

Accelerating plastic waste collection for recycling in Ibadan

Joseph SijiAyodeji

*Environment and physical Infrastructure Policy Department
Nigerian Institute of Social and Economic Research(NISER), Nigeria.
josephsiji12@gmail.com*

Abstract.

Background: Plastic use in various ways has driven its production to be as high as 7.8 billion tonnes in 2015 and as a result of its linear usage that spans acquisition, consumption, and disposal, about 12 billion tonnes of plastic waste are expected to be discarded by 2025 causing pollution which cities like Ibadan will contend with. This is owing to the absence of a framework and technology to manage the resulting plastic waste.

Materials and Methods: The study adopted a mixed method and multistage survey approach for the collection of data from Two Hundred (200) Respondents drawn randomly from households and public spaces like markets and motor parks, for attitudinal assessment towards sustainable plastic waste disposal practices. The collected data were statistically analyzed using SPSS for descriptive and inferential analysis.

Results: The study revealed a sizeable proportion of sampled individuals (69%) are willing to embrace clean or sustainable plastic waste disposal systems compared to 31% that are not willing to embrace sustainable plastic waste management in the city. Equally, 178(89%) choose to adopt clean plastic waste disposal by storing plastic waste in a designated place for collectors, and 22(11%) are willing to sell plastic waste to local waste scavengers. However, the willingness to embrace sustainable plastic waste disposal is influenced by some factors like educational status, income, age, and gender of the respondents. Of these factors, education is significant at 0.62 implying education affects waste sorting and separation.

Conclusion:The study recommends regulators come up with a framework that promotes awareness and involvement of relevant stakeholders like the consumers and recyclers in adopting attitudes like separation and sorting of waste to sustain schemes like Kerbside and BringSystem for accelerated plastic waste collection.

Key words: Plastic Waste, recycling, Kerbside, Bring System, Sustainable disposal

Date of Submission: 16-12-2022

Date of Acceptance: 31-12-2022

I. Introduction

Owing to its acceptability in every aspect of human existence, plastic production has risen overtime reaching 7.8 billion tonnes in 2015, their consumption and disposal pattern continue to pose a serious threat to the environment and human health (United Nations Development Programme, 2019). With plastic consumption reaching 297.5 million tons, it is anticipated that by 2025, almost 12 billion tons of plastic would be dumped or disposed, following existing linear model of "take, make, use, and dispose" that is extremely costly to the environment, the economy, and health (Hameed, et al, 2021; United Nations Development Programme, 2019). While the rate of plastic manufacture remains constant, the output steadily deteriorates as the wastes that arise from improper disposal end up polluting the environment (Antonov, 2020)

According to the third report of the Royal Commission on Environmental Pollution in the United Kingdom published in Appannagari, pollution denotes the introduction of substances or energy into the environment by man that have the potential to cause risks to human health, damage to living things and ecological systems, destruction of structures or amenities, or interference with legal uses of the environment (2017).

This occurs when poorly managed system such as landfills cause either the escape of plastic waste or the escape of landfill leachates resulting in many effects on the health of ecosystems and humans (Verma et al, 2015). A major challenge of plastic waste is the peculiarity of its production and consumption across various climes. In the UK, several tonnes of plastics to the tune of about 5 million are yearly consumed with just about one-quarter recycled, and the rest landfilled. In India, about 24 million tonnes are consumed annually of which 5.6 million tonnes get discarded as plastic waste in a similar situation to what obtains in many other lower-middle-income countries like Nigeria, where a centrally organized waste collection infrastructure is almost

nonexistent (Alhazmi, Almansour and Aldhafeeri, 2021). This development prompts suggestions, by researchers, that by 2050, oceans might contain more plastics than fish in terms of weight (Alabi et al. 2019).

In response to the foregoing, plastic waste management can be viewed as a system that has the potential to create value at each stage of the value chain especially with respect to; fair and decent employment, sustainable revenue generation, climate and environmental protection benefits (GSMA, 2021). At present, strategies to collect, sort, incinerate, bury or reuse plastic waste obviously fall short of the ever-growing volume of plastic waste and as such connotes plastic waste management problem (Barrowclough, 2022). In the meantime, plastic recycling value chains in LMICs would suffice and will involve a wide range of actors responsible for segregating, collecting, sorting, aggregating and recycling (GSMA, 2021).

With numerous advantages accruing from plastics sorting and recycling, Kehinde et al, (2020) highlight importance of recycling as beneficial to construction, architecture, clothing, arts and designs well as being a means of earnings when collected plastic wastes are sold to the recyclers. In their view, Singh and Trivedi (2020) adjudged plastic waste recycling is efficient in dealing with plastic waste phenomenon however its effectiveness is profoundly depended on public awareness, economic viability, and the implementation of public infrastructures. This prompted Sorme et al (2019) to allude increased recycling of plastic waste to some underlying factors like waste sorting at household level. Sorting according to them would depend on; social demographic factors, such as age; economic incentives, waste fees; awareness and knowledge on recycling, and availability of system for waste collection. Mwanza, Mbohwa, and Telukolaire, (2018) in their view opined institutionalization of collection scheme is an integral part of plastic recycling and advocating more strategies aside technology to sustain global resource.

In the meantime, recycling is considered one of the options in the solid waste management hierarchy capable of reducing the impacts inherent in End of Life (EoL) and End of Use (EoU) of plastic products and instead recycling is deemed a sustainable manufacturing process as recovered plastic wastes are used for manufacturing new products (Mwanza and Mbohwa, 2017). Ncube, et al, (2021) established that considerable quantity of plastic packing is in use and owing to the nature of its usage and disposal lifespan, recycling is vital to ameliorating its associated pollution. They however, identified collection, sorting and processing as three vital steps to successful plastic recycling. Thus recycling is viewed as industrial process that commences with plastic waste sorting (Aikowe and Magancova (2021).

Plastic has a high recovery and recycling potential yet plastic recycling rate in Nigeria is reportedly less than 12% which less matches the plastic waste generation compared to Cameroon and India where annual recycling rates are 20% and 47% respectively. In a bid to achieving circularity of plastic, the role of food and beverages recycling is expected to be tailored to collection, recovery and recycling of post-consumer packaging waste inline with the Extended Producer's Responsibility Guidelines (Naijalink Research, 2020). This is consistent with Siti, Tri and Haruki (2021) work on post-consumer packaging wastewhere incorporation of informal sector for take-back (collection of plastic wastes for recycling) to enhance recycling was given much credence. Hahladakis et al, (2018) assessed the yield of multiple collection recycling schemes such as Kerbside Collection, Household Waste Recycling Centres, Bring Sites /banks in England and their findings show that kerbside collection system is higher than household waste recycling centres and Bring Backs (BBs). With awareness of the need to attain some SDG targets, countries or nations substitute their linear economic models with circular economic model that reflect a system that revolves around optimal resources utilization, sustainable materials and effective waste management driven by implementation of Extended Producer Responsibility (EPR) (Ajania and Kunlere, 2019). While combination of structures like bring systems, kerbside collection and recycling banks proved to be a major driver of increased recycling (Kehinde et al, 2020), this could be explored in Ibadan for heightened plastic waste collection for onward recycling.

Complementing this is the influence of consumers via sorting and separation in ensuring the sustainability of frameworks for collecting plastic waste for recycling. Thus age, income, gender and educational status of the consumers are critical in driving plastic wastes recycling as solution for infrastructural deficits as well as environmental pollution and degradation. With any known collection framework lacking in Ibadan, application of relevant schemes could be explored as option for heightening plastic waste collection in the city. In this regard, the evident compelling issues in managing plastic wastes would require institutionalizing a framework for effective and sustained plastic waste management to avert acute plastic pollution in our environment and ocean annually (Geyer et al., 2017). However, there has not been a similarly anticipated framework for plastic waste collection system in Ibadan metropolitan city for recycling. Thus the study focuses on assessing the issues that could aid plastic waste collection in the city.

II. Materials and Methods

Ibadan is the administrative capital of Oyo State and the third largest metropolitan area in Nigeria based on population, after Lagos and Kano according to the 2006 Nigerian census. The population in the city particularly supports trade in beverages and other businesses in the line of packaging and other businesses that

promote generation and disposal of plastic wastes. As at 1999 the city had a total population of 1,829,300 at a growth rate of 1.65%, and by the 2006 census was said to have a population 1.34 million people (Adelekan, 2016) and by 2019 the population had risen to 3,464,000 with an increase of 2.39% from 2018 (Macro Trends, 2020).

Ibadan lies within the coordinates of 7°23'47"N and 3°55'0"E while occupying a total area of 3,080 km².

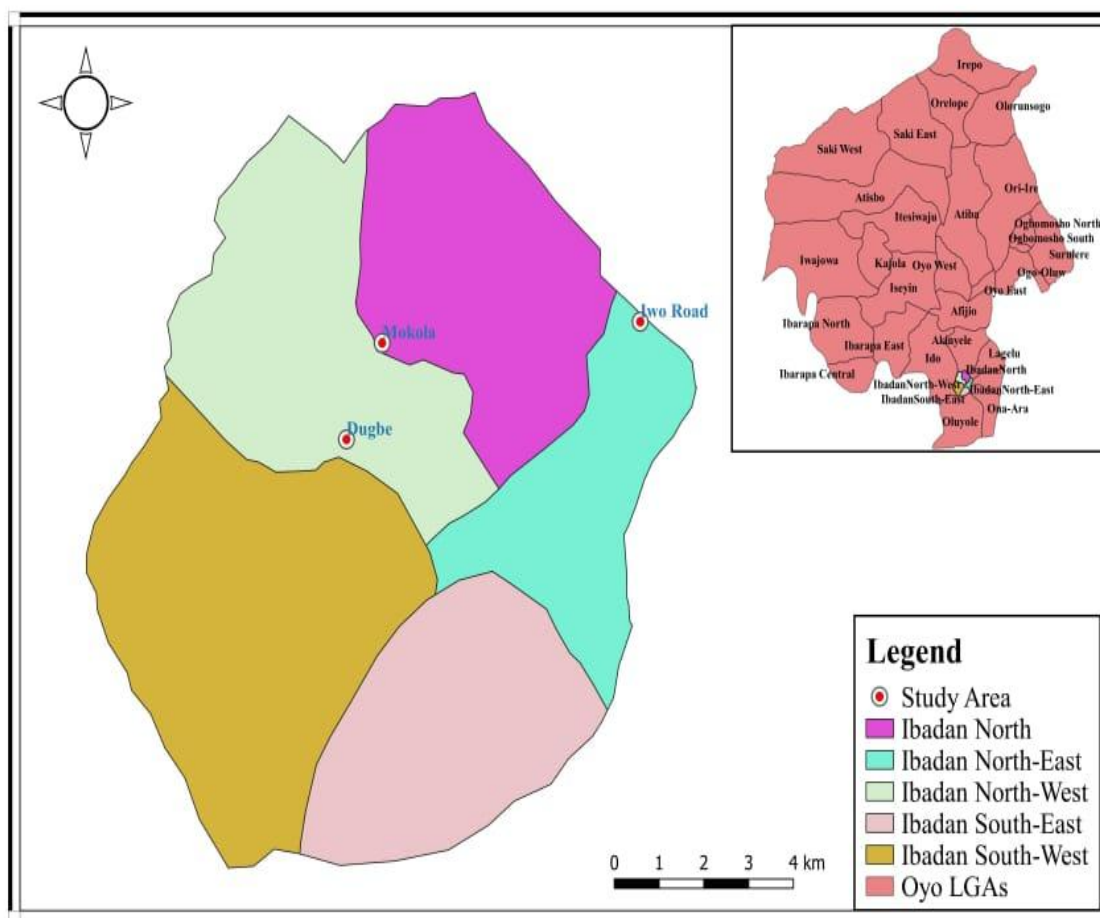


Fig. 1 Ibadan Metropolis

Methodology

The study adopted a mixed method comprising qualitative and quantitative research techniques. The quantitative approach employed questionnaire to capture relevant variables underlying plastic collection in the study area from 200 randomly drawn respondents from markets, motor parks, and households within the metropolis. The qualitative approach on the other hand, involved the use of key informant interviews, field observation to generate relevant qualitative data to complement the quantitative data on plastic waste management in the metropolis. Data Collection for the study adopted a multistage sampling technique involving purposive selection of geographical locations that meet study condition; followed by random identification of sample location within the chosen geographical area and random sampling of respondents who are potential or active plastic wastes generators. Data and information from administration of questionnaires were quantitatively analyzed using descriptive and inferential statistical analytical tools while those of qualitative sources were content analysed.

Model Specification

The logistic regression model was used to identify and quantify factors that predict attitude and responses of urban plastic generators towards sustainable plastic disposal. This model is appropriate because the dependent variable is discrete (that is, binary yes =1, otherwise = 0) as it measures whether one is willing to adopt sustainable plastic waste disposal or not. When the outcome variable is restricted to two values (such as

this), a binary logistic regression is appropriate. The logistic model can be written in terms of the log of the odds:

$$\frac{\text{LogProb (adoption of sust plastic waste disp)}}{\text{Prob (noa adoption of plastic waste disposal)}} = B_0 + B_i X_i + \dots \dots \dots B_n X_n \quad (1)$$

The odds of adopting sustainable plastic waste disposal is defined as the ratio of the probability that households will adopt sustainable plastic waste disposal to the probability that they will not adopt. The logistic regression coefficient is interpreted as the change in the log odds associated with a one-unit change in the independent variable. If the coefficient is positive, it increases the odds of experiencing the outcome, when negative it decreases the odds. When the coefficient is 0, the odds are left unchanged. Logistic regression measures the relationship between the categorical dependent variable and one or more independent variables, which may, or may not be continuous. This is done by estimating probabilities. In a logistic regression model, the estimated probabilities are restricted to 0, 1 through the logistic distribution function because the model predicts the probability of the instance being positive. The model is estimated as:

$$\ln\left(\frac{\pi}{1-\pi}\right) = \alpha + \beta_1 X_1 + \beta_2 X_2 \dots + \beta_k X_k \quad (2)$$

$$\pi = \text{Probability (Y = outcome of interest | } X_1 = X_1, X_2 = X_2, X_k = X_k) \\ = \frac{e^{\alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_k X_k}}{1 + e^{\alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_k X_k}} \quad (3)$$

β are the values of the logistic regression equation for predicting the dependent variable from the independent variables. The empirical model to be used is

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \epsilon \quad (4)$$

Where

Y=Willingness to embrace sustainable plastic waste disposal (Willing =1; Otherwise =0)

X₁ = Gender (male=1; female=0)

X₂ =Primary Education level(yes =1; no =0)

X₃ = Secondary School(yes=1; no=0)

X₄= Tertiary Education (yes=1; no=0)

X₅= Age (years)

X₆= Income(Naira)

A= constant term

III. Result

Table no 1 shows marital status of the respondents under marital status, gender, education, age and occupation. With respect to marital status, 66 single, 130 married, 2 Widowed/Widower and 2 separated individuals were sampled and they constituted 33%, 65%, 1 % and 1 % of the respondents respectively. This implies majority of the respondents are married.

Table no 1: marital status of respondents

| Marital Status | Frequency | Percentage |
|-----------------|------------|--------------|
| Single | 66 | 33.0 |
| Married | 130 | 65.0 |
| Widowed/Widower | 2 | 1.0 |
| Separated | 2 | 1.0 |
| Total | 200 | 100.0 |

With respect to gender, the number of male respondents were more than the female respondents as 134 male constituting 67% of the respondents were sampled compared to 66 females that account for 33%. Importantly, education qualification of the respondents is vital thus necessitating a need for assessment

Table no 2: gender of respondents

| Gender | Frequency | Percentage |
|--------------|------------|--------------|
| Male | 134 | 67.0 |
| Female | 66 | 33.0 |
| Total | 200 | 100.0 |

While the majority of the respondents (64%) are tertiary institution certificate holders, those with primary school certificate (4.5%) are the least sampled respondents. Other respondents comprised people with secondary school certificates and those with no formal education and they constitute 23 % and 8% of the respondents respectively.

Table no 3: education status of respondents

| Education Status | | |
|-------------------------|------------|--------------|
| No Formal Education | 16 | 8.0 |
| Primary School | 9 | 4.5 |
| Secondary School | 46 | 23.0 |
| Tertiary Education | 129 | 64.5 |
| Total | 200 | 100.0 |

Age of respondents is equally vital to quality of information provided by the respondents. Information about age of the respondents are categorical and age category 25-34 has highest number of respondents with about 48% while those 65 years and above, constituting about 1% are those least sampled. Other categories 15-24, 35-44, 45-54 and 55-64 account for 5%, 23%, 14% and 10% respectively. This implies more active or working class individuals were sampled.

Table no 4: age of respondents

| Age | | |
|--------------------|------------|--------------|
| 15-24 | 11 | 5.5 |
| 25-34 | 95 | 47.5 |
| 35-44 | 45 | 22.5 |
| 45-54 | 29 | 14.5 |
| 55-64 | 19 | 9.5 |
| 65 years and above | 1 | 0.5 |
| Total | 200 | 100.0 |

Occupation of the respondents were equally sought through the questionnaire and of the 200 sampled respondents, Self-employed individuals outnumbered other category of people with respect to occupation. Those engaged in Former Salaried employment, students and informal salaried wage employment accounted for about 12%, 17% and 3% respectively.

Table no 5: occupation of respondents

| Occupation | | |
|-----------------------------------|------------|--------------|
| Formal Salaried Employment | 23 | 11.5 |
| Self Employed | 135 | 67.5 |
| Informal Salaried Wage Employment | 7 | 3.5 |
| Student | 33 | 16.5 |
| Others | 2 | 1.0 |
| Total | 200 | 100.0 |

Frequency of plastic waste disposal is crucial to the health of environment owing to the fact that most plastic products are single use and possesses poor degradability coefficient thus necessitating the need to understand the rate at which plastics are dumped into the environment. Therefore, information on frequency of plastic waste disposal was sought from the respondents to understand the discharge pattern of plastic wastes into the environment for an insight into collection plans. From the information provided by the respondents, plastic wastes are discarded daily and weekly. Those that discard plastic wastes daily account for 92% of the respondents while those that discard weekly account for 8%. This implies plastic wastes mount in the city on daily basis thus necessitating a need to match the collection with disposal rate. Equally, embracing clean plastic waste disposal is central to accelerating plastic waste collection for recycling in the city, the need to probe into willingness of the respondents to embrace clean plastic waste disposal system cannot be overemphasized.

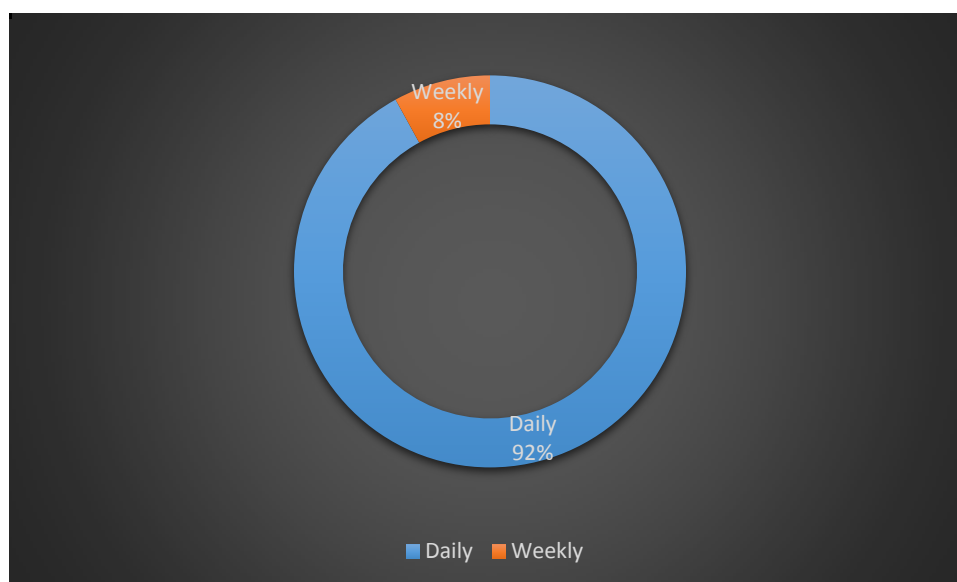


Fig 2 Frequency of Plastic Waste Disposal
Source: Authour's fieldwork, 2022

Current Plastic Waste Management Scenario in Ibadan

Regulatory agency in the study area initiated a pilot scheme christened clean and green, with gated communities where solid wastes such as plastic products were to be collected using bags that were distributed in association with sterling bank. However, the initiative collapsed over time and never materialized thus culminating in solid waste management and environmental issues. Another initiative, in pipe line, is zero waste, zero budget. According to a ranking officer of the ministry of environment, Oyo State, the initiative aims to incorporate traders, artisans into this new initiative to proffer solution to waste management in the state. Zero budget means the government will not need to budget and spend huge resources on solid waste management while zero waste would apply the three Rs (Reduce, Reuse and Recycle) to promote circular economy within the state. This will be achieved through empowerment of recycling firms at the waste dumps (Awotan waste dumpsite) where plastic wastes like PETs are aggregated, crushed, pelletized and sold as raw materials to plastic companies. With respect to educating and enlightening the citizens towards embracing sustainable plastic waste disposal, a ranking officer of the environment reveals plans are underway to roll out an awareness programme that will drive sustainable plastic waste management in the city. This implies much has not really been achieved with regards to awareness programs.

As at today, plastic waste scenario is conspicuous in the city as evident in the drains, open plots, and other places like canals in the metropolitan Ibadan city. While information on plastic waste collection rate is grossly unavailable, collection exercise is almost absolutely undertaken by the informal sector. Though few management exercises exist between scavengers and the merchants who buy the discarded products from the scavengers and supply the recycling firms in the city. Nonetheless, the current plastic waste collection rate is far outweighed by daily plastic waste generation in the city. In this regard, more overarching strategy is anticipated to drive more plastic waste collection in the city for recycling and central to achieving this goal is institutionalizing frameworks that motivates plastic waste collectors to increase their collection capacity for the overall environmental balance.

Willingness to Embrace Clean Plastic Waste Disposal System

Willingness of the residents to embrace clean or sustainable plastic waste disposal system is crucial to sustainable plastic waste management especially plastic waste recycling in the city. Thus information on this crucial aspect of plastic waste management was sought from Two Hundred (200) respondents. 69% of the respondents indicated willingness to embrace sustainable plastic waste disposal while 31% indicated unwilling attitude towards sustainable plastic waste disposal. This implies the need for more effort to achieve anticipated compliance with sustainability standard where adoption of tools like Kerbside would be made available for collection of plastic waste at appropriate locations in the city.

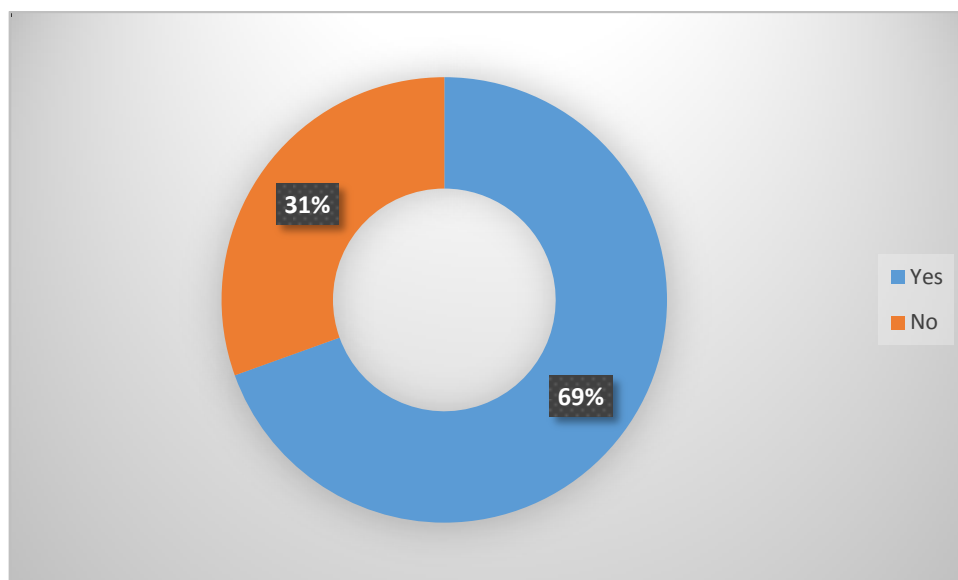


Fig 3 Willingness to Embrace Sustainable Plastic Waste Disposal
Source: Authour's fieldwork, 2022

Disposal pattern of plastic waste by consumers in the city is believed to leave some impacts on the environment thus a need for an overarching approach is anticipated. However, willingness of the practitioners and stakeholders towards embracing clean plastic waste disposal system is key. In the study, sampled residents gave their opinion towards embracing clean plastic waste disposal. and they (89%) intend to execute this by storing in a designated place for collectors while 11% would sell to local waste scavengers. This suggests a possible improvement in plastic waste collection rate thus eventually leading to improved recycling rate.

With sizeable respondents willing to adopt clean plastic waste disposal as indicated in figure 3, the residents choose to embrace clean plastic waste by; storing used plastic materials in a designated place for collectors as indicated by 178(89%) of the sampled respondents while 22(11%) of the respondents sell to local plastic waste scavengers as shown in fig 4. Storing in a designated place in particular is vital for Kerbside model thus culminating into significant progress in plastic waste management as recorded in cities adopting this system.

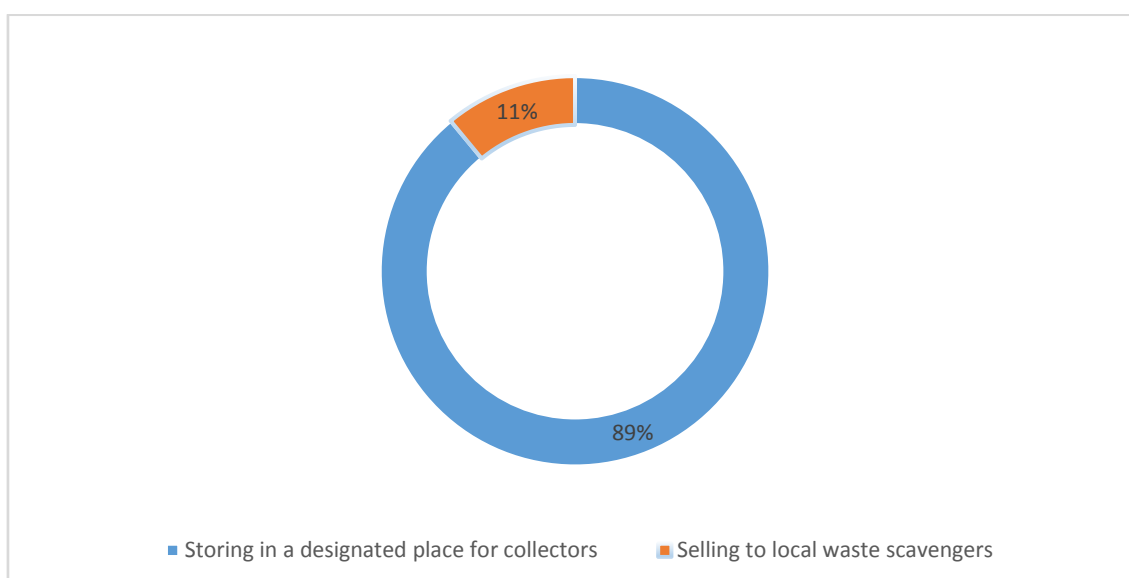


Fig 4 Sustainable Plastic Waste Management by the Respondents
Source: Authour's fieldwork, 2022

Table 2 Logistic Regression Results

| Explanatory Variables | Coefficient | Standard Error | Wald | Prob>Z |
|-----------------------|-------------|----------------|-------|--------|
| Primary Education | .605 | .653 | .860 | .354 |
| Secondary Education | -.112 | .839 | .018 | .894 |
| Tertiary Education | .816 | .437 | 3.488 | .062 |
| Age | -.149 | .186 | .648 | .421 |
| Income | .044 | .133 | .111 | .739 |
| Gender | .237 | .377 | .397 | .529 |
| Constant | .754 | .564 | 1.789 | .181 |

a. Variable(s) entered on step 1: Edu_status, Age, Income, Gender.

Further, an analysis of data from binary regression model to show the impacts of some socioeconomic variables like Income, Education, Age and Gender was done to make inferences to substantiate underlying management issues. The aforementioned may play roles in achieving sustainable plastic waste disposal and management hence their test to know which of the variables affect sustainable plastic waste management in Ibadan. Of the socioeconomic variables highlighted, Education(Tertiary) is the only variable that is significant. As a socioeconomic factor that plays vital role in plastic waste management at household and at communal level, it is a vital aspect that determines the knowledge of the need to adopt sustainable plastic waste disposal. Thus it is expected that an individual's level of education will influence plastic consumption and disposal pattern. That is, adoption of sustainable plastic waste management with respect to sorting and separation of plastic from usual municipal wastes will be influenced by consumers' level of education. This variable is statistically significant at 0.62 suggesting tertiary education would play active role in plastic waste management chain.

IV. Conclusion and Recommendation

The study revealed information on frequency of plastic waste disposal in Ibadan which was assessed on daily and weekly basis. With 92% and 8% of the respondents disposing plastic wastes daily and weekly respectively, 69% of the respondents are willing to embrace sustainable plastic waste disposal. In the same vein, 89% of the respondents willing to embrace sustainable plastic waste disposal through storing plastic wastes in a designated place for collectors while 11% choose to sell plastic wastes to local plastic scavengers.

Further, the study found education to be a significant driver of sustainable plastic waste management even as the metropolis lacks a well regulated framework that would drive accelerated plastic waste management with regards to return or collection of the discarded plastic products. To therefore achieve a desired height in recycling of plastic wastes, it recommended that;

Waste regulators come up with a framework that promotes awareness and involvement of relevant stakeholders like the consumers and recyclers on appropriate plastic disposal system. Consumers role towards separation, sorting and storage of plastic wastes from consumers are vital to sustainability of recycle chain. As obtainable in some climates, regulators develop a scheme like Kersibe and BringSystem that accelerate collection of plastic waste materials. The scheme like BringSystem may have financial incentives integrated in it to encourage residents separate and return used plastic materials. This will help improve recycling as materials would always be made available and at the same preventing plastic wastes from polluting the environment.

References

- [1]. Adelekan, I OIbadan City Diagnostic Report. Urban Africa Risk Knowledge
- [2]. Ajani, I. A. and Kunlere I. O.(2019): Implementation of the Extended Producer Responsibility (EPR) Policy in Nigeria: Towards Sustainable Business Practice. Nigerian Journal of Environment and Health. Vol 2pp 44–56. ISSN:2616-0714(Print), eISSN: 2616-0706
- [3]. Aikowe, L.D and Mazancova, J (2021) plastic waste sorting intentions among university students. Sustainability vol 13. No 7526. <https://doi.org/10.3390/su13147526>.
- [4]. Alhazmi, H.; Almansour, F.H.; Aldhafeeri, Z. (2021) Plastic Waste Management: A Review of Existing Life Cycle Assessment Studies. Sustainability, 13, 5340. <https://doi.org/10.3390/su13105340>
- [5]. Antonov, E (2020) Deposit-refund systems in Europe. B.Sc Thesis submitted to the Faculty of Economics and Administration, Masaryk University, Brno.
- [6]. Geyer, R., Jambeck, J.R., and Law, K.L. (2017) Production, use, and fate of all plastics ever made. Scientific Advancement. Vol 3: e1700782.
- [7]. GSMA(2021) Digital Dividends in Plastic Recycling
- [8]. Hameed, I., Khan, K., Waris, I., and Zainab, B. (2021) Factors influencing the sustainable consumer behavior concerning the recycling of plastic waste. Environ Quality Management. Pp 1–11. <https://doi.org/10.1002/tqem.21815>

- [9]. Hahladakis, J N Purnell, P, Elemi, I, Velis, C A and Atseyinku, M (2018) Post-consumer plastic packaging waste in England: Assessing the yield of multiple collection-recycling schemes. *Waste Management*. Vol 75 pp 149–159 <https://doi.org/10.1016/j.wasman.2018.02.009>
- [10]. Kehinde, O, Ramonu, O. J., Babaremu, K. O and Justin I. D (2020) Plastic Wastes: environmental Hazard and instrument for wealth creation in Nigeria. *Hellion*. Vol. 6
- [11]. Macrotrends L. L. C (2020) Ibadan, Nigeria Population 1950-2020. Retrieved from www.macrotrends.net/cities/21990/ibadan/population
- [12]. Mwanza, B.G., Mbohwa, C and Telukolaire, A (2018) Strategies for the recovery and recycling of plastic solid waste (PSW): A focus on plastic manufacturing companies. *Procedia Manufacturing* Vol 21. Pp 688-693
- [13]. Mwanza, B. G., Mbohwa, C (2017) Drivers to Sustainable Plastic Solid Waste Recycling: A Review. *Procedia Manufacturing*. Pp 649-656
- [14]. Naijalink Research (2020) Business opportunities in Nigeria's waste and circular economy sector.
- [15]. Ncube, L. K., Ude, A. U., Ogunmuyiwa, E. N. Zulkifli, R. and Beas, I.N. (2021) An Overview of Plastic Waste Generation and Management in Food Packaging Industries. *Recycling*, No 16, No12. <https://doi.org/10.3390/recycling6010012>
- [16]. Norden (2014) Collection and Recycling of Plastic Waste Improvements in Existing Collection and Recycling Systems in the Nordic Countries. ISBN 978-92-893-2804-3 ISBN 978-92-893-2805-0 (EPUB) <http://dx.doi.org/10.6027/TN2014-543>. ISSN 0908-6692
- [17]. Singh, P and Trivedi, L (2020) Plastic Waste Management. *GIS Science Journal*. ISSN No: 1869-9391. Pp 25-31
- [18]. Siti, K. P, Tri, E. B. S and Haruki A (2021) Post-Consumer plastic packaging waste management in Indonesia: a producer responsibility approach. *E3S Web of Conferences* 325, 03005 <https://doi.org/10.1051/e3sconf/202132503005>
- [19]. Sorme, L, Voxberg, E, Roselund, J, Jensen, S, and Augustsson, A (2019) Coloured Plastic Bags for Kerbside Collection of Waste from Households –To Improve Waste Recycling. *Recycling*. Doi:10.3390/recycling4020020
- [20]. United Nations Development Programme, (2019). *Plastics and Circular Economy: Community Solutions*.
- [21]. Verma, R, Vinoda, K. S. Papireddy, M. and Gowda, A.N.S (2015), Toxic Pollutants from Plastic Waste- A Review. *International Conference on Solid Waste Management, 5IconSWM.Procedia Environmental Sciences*. Vol. 35. pp 701 –708

Joseph Siji Ayodeji. "Accelerating plastic waste collection for recycling in Ibadan." *IOSR Journal of Humanities and Social Science (IOSR-JHSS)*, 27(12), 2022, pp. 51-59.