nsukka is a municipality situated in Enugu State, located in South-East Nigeria. Adjacent towns that share borders with Nsukka are Edem Ani, Alor-uno, Opi, Orba, and Ede-Oballa, Obimo. Other nearby towns include

 

Enugu Ezike, Nimbo, Adani, Obollo-Afor, Uzo Uwani, and Mkpologwu, all of which also lay claim to the name Nsukka.

Nsukka, Nigeria boasts a land area of 1810km2 and a population of 309,633 according to the 2006 census. The rapid urbanization process that has swept across the country since the early 1960s has brought with it a host of issues. As urban slums have emerged to accommodate the labor force servicing the economic activities of urban environment, industries have contributed significantly to the generation of waste. Unfortunately, the waste generated is often left unmanaged and disposed of, thus a burgeoning plastic pollution crisis has been occurring on land and at sea (United Nations Environmental Programme, 2021). Today, it is not uncommon to come across piles of festering waste dumps in various parts of Nsukka.

Plastic waste is a global problem that has caused significant harm to the environment. In Nigeria, waste management is not given the proper attention it deserves and Nsukka is no exception, being an undeveloped region in Enugu state. Plastic pollution has become a formidable challenge due to improper management of the approximately 12 billion tons of plastics waste predicted to be transferred or discharged into the environment by the year 2050 (Editors, 2021). These predictions are significantly higher than the 4.9 billion tons handled in 2015 (Editors, 2021). Inadequate landfilling and incineration options are also increasing carbon footprints and the emission of hazardous atmospheric pollutants (Aragaw and Mekonnen, 2021). With the nature of refuse generation in Nsukka, the researcher seeks to study the amount of solid waste produced daily, monthly and yearly, as well as the types of solid waste generated and recycling rate, the environmental impact on health and resources (land availability), the management techniques in place and the governments' driving force to effectively carry out their responsibilities without difficulty, in order to promote better healthcare and environmental development.

Waste management is a pressing national and global issue. However, research has shown that the volume of waste is not the primary concern, but rather the ability or inability of governments, individuals, and waste disposal companies to effectively manage waste and take care of the environment. Undoubtedly, an unclean environment has a profound impact on the standard of living, aesthetic sensibilities, and overall health of individuals, thus affecting the quality of their lives. Enugu, Nsukka like many other developing urban centers, faces the challenges of poor planning, inadequate infrastructure and substandard sanitation systems which have led to a number of problems, including uncontrolled growth and lack of access to basic amenities. In only a few of previous studies, efforts were put to address the holistic influences of plastic pollution on environmental quality, health risks, eco-toxicity, energy resilience, climate action, and the UN's Sustainable Development Goals (SDGs) from a balanced perspective (Yuan et al., 2021; Rai et al., 2022a). It is evident that concerted efforts must be made to improve waste management practices and preserve the environment. This rapid expansion has resulted in significant waste management challenges for the city. Increasing global plastic waste generation has also resulted to increased public awareness about the negative environmental impacts of plastic pollution (Walker et al., 2021).

However, the focus of this study is on the pressing issue of Plastic Waste Management in Nsukka, Enugu state. It is a constant battle against the harmful consequences of unregulated waste disposal, and the ultimate goal of achieving a clean and healthy environment for all residents. Improper disposal of waste management practices in Nsukka metropolis has led to serious issue such as health hazards, traffic congestion, unsightliness and blockages of drainages, land occupancy among others; thus, plastic mismanagement threatens the ability of the global community to sustainably manage plastic production, plastic waste and plastic pollution (Kumar et al., 2021).

The primary objective of this study is to establish ecosystem-friendly solutions for plastic waste disposal in the metropolitan city of Nsukka. The specific goals are to identify the specific sources of plastic waste in Nsukka metropolis, to assess the impacts of plastic waste on humans and the environment in Nsukka metropolis and further more to identify ways to reduce the amount of plastic waste produced in Nsukka metropolis. By adopting these aims, we can effectively tackle the pressing issue of plastic waste management in Enugu state and create a cleaner and healthier environment for all.

## 2. Significance of the Study

The rate of plastic waste generation is a growing issue in Nsukka metropolis and around the world. Plastic pollution has been linked to negative impacts on the environment, including pollution of air, water and soil and constitutes harm to human life. This research serves as a contribution towards the goal of making Nsukka one of the cleanest 21st century cities in the world. Achieving this goal would enhance the state's tourism, bringing in revenue and creating jobs for its citizens which will reduce the unemployment rate. By implementing the

 

recommendations and suggestions from this study, the impact of diseases such as Malaria, diarrhea, cough, catarrh, cold, and fever can be significantly reduced. This would also decrease the high rates of resident's mortality.

## 3. Materials and Methods

This study was carried out in Nsukka Local Government Area, Enugu State. Nsukka had a population of 309,633 as at 2006 census and an area of 5,545.38 square kilometres. Its inhabitants are predominantly civil servants, traders, farmers and students. The main campus of University of Nigeria is located in the study area. Data was collected through field work, nylon bags and weighing balance oral interview, and physical observation. GPS (the Global positioning system) app will be used to locate and describe the characteristics (coordinates) of Government Approved waste dumps in Nsukka metropolis and determine the overall plastic waste composition., identifying sources of plastic waste, determining the effects of plastic waste and suggesting the management measures will be determined with the use of field work.

Oral interviews were used to know or classify the method of plastic waste disposal in Nsukka metropolis.

The population of this study consists of inhabitants of the selected areas and Government approved waste dumps in Nsukka metropolis. The following areas were selected for this study and they include: University Market Road leading to the Institute of Education at UNN, the First Bank of UNN, the Civil Engineering building at UNN, Nsukka town, Ogige Main Market Road, Onuiyi junction, Beach Junction, Student Union Building (SUB UNN) and residential areas at Odim, Odenigwe and Hilltop.

The research design closest in getting direct information from the sample population is the Survey method. Considering the nature of this study, Survey Design was used. The survey research is one in which a group of people or items is studied by collecting and analyzing data from only a few people or items considered to be representative of the entire group. In other words, only a part of the population is studied, and findings from this are expected to be generalized to the entire population (Nworgu et al., 1991). Similarly, (Mc Burney et al., 1994) defines the survey assessing public opinion or individual characteristics by the use of questionnaire and sampling methods. Survey design involves: Interviews(asking questions to a research topic one-on-one and also gives room for follow-up questions and gain additional insight), Online forms(this involves using the internet and creation of software programs to create intuitive online forms with a variety of questions including short-answer and multiple-choice), Focus groups(this involves facilitating discussions with a group of research subjects to gain valuable research insights from your sample population), questionnaires(here, you list questions for a research subject to answer thereby making it one of the most effective data collection method), etc.

For this study, the field work survey method and GPS (Global positioning system) where used as it the most effective method suitable for the project.

- The GPS was used to locate and describe the characteristics (coordinates) of Government Approved waste dumps in Nsukka metropolis. Determination of the plastic waste composition.
- Identifying sources of plastic waste
- Use of oral interview to know or classify the method of plastic waste disposal in Nsukka metropolis.

### *3.1. Method Of Sampling*

Taro Yamane's formula is used to calculate an appropriate sampling size from a population.

$$n = \frac{N}{1 + Ne^2}$$

Where, n = Sample size N = Population size, e = marginal error or level of precision
N = 309,633 Population of Nsukka
Confidence level =95%, e = (100 – 95), e = 5% = 0.05

$n = \frac{309633}{1+309633*0.05^2}$ = 400 persons, assuming 4 persons per a home therefore 100 homes were the sample for data collection.

The sampling site was divided into the following areas: University Market Road leading to the Institute of Education at UNN, the First Bank of UNN, the Civil Engineering building at UNN, Nsukka town, Ogige Main Market Road, Onuiyi junction, Beach Junction, Student Union Building (SUB UNN) and residential areas at Odim, Odenigwe and Hilltop.

 

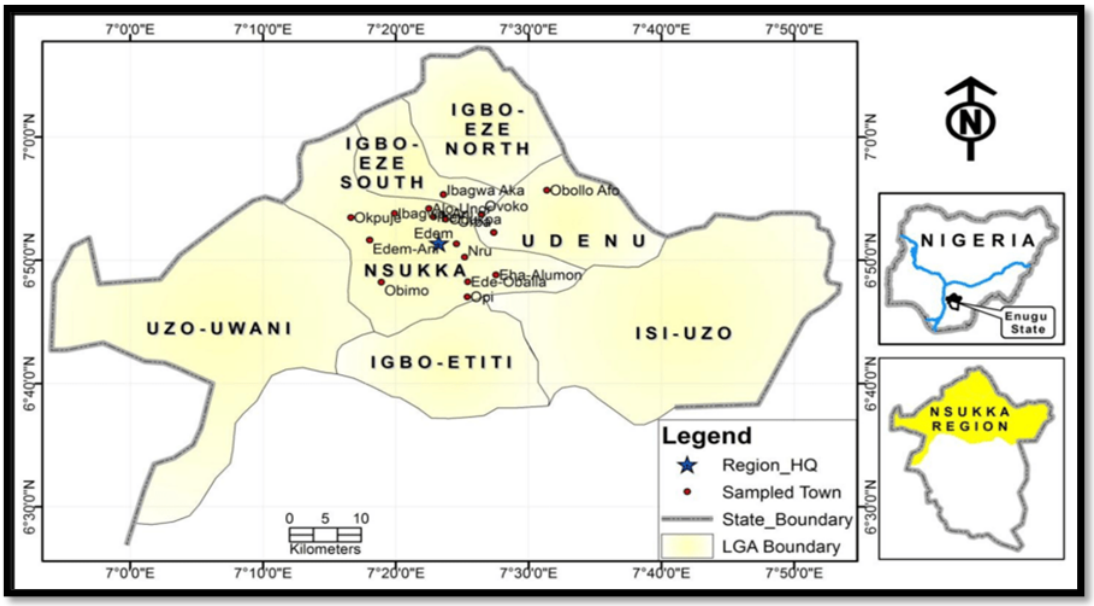


Figure 1: Map of Nsukka Agro-ecological zone showing the sampled areas.
Source: Geography Department, University of Nigeria, Nsukka.

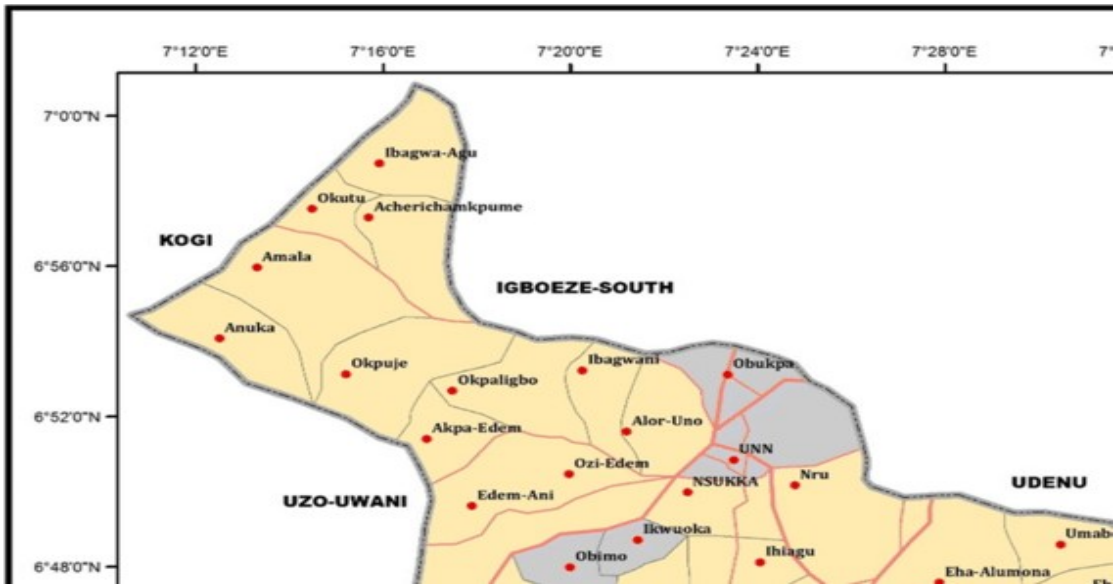


Figure 2: Evaluation of some heavy metals and physicochemical properties of public refuse dumpsites in Nsukka metropolis.
Source: Geography Department, University of Nigeria,Nsukka.

 

Figure 3: Orba Road Refuse Dumpsites in Nsukka Metropolis


Figure 4: Showing information on how plastic waste is being collected and disposed

3.2: *Results and Findings*

The data collection process involved distribution of one hundred (100) questionnaires to a sample of inhabitants of selected locations in Nsukka metropolis which comprises of students, families, market peoples etc. The interview was done both online and offline. The demographic data such as Gender, Age, Number in the family,

 

educational qualification and main source of plastic waste in the family were collected. GPS was used to locate the government approved dumpsite; this was to enable us gather information on quantity of plastic waste collected in the location.

The questionnaire measured the following:

- Sources of plastic waste in Nsukka metropolis
- Impacts of plastic waste on humans and environment in Nsukka metroplolis
- Plastic waste management measures in Nsukka metropolis

The responses were given on a 5-point LIKERT scale where: 1 = Strongly Disagree (SD); 2 = Disagree (D); 3 = Neutral (N); 4 = Agree (A); 5 = Strongly Agree (SA).

*3.3: Distribution of respondents according to Demographic characteristics*

The distribution of respondents according to gender, age, educational qualification and number of family members. It could be seen that the gender is balanced with 60% are male and 40% are female. Most people are with age group of 21-25 and 84.0% of the respondents have got at least the bachelor's degree. Most of the families interviewed have about 5-6 number of family members.

Table 1: Distribution of respondents according to Demographic characteristics

| S/N | Demographic Characteristics | Frequency | Percentage | Total |
|---|---|---|---|---|
| 1 | Gender: Male<br>Female | 60<br>40 | 60.0<br>40.0 | 100 |
| 2 | Age Group: 16-20 Years<br>21-25 Years<br>26-30 Years<br>31-35 Years<br>36- 40 Years | 6<br>67<br>21<br>5<br>1 | 6.0<br>67.0<br>21.0<br>5.0<br>1.0 | 100 |
| 3 | Highest Educational Qualification:<br>Ordinary National Diploma<br>Higher National Diploma<br>Bachelor Degree<br>Doctorate | <br>9<br>6<br>84<br>1 | <br>9.0<br>6.0<br>84.0<br>1.0 | 100 |
| 4 | Number in the Family:<br>1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9 | <br>2<br>4<br>4<br>10<br>20<br>19<br>17<br>17<br>7 | <br>2.0<br>4.0<br>4.0<br>10.0<br>20.0<br>19.0<br>17.0<br>17.0<br>7.0 | 100 |

Table 2: Distribution of respondents according to main source of plastic waste in the family

| S/N | Main source of plastic waste in the family | Frequency | Percentage (%) |
|---|---|---|---|
| 1 | Sachet water | 41 | 41.0 |
| 2 | Bottle and container caps. | 24 | 24.0 |
| 3 | Plastic chair | 1 | 1.0 |
| 4 | Bags | 10 | 10.0 |
| 5 | Straws and stirrers | 0 | 0 |
| 6 | Food wrappers and containers | 17 | 17.0 |
| 7 | Takeout containers | 2 | 2.0 |
| 8 | Others | 5 | 5.0 |
| | Total | 100 | 100 |

From the table above, the main source of plastic waste in the family is sachet water.

 

*3.4: Analysis Of the Data Obtained from the Research Questions Using Mean Rating Value, Relative Important Index and Regression***.**

In order to determine the weight of the response generated from the survey, a multi-attribute analytical method was used which involves the computation of the Relative Importance Index (RII) of each response. The RII was used to rank the attributes depending on their value. The equation used for RII can be seen below:

**Relative Importance Index (RII)**

$$RII = \frac{5\,n_5 + 4\,n_4 + 3\,n_3 + 2\,n_2 + 1\,n_1}{A * N}$$

Where: each response is multiplied by their point on Likert scale and then the total of each response is divided by population size multiplied by 5.

To enable the mapping of prioritization of attributes into a continuum 5-point Likert scale was transformed into the following band using their interval.

Table 3: Rescaled Five-Band Rating

| **Point** | **Rating Scale** | **Minimum** | **Maximum** |
|---|---|---|---|
| 5 | Very High | 4.21 | 5.00 |
| 4 | High | 3.41 | 4.20 |
| 3 | Moderate | 2.61 | 3.40 |
| 2 | Low | 1.81 | 2.50 |
| 1 | Very Low | 1.00 | 1.80 |

*3.5: Sources, Impacts and Management Measures Of Plastic Waste In Nsukka Metropolis.*

Inadequate waste disposal facilities or total absence of it especially in rural areas make people throw away waste plastic materials (polyethylene bags, broken plastic buckets, bottles, plates, sachets, spoons etc.) into farm lands, water ways, schools, hospitals and other public places. These waste plastic materials are none degradable in the soil and no doubt contaminate agricultural soils and block drainage systems. It is observable that Nigerians are more interested in waste disposal and less concerned with waste management.

 

Table 4: Sources Of Plastic Waste in Nsukka Metropolis.

| S/N | How much do you agree that the following points are possible sources of plastic waste in Nsukka metropolis? | *Strongly agree* | *agree* | *Neutral* | *Disagree* | *Strongly disagree* | *Total* |
|---|---|---|---|---|---|---|---|
| SPW-1 | Plastic Bottles and nylons are the most abundant waste in Nsukka metropolis | 47 | 34 | 5 | 4 | 10 | 100 |
| SPW-2 | Straws and stirrers in the environments are regarded as plastic waste | 29 | 44 | 7 | 11 | 9 | 100 |
| SPW-3 | Mismanagement of all source of plastic wastes are caused by consumers | 30 | 40 | 10 | 11 | 9 | 100 |
| SPW-4 | Damaged Plastic chair contributes to plastic waste | 29 | 43 | 8 | 13 | 7 | 100 |
| SPW-5 | Food wrappers and containers contribute to plastic waste generation | 36 | 42 | 9 | 4 | 9 | 100 |
| SPW-6 | Broken plates and cups are source of plastic waste | 23 | 36 | 17 | 13 | 11 | 100 |
| SPW-7 | Plastic industries contribute to plastic waste generation | 14 | 44 | 16 | 16 | 10 | 100 |
| SPW-8 | Used sachets of water, biscuits are sources of plastic waste in the society | 35 | 33 | 10 | 9 | 13 | 100 |
| SPW-9 | Single use and unrecycled plastics constitute plastic waste | 35 | 35 | 12 | 10 | 8 | 100 |
| SPW-10 | Household equipment like broken buckets and bowls are sources plastic | 26 | 51 | 11 | 4 | 8 | 100 |
| SPW-11 | Plastic waste can be made of Nylon and poly materials | 29 | 46 | 12 | 5 | 8 | 100 |
| SPW-12 | Offices and firms contribute to the generation of plastic waste | 24 | 35 | 23 | 13 | 5 | 100 |
| SPW-13 | Schools and markets contribute to the generation of plastic waste | 35 | 43 | 3 | 8 | 11 | 100 |
| SPW-14 | Fertilizer bags, and other disposable plastic bags are sources of plastic waste | 26 | 35 | 20 | 13 | 6 | 100 |
| SPW-15 | Building materials like pipes, PVCs, sockets and cement bags are source of plastic waste | 25 | 40 | 14 | 11 | 10 | 100 |

 

Table 5: Impacts Of Plastic Waste on Human and The Environment In Nsukka Metropolis

| S/N | How much do you agree that the following are the impacts of plastic waste? | *Strongly agree* | *Agree* | *Neutral* | *Disagree* | *Strongly disagree* | *Total* |
|---|---|---|---|---|---|---|---|
| EPW-1 | Heavy use of plastics increases the pollution in the environment | 37 | 38 | 7 | 13 | 5 | 100 |
| EPW-2 | Plastic pollution can have a negative impact on wildlife | 32 | 30 | 21 | 15 | 2 | 100 |
| EPW-3 | Plastic food storage packages have toxic chemicals. | 36 | 35 | 13 | 12 | 4 | 100 |
| EPW-4 | Massive accumulation of plastic bags blocks drainage systems | 39 | 29 | 16 | 11 | 5 | 100 |
| EPW-5 | Plastic wastes alter the quality of the soil | 36 | 35 | 12 | 13 | 4 | 100 |
| EPW-6 | Micro plastics that are often found in the environments, can contaminate food and water supply posing a risk to human health | 33 | 39 | 11 | 10 | 7 | 100 |
| EPW-7 | Plastic waste can possibly block sunlight | 19 | 20 | 27 | 23 | 11 | 100 |
| EPW-8 | Plastic waste in landfill can release harmful greenhouse gas, leading to climatic change | 18 | 30 | 25 | 24 | 3 | 100 |
| EPW-9 | Plastic wastes to an extents reduced the anesthetic nature of Nsukka | 26 | 36 | 14 | 15 | 9 | 100 |
| EPW-10 | Incinerating of plastics causes hazardous emission of harmful gases | 25 | 40 | 11 | 20 | 4 | 100 |
| EPW-11 | Plastic wastes can also contribute to climatic crisis | 25 | 33 | 15 | 19 | 8 | 100 |
| EPW-12 | Production of plastic is one of the most energy-intensive manufacturing processes in the world | 19 | 29 | 30 | 17 | 5 | 100 |
| EPW-13 | Plastic waste can decrease reproductive health, and cancer | 19 | 35 | 25 | 13 | 8 | 100 |
| EPW-14 | Animals often confuse plastic bag/nylon for food, therefore blocking their digestive processes | 25 | 40 | 19 | 13 | 3 | 100 |
| EPW-15 | Plastic wastes in water bodies can affect aquatic lives | 40 | 37 | 13 | 8 | 2 | 100 |

 

Table 6: Plastic Waste Management Measures

| S/N | **How much do you agree that the following measures will help in reducing plastic waste in Nsukka metropolis**? | ***Strongly agree*** | ***Agree*** | ***Neutral*** | ***Disagree*** | ***Strongly disagree*** | ***Total*** |
|---|---|---|---|---|---|---|---|
| PWM-1 | Prohibiting one time use plastics can reduce wastes | 28 | 31 | 15 | 18 | 8 | 100 |
| PWM-2 | Plastic waste can be managed by converting plastics to biogas | 44 | 30 | 17 | 8 | 1 | 100 |
| PWM-3 | Recycling which involves collection, sorting, and processing of plastic materials to produce new products remains the best plastic management | 56 | 23 | 8 | 8 | 5 | 100 |
| PWM-4 | Plastic waste can be avoided totally by burning | 28 | 32 | 14 | 17 | 9 | 100 |
| PWM-5 | Provision of waste bins in strategic location can help manage plastic waste | 46 | 37 | 7 | 4 | 6 | 100 |
| PWM-6 | Plastic waste can be made useful through incineration and pyrolysis | 33 | 37 | 19 | 8 | 3 | 100 |
| PWM-7 | Plastic waste management is very important in the society | 47 | 35 | 9 | 6 | 3 | 100 |
| PWM-8 | Plastic reuse should be encouraged | 40 | 38 | 12 | 7 | 3 | 100 |
| PWM-9 | Every family, office, schools and churches, should have an approved waste management system other than littering | 48 | 34 | 9 | 6 | 3 | 100 |
| PWM-10 | Proper plastic waste management helps to preserve nature | 45 | 36 | 9 | 6 | 4 | 100 |
| PWM-11 | Law should be made against improper disposal of waste | 38 | 45 | 7 | 7 | 3 | 100 |
| PWM-12 | Awareness and educational programs on plastic waste management should be encouraged. | 45 | 37 | 10 | 4 | 4 | 100 |
| PWM-13 | plastic waste management should be advocated by individuals, government and non-governmental agencies | 40 | 44 | 9 | 6 | 1 | 100 |
| PWM-14 | Installing cameras in strategic places just like in developed country can help improve the rate of management | 39 | 40 | 9 | 8 | 4 | 100 |
| PWM-15 | Proper management aids a quality living hence should be taken seriously | 43 | 42 | 6 | 7 | 2 | 100 |

 

*3.6: The Relative Index Table, Showing Sources of Plastic Waste, Its Impacts on Life and Environment and Plastic Waste Management*

Table 7: Source Of Plastic Waste Showing the Relative Importance Index

| S/N | Items | Rii | Index |
|---|---|---|---|
| SPW-1 | Plastic Bottles and nylons are the most abundant waste in Nsukka metropolis | 0.808 | 1 |
| SPW-2 | Straws and stirrers in the environments are regarded as plastic waste | 0.746 | 7 |
| SPW-3 | Mismanagement of all source of plastic wastes are caused by consumers | 0.742 | 8 |
| SPW-4 | Damaged Plastic chair contributes to plastic waste | 0.748 | 6 |
| SPW-5 | Food wrappers and containers contribute to plastic waste generation | 0.784 | 3 |
| SPW-6 | Broken plates and cups are source of plastic waste | 0.694 | 13 |
| SPW-7 | Plastic industries contribute to plastic waste generation | 0.672 | 14 |
| SPW-8 | Used sachets of water, biscuits are sources of plastic waste in the society | 0.736 | 9 |
| SPW-9 | Single use and unrecycled plastics constitute plastic waste | 0.758 | 5 |
| SPW-10 | Household equipment's like broken buckets and bowls are sources plastic | 0.766 | 4 |
| SPW-11 | Plastic waste can be made of Nylon and poly materials | 0.786 | 2 |
| SPW-12 | Offices and firms contribute to the generation of plastic waste | 0.72 | 11 |
| SPW-13 | Schools and markets contribute to the generation of plastic waste | 0.766 | 4 |
| SPW-14 | Fertilizer bags, and other disposable plastic bags are sources of plastic waste | 0.724 | 10 |
| SPW-15 | Building materials like pipes, PVCs, sockets and cement bags are source of plastic waste | 0.718 | 12 |

**The Results Above Shows** Item 1 i.e. Plastic Bottles and Nylons as The Most Abundant Waste in Nsukka Metropolis

 

Table 8: Impacts Of Plastic Waste Showing the Relative Importance Index

| S/N | Items | RII | Index |
|---|---|---|---|
| EPW-1 | Heavy use of plastics increases the pollution in the environment | 0.778 | 1 |
| EPW-2 | Plastic pollution can have a negative impact on wildlife | 0.75 | 3 |
| EPW-3 | Plastic food storage packages have toxic chemicals. | 0.774 | 4 |
| EPW-4 | Massive accumulation of plastic bags blocks drainage systems | 0.772 | 5 |
| EPW-5 | Plastic wastes alter the quality of the soil | 0.772 | 5 |
| EPW-6 | Micro plastics that are often found in the environments, can contaminate food and water supply posing a risk to human health | 0.762 | 2 |
| EPW-7 | Plastic waste can possibly block sunlight | 0.626 | 13 |
| EPW-8 | Plastic waste in landfill can release harmful greenhouse gas, leading to climatic change | 0.572 | 14 |
| EPW-9 | Plastic wastes to an extent reduced the anesthetic nature of Nsukka | 0.71 | 9 |
| EPW-10 | Incinerating of plastics causes hazardous emission of harmful gases | 0.724 | 8 |
| EPW-11 | Plastic wastes can also contribute to climatic crisis | 0.696 | 10 |
| EPW-12 | Production of plastic is one of the most energy- intensive manufacturing processes in the world | 0.68 | 12 |
| EPW-13 | Plastic waste can decrease reproductive health, and cancer | 0.688 | 11 |
| EPW-14 | Animals often confuse plastic bag/nylon for food, therefore blocking their digestive processes | 0.742 | 6 |
| EPW-15 | Plastic wastes in water bodies can affect aquatic lives | 0.732 | 7 |

**The Results Above Shows Item 1 i.e.** Pollution as the Most Common Impact of Plastic Waste

Table 9: Plastic Waste Management Showing The Relative Importance Index

| S/N | Items | RII(Total/A/N) | Index |
|---|---|---|---|
| PWM-1 | Prohibiting one time use plastics can reduce wastes | 0.742 | 11 |
| PWM-2 | Plastic waste can be managed by converting plastics to biogas | 0.816 | 7 |
| PWM-3 | Recycling which involves collection, sorting, and processing of plastic materials to produce new products remains the best plastic management | 0.834 | 2 |
| PWM-4 | Plastic waste can be avoided totally by burning | 0.74 | 12 |
| PWM-5 | Provision of waste bins in strategic location can help manage plastic waste | 0.826 | 5 |
| PWM-6 | Plastic waste can be made useful through incineration and pyrolysis | 0.778 | 10 |
| PWM-7 | Plastic waste management is very important in the society | 0.834 | 2 |
| PWM-8 | Plastic reuse should be encouraged | 0.81 | 8 |
| PWM-9 | Every family, office, schools and churches, should have an approved waste management system other than littering | 0.836 | 1 |
| PWM-10 | Proper plastic waste management helps to preserve nature | 0.824 | 6 |
| PWM-11 | Law should be made against improper disposal of waste | 0.816 | 7 |
| PWM-12 | Awareness and educational programs on plastic waste management should be encouraged. | 0.83 | 4 |
| PWM-13 | plastic waste management should be advocated by individuals, government and non-governmental agencies | 0.832 | 3 |
| PWM-14 | Installing cameras in strategic places just like in developed country can help improve the rate of management | 0.804 | 9 |
| PWM-15 | Proper management aids a quality living hence should be taken seriously | 0.834 | 2 |

 

**The Results Above Shows item 9 i.e.** Every Family, Office, Schools and Churches, Should Have an Approved Waste Management System Other Than Littering as the Best Way of Plastic Management.

## 4.Conclusion

The burden of plastic waste in Nsukka metropolis has been a growing concern in recent years, with far-reaching implications for the environment, human health, and the economy. This study investigated the sources, impacts, and management measures of plastic waste in Nsukka metropolis with a view to identifying effective strategies for mitigating these problems.

The result findings showed that the most abundant source of plastic waste is plastic bottles and nylons, with a Relative Importance Index (RII) of 0.808. This highlights the need for effective waste management strategies for these materials. To address this, a deposit-refund scheme for plastic bottles and nylons could be implemented, and recycling facilities for these materials could be established. Additionally, food wrappers and containers contribute significantly to plastic waste generation, with an RII of 0.784. This emphasizes the importance of proper disposal and recycling of food packaging materials. Furthermore, food vendors and consumers could be encouraged to use biodegradable or recyclable packaging materials, and designated collection points for these materials could be established.

The survey also revealed the most prominent impact of plastic waste on humans and the environment in Nsukka metropolis. The heavy use of plastics increases pollution in the environment, with an RII of 0.778. This underscores the need for reduced plastic usage and effective waste management. To address this, policies promoting sustainable practices could be implemented, such as reducing single-use plastics, and investments could be made in waste management infrastructure. Furthermore, plastic pollution has negative impacts on wildlife, with an RII of 0.75. This highlights the importance of protecting the environment and wildlife from plastic pollution. To address this, measures could be implemented to prevent plastic waste from entering waterways and natural habitats, and conservation efforts could be supported.

Furthermore, the survey reveals the most effective measures for plastic waste management in Nsukka metropolis. Recycling is the best plastic management practice, with an RII of 0.834. This emphasizes the importance of recycling in effective plastic waste management. To address this, recycling programs could be established and promoted, and investments could be made in recycling infrastructure. waste management media campaign contributes on a high extent to the attitudinal change of people from open dump, burning and gutter dumping of refuse to wastebin/dumpsite dumping. This is encouraging as it would help engender proper and healthy environment about 61% of respondents believed that media campaigns play a vital role. A waste management media campaign plays a significant role in changing people's attitudes from open dumping, burning, and gutter dumping to wastebin/dumpsite dumping. This is encouraging because it would help create a proper and healthy environment. Approximately 82% of respondents thought that media campaigns, educational programs are essential to creating a proper mechanism for disposing of plastic waste in cities. They also help to create the knowledge and attitudes that are necessary for a proper and sustainable waste management in the state. on proper plastic waste disposal mechanism in the metropolis. It helps to engender the right attitudes and knowledge needed for a proper and sustainable waste management in the state. The conclusion that media campaigns are essential in encouraging environmental behavior change has been validated by studies. As cited in Andrew (2022) and Rim-Rukeh & Ogbemi (2007:493), Koser, R. (2017) asserts that it can assist individuals in enhancing their understanding of and collaboration with the environment and natural resources. Kurtycz (2005), cited in Andrew (2022), also emphasized the necessity for improved communication to increase people's capacity to engage in daily practices by providing a better grasp of attitudes, behaviors, environmental principles, and waste management theories.

Additionally, every family, office, school, and church should have an approved waste management system, with an RII of 0.836. This highlights the need for collective responsibility in plastic waste management. To address this, individuals and organizations could be encouraged to adopt proper waste management practices, and education and resources could be provided to support this effort.

Conclusively, the burden of plastic waste in Nsukka metropolis is a pressing environmental issue that requires immediate attention and action. Through this study, we have uncovered the alarming rates of plastic waste generation, the inadequate waste management infrastructure, and the devastating impacts on the environment and human health. The findings of this research highlight the need for a multifaceted approach to address the plastic waste problem in Nsukka metropolis, community engagement and individual behavior change.

 

Overall, the findings of this survey provide valuable insights into the sources, impacts, and management of plastic waste in Nsukka metropolis and addressing these issues, Nsukka metropolis can work towards a cleaner, healthier, and more sustainable environment.

**5.Recommendation**

To effectively mitigate the burden of plastic waste in Nsukka metropolis, it is recommended that the government implements policies and regulations that promote sustainable waste management practices. This includes enforcing laws and regulations on plastic waste disposal, increasing public awareness and education on the impacts of plastic waste, and providing incentives for businesses and individuals to adopt environmentally friendly practices. The campaign on environmental sanitation should be strengthened; it should be inculcated into daily life of every citizen of Nsukka. The introduction of public campaigns on the hazards caused by solid waste on the health of the general populace should go a long way in curbing the rate of indiscriminate littering of waste along the streets, roads and drainage channels. Government agencies and non -governmental organization should organize workshops, seminar and symposium to educate the public on the problems associated with improper solid waste management and the best way of managing and disposing their solid wastes.

Additionally, the establishment of effective waste management infrastructure, including recycling facilities and waste-to-energy plants, is crucial for reducing plastic waste in the metropolis. Furthermore, community engagement and participation in plastic waste management is essential, and this can be achieved through public awareness campaigns, community clean-up initiatives, and education programs. Finally, individuals, businesses, and organizations must take responsibility for their plastic waste generation and adopt sustainable practices such as reducing, reusing, and recycling plastic materials. Recycling of wastes will contribute positively in combating refuse problems in our environment. It was observed from the data generated from the respondents that plastics constitute part of the refuse generated and if they are recycled, it will reduce pollution problem.

It is also recommended that the government and relevant stakeholders invest in research and development of new technologies and innovations that can help address the plastic waste problem in Nsukka metropolis. This includes exploring alternative materials to plastic, developing biodegradable plastics, and improving waste management infrastructure. Moreover, collaboration and partnerships between government, private sector, and civil society organizations are crucial for effective plastic waste management. The ‘throwaway culture’ of plastic waste causes vast negative consequences, mainly physical and toxicological harm to the ecosystem. This ubiquitous nature of plastic has led policymakers across the globe to develop local and international policies), and regulations to reverse and slow down the existing menace (van der Marel, 2022). Legal frameworks related to sustainable materials were initiated nearly four decades ago, and the initial policies focused on material waste reduction (da Costa et al., 2020, Syberg et al., 2021).

Lately, several legislations, directives, bans, and levies have been adapted to face growing plastic production at the global, regional, and national levels. Each country adopted different legal systems (policies and legislation) on plastic and plastic waste management to address grievances and consequences presented in society Simply, these legislations should promote investments for the transition to a circular economy, elimination of hazardous chemicals from newly designed plastic products, and removal of harmful substances from the environment (Johansen et al., 2022). For example, South Korea introduced ‘a pay-as-you-throw system’ model to control plastic waste at the end of life (Murti et al., 2022). In addition, South Korea adopted several circular economy strategies, such as the Safe Disposal-Waste Policy in 1980, the Recycling Policy (1992–2003), the Resource Circulation Act in 2016, the Resource Circulation Master Plan (2018–2027), and the Plastic Waste Control Plan (2018–2039, target to reduce plastic waste to 50 % and increase recycle plastic waste to 70 %) (Murti et al., 2022).

Governments, industries, and international bodies play a pivotal role in shaping policies that promote sustainable plastic management and contribute to achieving the broader SDGs (Kumar et al., 2021). By implementing these recommendations, Nsukka metropolis can reduce the burden of plastic waste, protect the environment, and promote sustainable development.

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