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Towards Sustainable Solid Waste Management Practices in Port Harcourt Rivers State, Nigeria

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ABSTRACT: Environmental pollution is a major issue in Port Harcourt. The improper discarding of solid wastes has led to poor aesthetics, clogged drainages, pollution of ground water and habitats for disease carriers such as mosquitoes, rodents and other insects. Regrettably, open dumping in non-sanitary landfills coupled with less public enlightenment on the impacts of indiscriminate solid waste disposal is prevalent. Sustainable Solid Waste Management system advocates the sound handling of solid wastes in an environmentally benign manner by advancing waste reduction/recycling and waste separation practices. On this note, this study seeks to ascertain the knowledge of residents on solid waste management as well as recommended possible sustainable methods to improve the management of solid waste in Port Harcourt city. Questionnaires were distributed as methods of data collection. A sample size of 400 was obtained using the Taro Yamen Equation. The survey population was drawn from residents of Port Harcourt. The statistical method employed in this study was descriptive statistics of frequencies and percentages. Findings showed that most of the respondents acclaimed that Port Harcourt is a city with a dysfunctional solid waste management system. 51.2% of the respondents acknowledged the improper management landfill sites, 56.3% of the respondents reported that they frequently generate food wastes that are disposed on dumpsite. Majority of these wastes are collected once in a week which is not a healthy practice. It was recommended that recycling facilities should be built in other to recycle the solid wastes; new engineered landfills should be constructed with proper collection/treatment of leachate; fines should be imposed on residents that indiscriminately discard their waste; and food wastes should be composted or used as animal feeds so as to reduce the volume of wastes discharged into the landfills and prevent environmental and public health pollution.

KEYWORDS: Sustainable, Solid waste, Management, Waste reduction.

I. INTRODUCTION

Solid waste disposal is a topic demanding attention. Port Harcourt is home to various oil companies, health centres, industries, markets, institutions etc. The continued practice of conventional methods of waste disposal in the metropolis has resulted in the dearth of a sustainable environment [1]. Other factors such as unskilled management workforce, inadequate waste management and transportation facilities, ineffective approaches to carrying out waste management, such as open dumps, few skilled labour, premature law enforcement, and the lack of monitoring, evaluation and supervision of waste management activities have exacerbated the underlying health threats [2]. Excessive inhalation of chemical wastes triggers the prevalence of infectious diseases thereby creating a global interest in Nigeria's environmental quality and solid waste management techniques. In Port Harcourt, open dumps technique is the established norm of solid waste disposal [3]. Open dumps release large amounts of hazardous and harmful chemicals to nearby groundwater, surface water and the ecosystem through leachates and landfill gas. Such release contains potential carcinogens which threatens public health [4]. A structured, supervised and controlled waste management plan is needed to protect against aggressive health hazards [1]. This study aims to determine the sustainable solid waste management practices in Port Harcourt.

II. LITERATURE REVIEW

Solid waste management entails the systematic coordination of generation, collection, storage, transportation, source separation, treatment and disposal of solid waste [5]. Sustainable Solid Waste Management describes basic principles and recent developments for the environmentally sustainable handling of solid waste. It positioned waste reduction and waste separation practices as the most favoured component in the waste hierarchy because they have a major effect on the final products of the general solid waste management process [6]. With a sustainable solid waste management in place, impacts related with inappropriate waste disposal like pollution on environment, public health and land use will be curbed [7]. Hence, preventing or reducing waste at the source is the main priority for a



successful implementation of sustainable waste management program [9]. The conventional solid waste management system in Port Harcourt requires a shift towards a more sustainable solid waste management in order to absorb these health and environmental benefits. Port Harcourt’s recent waste management system hinder potential residents’ abilities to fulfil their needs for a cleaner and healthier environment. The study showed the method of assessment of practices of sustainable solid waste management in Port Harcourt. It revealed that the target proportion of the solid waste is organic in nature- food waste.

III. METHODOLOGY

This study starts by carrying out a survey designed to ascertain the knowledge of Port Harcourt residents on solid waste management and disposal, identify the methods of solid wastes disposal, and determine the residents’ awareness of the impacts of indiscriminate waste disposal on environmental and public health. Both the quantitative and the qualitative research methods were adopted in analysing data. The questionnaire contained fifteen (15) questions which were grouped into three (3) sections namely: Section 1- Prior knowledge of the citizens; Section 2- Methods practised by the residents; Section 3- Problems associated with solid waste management and disposal in Port Harcourt. The capital and largest city of Rivers State, Nigeria is Port Harcourt. It is located along the Bonny River in the Niger-Delta region. It lies on the 4°49" N 7°21" E. Temperatures in the region are relatively stable with little changes throughout the year. Average temperature is typically between 25°C - 28°C [3]. With long and heavy rainfall seasons and very brief dry seasons, it showcases a tropical wet climate. In certain coastal areas and urban centres, the wet season is marked by heavy rainfall and periodic flooding. It starts in April and ends in November with the dry season starting from late November to March. Although, unlike some cities, rainfall in Port Harcourt occurs frequently during the year [9]. Port Harcourt consists of eight (8) Local Government Areas namely; the whole of Port Harcourt Local Government Area (LGA) and parts of Oyiibo, Okrika, Ogu/Bolo, Obio/Akpor, Ikwerre, Etche ,Eleme LGAs has approximately 2 million people. The rapid aerial and population expansion has stretched the few available basic utilities of the city [2].

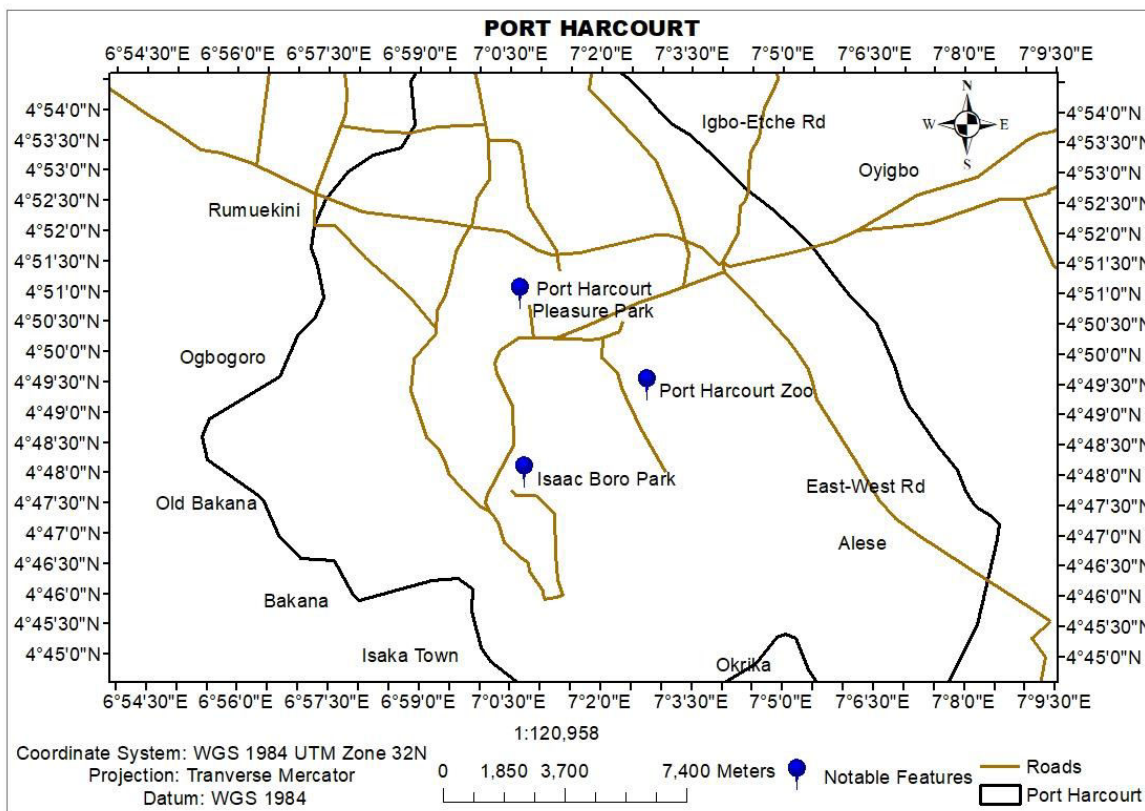


Figure Fehler! Kein Text mit angegebener Formatvorlage im Dokument..1 Map of Port Harcourt
Source: Adapted from Google Maps (2020).



The target population consists of all individuals residing in Port Harcourt. This study examines the methods and difficulties of solid waste management system among residents in Port Harcourt. The population of Port Harcourt was given as 1,481,000 in 2006 census. The simple random sampling method was adopted in administering copies of the questionnaires. The Taro Yamen equation $\left(n = \frac{N}{1+N(e)^2} \right)$ was used to determine the sample size Yamen [10]. This equation was used because the population size of the study area was known. The sample size is calculated below: n represents the sample size = 400, N represents population size = 1,481,000 while e represents the marginal error = 0.05.

$$n = \frac{1,481,000}{1 + 1,481,000(0.05)^2} = \frac{1,481,000}{3702.5025} = 399.9$$

Questionnaires were used as the primary method for data collection because it's economical and projects a wide coverage. It was also designed using Google forms. The links generated were sent randomly to respondent emails, and social media platforms. To ensure comprehension before filling, there were simple and easy to read questions. The time allotted was approximately five (5) minutes. The questionnaires were submitted after it was completed. Out of 400 distributed questionnaires, 2 responses were deleted because their responses did not tally with the questions provided. The data gathered were analysed and conclusions were drawn. Data collected from the questionnaire administered were analysed both qualitatively and quantitatively using descriptive statistics. Results were presented in tables and charts as frequencies and percentages. Microsoft Excel software package was used.

IV. RESULTS AND DISCUSSIONS

The outcomes gathered from the analysis of the data and discussions are presented in this chapter.

1.1.1.1 Objective one: Knowledge of residents on solid waste management and disposal

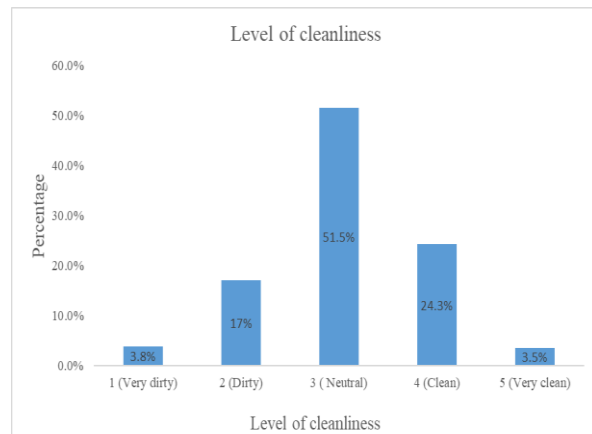


Fig 4.14 Response to whether residents considered themselves capable of disposing waste in a safe and environmentally friendly manner.

Figure Fehler! Kein Text mit angegebener Formatvorlage im Dokument..2: Response to the level of cleanliness in Port Harcourt

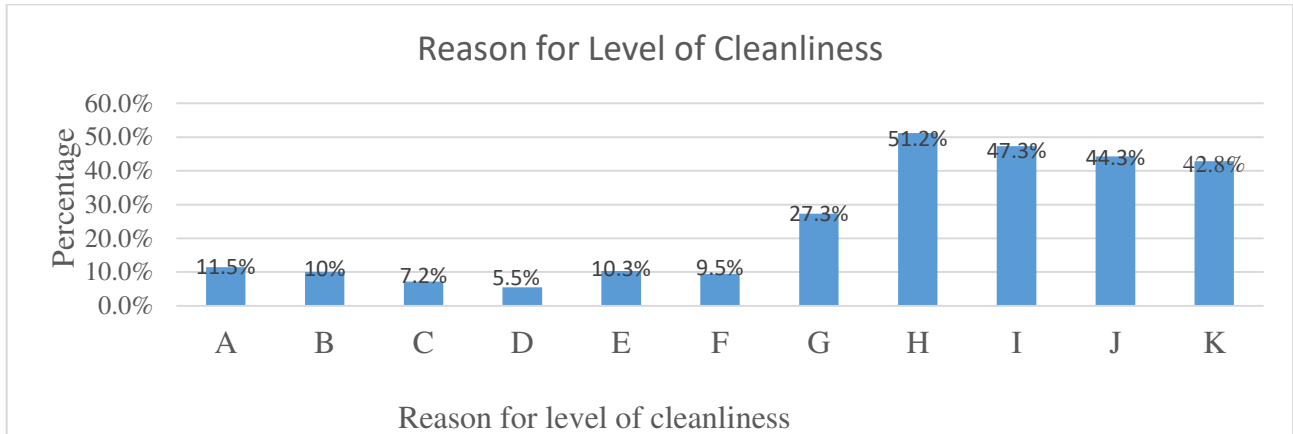


Figure Fehler! Kein Text mit angegebener Formatvorlage im Dokument..3: Response to the reason for the level of cleanliness

- A) Residents are aware of the health concerns that could result from dirty environments
- B) The government agencies responsible have designated appropriate dumpsites for the safe disposal of solid waste
- C) Residents have been duly informed of the methods of safe disposal of solid waste
- D) There are suitable bins for the segregation of solid waste
- E) Fines are imposed on residents who don't comply with the disposal guidelines
- F) The Environmental Sanitation organized by the state is very effective in the safe disposal of solid waste
- G) Wastes are littered everywhere, and there are no designated sites for the safe disposal of solid waste
- H) Landfill sites are not properly managed, and could become hazardous to neighbouring communities
- I) There aren't any measures for suitable segregation of solid waste.
- J) There are very few facilities that recycle the generated waste, and hence the proliferation of solid wastes
- K) Solid wastes that are non-biodegradable are a major cause of environmental and health hazards

Objective two: Solid waste management methods of disposal in Port Harcourt.

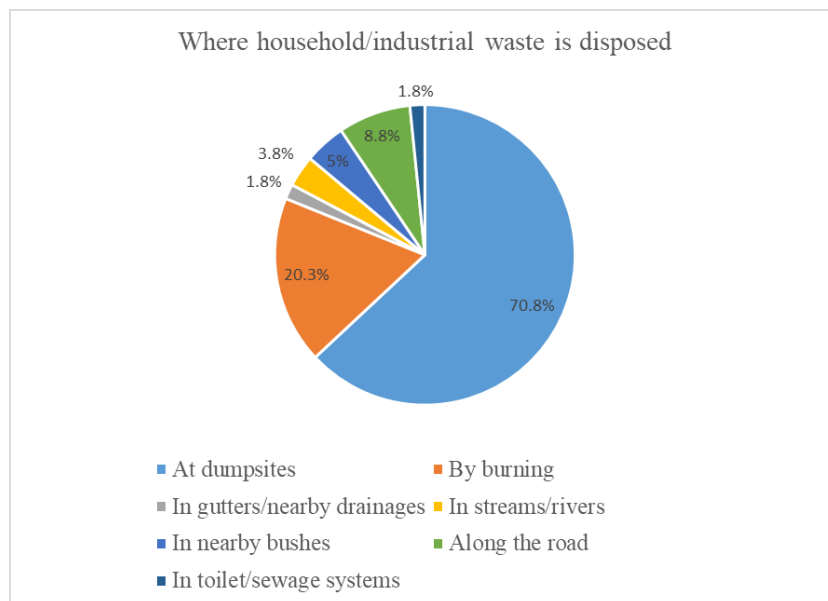




Figure Fehler! Kein Text mit angegebener Formatvorlage im Dokument..4: Response to where their household/industrial waste are disposed
Objective Three: Problems of solid waste management and disposal practice in Port Harcourt

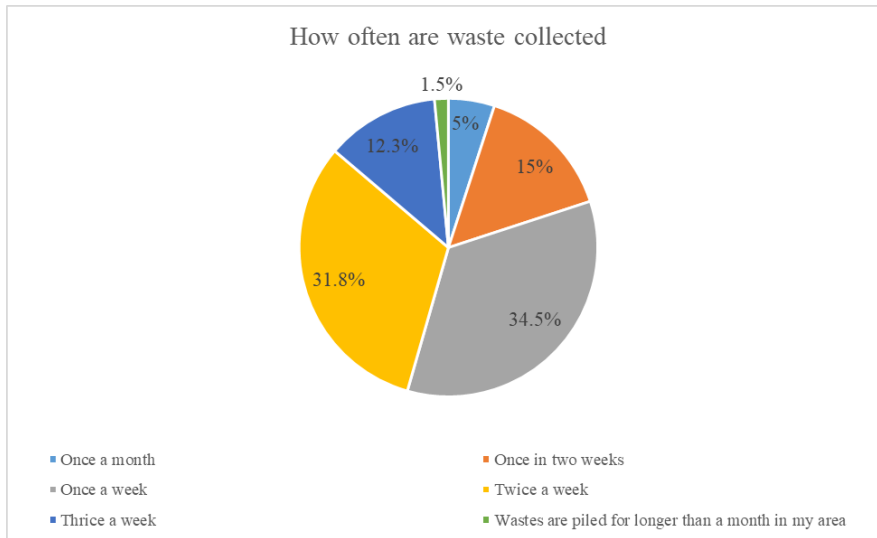


Figure Fehler! Kein Text mit angegebener Formatvorlage im Dokument..5: Response to how often waste are collected in their area

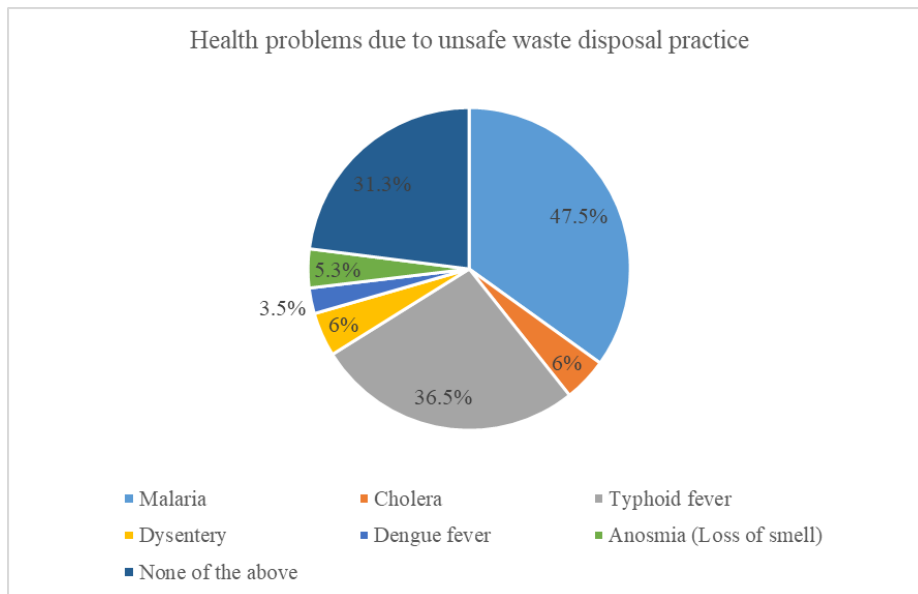


Figure Fehler! Kein Text mit angegebener Formatvorlage im Dokument..6: Response to health problems due to unsafe waste disposal practice

Table 4.1 Responses to ascertain the knowledge of residents on solid waste management and disposal

On a scale of 1-5 how would you rate the level of Cleanliness in Port Harcourt	Frequency	Percentage (%)
1 (Very dirty)	15	3.8
2 (Dirty)	68	17
3 (Neutral)	206	51.5
4 (Clean)	97	24.3



5 (Very clean)	14	3.5
What do you consider as possible causes for the level of cleanliness? Residents are aware of the health concerns that could result from dirty environments.	Frequency 46	Percentage (%) 11.5
The government agencies responsible have designated appropriate dumpsites for the safe disposal of solid waste.	40	10
Residents have been duly informed of the methods of safe disposal of solid waste.	29	7.2
There are suitable bins for the segregation of solid waste	22	5.5
Fines are imposed on residents who don't comply with the disposal guidelines.	41	10.3
The Environmental Sanitation organized by the state is very effective in the safe disposal of solid waste.	38	9.5
Wastes are littered everywhere, and there are no designated sites for the safe disposal of solid waste.	109	27.3
Landfill sites are not properly managed, and could become hazardous to neighbouring communities.	205	51.2
There aren't any measures for suitable segregation of solid waste.	189	47.3
There are very few facilities that recycle the generated waste, and hence the proliferation of solid wastes	177	44.3
Solid wastes that are non-biodegradable are a major cause of environmental and health hazards	171	42.8
Do you consider yourself capable of disposing solid wastes in a safe and environmentally friendly manner?		
Yes	286	67
No	31	7.8
I'm not sure I know what to do	101	25.2

Table Fehler! Kein Text mit angegebener Formatvorlage im Dokument..1 Responses to identify the various solid waste management methods of disposal in Port Harcourt.

How would you measure the quantity of solid waste generated?	Frequency	Percentage (%)
I generate more plastic/can wastes than food wastes	80	20
I generate more food wastes than plastic wastes	225	56.3
I generate more paper wastes than food and plastic/can wastes	47	11.7
I generate more electronic wastes than food and plastic/can wastes	4	1
I generate more glass wastes than food and plastic/can wastes	8	2
I generate more construction wastes than all other types of wastes	2	0.5
I generate plastic/can, food, electronic, construction, glass wastes in equal proportion.	34	8.5
Where do you dispose your household/industrial waste?	Frequency	Percentage
At dumpsites	283	70.8
By burning	81	20.3



In gutters/nearby drainages	7	1.8
In streams/rivers	15	3.8
In nearby bushes	20	5
Along the road	35	8.8
In toilet/ sewage systems	7	1.8

Table Fehler! Kein Text mit angegebener Formatvorlage im Dokument..2 Responses to determine the problems of solid waste management and disposal practice in Port Harcourt

How often are waste collected in your area?	Frequency	Percentage (%)
Once a month	20	5
Once in two weeks	60	15
Once a week	138	34.5
Twice a week	127	31.8
Thrice a week	49	12.3
Waste are piled for longer than a month in my area	6	1.5

Which of the following health problems have you/family members/staff suffered from due to unsafe waste disposal practices?	Frequency	Percentage (%)
Malaria	190	47.5
Cholera	24	6
Typhoid fever	146	36.5
Dysentery	24	6
Dengue fever	14	3.5
Anosmia (Loss of smell)	21	5.3
None of the above	125	31.3

V. DISCUSSION OF FINDINGS

Objective One: What knowledge do the residents have about solid waste management, and disposal?

From the results, most persons (67%) acclaimed that they are capable of disposing waste in a safe and environmentally friendly manner. In fig 4.7 Respondents were provided with options to pick from and no limit was set for how many options they could pick. These options described what they perceived about waste management and disposal system in Port Harcourt. Options (tagged A-K) were used and grouped into two, A-F formed group 1 and G-K formed group 2. Group 1 depicted features for a functional solid waste management system while Group 2 depicted features of dysfunctional solid waste management system. The data above shows that Port Harcourt residents have knowledge on solid waste management and disposal with 229(57.3%) residents having lived in Port Harcourt for above 6 years. From the analysis, 205(51.2%) acclaimed that Port Harcourt Landfill sites are hazardous to neighbouring communities, this agrees with the findings of [3] where It was highlighted that landfill liners are absent in the sites. Also, absence of leachate pipes/covers put both ground and surface water at pollution risks.

Options from the dysfunctional solid waste management system received the highest number. These included, no measures for suitable segregation of solid waste, few facilities that recycle waste, wastes are littered everywhere, few designated sites for the safe disposal of solid wastes and landfill sites are not properly managed.

Landfill sites not properly managed could become hazardous to neighbouring communities. This poses a threat to the public health and the environment as landfill gases and leachate would pollute both the surface water, ground water and also produce foul odour. To avoid this and dispose waste in a sustainable way, land fill sites should be well engineered to tackle the leachates and trap the land fill gases so they do not pollute the environment. Measures should be put in place by the government to allow for suitable segregation of waste and waste recycling. Furthermore, the land fill gases



can be used as renewable energy resource and create employment opportunities for residents. This would foster a transition to a more sustainable waste management and disposal system.

Objective Two: What are the various solid waste management methods of disposal in Port Harcourt?

Findings show that a huge number of citizens thrash their wastes in dumpsites (70.8%). These dumpsite locations are not in close proximity, as 56.3% (225) of the respondents travel for more than 20 minutes to get to the dumpsites, hence the tendency to litter the streets is high. Also, 56.3% of people generate more food wastes which are being disposed in dumpsites. As food wastes degrade, they release various greenhouse gases as well as producing foul odours. They act as breeding grounds to flies, rodents too. From the data presented in table 4.2, it shows that most Port Harcourt residents generate food waste 225(56.3%). The dumpsite is the most prevalent method used 283(70.8%). These findings also agree with the findings of [9], It was stated in their research that open dumpsites are mostly prevalent as the method of disposal used in Port Harcourt and that majority of the municipal solid wastes are usually made up of food and garden wastes (37.6%). Disposing these food wastes in the dumpsites creates a negative impact on the environment and also public health

To eliminate food waste that go to dumpsites, the various sustainable activities should be performed;

- I. Composting: Composting is the natural process of decomposition and recycling of organic material into a humus rich soil amendment known as compost. Composting is an environmentally friendly way to recycle food waste. Food wastes like vegetables, fruits wastes, bread, rice, potatoes and cereals should be composted.
- II. Food wastes can be used for animal feed or manure for soil.
- III. More people should be enlightened through consumer education campaigns on good food storage. This can reduce the amount of food waste being generated.

In the response to type of plastic waste generated, 47.7% of the respondents' stated that they generated polyethylene bags. These polyethylene bags are non-biodegradable and are disposed at dumpsites. This is not environmentally sustainable. The major impact of plastic bags on the environment is that it takes many years for them to decompose. In addition, toxic substances are emitted when plastic bags are under sunlight. They also release a toxic substance into the air causing ambient air pollution

An environmentally sustainable way(s) would be to replace polythene bags with paper bags or cotton cloth bags because these are recyclable.

Objective Three: What are the problems associated with the solid waste management system in Port Harcourt?

Data collected indicated that most food wastes are being compiled for a week or longer than a week (56% of the respondents). As these food wastes are compiled for a considerably long time before collection, they could lead to several health problems e.g. Malaria, Typhoid Cholera etc. When asked which of the following health problems residents have suffered from due to unsafe waste disposal practices, a higher percentage suffered from malaria and typhoid fever. This finding agrees with the findings of [11] where it was stated in their research that due to unsafe waste disposal residents are at risk of these diseases. Government waste authorities should design and implement waste collection strategies and policies that depend on the needs of the collection zone (e.g. population density, social class of residents, types of buildings etc.). This would help them ascertain the volume of food and plastic wastes that would be generated from each area for proper waste planning. Importantly, they should ensure wastes are collected/disposed at least thrice a week from collection zones, this would help to reduce the environmental/health hazards generated by these wastes. Waste policies should also include measures for segregating food and plastic waste to ease the subsequent waste sorting for re-use and recycling.

VI. CONCLUSION

Waste not adequately handled has a negative effect on public health, environment and aesthetic values.

Dealing with solid waste needs a sustainable solid waste management system which comprises of solid waste prevention/minimization, reuse, recycling, collection and disposal programme being embedded in community preference and aspirations. Establishing this and its implementation becomes necessary. Implementation is aimed at achieving the goal of making the environment free from solid waste for the improvement of human health and environmental protection. This offers job opportunities and a source of energy production.



Governments should fund researches on the best practices of waste management system and establish efficient incinerators and solid waste recycling facilities in order to create jobs for unemployed youths. Also, government should sensitize the Public on the benefits of proper waste management practices.

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