

A SOCIO-ECONOMIC EVALUATION OF WASTE POLYTHENE TEREPHTHALATE (PET) BOTTLES GENERATION, RE-USAGE AND DISPOSAL IN BENIN METROPOLIS

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Abstract

This study examined the generation, usage, and disposal of Polyethylene Terephthalate (PET) bottles in Benin Metropolis from a social-economic perspective. Questionnaires were designed and distributed to randomly selected households and business owners in twenty wards across the four local government areas (Egor, Ikpoba-Okha, Ovia North-East, and Oredo) in the Metropolis. The study revealed that PET bottles are used daily by most of the people sampled in the study. Over 79% of the respondents use between one and three PET bottles daily, while 9.9% of the respondents use between 4 and 7 bottles per day for various purposes and reasons. This indicates a high level of waste PET bottle generation in the Metropolis. The study also revealed that though a majority of the respondents are aware of the environmental impacts of plastic pollution, only a few of them are making efforts to combat the impacts. A huge percentage of the respondents prefer "throwing away" as a disposal method for waste PET bottles, accounting for the vast amount of waste PET bottles in the environment in Benin Metropolis. This implies a dearth of knowledge among many residents on the value of waste PET bottles. Hence, the need for collaborative efforts among policymakers, industries, and the public to formulate and implement effective waste management strategies that will promote recycling and increase awareness for sustainable management practices to mitigate the

environmental impacts associated with waste PET bottle accumulation. Finally, viable solutions are also recommended for necessary implementation.

Keywords: Circular economy; PET bottles; re-use; recycling; waste management

INTRODUCTION

Polyethylene Terephthalate (PET) is an indispensable material in modern packaging due to its remarkable attributes such as lightweight, durability, and recyclability. As a lightweight material, PET significantly reduces costs of transportation and energy consumption level during distribution which contributes to reducing environmental impact. Moreover, the durability of PET ensures the integrity of packaged goods, safeguarding them from damage or contamination. Its most remarkable attribute is its recyclability which contributes to environmental sustainability and offers a closed-loop system wherein discarded bottles can be reprocessed into new products or used for other purposes (Bedell, *et al.*, 2018). As explained by Gallego-Schmid, *et al.*, (2020), circular economy model not only mitigates waste accumulation but also conserves natural resources and reduces greenhouse gas emissions. Consequently, PET emerges not merely as a packaging material but as a symbol of innovation and responsible consumption for

promoting the principles of sustainability and resource efficiency.

The ubiquitous presence of PET in global consumption patterns is due to its attributes of lightweight, durability, and recyclability (Chowdhury, *et al.*, 2018). Globally, PET consumption has increased side-by-side with the proliferation of packaged beverages, personal care products, and food items. This increase is witnessed in every part of Nigeria and has constituted a substantial portion of municipal solid waste. The widespread use of PET has profound implications for waste management systems such as littering, landfill accumulation, marine pollution, leaching of chemicals from PET into food and beverages, and so on (Alabi, *et al.*, 2019). The non-biodegradable nature of PET exacerbates landfill congestion and environmental degradation and further compounded by inadequate recycling facilities. Consequently, the escalating PET consumption calls for urgent need to formulate and implement waste management strategies for mitigating its environmental impact.

Benin metropolis is situated in the South-South region of Nigeria. The metropolis stands as a critical urban centre that is characterised by dynamic demographic shifts, rapid urbanization, and evolving waste management challenges. With an estimated population of 1.9 million people and population growth rate of 3.48% (Macrotrends, 2024), the metropolis serves as a hub of economic, social, and cultural activities in Nigeria. The urbanization rate in Benin metropolis has increased as a result of rural-urban migration, economic opportunities, and infrastructural development. This influx of residents has placed significant strains on existing infrastructure and services especially the waste management systems. The enhancement of waste management in Benin metropolis is imperative in addressing public health concerns, promoting environmental sustainability, and supporting the city's continued growth and development. However, the metropolis grapples with persistent issues of inadequate infrastructure, informal waste practices, and environmental degradation despite efforts to improve waste collection and disposal methods.

The increased consumption of PET bottles in Benin metropolis ought to be matched with its waste management implications. However, the

absence of comprehensive data concerning PET generation rates and citizen perceptions poses a formidable barrier to making data-driven policies that will promote sustainable urban development. The dearth of empirical evidence also impedes the formulation of workable strategies to address the escalating challenges associated with PET waste accumulation and disposal. Moreover, without a thorough understanding of citizens' attitudes and behaviours towards PET usage and disposal, efforts to foster community engagement and promote recycling initiatives will be limited. Consequently, the current situation of PET generation, usage and disposal calls for a rigorous investigation to provide empirical-based evidence on the interplay between PET consumption patterns, waste generation rates, and socio-economic factors in Benin metropolis. This study seeks to fill this gap by investigating the social-economic perspective of polyethylene terephthalate generation rate in Benin metropolis.

The specific objectives of this study includes to; determine the rate of PET bottles generation in Benin Metropolis; establish citizens' perception of PET bottle management (usage and disposal) approach; and to examine PET bottles as circular economic resources for wealth creation.

LITERATURE REVIEW

Polyethylene Terephthalate (PET) Bottles and its Generation

Polyethylene terephthalate is a versatile thermoplastic polymer that serves as the primary material in the production of bottles. The manufacturing process typically involves injection or blow moulding techniques to shape the molten PET resin into bottles of varying sizes and designs (Nisticò, 2020). PET bottles have raised significant environmental concerns due to their persistence in the environment and limited recycling rates. Poor or improper disposal of PET bottles contributes to littering, landfill accumulation, and marine pollution that exacerbate ecological degradation.

PET generation rate refers to the rate at which PET waste is produced within a specific geographic area or over a defined period (Karak, *et al.*, 2012). Understanding PET generation rates is crucial for waste management and environmental sustainability efforts. PET generation rates are influenced by various factors such as population density, consumption

patterns, economic development, and waste management infrastructure. In urban areas with high population density and consumerism, its generation rates tend to be higher due to increased consumption of bottled beverages, packaged foods, and other PET-containing products. Moreover, economic development and rising standards of living often correlate with increased PET usage, as consumers have greater purchasing power and access to packaged goods (Jayachandran, 2022). Another determining factor that plays a significant role in PET generation rates is the behaviour of consumers. Preferences for convenience, portability, and shelf-life extension contribute to the widespread use of PET packaging among consumers. Single-use PET bottles, in particular, are popular for their lightweight, durability, and recyclability. However, the convenience of single-use packaging also leads to higher rates of PET waste generation, as these bottles are often discarded after a single use rather than being recycled or reused.

The estimation of PET generation rates requires comprehensive data on consumption patterns, product packaging, and waste generation. Commonly used methods for estimating PET generation include waste composition studies, waste audits, and waste generation models (Adeniran, *et al.*, 2017). Waste composition studies involve sorting and analysing municipal solid waste samples to quantify the percentage of PET in the waste stream. Waste audits involve weighing and categorising waste collected from households, businesses, or disposal facilities to calculate PET generation rates. Waste generation models use statistical techniques and empirical data to predict waste generation based on demographic, economic, and consumption variables.

The accuracy of the measures used for PET generation rates is essential for guiding policymakers on formulating and implementing policies and strategies on waste management. Policymakers and waste managers can identify trends, assess the effectiveness of recycling programmes, and allocate resources appropriately by quantifying the amount of PET waste generated. Additionally, PET generation rates help in identifying opportunities for waste reduction, reuse, and recycling initiatives. It is important to note that the implications of PET generation rates extend beyond waste

management to include environmental sustainability and resource conservation. PET production requires fossil fuels and energy-intensive processes that could contribute to carbon emissions and resource depletion. Additionally, improper disposal of PET wastes can have detrimental effects on ecosystems, wildlife, and human health and cause environmental degradation through the release of micro plastics and toxic chemicals that could potentially contaminate soil and water sources.

Usage of Polyethylene Terephthalate (PET) Bottles

The usage of PET bottles is a prominent aspect of contemporary consumer culture that is widely used for food and beverage, personal care, and household products. PET bottles are extensively used in the packaging of beverages, such as water, soft drinks, juices, and alcoholic beverages because of its lightweight, durability, and transparency (Mohamed, 2016). These attributes make PET bottles convenient for on-the-go consumption and enhance product accessibility and convenience for consumers. They are also used for packaging of personal care products such as shampoo, lotion, and liquid soap, as well as household items like cleaning agents and cooking oils.

PET bottles are beneficial to both producers and consumers. They provide producers with a cost-effective packaging solution and optimal production processes that enhance the efficiency and scalability of their products. The lightweight nature of PET bottles reduces transportation costs and carbon emissions which contributes to operational sustainability (Sarda, *et al.*, 2022). Moreover, PET bottles facilitate product differentiation and branding through customisable designs, labels, and shapes that enables companies to enhance brand visibility and consumer engagement. From a consumer perspective, PET bottles offer convenience, portability, and product freshness. The lightweight design of PET bottles allows for easy movement and transport. The transparency of the appearance allows consumers to visually inspect product contents. PET bottles are also shatter-resistant that reduces the risk of breakage during handling and transportation.

Disposal of Polyethylene Terephthalate (PET) Bottles

PET bottles disposal represents a critical aspect of waste management and environmental sustainability. This is because of the widespread usage of the containers across various industries, business enterprises and households. The limited biodegradability of PET bottles presents a significant disposal challenge. Poor disposal practices such as littering, landfill dumping, and inadequate recycling contribute significantly to environmental pollution, ecosystem degradation, and public health risks (Ike, *et al.*, 2018). PET bottles that end up in landfills can take hundreds of years to decompose thereby releasing harmful chemicals and micro plastics into the soil and groundwater.

There are several methods for disposing PET bottles. These include recycling, land filling, incineration, and reuse. Recycling represents the most environmentally sustainable option because it conserves resources, reduces energy consumption, and mitigates pollution. PET bottles collected for recycling are sorted, cleaned, and processed into recycled PET (rPET) pellets, which can be used to manufacture new bottles, fibres, and packaging materials. Land filling and incineration are common disposal methods that pose environmental risks and contribute to greenhouse gas emissions, air pollution, and resource depletion.

Empirical Review

Abdulkarim and Abiodun (2012) evaluated the challenges associated with PET bottle generation and disposal in Kano State. The study focused on the consumption patterns of beverages packaged in PET bottles, waste PET bottle management, and their socio-economic and environmental ramifications. Descriptive survey design was used, and data were collected using questionnaire distributed to 150 randomly selected respondents from twelve wards across six metropolitan Local Government Areas. Findings revealed a notable prevalence of PET bottle waste generation in Kano metropolis which is primarily attributable to consumerism characterised by unregulated acquisition tendencies, despite consumers' awareness of associated implications. It was also found that the disposal of PET bottles posed significant challenges for urban residents and the environment.

Kehinde, *et al.*(2020) examined the environmental hazards of plastic waste and its wealth creation potentials. The study found that plastic waste emits toxic gases upon exposure to heat and obstructs drainage systems which can exacerbate flood occurrences and soil erosion as well as deterioration of road infrastructure. This makes it imperative for transitioning towards renewable energy sources and sustainable development The study emphasized the need for urgent measures to repurpose plastic waste through recycling initiatives, presenting opportunities for wealth creation and economic diversification in Nigeria.

Egun and Evbayiro (2020) examined the PET bottle management framework in Nigeria and advocates for the implementation of an integrated PET bottle model/system that is aimed at promoting sustainable waste management practices, conserving resources, enhancing environmental hygiene, and fostering economic advancement in the country. The study identified the importance of adopting a comprehensive and locally driven approach in formulating national policies concerning plastic waste management to include active citizen involvement and stimulation of financial investments in waste management initiatives. The study highlighted the challenges of PET bottle management to include irregularity of size, design, and colour, poor consumer disposal behaviour, and policy legislation.

Environmental Rights Action / Friends of the Earth Nigeria (2021) examined the impact of Plastic leakage, hotspots and flooding linkages in Benin City. The study found that plastic waste (notably PET and sachets) accumulates around markets, drains and waterways; poor collection and few public receptacles drive leakage; post-rain clean-outs repeatedly extract mixed PET/sachet debris from culverts—imposing clean-up costs on local authorities and traders.

Elehinafe, *et al.* (2021) examined the sources, effects, and management of waste PET packaging materials in developing countries. The study found that certain chemicals utilized in PET packaging material production such as additives, pose environmental risks, as do some degradation by-products that may emerge throughout the lifecycle of PET packaging materials. It was also inferred that addressing waste PET packaging materials necessitates

concerted efforts from both sources of generation and through measures such as recycling, public awareness campaigns, reuse initiatives, regulatory measures, product substitution, and enhancements in waste collection practices to alleviate their environmental impacts.

In their study on awareness–practice gap and neighbourhood patterns in Benin City, Adekola et al., (2021) found that there is widespread awareness of waste problems but low source-segregation; neighbourhood type correlates with attitudes/behaviours that enable plastic leakage; implications for GHG emissions from poor waste handling.

UNIDO country study (2022), on national mapping of actors/flows for major polymers incl. PET found that PET is a leading recyclable with price premiums for cleanliness/baling; informal pickers and itinerant buyers are central to feedstock aggregation; transport and depot density shape margins—relevant for cities like Benin lacking large in-state reprocessors.

Okeola *et al.*(2023) examined the impact of extended storage conditions on the physicochemical properties, presence of toxic metals, microbial content, and health risk assessment of three randomly selected brands of sachet and bottled water in North Central, Nigeria. The findings indicated that the physicochemical parameters of both sachet and bottled water samples complied with the standards set by the World Health Organization (WHO) and the Standard Organization of Nigeria (SON). However, heavy metal analysis revealed concentrations of chromium (Cr), lead (Pb), and iron (Fe) exceeding the permissible limits established by WHO and SON, posing potential health risks. Additionally, microbial analysis demonstrated elevated microbial counts that show inadequate quality control measures.

Ezeudu, Tenebe and Ujah, (2024) in their study on National status synthesis with empirical inputs Sustainability deploying a mixed evidence review with Nigerian datasets on production, consumption and end-of-life, found that rapid PET growth, limited sanitary landfilling, nascent EPR; underscores need to integrate informal sector to meet recovery targets.

In a study on Stakeholder awareness and DRS potential (Nigeria; UNN case) Environments that

explored explores deposit-return feasibility with single-use plastic bottle/sachet in focus. The study reported that stakeholders indicate DRS could materially raise collection rates for PET; success hinges on convenient return points and predictable payouts, evidence useful for Benin market/transport hubs (Ogbuabor et al., 2024).

Theoretical Framework

This study was built on two theories: Extended Producer Responsibility (EPR) and Circular Economy theories. A budding body of experimental work has used the Extended Producer Responsibility (EPR) and Circular Economy (CE) frameworks for the study of PET bottles and related packaging streams. Cross-country analysis discover that EPR instruments when paired with matching measures such as product-design requirements , deposit refund systems (DRS) and strong producer responsibility organisations (PROs) consistently improve collection and recycling outcomes for PET, while outcomes vary with regulatory design and enforcement (Tumu et al., 2023; Pani et al., 2021).

EPR was propounded by Thomas Lindhqvist, a Swedish economist and environmental policy expert in the 1990s as a response to the growing concerns about the environmental consequences of industrial production and consumption patterns (Tojo, *et al.*, 2017). The theory argues that manufacturers be held accountable for the entire lifecycle of their products, that is, from design and production to disposal and recycling (Tojo et al., 2017). The theory posits that manufacturers should design products with environmental considerations in mind, implementing strategies to reduce waste generation, and financing or facilitating the collection and recycling of end-of-life products. The focus of the theory is to provide incentives for producers to internalise the environmental costs associated with their products and adopt more sustainable production practices such as eco-design, materials substitution, and waste minimization (Joltreau, 2022). EPR encourages a more equitable distribution of responsibility and promotes the principle of “polluter pays” by shifting the burden of waste management and recycling from taxpayers and local governments to producers. This theory is relevant to this study as it fosters collaboration between stakeholders such as producers, consumers, government

agencies, and recycling industries to develop efficient and effective systems for product stewardship and environmental protection.

The second theory is the circular economy theory also known as circular economy model. It is a holistic framework that redefines economic systems by prioritising resource efficiency, waste reduction, and sustainability (Kirchherr, *et al.*2023). The circular economy model proposes an alternative to the traditional linear "take-make-dispose" approach to production and consumption by ensuring that resources are kept in use for as long as possible through strategies such as reuse, remanufacturing, recycling, and regeneration. The core idea of the model is to close the loop on material flows, whereby products, components, and materials are continually circulated within the economy rather than being discarded after use (Lüdeke-Freund, *et al.*, 2019). This shift requires a fundamental rethinking of product design, supply chains, business models, and consumption patterns to minimise waste generation, maximize resource recovery, and create value from waste streams. The circular economy model is highly relevant to PET bottle usage and disposal as it emphasises minimizing waste and maximizing resource efficiency. The implementation of circular economy principles will make stakeholders to create closed-loop systems for PET bottles to be recycled into new products and reduce the dependence on new materials.

METHODOLOGY

This study employed a cross-sectional research design that focused on households and businesses in Benin metropolis, Edo State, Southern

Nigeria. The study covered consumers and sellers of bottled drinks in the four Local Government Areas (LGAs) in Benin Metropolis. The LGAs are Egor, Ikpoba-Okha, Ovia North-East and Oredo. Data were collected with administered questionnaires. Two hundred (200) copies of the questionnaire were administered to business owners in the four LGAs while two hundred and forty (240) copies were administered to households. Out of the 440 copies administered, 379 copies (household – 208, business – 171) were found usable for data analysis. This represents 86.14% response rate.

The questionnaire comprised three sections: the first section gathered data on the demographic information of the respondents such as gender, age, education family size and business activities. The second section gathered information on general information of PET such as how often do people use PET bottle, the number of plastic water bottles or beverages used or sold, reasons for drinking bottled water, awareness of the environmental impacts of plastic pollution and how PET bottles are disposed of after usage. The third section assessed PET usage and disposal.

Data collected were descriptively analysed using percentages, mean, and standard deviation. All statistical procedures were conducted using the Statistical Package for the Social Sciences (SPSS 24) and Microsoft Excel ®.

RESULTS AND DISCUSSIONS

Results from the analysis of the demographic profile (gender, age, education family size and business activities)of respondents are presented in Table 1.

Table 1: Respondents' demographic information

Variables	Categories	Household		Business		Both	
		Frequency	%	Frequency	%	Frequency	%
Gender	Male	82	39.4	65	38.0	147	38.8
	Female	126	60.6	106	62.0	232	61.2
	Total	208	100.0	171	100.0	379	100.0
Age	15years & below	23	11.1	24	14.3	47	12.5
	16 - 20years	67	32.2	42	25.0	109	29.0
	21 - 30years	70	33.7	42	25.0	112	29.8
	31 - 40years	29	13.9	25	14.9	54	14.4
	41 - 50years	13	6.3	11	6.5	24	6.4
	Above 50years	6	2.9	24	14.3	30	8.0
	Total	208	100.0	168	100.0	376	100.0

Variables	Categories	Household		Business		Both	
		Frequency	%	Frequency	%	Frequency	%
Education Qualification	SSCE/GCE	83	41.1	83	50.0	166	45.1
	NCE/Diploma/OND or Equivalent	22	10.9	44	26.5	66	17.9
	HND/B.Sc or Equivalent	61	30.2	34	20.5	95	25.8
	Postgraduate	36	17.8	5	3.0	41	11.1
	Total	202	100.0	166	100.0	368	100.0
Family Size	Less than 5	38	18.3	Not Applicable		38	18.3
	5 - 10	166	79.8			166	79.8
	Above 10	4	1.9			4	1.9
	Total	208	100.0			208	100.0
Business Activity	Retailing	Not Applicable		81	50.0	81	50.0
	Restaurant			35	21.6	35	21.6
	Distributor			18	11.1	18	11.1
	Wholesale			24	14.8	24	14.8
	Producer			4	2.5	4	2.5
	Total			162	100.0	162	100.0

Results of the analyzed data revealed that 147 (38.8%) of the respondents were male while 232 (61.2%) were female. The age distribution of the respondents showed that 47 (12.5%) of the respondents were 15 years and below, 109 (29%) were 16 – 20 years old while 112 (29.85%) were 21 – 30 years old. The respondents that were between 31 and 40 years old were 54 which represented 14.4% of the total respondents. The results also show that 24 (6.4%) of the respondents were 51 -50 years old while the remaining 30 (8%) respondents were 50 years and above. This shows that majority of the respondents are between 16 and 30 years old.

The educational qualification shows that 166 (45.1%) are holders of Senior Secondary Certificate Examination/General Certificate Examination (SSCE/GCE) while 66 (17.9%) have National Certificate of Education/Diploma/National Diploma (NCE/Diploma/ND) or Equivalent. 95 (25.8%) of the respondents are first degree holders while 41 (11.1%) have postgraduate qualification. The family size of the household respondents shows that 38 (18.3%) have a family size of less than 5 while 166 (79.8%) of them have a family size of 5 to 10 members. Only 4 (1.9%) of the respondents have family size of more than 10. The business activities of the business respondents shows that 81 (50%), 35 (21.6%), 18

(11.1%), 24 (14.8%) and 4 (2.5%) were into retailing, restaurant, distribution, wholesaling and production respectively.

Table 2 presents the results of the items or questions on PET generation rate in Benin Metropolis. The questions centred around how often do people use PET bottle, the number of plastic water bottles or beverages used or sold, reasons for drinking bottled water, awareness of the environmental impacts of plastic pollution. Table 2 shows that 157 (42.9%) of the respondents use PET bottles daily while 158 (43.2%) use PET bottles occasionally. 47 (12.8%) and 4 (1.1%) indicated that they rarely or never use PET bottles. This shows that the level of usage or generation of PET bottles is high among the respondents as majority of them indicated that they used it daily or occasionally.

As household level, the results show that 161 (79.7%) of the respondents used between 1 and 3 PET bottles daily while the 20 (9.9%) of the respondents used between 4 and 7 bottles per day. Only 21 (10.4%) of them indicated that they do not use PET bottles daily. For business respondents, the results show that 59 (35.5%), 47 (28.3%), 22 (13.3%), and 38 (22.9%) sold and average of less than 50, 50 to 100, 101 -200, and above 200 plastic water bottles or beverages such as Coke, Fanta etc per day.

Table 2: PET bottles generation rate

Variables	Categories	Household		Business		Both	
		Frequency	%	Frequency	%	Frequency	%
How often do you use PET bottle?	Daily	70	34.5	87	53.4	157	42.9
	Occasionally	105	51.7	53	32.5	158	43.2
	Rarely	24	11.8	23	14.1	47	12.8
	Never	4	2.0	-	-	4	1.1
	Total	203	100.0	163	100.0	366	100.0
Approximately how many plastic water bottles or beverages (e.g. Coke, Fanta etc) do you drink a day?	1 - 3	161	79.7	Not Applicable		161	79.7
	4 - 7	20	9.9			20	9.9
	None	21	10.4			21	10.4
	Total	202	100.0			202	100.0
Approximately how many plastic water bottles or beverages (e.g. Coke, Fanta etc) do you sell a day?	Less than 50	Not Applicable		59	35.5	59	35.5
	50 - 100			47	28.3	47	28.3
	101 - 200			22	13.3	22	13.3
	Above 200			38	22.9	38	22.9
	Total			166	100.0	166	100.0
Do you carry a refillable water bottle with you?	Yes	102	49.3	54	33.1	156	42.2
	No (It is not convenient)	74	35.7	78	47.9	152	41.1
	No (I have not considered it as an option)	31	15.0	31	19.0	62	16.8
	Total	207	100.0	163	100.0	370	100.0
Reasons for consuming bottled drink/water	Convenience	88	42.3	56	32.7	144	38.0
	Affordable	51	24.5	24	14.0	75	19.8
	Clean	94	45.2	66	38.6	160	42.2
	Safe	83	39.9	59	34.5	142	37.5
	Packaged in a portable manner	78	37.5	48	28.1	126	33.2
How informed are you about the environmental impacts of plastic pollution	Very informed	133	64.9	94	55.6	227	60.7
	Uninformed	26	12.7	30	17.8	56	15.0
	I have a vague idea	46	22.4	45	26.6	91	24.3
	Total	205	100.0	169	100.0	374	100.0

Majority of the respondents (156, 42.2%) indicated that they do carry a refillable water bottle with them while 152 (41.1%) indicated NO as a result of inconvenience. 62 (16.8%) respondents indicated NO as a result of not considering it as an option. The reasons for consuming bottled drinks and water in order of importance are cleanliness (42.2%), convenience

(38%), safety (37.5%), portability (33.2%) and affordability (19.8%). The results also showed that majority (60.7%) of the respondents are informed about the environmental impacts of plastic pollution. 56 (15%) indicated that they are not informed while 91 (24.3%) tend to have a vague idea about the environmental impacts of plastic pollution.

Table 3: PET bottle usage

Statement	Household		Business		Both	
	Mean	Rank	Mean	Rank	Mean	Rank
I often use PET bottles to store beverages or other liquids	1.93	3rd	2.38	4th	2.14	4th

Statement	Household		Business		Both	
	Mean	Rank	Mean	Rank	Mean	Rank
I reuse PET bottles for do-it-yourself (DIY) projects such as creating flower pots and other crafts at home	3.08	1st	3.07	1st	3.08	1st
PET bottles are used as a means of dispensing water	1.92	4th	2.55	3rd	2.20	3rd
I often use PET bottles for storing household items such as grains, spices, or small items	2.52	2nd	2.80	2nd	2.65	2nd
Overall Mean & Standard Deviation	2.36		2.70		2.52	

Table 3 shows the usage of PET bottle by households and among business owners. For household, PET bottles are mostly used for do-it-yourself (DIY) projects such as creating flower pots and other crafts at home ($\bar{X}=3.08$; Rank = 1st), for storing household items such as grains, spices, or small items ($\bar{X}=2.52$; Rank = 2nd), for storing beverages or other liquids ($\bar{X}=1.93$; Rank = 3rd), and as a means of dispensing water ($\bar{X}=1.92$; Rank = 4th). For business owner, the assessment of PET bottles usage include for do-it-yourself (DIY) projects such as creating flower pots and other crafts at home ($\bar{X}=3.07$; Rank = 1st), for storing household items such as grains,

spices, or small items ($\bar{X}=2.80$; Rank = 2nd), as a means of dispensing water ($\bar{X}=2.55$; Rank = 3rd) and for storing beverages or other liquids ($\bar{X}=2.38$; Rank = 4th).

For both household and business owners, the usefulness of PET bottles include for do-it-yourself (DIY) projects such as creating flower pots and other crafts at home ($\bar{X}=3.08$; Rank = 1st), for storing household items such as grains, spices, or small items ($\bar{X}=2.65$; Rank = 2nd), as a means of dispensing water ($\bar{X}=2.20$; Rank = 3rd) and for storing beverages or other liquids ($\bar{X}=2.14$; Rank = 4th).

Table 4: PET bottle disposal

Statement	Household		Business		Both	
	Mean	Rank	Mean	Rank	Mean	Rank
I support community-based recycling programmes that encourage the collection and proper disposal of PET bottles	2.30	3rd	2.01	5th	2.17	3rd
There are designated collection bins for PET bottles in public spaces, residential areas, and commercial establishments	2.62	1st	2.72	2nd	2.67	1st
Regulations related to PET bottle proper disposal are not stringently implemented	2.11	4th	2.08	4th	2.10	4th
There is low public awareness campaigns to educate citizens about the environmental impact of improper PET bottle disposal	1.70	5th	2.15	3rd	1.90	5th
There are partnerships with recycling companies or local businesses to provide incentives for participating in PET bottle collection and disposal	2.48	2nd	2.87	1st	2.66	2nd
Overall Mean & Standard Deviation	2.24		2.37		2.30	

Table 4 shows the disposal of PET bottle by households and among business owners. For household, the disposals of PET bottles are assessed as follows: usage of designated collection bins for PET bottles in public spaces, residential areas, and commercial establishments ($\bar{X}=2.62$; Rank = 1st), partnerships with recycling companies or local businesses to provide

incentives for participating in PET bottle collection and disposal ($\bar{X}=2.48$; Rank = 2nd), support community-based recycling programmes that encourage the collection and proper disposal of PET bottles ($\bar{X}=2.30$; Rank = 3rd), Regulations related to PET bottle proper disposal are not stringently implemented ($\bar{X}=2.11$; Rank = 4th), low public

awareness campaigns to educate citizens about the environmental impact of improper PET bottle disposal ($\bar{X}=1.70$; Rank = 5th). For business owners, the disposals of PET bottles are assessed as follows: partnerships with recycling companies or local businesses to provide incentives for participating in PET bottle collection and disposal ($\bar{X}=2.87$; Rank = 1st), usage of designated collection bins for PET bottles in public spaces, residential areas, and commercial establishments ($\bar{X}=2.72$; Rank = 2nd), low public awareness campaigns to educate citizens about the environmental impact of improper PET bottle disposal ($\bar{X}=2.15$; Rank = 3rd), Regulations related to PET bottle proper disposal are not stringently implemented ($\bar{X}=2.08$; Rank = 4th), and support community-based recycling programmes that encourage the collection and proper disposal of PET bottles ($\bar{X}=1.90$; Rank = 5th).

For both household and business owners, the disposals of PET bottles are assessed as follows: usage of designated collection bins for PET bottles in public spaces, residential areas, and commercial establishments ($\bar{X}=2.62$; Rank = 1st), partnerships with recycling companies or local businesses to provide incentives for participating in PET bottle collection and disposal ($\bar{X}=2.48$; Rank = 2nd), support community-based recycling programmes that encourage the collection and proper disposal of PET bottles ($\bar{X}=2.30$; Rank = 3rd), Regulations related to PET bottle proper disposal are not stringently implemented ($\bar{X}=2.11$; Rank = 4th), low public awareness campaigns to educate citizens about the environmental impact of improper PET bottle disposal ($\bar{X}=1.70$; Rank = 5th).

Table 5: Approaches to PET bottle disposal

S/N	Options	Household		Business		Both	
		Frequency	%	Frequency	%	Frequency	%
1	Throw in the recycling bins	123	59.1	82	48.0	205	54.1
2	Donate for re-use	43	20.7	47	27.5	90	23.7
3	Sell it	11	5.3	19	11.1	30	7.9
4	Burn it	28	13.5	20	11.7	48	12.7
5	Throw it anywhere	79	38.0	42	24.6	121	31.9

Note: Since a checklist scale was used, the % was computed over total number of respondents (that is, 208)

Table 5 shows the approaches to disposal of PET bottle by households and among business owners. For household, 123 (59.1%) preferred disposing of their PET bottles by throwing them in the recycling bins while 79 (38%) throw them anywhere. 43 (20.7%) prefer donating it for re-use while 28 (13.5%) prefer burning them. Only 11 (5.3%) prefer selling them. For business owners, 82 (48%) preferred disposing of their PET bottles by throwing them in the recycling bins while 42 (24.6%) throw them anywhere. 47 (27.5%) prefer donating it for re-use while 20 (11.7%) prefer burning them. Only 19 (11.1%) prefer selling them. For household and business owners, 205 (54.1%) preferred disposing of their PET bottles by throwing them in the recycling bins while 121 (31.9%) throw them anywhere. 90 (23.7%) prefer donating them for re-use while 48 (12.7%) prefer burning them. Only 30 (7.9%) prefer selling them.

PET Bottles as Circular Economic Resources for Wealth Creation

Polyethylene terephthalate (PET) bottles hold significant potential as circular economic resources for wealth creation in Nigeria. PET bottles are widely used in Nigeria especially among beverage firms and table water companies. PET bottles have considerable economic value as recyclable materials. The recycling industry in Nigeria, though still in its nascent stage, has been gaining momentum, driven by increasing awareness of environmental issues and the potential economic benefits of recycling. According to the Recycling Association of Nigeria (RAN), the PET recycling rate in Nigeria has been steadily increasing, with more recycling facilities being established across the country. These facilities collect, sort, and process PET bottles into recycled PET (rPET) flakes or pellets, which can be used as raw material for manufacturing new products such as bottles, fibres, and packaging materials.

Moreover, the circular economy model emphasises the importance of keeping resources in use for as long as possible through strategies such as reuse and remanufacturing. The initiatives for promoting the reuse of PET bottles have the potential to generate income for entrepreneurs while reducing waste and environmental impact. Stakeholders in the informal sector play a significant role in PET bottle collection and recycling in Nigeria. Waste pickers, commonly known as "scavengers," collect PET bottles from landfills, streets, and households, selling them to recycling facilities for a profit. This informal sector provides employment opportunities for thousands of individuals and contributes to the informal economy of Nigeria.

CONCLUSION

The study insightfully discusses the generation, usage, and disposal of Polyethylene Terephthalate (PET) in Benin Metropolis from a social-economic perspective. Questionnaires were designed and distributed to households and business owners in four LGAs (Egor, Ikpoba-Okha, Ovia North-East and Oredo) in Benin Metropolis. The study revealed that PET bottles are used (or generated) on daily basis by most of the people sampled in the study. Over 79% of the respondents use between one and three PET bottles daily. This shows high level of PET bottle generation in the metropolis. The major reasons for consuming bottled drinks and water include cleanliness, convenience, safety, portability and affordability. The study also showed that majority of the respondents is informed about the environmental impacts of plastic pollution. It was also found that PET bottles are used DIY projects such as creating flower pots and other crafts at home, for storing household items such as grains, spices, or small items, as a means of dispensing water, and for storing beverages or other liquids. The popular approaches used by household and business owners in disposing of PET bottles include disposal in recycling bins, indiscriminate dumping, burning or selling them. The study concludes that collaborative efforts are needed among policymakers, industries, and the public to formulate and implement effective waste management strategies that will promote recycling and increase awareness for sustainable management practices to mitigate the environmental impacts associated with PET waste accumulation.

RECOMMENDATIONS

The following recommendations are made based on the research findings:

Implementation of sustainable recycling programmes: Based on the high level of PET bottle generation in Benin metropolis, there is a need for Government to design and implement robust recycling programmes that will connect the people with recycling facilities to establish convenient collection points and educate residents on the importance of recycling PET bottles. Doing this can help divert a significant portion of PET waste from landfills and reduce environmental impact.

Promotion of do-it-yourself (DIY) reuse initiatives: There is an opportunity to promote creative reuse initiatives of PET bottles since they are commonly used for DIY projects and household storage. Manufacturers in collaboration with middlemen (wholesalers, distributors and retailers) should organise workshops on repurposing PET bottles into useful items like flower pots, building materials and so on. This will help in reducing waste and foster a sense of environmental responsibility and creativity among residents.

Raising awareness on environmental impacts: There is need for continuous education and awareness campaigns to sustain and increase the level of awareness of the environmental impact of poor management of PET bottles. This can be achieved by disseminating information via social media, educational seminars, and community events on the detrimental effects of PET waste accumulation and the benefits of proper disposal and recycling.

Rewarding responsible disposal practices: Incentivizing responsible disposal practices can help discourage improper disposal methods like littering or burning of PET bottles. For example, retailers can be empowered to implement a deposit-refund system where individuals receive a monetary reward for returning PET bottles to designated collection points. Importantly also, businesses could be encouraged to adopt sustainable packaging practices or offer discounts for customers who bring their own reusable containers to reduce reliance on single-use PET bottles.

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