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A STUDY ON THE DISPOSAL OF POLYETHYLENE TEREPHTHALATE (PET) BOTTLES IN SELECTED METROPOLISES IN EKITI STATE

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Abstract: The purpose of this study was to assess the environmental risks associated with polyethylene terephthalate (PET) bottles from a variety of beverages. Data was collected in chosen towns in some selected parts of Ekiti metropolis, Nigeria, using a descriptive study design. While the study locations were studied, waste PET bottles were gathered from significant dumping sites inside each of the selected municipalities. Based on a numerical probability of 7% sampling error at a 94% confidence level, samples were chosen and logical conclusions were drawn from the data. The findings revealed that trash PET bottle generation was higher in Ado Ekiti, the state capital, than in other cities/towns. The observed circumstances were caused by customers' excessive consumption and disposal. Even though customers are aware of the negative environmental impact of trash PET bottles, they continue to throw them away indiscriminately in cities, adding to the solid waste brook. The people have discovered that the indiscriminate disposal of PET bottles is causing them several problems. As possible remedies to the concerns identified, community reorientation and information provision that will focus emphasis on altering the prevailing trend are advised.

Keywords: PET Bottles, Waste Management, Ekiti Metropolis, Solid Waste Generation

1. INTRODUCTION

Solid waste is defined as any garbage, sludge, refuse from a waste treatment plant or air pollution control facility, and other disposed material, including solids, semi-solid, liquid, or gaseous matter contained as a result of industrial, commercial, mining, and agricultural activities, as well as community activities, as defined by the United States Congress in 1976. Metal, vegetables, plastic, paper, rubber, wood, glass, or polyethylene are examples of solid waste (6). Waste management is a crucial component of environmental management (6). This includes planning the trash and waste generating process, transportation, regulation, evacuation, collection, storage, control, treatment, and monitoring, as well as coordinating all management measures to maintain the environment's quality, stability, and sustainability (4). An environmental management system is a coordinated system or methods for managing the environment to ensure that it is sustainable, stable, and maintains its quality (5).

Nigeria consumes over 1.2 million tonne of soft drinks table water every year. The plastics of these drinks are used to manufacture home materials, plastic packaging, domestic products, and electrical and electronic goods (1). Every year, 100 billion PET bottles containing bottled water and soft drinks are consumed around the world. All recycling plants around the world recycled about 12% of this total, with the rest ending up in landfills, garbage bins, and open dump sites in cities all over the world (2). The use of PET as packaging for beverages/soft drinks and food are on the increase with the same trend as the bottled water (3). Numerous trash landfills serve as the primary disposal route in many developing countries like Nigeria. More than 60% of public solid wastes are disposed to landfill in Nigeria. Polymers account for a significant portion of trash, and their consumption expands dramatically (10). Despite the fact that polymers make up 5–15 percent of public solid waste and 20–30 percent of the volume, they are not chehaliers (4). Synthetic polymers are non-degradable and take a long time to degrade.

PET is a remarkable barrier material with transparency, high strength, and heat stability that is gradually becoming more popular among manufacturers. Purchasers also pick or prefer PET for a variety of reasons, including its light weight, low cost, shatter resistance, reseal ability, and recyclable nature (5). An increase in the consumption of PET bottle products has been related to a rise in buyer or consumerism culture. Bottled water consumption has been linked to healthy living and product design in prior studies. Other intrinsic and external factors come together to create a link between the customer and the product (7). As a result of this link, the usage of PET bottles has increased in various parts of the world, resulting in a rise in plastic trash generation.

Bottled water has been on the market in Nigeria for some time but in recent years, more of the products have gained notice and appeal (8). Various PET bottle packages for variety products have been launched and introduced into the market by various industries in the country. According to a survey conducted by Euro Monitor International (9), PET bottle packaging outperforms alternative packaging materials in the

marketplace. It was estimated that Nigeria produces over 200 million PET bottles per day. The issue is that consuming the items merely results in surplus which is beyond the capacity of the majority of producers to manage.

Plastic pollution is defined as the unregulated or unmonitored disposal of plastic products in the environment. Plastic pollution frequently penetrates the oceans, causing problems for marine animals, which then serves as a possible source of plastic ingestion by humans via the food chain. As a result, the use of waste plastics in conjunction with other wastes has been recorded in the pursuit of zero waste (10, 11). Plastic recycling is the process of repurposing waste plastic as a primary source of raw materials to make a variety of usable and marketable products. Recycled material, on the other hand, must be handled in a way that minimizes contamination (15). Thus, current recycling methods involve filtering for size and type, a comprehensive washing and separation operation, crushing, drying and granulation to produce a recycled resin pellet product that can be utilized. Nevertheless, low economic value of waste plastic, and the difficult filtering process, has been causing low plastic recycling rates (14). Furthermore, as compared to virgin polymers, recycled plastic might lose qualities due to processing heat, contamination, and the immiscibility of different polymer grades (15). Non-food packaging, traffic bollards and advertising, garden furniture, and plastic lumber are among the current applications for the relatively tiny fraction of plastic components made from recycled plastics (11).

PET bottles, for example, are recyclable and can be used to make film and foil, automotive parts, food containers, and plastic bottles. Recycling is good for the environment in several ways. The strategy conserves natural resources while saving energy and eliminating waste (10). It also mitigates mining, forestry, and manufacturing's detrimental effects (16). According to reports, recycling can cut the amount of waste produced by an ordinary person by 60% over the course of their lives (13).

Recycling is essential in countries like Japan and Germany, where 50 percent of waste is recycled. Less than 30% of total municipal waste is recycled each year in other industrialized countries throughout the world, but the Global South (i.e. developing countries) has embraced recycling as a waste management approach. (9). Recycling is generally beneficial and efficient as a waste management approach, but it is often costly. For instance, in Ekiti State, a number of brands of fruit juice, beverages, milk drinks, bottled water, and soft drinks are widely available in a variety of packaging options, including polythene sachets, cans, synthetic paper packages, PET bottles, and glass bottles. According to the fundamental economic structure of the marketing world, each packaging material competes with the others for consumer attention and consumption. PET bottle packaging is new to most brands of various sorts of beverages, yet it has an equal and good possibility of enticing customers over alternative packaging materials.

More trash PET products are observed cluttering the ecosystems in the selected cities as the use and acceptability of PET materials grows. The goal of this study is to determine the obstacles to PET bottle production and disposal in Ekiti State. This will be one of the crucial steps in reducing the global negative impact of indecent methods of disposing waste PET materials. The cities chosen are those where commercial activity is increasing as a result of the presence of higher education and government institutions.

The goal of this study is to evaluate the issues surrounding PET bottle production and disposal in Ekiti. Based on the inherent nature of the data gathered by the survey, four postulates were proposed. The investigation of these postulates offered answers to the queries while also assisting in the determination of the truth prior observations and empirical analysis the following were the inquiries:

- Is there any spatial variation in customers' preferences for beverages packed in PET bottles in Ado metropolis?
- Are PET bottle buyers aware of the environmental consequences of their purchases?
- Is there any correlation between consumer awareness and product consumption?
- Is there a link between a consumer's income and their usage of PET bottle products?

Bottled drinks are generally consumed in large quantities in countries all over the world. According to studies, the world's fastest expanding business is bottled water manufacture, and PET bottles are now chosen by the water and carbonated beverage industries all over the world. People link bottled water with healthy living, according to World Watch Institute (2011) studies.

2. MATERIALS AND METHODS

The primary source of material for this project is polyethylene terephthalate (PET) bottles from various drinks and water, with the full meanings of the abbreviations indicated below:

- BMD – Bottled milk drinks
- PBJ – Plastic bottled juice
- SGB – Soft drinks in glass bottles
- SPB – Soft drinks in PET bottles
- SPW – Satchel pure water
- CND – Canned drinks
- BTW – Bottled table water



Figure 1. Refuse dumpsite in Ado



Figure 2. Refuse dumpsite in Emure



Figure 3. Refuse dumpsite in Ijero



Figure 4. Refuse dumpsite in Ekiti East



Figure 5. Refuse dumpsite in Oye



Figure 6. Refuse dumpsite in Ikere

The PET samples were collected in the areas shown in Figure 1, with the State capital being Ado-Ekiti, one of the major cities in Ekiti State, Nigeria, located in the country's south-west. It is bordered on the north and west by the local governments of Irepodun and Ifelodun, respectively, and on the south and east by the local governments of Ikere and Igboyin. The Greenwich meridian is located between 70° 39' 28" and 70° 35' 73" north latitude and 50° 10' 12" and 50° 19' 20" east longitude. After the state of Ekiti was founded on October 1, 1996, Ado-Ekiti became the capital city. The following abbreviations were used in this paper as well: A-Ado, E-Emure, I-Ijero, E-Ekiti East, O-Oye, I-Ikere.

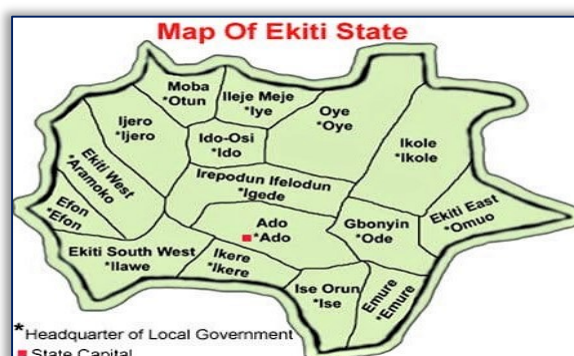


Figure 7. The Map of Ekiti State

3. PROCEDURE FOR DATA COLLECTION

For this investigation, an 8 percent range of tolerable sample error was established at 95 percent confidence level to eliminate bias and ensure a greater degree of precision, accuracy, and reliability. By using the general sample size calculation for computing population percentage, a sample size of 150 was obtained. The study's samples were thus based on a statistical probabilistic estimation rather than the overall population size of Ekiti metropolis. Quantitative analysis (the use of questionnaire) was used to get the sample size. The questionnaires were distributed to 150 people, they are the representatives of Ekiti whole population. The 150 people who got the questionnaires of the survey were chosen at random from 12 wards in each of the six administrative zones (the selected towns) in Ekiti with 25 people from each zone. All the respondents filled the questionnaires and returned them for data collection.

The questionnaires were distributed among students of FUOYE, EKSU and indigenes of each administrative zones. The questionnaires were subdivided into two sections, section A contains the respondents' personal data while section B contained their choice of drink, their awareness of PET products, their waste disposal methods of the bottles and if they have any idea of the pollution problem associated with indiscriminate disposal.

The non-parametric Pearson's chi-square (χ^2) statistical analysis and bivariate correlation analysis were utilized as inferential statistics in this work.

4. POSTULATE TESTING

— Postulate One

H_0 : There is no difference in client demand for drinks packed in PET bottles across the Ekiti metropolitan area.

H_A : Customer demand for drinks packaged in PET bottles is spatially heterogeneous in the Ekiti metropolitan area.

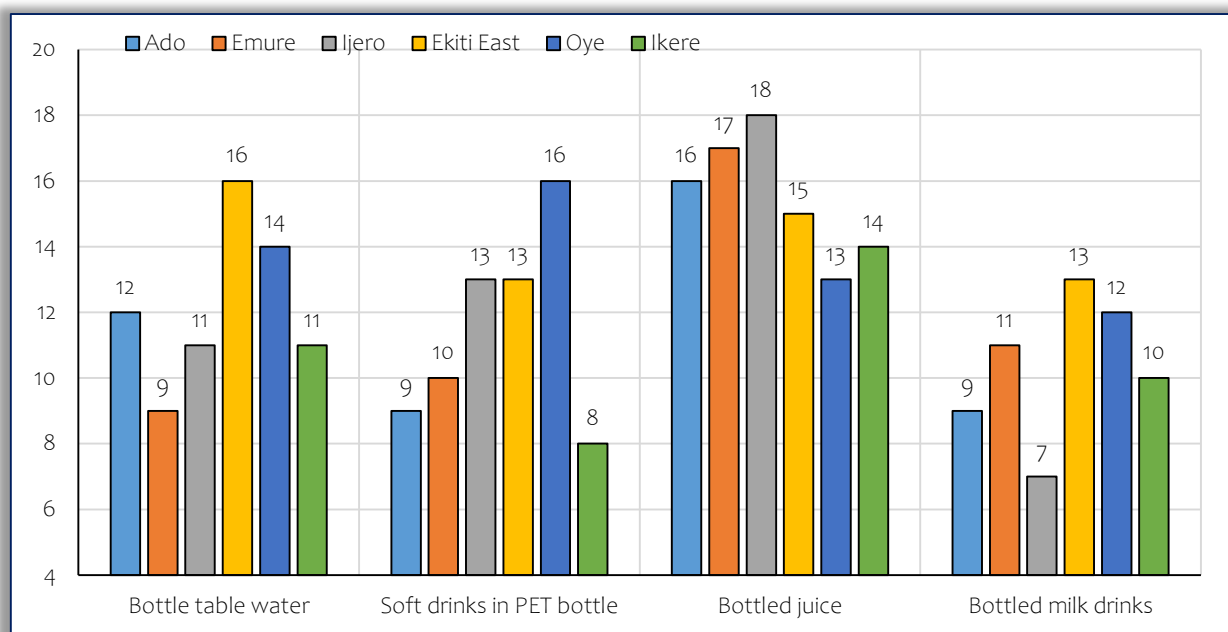
— Postulate Two

H_0 : Bottle made of PET the consequences of utilizing the substance are generally communicated to users in Ekiti metropolis.

H_A : PET bottle users in Ekiti are frequently unaware of the negative implications of using the product.

5. RESULTS AND DISCUSSION

Table 1 shows $P.05$, X^2_{cal} 5.81, X^2_{crit} 23.746, and $Df = 15$. The distribution of trash PET bottles in the selected cities was displayed. Consumption is high across the board. As a result of statistical testing, both the spatial pattern of consumption and the rate of consumption/preference for the product can be regarded confirmed. As a result of this finding, it's acceptable to assume that the pattern and/or rate of PET bottle waste generation across the selected cities within Ekiti State were the same.



Plot 1. Waste Product from the Selected Cities

The data was collected from the questionnaires with the information given by the respondents. $t_{P.05}$, $df = 5$, the estimated X^2 value (3.4202) is less than the tabulated critical X^2 value (10.5165). This suggests that most customers are aware of the consequences of using the product. As a result, the null hypothesis (H_0) is accepted, whereas the alternative hypothesis (H_A) is rejected.

As a result of the findings, it can be stated that customers are generally aware of the socioeconomic and environmental consequences of using the items, particularly in terms of solid plastic waste management in their communities. The table also shows that the percentage of respondents who are aware is two times higher than the percentage of respondents who are clueless. This logically confirms that the vast majority of respondents are aware of the consequences of ingesting PET bottle products. The data below was gotten from the respondents of the questionnaires in each zone.

Table 1. Awareness of the consumers of PET products

S/N	Location	Aware	Not aware	Row–Total
1	Ado	16	5	21
2	Emure	12	9	21
3	Ijero	14	7	21
4	Ekiti East	16	5	21
5	Oye	17	4	21
6	Ikere	13	8	21
7	Colum–Total	88	38	126

— Postulate Three

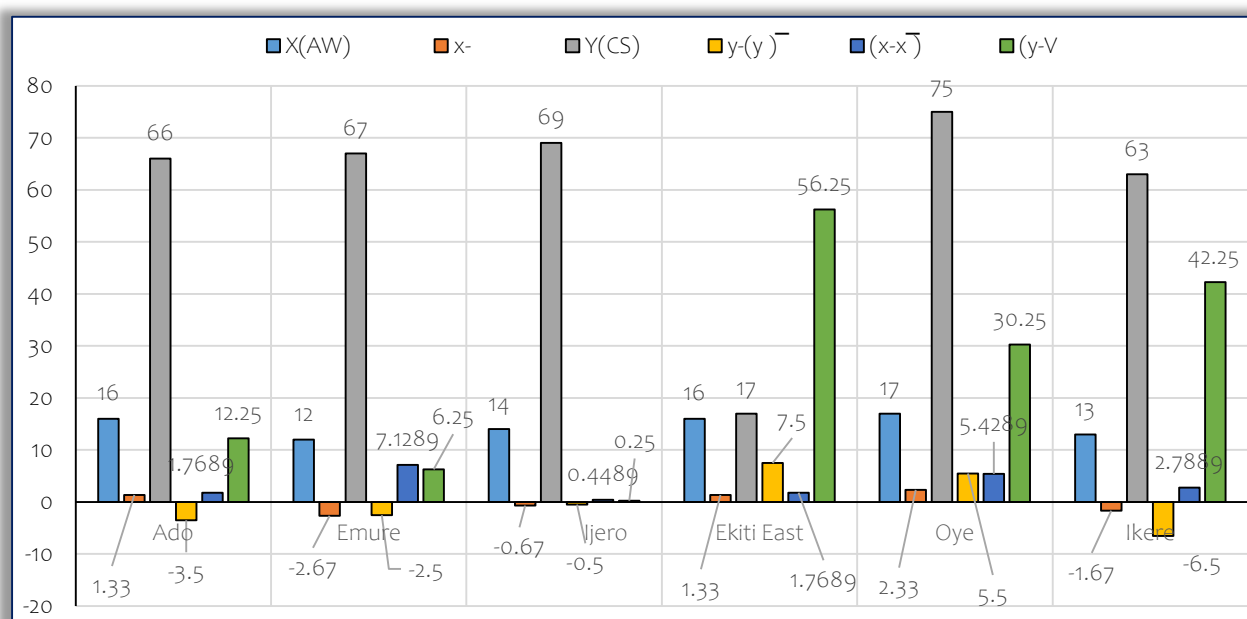
H_0 : There is no link between customers' understanding of the impacts of drinking beverages packed in PET bottles and their product selection.

H_A : The desire for a product is positively associated to the consumer's understanding of the impacts of drinking beverages packaged in PET bottles.

Table 2: Correlation Analysis Table

Location	X(Aw)	$x - \bar{X}$	Y(Cs)	$y - \bar{Y}$	$(x - \bar{x})$	$(y - \bar{y})$
Ado	16	1.33	66	-3.5	1.7689	12.25
Emure	12	-2.67	67	-2.5	7.1289	6.25
Ijero	14	-0.67	69	-0.5	0.4489	0.25
Ekiti East	16	1.33	77	7.5	1.7689	56.25
Oye	17	2.33	75	5.5	5.4289	30.25
Ikere	13	-1.67	63	-6.5	2.7889	42.25
	$\bar{X} = 14.67$		$\bar{Y} = 69.5$			

x = Awareness, y = Consumption, $r_p = 0$, * No Relationship



Plot 2. Correlation Analysis

In a 90% confidence level, the degree of precision, reliability, and accuracy at a 7% range of sampling error was chosen for this investigation. The traditional sample size formula for computing population percentage yielded a sample size of 150. As a result, the study's samples were based on statistical probabilistic estimation rather than sampling the total population of Ekiti metropolis. Nonetheless, the sample of 150 people is representative of Ekiti's entire population. The 150 people who took part in the poll were chosen at random from Ekiti's sixteen local government units.

— Interpretation

The correlation coefficient obtained from the above analysis is 0. This clearly shows that there is no link between consumer awareness and their choice for or consumption of beverages packed in PET bottles. This generally implies that even when consumers are aware of the implications of their actions, they continue to demand or consume the goods. As a result, it can be argued that consumerism (consumer culture) is the primary cause of PET bottle trash generation. Because consumers are unable to control their need for the product, more PET bottle waste is generated as a result of their consumption of beverages packaged in the material.

— Postulate Four

Ho: There is no correlation between consumer income and PET bottle consumption or preference.

HA: Consumer income and their use of or preference for PET bottle products are linked.

Table 3: The Relationship between Consumer Income and PET Bottle Product Consumption

Income levels	Inc	Csp	Inc _r	Csp _r	Inc _r –Csp _r	d ²
0 – 40000	63	96	1	2	–1	1
40001–80000	48	165	2	1	1	1
80001–12000	18	72	3	3	0	0
120,0001–100,000	6	24	5	5	0	0
160004–200000	7	28	4	4	0	0
200001–240001	5	20	6	6	0	0
240001,280000	3	12	7	7	0	0
280,001+	0	0	8	8	0	0
	150	417				Σd ² = 2

$r_s = 0.9$, Relationship that is significant (extremely strong)

— Interpretation

The coefficient of correlation indicates that there is a 90 percent positive association between consumer income and consumption of beverages packed in PET bottles. As a result, the alternative hypothesis is accepted, while the null hypothesis is rejected. The consumption/desire for PET bottle products varies practically immediately with income status scores, as seen in the table above, however the frequency of preference is strong for all income levels. This suggests that, while income level is related to PET bottle use, the products are nonetheless more affordable or preferred/consumed by people of all income levels. As a result of this observation, it is argued that consumers generally have both the desire and the ability to purchase, and that the existing rate of PET bottle trash creation will remain (at least) constant as long as the observed consumption status exists.

The questionnaire also reviewed the respondents' waste disposal method of the PET bottles. The proper method of disposal involves the use of waste bins at schools and homes, while the improper method involves the use of gutters, streets, open space etc.

Table 4. Waste disposal method of the consumers of PET products

S/N	Location	Proper Method	Improper Method	Row–Total
1	Ado	6	19	25
2	Emure	2	23	25
3	Ijero	4	21	25
4	Ekiti East	4	21	25
5	Oye	5	20	25
6	Ikere	3	22	25
7	Colum–Total	24	126	126

6. CONCLUSIONS

PET bottle waste is mostly generated as a result of growing use of beverages packaged in PET bottles, resulting in economic, environmental, and social issues in the city. Major contributions have been recognized as unrestrained consumption, unregulated product manufacture and distribution, and inappropriate waste disposal and management. The following remedies are recommended for adoption by households, individuals, and relevant agencies, particularly the administration of Ekiti city, in order to address the difficulties presented in this study. Ekiti State's social, business, educational, and research organizations all contribute to the reduction of product consumption (PET bottle items) in the state, notably in the city.

They can help with further research and public education, as well as providing relevant research material (reports) to the government in order to support positive policies in the face of the trend. Public waste managers should strive to collect and remove abandoned PET bottles from streets and dumpsites on a regular basis, as well as establish a better waste management system.

Either people should learn to manage their urges and resist peer pressure, or they should let reason lead their beverage selection and consumption. Instead, consumers should avoid unnecessary purchases and consumption of beverages packaged in PET bottles because they are aware of the environmental impact. Only purchasing or consuming what is needed at any given time, as well as choosing only environmentally friendly alternatives (packages) such as those packaged in glass bottles that do not normally enter the public waste stream, would go a long way toward reducing the waste generated by PET bottle products. Garbage PET bottles should be collected and evacuated from streets and dumpsites on a regular basis, and a better technique of effectively managing the waste should be devised.

The government must evaluate and re-design its economic, industrial, and environmental policies to include limitations on the proliferation of PET bottle packaging items, which is sweeping the city right now. The government should oversee PET bottle manufacturers' production and distribution, and businesses that make PET bottle drinks should have recycling facilities at their industrial locations in the city. Manufacturing industries should be required to purchase waste bottles from the general public in order to reduce the expense of waste disposal for individuals and the government's budget (for public municipal waste management). This will help to lessen the environmental and social consequences of the city's waste bottle rubbish.

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