Households' Waste Management in Ibadan, Oyo State, Nigeria- The Identified Waste Collection Services and Disposal Strategies versus Waste Collection Expenditure.

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Summary: The study examined the methods of households' waste disposal by individuals in Ibadan. It also established the relationship between households' waste management expenditure and waste disposal strategies engaged by households. The study made use of descriptive survey design. Data were obtained through the use of questionnaire to interview household heads and the copies of questionnaire distributed to households were 500. Heads of households were selected using multi-stage sampling technique. The results were presented using Tables, Charts, Chi-Square test. The results showed that less than average (41%) of the households in Ibadan, Oyo State subscribed to waste collection services. The common methods of household's waste disposal were burning (subscribers; non-subscribers- 58.7%) and the indiscriminate dumping all over the public and residential places such as in the drainage, in the bush, and the rivers which was commonly carried out among non-subscribers was 33%. Moreover, the subscribers for waste collection services paid more to ensure a sanitary environment than the non-subscribers in the city, which was expected to bring about better healthy lives for both humans and animals, thereby improving their productivity. It was therefore recommended that proper waste management practices should be improved upon and waste collection service subscription should be campaigned for among the residents by waste management stakeholders.

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1. Introduction

The primary goal of waste management is to protect the environment, human health, and wellbeing through effective waste management practices (World Bank, 2018). The proper management of waste generated by the economic agents largely contributes to numerous sustainable development goals in human society. Among the 17 Global goals, quite a number of them can be effectively attained by focusing on the component of management of waste, especially in the area of waste disposal (Mirela et al., 2022; Laurieri et al, 2020). When waste is properly managed, it will ensure good human health and elongate life expectancy, reduce poverty rate, increases food security through uninterrupted agricultural activities, clean water and sanitation, improve labour productivity, protection against climate change, protection of life below water and on land.

Waste disposal strategy, which is one of the aspect of waste management is the method by which waste is discarded. Waste materials are usually characterized by their quality, component and nature (Coker et al, 2016); which prompts its classification into various classes such as industrial waste, household waste, bio-medical waste, commercial waste, institutional waste, among others. Waste disposal measure to adopt, largely depends on the sources, since waste composition and characteristics varies according to source (Tchobanoglous et al, 1993). Among various sources earlier mentioned, households contribute significant amount of waste because waste is usually generated by every member of a household on a daily basis. This type of waste constitutes the major problem of waste management in most cities of Nigeria.

However, in Nigeria, existing poor waste management practices are mainly associated to inefficient disposal methods by individuals, and inefficient coverage of collection system (Coker et al, 2016). Specifically, Ibadan city- the capital city of Oyo State, which is the study location is noted for its rapid growth rate. Also, since the core areas of Ibadan are highly populated, accompanied with massive waste generation; hence, has a great influence on the overall characteristics' assessment of Ibadan. Statutorily in Oyo State, solid waste collection is the sole responsibility of the municipal government – Oyo State Solid Waste Management Authority (OYOWMA) established in 1997, with the collaboration of private sector participants and other waste management stakeholders. Despite the increasing level of environmental sanitation program execution in the city in the recent time, the city has a higher proportion of illiterate people, who may be

ignorant of the importance of waste management (Omolawal and Shittu, 2016), those unwilling to pay for the organized waste collection services and one of the major limitations against subscribing to the social services of private sector in the developing countries is the cost incurred by the consumers (Agunwamba, 1998, Ogwueleka, 2009). In Ibadan, it is evident that the low socio-economic status of the residents is responsible for unwillingness to pay for waste collection services (Rahji and Oloruntoba, 2009), thereby improperly dispose their waste. This consequently, has contributed to waste management issues in the city of Ibadan.

A pertinent critical challenge is on how to establish sustainable and effective household solid waste collection interventions that are cost effective and environmental appropriate. Hence, the waste disposal strategies is often time, habitually in control of individuals and households as against the established government policy intervention on waste management. The assessment of extant literature revealed that the issue of household waste disposal strategies and willingness to pay for waste subscription by majority has not been given adequate attention in the city. Waste disposal strategy largely depends on the household willingness to pay for effective and quality waste management. Therefore, waste disposal strategy further determines the waste management expenditure.

Hence, the study aimed to investigate the various existing strategies adopted by households of Ibadan in disposing their waste. The study also aimed to establish the relationship that exists between waste disposal strategy and the amount paid to manage waste. This is very crucial because the methods of waste disposal and waste management costs may have either positive or negative implications on the health of animal, humans, and on the environment and these may eventually determine productivity of labour and economic status among the residents.

Generally speaking, waste management activities are primarily carried out by individual households in cities using various strategies. Community management is progressively common in rural areas, however, in urban locations, there are unusual joint responsibilities with communities and thereby lack proper initiatives. Effectual social interrelationship, such as awareness, NGO formation, micro-financial and user group services, waste consumer education, promotion of hygiene, and health education, is necessary to effectively deliver service and this is vital for community management (Muller & Hoffman, 2001). This claim is supported by Minn and Laohasiriwong (2010) and Fridah (2014) emphasized on creating awareness and environmental education as a suitable approach to encourage the participation of individuals.

Considering waste disposal by inhabitants in a community, Masood and Barlow (2013) showed historically that waste disposal has been challenging. As claimed by Yoada, Chiwura, and Adongo (2014), waste management practice is a function of people's perceptions about sanitation. For reasonable and effective waste management, the waste generators could be encouraged to put in more effort (Hafeez *et al*, 2016). Hornsby *et al* (2016), and Gangolells *et al.*, (2014) found that poor waste management was noticeably rampant in the public areas of most cities and that the major decision that could be taken is the enforcement of compliance with existing regulations on waste management. Aleluia and Ferrao (2016) noted that effective waste management was achievable if generated waste was properly separated by people for instance, in manufacturing businesses, individuals, especially households. However, it is crucial for waste generators to be aware of how to properly manage waste, for instance, how to separate diverse types of waste (Thabo *et al*, 2017).

Yasmin *et al* (2015) observed that inappropriate waste disposal resulted in a health hazards for residents. The various household waste disposal methods and waste practices by people with the effect on health were also examined by Ramatta *et al* (2014). The study showed that virtually all respondents disposed of food remains and just above the average of the households disposed of plastic materials respectively as wastes and it also revealed that above the average of the households disposed of their waste at community bins or had waste picked up at their homes by private contractors; while much, but less than average disposed of their waste in drainage, roadside, holes, and nearby bushes. Above-average were unsatisfied with the services of private contractors as a result of the irregular and collection cost. Almost all respondents had awareness of the health impact of improper waste management. Educational qualification of the people, proper awareness and collection of waste by private contractors, coupled with the provision of additional waste bins in the community can serve as antidotes in preventing diseases. Similarly, Fadhullah et al, (2022) analysed the various components of waste in Malaysia as thus: food debris and plastic materials were disposed by 74.3 % and 18.3% of households respectively. Approximately 49.7% of the households did not segregate their waste while 50.3% did. About 95.9% of the respondents that indicate their awareness about improper waste management could lead to disease; such as malaria and diarrhea.

Furthermore, different waste disposal methods of the residents on domestic wastes were also identified by others. They further identified the factors that hindered effective and efficient domestic waste management. Banjo *et al* (2009) identified that the

household waste management problem is a result of wrong attitudes and perceptions of the people towards sanitation issues in the city. The majority of members of the household involved in waste disposal are females of middle age. Approximately, an average of the respondents was said to be married, above the average of the sample size were traders with little or no knowledge of the danger in living in unclean environments. Exactly an average of the respondents gave their waste to waste-collectors, few people burn waste and very few respondents discard their waste in gutters. The study by Longe *et al* (2009) also evaluated solid waste management practices by people in terms of a variety of environmental behaviours, attitudes and perceptions within households. The results claimed that public opinion and perception on solid waste management system was considered to be irregular and inefficient collection system, with low supervision of the private waste service providers by the local authority. The middle and high-income socio-economic groups were more willing to pay for private waste services than in the low-income group. The selected residential areas were classified into high, middle, and low socioeconomic strata.

To further determine the residents' waste disposal approach, Kaoje *et al* (2015) claimed that the mean age of the respondents was 30 years. The majority of the respondents expressed their concerns about the haphazard littering of the city with waste and over half of the respondents agreed that residents were responsible for the careless handling of wastes while some considered it as an error from the government. Although virtually all the respondents owned up to the fact that residents are the proper agent to clean their surroundings, a lower percentage of respondents claimed that residents should exclusively take the responsibility for the cleaning; while almost half of the sample argued that both government and residents should jointly be responsible for the cleaning. Approximately half of the respondents reported that inappropriate waste disposal created health-related issues.

A study by Khoshmaneshzadeh et al (2021) was carried out to appraise the strategies on solid waste management developed by Elele community, which showed that dumping in open spaces was the most prevalent method of disposal with the percentage of 69.82%, while the least was land fill practice (Burial method) with 1.09%. Similarly, Dimkpa et al., (2023) aimed at determining the remedy to the predicaments associated to municipal waste management in Karaj and to identify the best approach of waste disposal. This study was designed and executed in five various steps. Out of the identified five steps, landfill is the best option and economy is the most important criterion with the sub-criterion of construction cost.

Moreover, Kenisha et al (2017) expressed that individual attitude that would gear towards higher levels of public participation as part of waste management decision-making is required. Kenisha and others further stated that issues of perception, interests, decision situation, the approach of commitment, and the essential resources and capacity are required to implement and develop involvement decisions. In addition, Onibokun and Kumuyi (1999) examined sanitation and waste management practices among residents in the city of Osogbo, to improve housing supply and sanitation to meet the target of millennium development goals (MDGs) on water and sanitation. Oja-Oba, ItaOlookan, and part of Ayetoro were selected to be investigated. It was observed that the in-sanitary environment of the communities had low access to infrastructural facilities due to its inadequacy, which majorly determined sanitation level.

Where waste collection services are often provided by waste management authorities, cooperation of the users is very crucial such as proper storage of waste separation, household waste, positioning of household waste bin, and discipline in the usage of municipal collection points. At times, waste collection activities may cease for some time, if waste that is deposited at public transfer points seems to mount up, and waste management authority could not transfer the waste to final disposal sites (Peter, 1996). In this case, it was expected that waste separation is very necessary as food remnants and other waste that can easily decompose and result in air pollution in the community should be avoided in the waste bins. The land filling remains the most usual approach of solid waste disposal by various communities for years (Komils *et al*, 1999). Open dumping is majorly used by the majority of people in urban centres in developing countries as their principal disposal method (Rushbrook, 1999).

Muyiwa, Ridwan and Hans-Rudolf (2023) investigate the present condition concerning the waste collection and coverage rates in sub-Saharan Africa. It was found that the waste collection and coverage rates were 65% and 67% respectively in Sub-Saharan Africa. It was also found that despite the involvement of private waste collectors, rates of collection and coverage are still far below the desirable level. This could be responsible to a whole lot of factors in which affordability and unwillingness to pay are quite responsible. The distances covered by truck are most time difficult due to some factors for instance, volume ratio of the truck compartment, truck capacity, waste density and collection frequency (Vu, Ng, Fallah, B, Richter, and Kabir, 2020). To substitute this, a waste pipes system called automated vacuum collection

(AVAC) has been anticipated and executed over the years (Wojciech, Jedrzeg, and Piotr (2023). Waste management fees are mostly charged by waste management authorities/agencies for the collection and disposal of waste generated by a household. It is used in the execution of waste management activities and the purchase of equipment among others. Zia and Devadas (2007) asserted that the management approach, where roles and responsibilities of waste management are not only the sole responsibility of the government and waste management authorities. They added that where roles are also collectively shared among the community and households is often suggested as the best approach (United Nations Environment Program, 2005).

One of the approaches is the willingness of the household to pay for the costs of waste collection and disposal. By implication, active roles could be played by people, and service delivery may be significantly contributed (Joseph, 2006). Various successful cases have been studied in the past on people's participation in waste management in developing countries (Rathi, 2006; Sujauddin *et al*, 2008). Though, the behaviour of people was a major obstacle for the waste management to be successfully implemented (Evison and Read, 2001); as Papageorgiou (2006) claimed that higher costs on waste management for households, could lead to a low and total unwillingness to pay for collecting waste generated. (Longe, 2009) also affirmed that there was the declining rate of the willingness of household heads to pay for waste generated since payment is based on the class of living area and location instead of volume of waste generated.

Services under the Lagos State law has become complicated by many residents who are reluctant to pay for disposal services of waste for poverty reasons and lack of interest to pay. People's attitudes determine not only the features of waste generation but also the effective demand for waste collection services, that is, the level of interest they have in collection services and in willingness to pay for it. Attitudes of service users could be positively influenced via awareness-building campaigns and educational factors to be negatively influenced with an inadequate waste collection as regards the public health and environmental conditions, and the value of effective disposal (Peter, 1996). According to him, such campaigns should also enlighten the public of their roles as waste generators and of their rights to the services of waste management as citizens. Similarly, people's waste generation and disposal systems are influenced by their neighbours' patterns of waste generation and disposal.

One major factor of unwillingness to pay in Nigeria is that the Waste Management Board is a sector that was created as a non-profit orientated services delivery, identified as a public good that calls for little or no charges (Agboje *et al*, 2014). According to World Bank and PPIAF (2017) established that new policy of fixing appropriate price for waste disposal should be based on the volume and how much revenue can be generated based on the condition of affordability. The lower the price charged for waste disposal, the more possible the acceptability of the scheme. Oluwaleye (2012) asserts that the generators of waste are unwilling to pay for the services, particularly when there is inefficiency in services delivery.

Conversely, people may at times be aware that poor sanitation influences their health adversely, particularly in developing and low-income countries, and thereby they are the most willing to pay for environmental improvements rather than paying a higher cost for treating illnesses (Rathi, 2006; Baba, 2013). However, most people at times are willing to pay for the waste disposal at their immediate environment but "out of sight and out of mind" occur that warrant them to be un-concerned with proper disposal (Chris and Roland, 1998).

Ezebilo (2013) studied the willingness of households to pay for improved management of residential waste. It was found that a larger percentage of the respondents supported residential waste management. There is the willingness of respondents to pay an averagely of 3,660 Nigerian Naira (the US $7.2 as at the time of the study) per annum. Education, income, type of lodge, and satisfaction with private sector participation in waste management service provision positively influenced the respondents' willingness to pay. The price, gender, household size, and activities of sanitary inspectors were negatively influenced. Also, Muniyandi found that household respondents are willing to pay (US$ 0.34), an equivalence of 170 Nigerian Naira monthly as at the period of 2021 for cleaning environment in semi-urban areas, and virtually all the respondents were willing to pay for waste management in a particular location of the study area.

The knowledge of the households' demand for solid waste management services was also important in developing a sustainable waste management strategy. This is crucial because the success of the strategy was to a large extent dependent on households' acceptance (Ezebilo, 2013). In developing countries, various studies have shown that the amount willing to pay, age, occupation, household size, income, and educational status have a great influence on household willingness to pay for waste management (Niringiye and Omortor, 2010). Simeon et al (2016) determined the factors that affect the household willingness to pay for disposal of solid waste in the Metropolis of Kumasi. A simple random sampling technique was adopted to select the sample size of three hundred and ninety-four households. To estimate the implication that respondents' perceptions on particular variables had on

the willingness of households to pay for waste disposal services; Logit regression was used to analyse the data. The variables that were considered were: the quality of services, effectiveness of bye-laws, education, income, awareness of health hazards of indiscriminate waste disposal, some socio-demographic variables, and residential areas. The findings showed that payment for solid waste disposal was a usual practice in the study area. The study noted that level of education, area of residence, income, and effective bye-laws were statistically significant as regards willingness to pay for solid disposal services. Similarly, Rahji and Oloruntoba (2009) adopted the contingent valuation method (CVM) to analyse the factors that determine household willingness to pay for the services of waste management in Ibadan, the capital city of Oyo State, Nigeria. It was shown that some factors such as property owned, occupation, income, and the amount paid affected willingness to pay. Chuen-Khee and Othman (2010) studied the economic values of household preferences for solid waste disposal in Malaysia, using the CVM, they found that age, ownership of house, and income influence willingness to pay for solid waste disposal options. Alta and Deshaz (1996) applied the CVM in their study of households' demand for improved solid waste management in Gujarwala, Pakistan, and found that quantity of waste generated by households, household size, and age influenced willingness to pay. In their (Niringiye and Omortor, 2010) study of the determinants of willingness to pay for solid waste management in Uganda, using the CVM, they found that age influenced willingness to pay. Yusuf *et al* (2007) also used the CVM to estimate the economic value of improved household waste management in Oyo state, Nigeria. They found that the price of waste management services, age, educational level, income, and household size influenced willingness to pay.

Efaw and Lanen (1979) developed a household theory which was later adopted as the empirical basis. In this study, data were collected on a monthly basis for four years in the 1970s from 3 different cities, which were: Sacramento, Grand Rapids, and Tacoma. Households encountered different categories of user fees in each of the cities. In each city, linear equations accommodating explanatory variables, particular were incorporated. It was found that demand for households' waste services varies positively with income. However, the response of households to user fees was statistically insignificant. Though, Jekins (1993) suggested that an obvious oversight has occurred by not considering the prices of goods that produce waste. It was also noted that another variable not considered in the analysis was the market price of recycled goods. Jekins further criticized the study claiming they failed to maximally use their available data as they should have pooled the data to yield more efficient estimates.

McFarland (1972) used revenue per tonne to serve as a proxy for a user fee. Jekins (1993) noted that crude estimates as average revenue would not explain the diversity of user fees in a community. McFarland obtained 1967 & 1968 data for 13 cities in California. The selected cities were considered because each of them employed user fees and the volume of household waste was known. A service-level fee which did not impose a positive cost on household waste collection was used. According to Jekins, McFarland only gave a general interpretation of the results of the analysis. Skumatz (1990) also used a similar proxy for the price as McFarland did use annual data of the period between 1971 and 1987. Jekins observed that the results were more consistent in the later years than the previous years of his data scope.

Morris and Holthasen (1994) adopted a quite different method to estimate household elasticity. A household production function was being used to motivate responses to various adoption of waste technology with the aid of calibration techniques. It was claimed that waste disposal services had price elasticity between -0.51 and -0.6, which was greater than the existing econometric literature would recommend. The cross-price elasticity for recycling was negative and less than 1. Conversely, the cross-price elasticity associated to waste reduction was close to 1; either less or greater. Though, the study had its result to slightly vary from other studies. The study also did not provide an alternative approach to the estimation of elasticity.

Jekins (1993) further applied panel data with a cross-section of 9 communities to estimate demand for household waste services. Five communities were with user fees; while the other 4 communities were without user fees to be used for comparison. The data set was difficult to construct, and it was described by Jekins as being observed as a comment on haphazard and restriction of the required information on the subject matter to investigate empirical economic analysis. The author used GLS for the analysis and the results showed that user fees had a negative relation with the household waste produced. His results of elasticity generated were within the range of values with other studies reports. Also, Reschovsky and Stone (1994) gave a more conventional empirical study of household waste management. An econometric model was used to analyse actual consumer responses to quantity-based price using survey data from Tompkins County in New York, carried out in September 1990. Reschovsky and Stone selected randomly 3,040 households with 1,422 returning. The study location was selected because it adopted a per-unit pricing system in March 1990. It assumed that incentives were required for a household to be encouraged in participation. The independent variables were income, education, and age; while the dependent variable was dichotomous showing recycling

or not for some specific types of waste. They estimated the equation using probit regression. The results obtained had some similarities with that of Wertz (1976).

Furthermore, Reschovsky and Stone permitted both household waste disposal and recycling. They noted that there could be motivation for recycling; however, recycling could stimulate additional costs, and motivation could generate over-recycling. They asserted concerning disposal that there was an alternative disposal source, which was illicit dumping by the roadsides. They found that households were more sensitive MPCs of waste reduction, but they were less sensitive to waste disposal costs. They suggested that there was a need to intensify efforts on recycling while quantity-based fees (weight/volume) as flat-rate fees would be ineffective.

Hong, Adams, and Love (1993) observed from the study by Richardson and Havelicek (1978) that household size and income were significantly identified as explanatory variables responsible for waste generation coupled with available disposal services (Wertz, 1976). The empirical results obtained by Hong *et al* suggested that the income elasticity for collection of waste is < 1. In addition, it was found that a user fee for household waste disposal had a positive effect on the behaviour of people to recycle, which was to support the results of Reschovsky and Stone (1994). Hong *et al* noted that a household had a lower probability to undergo recycling activity if much effort was given to it and that a household with a larger size was more possible to undertake to recycle and to demand more for waste collection services. However, Jekins 1998 found that the average size of the household was positively related to waste production. Kemper and Quigley (1976) affirmed that the number of collection visits by waste management authority per annum was not significantly related to the quantity of discarded waste in a year.

Strathman, Rrufulo, and Midaer (1995) estimated a different approach for household demand for waste services and demand for landfill disposal. It was argued that there may be an existence of efficiency gains by incorporating MC and price for collection of waste services Strathman et al expressed that various information is needed in estimating waste disposal services using household demand and relate with demand for landfills. The authors agreed that there are relationships between two demand estimates; they, therefore, referred to it in the later study of household demand for the services of waste disposal.

The demand equation was estimated by Strathman et al using OLS, which was corrected and adjusted seasonally for serial correlation. Data were obtained between the period 1984 and 1991 from Portland. The result of the household own price elasticity of demand estimates with the relationship was -0.45. The result seemed greater than what was obtained from estimates of relative studies. They suggested that the variation in the results of the analysis could be due to a lack of information as a result of the difficulty in obtaining data. He added that the high rate of illicit dumping among households in the community could lead to the variation. Neston and Podolsky (1996) questioned the study by Strathman et al that the elasticity estimates obtained were over-estimates as no inclusion for options for substitutes of waste disposal. Conversely, Strathman *et al* (1996) rejected the criticism of Neston and Podolsky. Strathman *et al* (1996) identified that price-induced rise in illicit dumping will augment the price elasticity estimates of demand for waste collection services.

Fullerton and Kinnaman (1996) provided an econometric study of household demand for waste services. They introduced a unit-price system for waste disposal of households with a concentration on inducement factors for indiscriminate dumping attitude. These authors made use of survey data collected on the households in Virginia, which quantified waste either in terms of weight or volume; instead of counting the contracted number of waste bins. Also, recycled materials were measured in weight rather than the number of frequencies of recycled materials collected. Four hundred households were surveyed, and they corrected and adjusted for seasonal outcomes in their analysis. Lower own-price elasticity estimates were obtained as compared to the previous studies.

Fullerton and Kinnaman (1996) also measured illicit dumping using two proxy measures. It was suggested that illicit dumping could account for between 28 and 43 percent reduction in waste after user-pay plans were introduced. The authors asserted that illegal dumping did not supply a direct measure of illegal behaviour. Choe and Fraser criticized Fullerton and Kinnaman as though they extensively considered illicit dumping; however, they did not know what action dumping entails. Strathman *et al* (1995) observed that the local officers in the Portland area when interviewed did not know if dumping illicitly had increased as there seemed to be no monitoring and enforcement for illicit dumping in the jurisdiction.

Several empirical findings on the responsiveness of households to waste charges have served as the basis for cost-benefit analysis (CBA). CBA is highly used to assess various waste management policy options. Existing literature gave conflicting results for user charges. Jekins (1993) admitted that a lot of welfare gain existed in user charge's introduction. Morris and Holthausen (1994) derived Hicksian compensated measure of the sum of US dollar 117 per annum would be deducted from the household head's annual income. This was believed not to make the household head better than he was before the

introduction of unit pricing- a once-a-week waste collection and recycling. This amount charged indicated substantial benefit or welfare improvement derived from the scheme. However, Fullerton and Kinnaman found that the unit price benefit did not include the administrative cost of implementation. By implication, the user fees implementation was not an economically oriented policy. Jakus *et al* (1997) and Tiller *et al* (1997) using non-market estimation techniques (contingent valuation and travel cost), had estimated the willingness to pay for recycling. Tiller *et al* showed that the cost of recycling services was far greater than the benefit derived by the participants.

2. Material and Methods

The study used a sample of 500 households derived from a population of households in Ibadan. Two local government areas each were purposively selected from urban and semi-urban areas. The names of the local government areas were Ona-Ara local government area, Egbeda local government area (semi-urban areas); Ibadan-North local government area, and Ibadan South-West local government area (urban areas). This was because the selected local governments were identified for high rate of illicit dumping of waste in the public areas. In each local government area, 2 streets were purposively selected. The streets/ areas were purposively selected because they were known for the high levels of indiscriminate waste disposal. The names of the 2 selected streets/areas from Ona Ara local government area were: Idi-Osan Amuloko Area and Sawia, in Olorunsogo. In Egbeda LGA, Adegbayi Olode and Alakia Isebo were selected. In Ibadan North local government area were: Iyemetu Aladorin and Alawada and Ibadan South West was Oke-Ado area and Gege Junction. Systematic sampling was adopted as the first house was chosen between 1 and 3, then subsequent households were considered at the interval of 2. Thereafter, a semi-structured questionnaire was administered to the selected household heads.

Thereafter, both the descriptive and inferential statistics were adopted for the study. Descriptive statistics such as graphs, tables, was adopted to analyse the method of waste collected and disposal strategy. Contigent Valuation analysis (Chi-Square) was used to establish the relationship between disposal strategies and waste management expenditure.

3. Results

Method of Waste Disposal and Collection in Ibadan

a. Waste Collection (WC):

The waste collection involves the transfer of solid waste from the point of generation to the landfill or the point of treatment**.** In the case of Ibadan, the household waste collection activity by the structure in the policy program should be exclusively handled by private waste collectors who are Private Sector Participants (PSPs). From Table I below, 58.3% of the respondents reported that private waste collectors do come to their environment; while 41.7 percent claimed that waste collector agencies did not show up in their environment. This indicates that the service of private participants has not covered the whole of Ibadan city. Insight from an in-depth interview indicates that 150 companies (Private sector participation) participated in waste collection in Ibadan city. Some of the in-depth interview respondents stated that the number of private sector participants in the waste collection was not sufficient, given the size of the city.

In reference to the efficiency of service delivery by private sector participants, our respondents were asked: "does waste collector agency come to your environment?" Out of those who reported that waste collector agency was within their reach, some subscribed to the waste collection services, while some of the householders did not. Quite a larger proportion subscribed as 71% of the participants subscribed. However, the proportion of participants that subscribed as related to the total population of those interviewed was 41.4%. This implies that a higher percentage of Ibadan residents did not engage the service of a waste collection agency.

The frequency of visits of waste collection activities varies; as some visit once a week, some twice a month, and once a month. Approximately, thirty-six percent of subscribers to waste collection services claimed that waste collection agencies usually came once a month to collect waste; while 48.3% of the subscribers indicated that waste collection contractors usually collect waste twice a month. Only those that stated that waste collection agencies do come twice in a month experienced the number of visits in alignment with the PSP arrangement. It shows that those waste collectors assigned under the jurisdiction of the waste collection subscribers that experienced "once in a month" and "not often" were not efficient enough in terms of prompt collection. This can be supported by an in-depth interview with an officer which stated thus:

> ***"……Also, it has been reported by the service users that some of the waste collector agencies under private sector participation are not effectively performing their duties as the refuse collectors assigned to their jurisdiction do not carry out the prompt collection"***.
>
> (Male/ Oyo State Waste Management- OYOWMA/ Director, Environmental Health Services/Sept. 2020)

Those that did not subscribe to the waste collection service comprise both the percentage of those

that stated that waste collectors did not show up in their environment and those that claimed that the waste collectors came but they did not subscribe for some reason(s). The reasons for not subscribing had multiple responses for both groups as some of the respondents indicated more than one reason. In Table 1, among the reasons indicated were: unaffordable charges, personally capable to dispose of waste when it is due, unsatisfactory waste collection service, lack of interest in waste collection service, non-availability of waste collection services. Statistically, out of the reasons for not subscribing for waste collection service for those who waste collector was within their reach, taking personal responsibility for the collection of waste for disposal took the highest weight, which was 35.7%. In reference to the inability to pay, 30.8% of the participants did not use the waste collection service.

Those that waste collection service providers were not within their reach, were asked if they would subscribe, provided it was available. Approximately 50.5% of the concerned indicated "yes", while the remaining percentage of 49.5% said "no". Moreover, those that indicated that waste collectors did not show up in their environment also gave reasons why they would not subscribe even if waste collection service was available. It was also a multiple response variable and "Charges unaffordable" took the highest strength among the options with 36.7% of the participants.

Table 1: Waste Collection Methods

Variable		Frequency of Households	% of Households
Does WC come to collect waste?	Yes	245	58.3
	No	175	41.7
Do you subscribe to WC services?	Yes	174	71.0
	No	71	29.0
How often does WC agency come to collect waste?	Once a week	24	13.8
	Once in 2 weeks	84	48.3
	Once a month	62	35.6
	Not often	4	2.3
Reasons for not subscribing despite availability (WC within their reach)	Charges unaffordable	44	30.8
	Personally dispose	51	35.7
	Unsatisfied Service delivery	34	23.8
	Un-interested	35	24.5
	Others	5	3.5
If WC is service available, will you subscribe?	Yes	101	50.5
	No	99	49.5
Reasons for not subscribing if Available (WC did not come to their environment).	Charges Unaffordable	36	36.7
	Personally dispose	33	33.7
	Unsatisfied service delivery	14	
	Un-interested	28	14.3
	Others	2	28.6
			2.0

Source: The Author, 2022

Figure 1 comprises both those that indicated that waste collection agents visit their environment and those who claimed that they did not visit their environment in Oyo State. Approximately 58.3% were those that claimed that waste collection agents were viewed in their vicinity, while forty-two percentage participant indicated that the waste collectors did not show up.

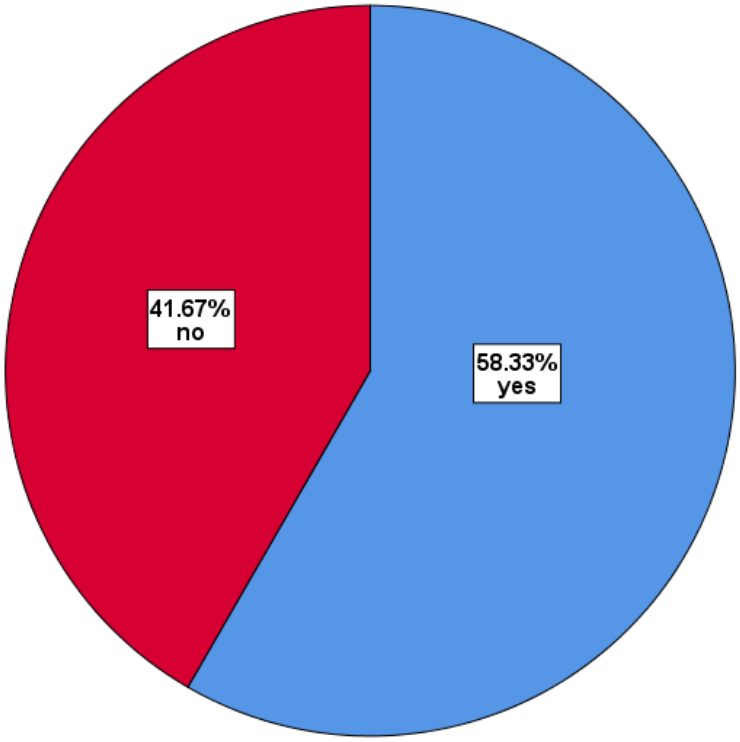

Figure 1: Waste Management Agents Visit Residential Environs to Collect Waste
Source: ***The Author, 2022***

b. Waste Disposal (WD):

This is part of the household waste management process that deals with waste removal and destruction or storage of damaged, used or other unwanted domestic waste. What constitutes appropriate waste disposal is that in a situation where waste cannot undergo thermal treatment or recycling for an economic viable or a technical reason, the waste should be disposed of in a landfill with proper treatment thereafter.

Also, in the case of Ibadan, household waste collection and disposal activities in Ibadan are committed into the care of private waste contractors, who are charged with the responsibility of disposing of waste into the government-approved landfills. From Table 2, there are various methods of waste disposal practices by residents of Ibadan, most of which were indiscriminately dumped in the drainage, on the street, road, rivers, burning among others. Approximately forty percent of the proportion of those that subscribed for waste collection services, when waste collection agency failed to come at the stipulated time engaged in "waste burning" strategy, which represented the largest proportion. While those that kept "waiting" till waste collection provider arrived was 35.1 percentage.

Moreover, 49.6% and 12.1% of non-subscribers to waste collection services engaged in burning strategy inside and outside respectively. This established that the largest percentage of both subscribers and non-subscribers engaged in waste burning. It was obvious that a larger percentage of non-subscribers to waste collection service practiced more of those indiscriminate methods of disposal, such as dumping in the drainage, on the street and river, among others, which has thereby resulted in the prevalence of abnormal waste disposal practices in the city.

None of the participants lived within the distance of less than 2km from the dumpsite, while 76 percent of residents lived at a distance of 5km and above from the dumpsites. This shows that the majority of the respondents lived not too close to the dumpsite location and this has the possibility not to reduce the health status of residents.

Table 2: Waste Disposal Methods

Variable		Frequency of Households	% of Households
Options when WC does not come (subscribers only)	Waiting for WC	61	35.1
	Waste Burning	70	40.2
	Digging a designated dumpsite	5	2.9
	Throwing in drainage	13	7.5
	Throwing on street/road	4	2.3
	Throwing in a designated place in the community	12	6.9
	Throwing in bush	9	5.2
	Throwing in river	3	1.7
	Throwing in an uncompleted building	2	1.1
	Throwing in other places	18	10.3
How do you dispose your waste? (non-Subscribers only)	Waste Burning	142	61.7
	digging a designated dumpsite	6	3.0
	Throwing inside the drainage	36	15.9
	Throwing on the street or road	44	19.0
	Throwing in a designated place within the Community	23	9.9
	Throwing into bush	35	15.1
	Throwing into river	20	8.6
	Throwing in an uncompleted building	16	6.9
	Throwing in other places	8	3.4
If you burn your waste, where do you burn it?	An incinerator within the compound	150	70.4
	Burn outside compound/not within immediate environ	58	27.2
	Burn it on the road	19	8.9
	Burn it in other places	1	0.5
How close is your residence to Dumpsite?	Less than 1km	0	0.0
	Btw 1 and 2km	32	7.6
	Btw 3-4km	69	16.4
	5km & above	319	76.0

Source: ***The Author, 2022***

Figure 2 illustrates the various waste management strategies available for those who subscribed for waste collection services in case waste collectors delayed in waste collection and those who did not subscribe at all for waste collection. "Waste burning" was observed to have the highest frequency for both those who subscribed and those who did not. Nevertheless**,** the higher percentage (61.7%) of participants who did not subscribe to waste collection service engaged in waste burning, while 40.2% of the subscribers to waste collection service engaged in waste burning strategy. The percentage of those subscribers of

the waste collection service that waited for waste collection agency despite the delay in the waste collection had the proportion of 35.1%.

The percentage of non-subscribers, who dumped waste in the drainage was 15.9% as against the percentage of subscribers who dumped waste in the drainage which was 7.5%. The same applied to non-subscribers and subscribers to waste collection services who dumped waste in the bush were 15.1% and 5.2% respectively. Moreover, the non-subscribers to the service of waste collection who dumped waste on the road/street had 19%; while 2.3% was the percentage of those that subscribed to waste collection service but as well dumped in the same place. Also, 8.6% of the non-subscribers of waste collection services agreed to dump waste in the river, while only 1.7% of the subscribers claimed to have disposed of their waste in the river. The practices of waste deposits on the road, in the drainage, in the bush, and the rivers are still pervasive, which could have negative effects on the health and economy of the residents.

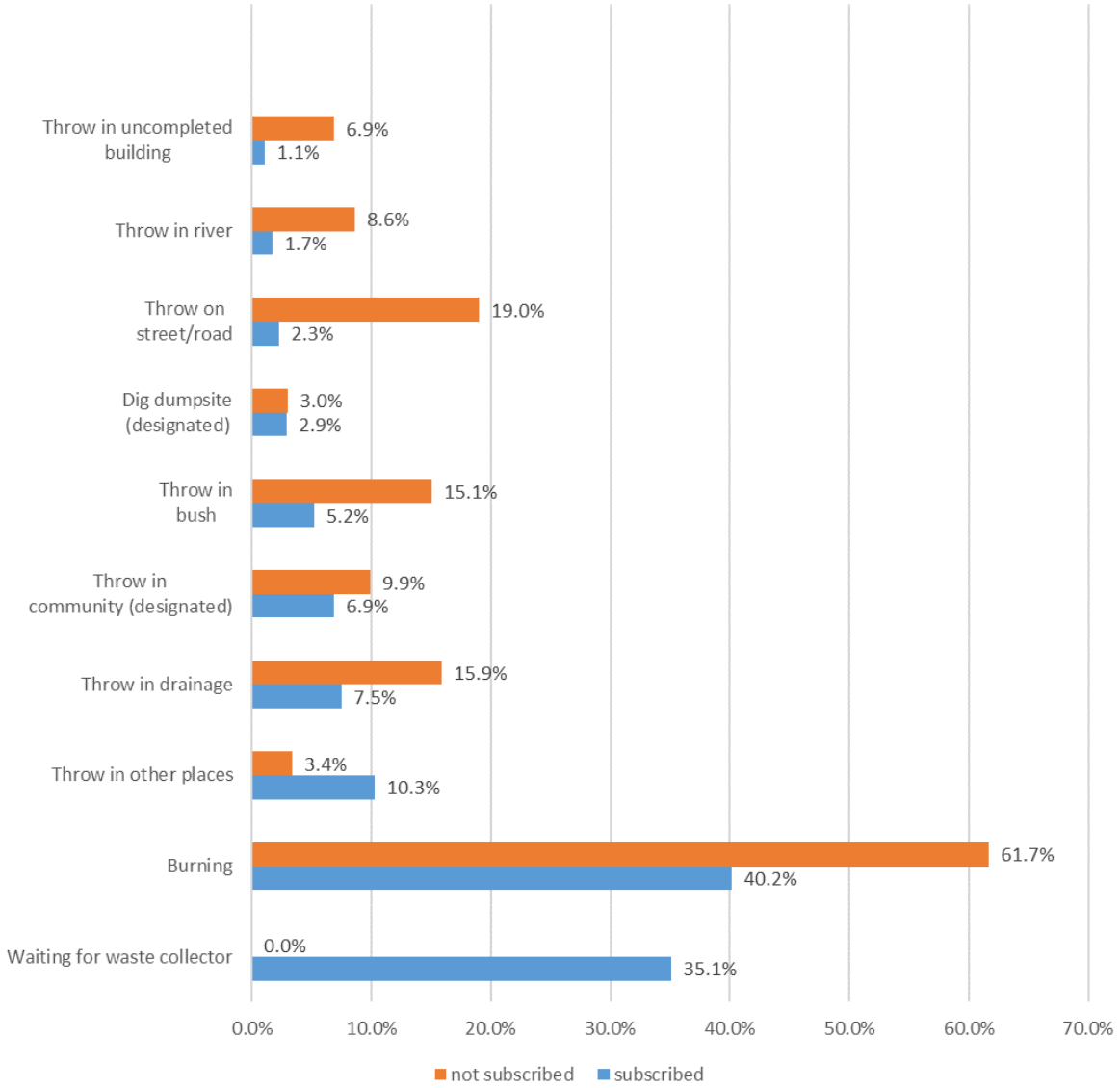

Figure 2: Waste Disposal Strategies between Subscribers and Non-subscribers in Ibadan
Source: The Author, 2021

4.2 Waste Management Expenditure and Waste Disposal Strategies

The type of waste disposal strategy one engages in will largely determine the amount of expenditure to be incurred on waste management. Waste management costs involve the cost incurred from waste storage, waste collection, and waste disposal among others. Waste collection and disposal conducted by waste collection agents are highly noticeable services that require substantial expenditure and challenging operational and maintenance issues. Furthermore, it is costly to operate, regarding investment costs, operational costs, and environmental costs (Faccio *et al*, 2011). This, therefore, tends to translate to high waste collection charges for services rendered to the subscribers.

In Table 3 the total population of 61.7% of the interviewed respondents, which comprise of both the subscribers and non-subscribers spent less than ₦500 for waste management monthly. A majority (78.2%) of those that subscribed for waste collection services in Ibadan claimed that they were satisfied with the services of the agencies. Eighty-one percent were willing to subscribe for the service of waste collection, while 64.9% of the subscribers maintained that they were satisfied with the charges. However, 35.1% were not satisfied with the charges for waste collection services.

Table 3: The Assessment of Waste Collection Services and Willingness to Pay by Households

Variable		req. of Household	% of Household
What is the amount paid monthly for WM service?	<₦500	259	61.7
	₦500-₦1000	51	12.1
	₦1001 - ₦2000	75	17.9
	Above ₦2000	35	8.3
For Subscribers Only Are you satisfy with WC Services?	Yes	136	78.2
	No	38	21.8
Are you willing to pay the amount charged for the services?	Yes	141	81.0
	No	33	19.0
If willing to pay, how much are you willing to pay per month?	Less than ₦1000	103	73.0
	₦1000 & above	38	27.0
Are you satisfied with the charges for WC services?	Yes	113	64.9
	No	61	35.1

Source: ***The Author, 2021***

Indiscriminate dumping strategies such as in the river, drainage, on the road among others are regarded as informal disposal strategies and appeared relatively cheaper strategies to dispose of waste. None of them paid above N500 to manage their waste. However, its cost implication on health and economy in the nearest future is relatively higher.

Considering the situation in Ibadan, the analysis in Table 4 indicates the percentage of participants that engaged in a particular waste disposal strategy and the waste management expenditure incurred for both waste subscribers and non-subscribers to the service of waste collectors. From the table, those that subscribed to the service of the waste collection agency, which can be viewed as a formal disposal strategy paid more for waste management practices than those that personally disposed of their waste. Some (17.1%) among those that engaged in self-disposal paid nothing. The highest paid monthly by non-subscribers for waste management was ₦500; precisely, the highest percentage of non-subscribers paid the lowest category of amount of money (₦1–₦100) to manage waste. However, the subscribers to the service of waste collectors paid a relatively exorbitant amounts for waste

management activities than expected or affordable by many, on the monthly basis

Table 4: Waste Disposal Strategies and Monthly Waste Management Expenditure of both Subscribers and Non-Subscribers to Waste Collection Service of Private Providers.

Do you subscribe for Waste Collectors to Services?	No Amount		₦1 – ₦100		₦101 – ₦200		₦201 - ₦500		₦501 - ₦1000		₦1001 – ₦1500		₦1501 – ₦2000		₦2001+	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Yes (Subscribers)	0	.0	0	.0	2	1.2	11	6.3	51	29.3	56	32.2	19	10.9	35	20.1
No (Non-Subscribers)	42	17.1	85	34.6	58	23.6	61	24.8	0	.0	0	.0	0	.0	0	.0

Source: The Author, (2021)

Based on the general observation, it is projected that the subscribers of waste that paid more are considered to have a stronger association between waste disposal strategy and waste management expenditure than those that did not subscribe. Non-subscribers in the context include those who did not view waste management in their vicinity and those who chose not to subscribe for waste management services because of one reason or the other.

From Table 5, the result of the individual P-value for each of the waste management strategies shows that no association exists between any of the waste disposal strategies and waste management expenditure for non-subscribers of waste collection service in Ibadan. For instance, 25 respondents who claimed that they burned within the compound spent almost nothing on monthly basis to dispose of waste or manage the environment. The p-value was 0.31. The highest paid monthly by non-subscribers could be spent to purchase nylon for packing and storing waste before disposal, kerosene or diesel used to burn, transport costs as the case may be, did not exceed ₦500, using Nigerian currency. This implies that the waste disposal strategy adopted did not have any strong relationship with the amount spent to manage waste either from waste storage, waste collection, and waste disposal stages by non-subscribers to waste collection service.

Table 5: Waste Disposal Strategies and Monthly Waste Management Expenditure of Non-Subscribers to Waste Collection service of Private Providers.

Non-Subscribers to WC	If No, how much did you spend on waste disposal								χ^2	P-value
	No Amount		₦1 – 100		₦101 – 200		₦201-500			
	Freq	%	Freq	%	Freq	%	Freq	%		
Burning within the compound	25	21.9	38	33.3	23	20.2	28	24.6	3.57	0.31
Burning outside the compound	5	17.9	11	39.3	9	32.1	3	10.7	3.70	0.30
Digging a designated dumpsite	0	0.0	1	16.7	3	50.0	2	33.3	3.68	0.30
Throwing inside the drainage	5	13.9	15	41.7	7	19.4	9	25.0	1.08	0.78
Throwing on the street or road	6	13.6	15	34.1	10	22.7	13	29.5	0.91	0.82
Throwing in a designated place within the Community	3	13.0	7	30.4	8	34.8	5	21.7	2.00	0.57
Throwing into bush	3	8.6	13	37.1	10	28.6	9	25.7	2.40	0.49
Throwing into river	4	20.0	9	45.0	4	20.0	3	15.0	1.68	0.64
Throwing in an uncompleted building	2	12.5	3	18.8	4	25.0	7	43.8	3.97	0.27
Throw in other place	0	0.0	4	50.0	3	37.5	1	12.5	3.22	0.36

Source: The Author, 2021

The findings from the Table 6 pointed out that majority (31.4%) of the subscribers to waste collection agencies paid the amount between ₦1,001 and ₦1,500. Also, 62.7% of the subscribers spent above ₦1,000 monthly for waste management. None of the subscribers fell into the category of spending nothing; because if you must subscribe, then you must pay for waste collection. There is a significant association at (P<0.01) between waste disposal strategy and waste management expenditure for the subscribers to waste collection services. This therefore established that the waste disposal strategy had a strong relationship with the amount spent to handle waste at waste storage and/or waste collection stage by waste subscribers of waste collection service in the city of Ibadan, Oyo State, Nigeria. This, therefore, supports the apriori expectation that there is the relationship between formal disposal strategy and the amount spent to manage such strategy. While informal disposal strategy has no relationship with the amount spent to manage.

Table 6: Waste Disposal Strategies and Monthly Waste Management Expenditure for Subscribers to Waste Collection Service of Private Providers

Did you Subscribe for WC services?	Nothing		₦1 - ₦100		₦101 - ₦200		₦201 - ₦500		₦501 – ₦1000		₦1001 - ₦1500		₦1501 – ₦2000		₦2001+	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Yes (Subscribers)	0	0	0	0	2	1.2	11	6.4	51	29.7	54	31.4	19	11	35	20.3

Chi-sq. = 371.40; p-value=0.001
Source: The Author (2021)

4. Discussion

The proportion of participants that subscribed was lower than the total proportion of those that did not subscribe to waste collection services. This implies that a higher percentage of Ibadan residents did not engage the service of waste collection providers. It was established from the findings that among various waste disposal strategies, the largest percentages of both subscribers and non-subscribers to the waste collection service in Ibadan engaged in waste burning. This showed that the common way of waste disposal is waste burning in the city. Also, some waste collection subscribers engaged in other means of waste disposal other than the service of a waste collection agencies. This sometimes occurs when the waste collection agent did not come at the stipulated time. The practices of waste deposit on the road, in the drainage, and the rivers were still pervasive among habitants in the city. Most of the participants lived far from the dumpsite locations and this may not contribute any negative implication on the health status of residents. However, in terms of tidiness of the residential premises, waste storage facility, types of waste collection/disposal practices, most of the residential areas in the city of Ibadan were assessed to practice unstandardized waste management, which may have adverse implications for both health and the economy of people.

Those that subscribed to the service of waste collection agency paid more than those that engaged in self-disposal. It also shows that there exists an association between the waste disposal strategy, and the amount paid to manage waste for the subscribers, while no association was established between the chosen waste disposal strategies and the amount paid for non-subscribers in Ibadan. This implies that the higher the payment to ensure environmental sanitation and hygienic setting in the residential premises, the higher the association with waste disposal strategy. In a clearer term, those who pay much to ensure sustainable environment obviously had more sanitary environment. Also, the higher the payment for waste management, the higher the possibility of achieving the underscored sustainable development goals (lower the likelihood of having diseases, reduce poverty rate because of there will be no out-of-pocket expenses on health and productivity is improved because of good health. In addition, increased agricultural produce is ensured if waste is properly managed, which leads to good soil quality. When waste management cost is incurred, the environment is free from water pollution which is not only save for mankind, but also for life below water and animals on land, our climate will be protected from the common waste disposal strategy, identified as waste burning. In a nutshell, waste management cost incurred now implies the lower or no future costs to be incurred. Since subscribers of waste collection incurred more cost to manage their environment than the non-subscribers, it therefore pays off for them as there would be no or lower

cost on health issues and other environmental costs that could possibly arise from improper disposal of waste relative to non-subscribers.

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