

GEOSPATIAL ANALYSIS OF SOLID WASTE MANAGEMENT IN OBAFEMI AWOLOWO UNIVERSITY CAMPUS, OSUN STATE, NIGERIA

BY

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ABSTRACT

Waste is an inevitable by-product of man's developmental activities and waste poses a threat to public health and the environment if it is not stored, collected, and disposed properly. This study assessed the solid waste management in Obafemi Awolowo University (OAU) Campus, Ile-Ife, Osun state which was carried out to examine the spatial distribution of waste collection points, assess the waste collection points, examine the method of solid waste disposal, assess the perception of respondents to solid waste disposal and evaluate how the current solid waste disposing methods can be improved towards achieving a sustainable environment. Both primary and secondary data were used for the study. Data were obtained through the use of questionnaire and field observations. The result of the geospatial analysis indicated that the spatial pattern and distribution of the waste collection points were dispersed, and that burning (59.2%) and open dumping (66.9%) were the prominent solid waste management practices adopted by the staff and students, respectively. Also, on the evaluation of the current solid waste disposing methods, (both staff (96.3%) and students (92.2%)) were well aware of the impact of improper solid waste disposal and management, to include air, water and land pollution, and diseases as the health impact of improper solid waste disposal and management. The study concluded with the need for improved solid waste management planning in the area as well as other college and university campuses in the region.

Key words: Obafemi Awolowo University Campus, Solid Waste, Solid Waste Management, Sustainable Environment.

INTRODUCTION

Human civilization has gone through different geological age, with each age of development presenting numerous challenges left for human society to solve. One of such alleviating activities that ignited the societal transit of humans through different geological age of human existence is the level of interaction between man and his environment (Goudie, 2018). Human existence has its root in the level of social interaction, and without these interactions, living is meaningless (Steiner and Stewart, 2009). A lot of scholars have been able to trace the predominant human activities that have contributed to social interactions over time, and among these contributing factors to social interaction is human-environment interaction activities (Moran, 2010) and waste is being generated as a result of human interaction with the environment. Waste is an inevitable by-product of man's developmental activity (Teo and Loosemore, 2001). Nowadays it is hard to find areas of human activity and development that have not harmed or affected the environment. Garbage and refuse arising from human activities, that is abandoned as unwanted and useless is referred to as Waste (Otchere et al., 2015).

Solid waste is the unwanted or useless solid materials generated from human activities in residential, industrial or commercial areas. A "solid waste" is defined as any discarded material that is abandoned by being disposed of, burned or incinerated, recycled or considered "waste-like" (Sharma et al., 2014). Solid waste includes garbage, construction debris, commercial refuse, sludge from water supply or waste treatment plants, or air pollution control facilities, and other discarded materials (Barupal et al., 2019). Solid waste can come from industrial, commercial, mining, or agricultural operations, and from household and community activities.

Waste poses a threat to public health and the environment if it is not stored, collected, and disposed properly (Nwachukwu, et al., 2013). Environmental effects of improper disposal of garbage, junk, among others, include surface water contamination, soil contamination, pollution, and leachate (Bhalla et al., 2014). These no doubt has a way of negatively impacting the ecosystem. One of the major challenges of both urban and rural settlers is that of solid waste disposal and management (Yoshioka et al., 2021). Waste can be seen littered and scattered everywhere, thereby defacing the physical environment. There is a waste management void left to be filled by putting in place sustainable structures and swift implementations of modern and best waste disposal practices to curtail the consequences of the year-long improper waste management in both urban and rural part of the country (Rudlin and Falk, 2009).

Wahab and Olabode (2018) assessed waste generated and adequacy of facilities used in managing streams of waste in privately owned hostel buildings in Ile-Ife Osun State, Nigeria but not the University hostels or Campus in general which is the focus of our research. The study carried out waste audit which included sorting and measurement of waste to determine components cum quantities of waste and perception of respondents on the stream of waste generated in the selected hostel buildings. Their observation was that garbage was most generated while the occupants had access to central waste storage facility to manage stream of waste generated in the hostel buildings. They however recommended that waste audit be taken as an integral part of waste management, though this study did not carry out waste audit, the components of waste in the Campus were observed. This study also went further to assess the spatial distribution of waste collection points as factor in proper waste collection, we also observe the different people and angles where the waste are coming from and examine their perception to the impact of improper waste management.

Adeniyi (2019) in his study of solid waste management in Obafemi Awolowo University, Ile-Ife looked at the quantity of the solid waste generated, examined the economic activities in the area influencing the generation of waste but did not examine the condition of the waste collection points nor the spatial distribution of the collection points and frequency of collection. Adeniyi also used factor analysis and ANOVA to articulate the factor contributing most to the quantity of waste generated in the University Campus but did not examine the perception of the respondents to the waste management, and concluded that solid waste storage, collection, transportation and disposal practices in OAU were not environment-friendly and that human and material resources currently available for waste management were inadequate to cope with the quantity of waste generated in the different activity areas on the campus. This study however evaluated the current solid waste disposing methods using geospatial analysis to evaluate the spatial pattern and distribution of the waste collection points and Chi-square was used to evaluate the perception of users in the Campus.

The Obafemi Awolowo University (OAU) Campus is one of the many academic settlement areas spread across the country and ravaged by the lack of a fully optimized and functioning solid waste management system. There are many economic activities spread across the campus which include buying and selling of both perishable and non-perishable goods. These goods

are sometimes exchanged, or packaged with non-degradable materials. These materials include, but not limited to papers, nylons, bottles, cans and many others that can be seen littered around different locations of the campus. The lack of visible changes to the current management of solid waste disposal on the campus served as the foundation on which this research was built, as it examined the spatial distribution of waste collection points, assessed the waste collection points, examined the method of solid waste disposal in OAU Campus and evaluated how the current solid waste disposing methods can be improved towards achieving a sustainable environment.

THE STUDY AREA

Obafemi Awolowo University is located in Ife central Local Government Area Ile-Ife, Osun State, Nigeria. The university lies between Latitudes 7°31'N to 7°32'N, and Longitudes 4°28'E to 4°32'E (Fig. 1). Ile-Ife, a town in Osun State, located about 80 kilometres north-east of Ibadan, Oyo State, is famous as the Centre of ancient civilization (Obafemi Awolowo University, 2012). Obafemi Awolowo University, Ile-Ife, formerly referred to as University of Ife, belongs to the first generation of federal universities, and was established on 8th June 1961. The Federal Government of Nigeria took over the university in August 1975, and in 1987, renamed it to Obafemi Awolowo University, Ile-Ife (Obafemi Awolowo University, 2012). The university is situated on a land area totalling about 11,350 hectares. It comprises of the main campus, student residential area, staff quarters, and a teaching and research farm (Obafemi Awolowo University, 2012).

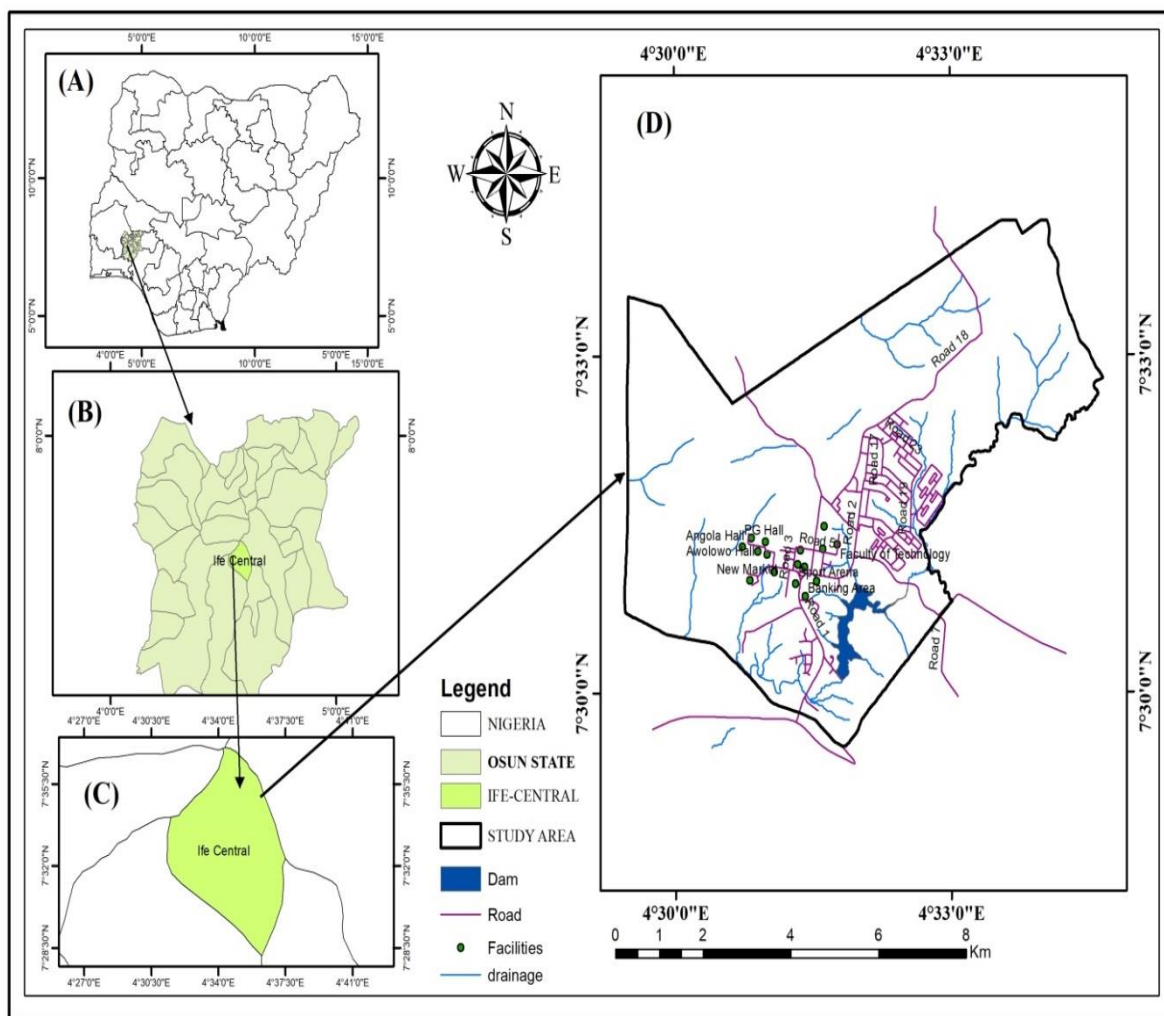


Figure 1: Obafemi Awolowo University, Ile-Ife

Obafemi Awolowo University has about two colleges and 13 faculties all located within the main campus. The students’ population rose steadily from 244 in 1962/1963 to 29,256 in 2011/2012 and is still rising. The university has about 103 academic departments and units as well as about seven specialized centres and institutes (Obafemi Awolowo University, 2012). Obafemi Awolowo University has nine halls of residence namely Akintola, Moremi, Alumni, Mozambique hall which accommodates the female undergraduate students; Fajuyi, Angola, Education Trust Fund (ETF), Awolowo Hall which accommodates the male undergraduate students and Murtala Muhammed Post graduate hall which accommodates both the female and male post graduate students. The university accommodates about 10,000–11,000 students, while the other students reside within the staff quarters, privately owned hostels close to the university main gate, or rented apartments within and around the university town.

The climate in Ile-Ife, Osun state is typical of the West African monsoon, with a significant seasonal shift in the wind pattern. The climate of Osun state is tropical. There are two seasons in a year: the wet season and the dry season. The moist marine south-west monsoon winds mainly affect Osun state between March and October, whereas the dry season occurs between November and February, when the dry, dusty winds blow from the Sahara Desert (Abiya et al., 2017; Akinyemi et al., 2019). The average yearly temperature is 26.5 degrees Celsius. It receives about 1311 mm of precipitation per year. January is the driest month of the year. In January, there is 6 mm of precipitation. June is the wettest month, with an average rainfall of

190 mm. The difference in precipitation between the driest and wettest months is 184 mm. The annual temperature variation is roughly 4.5 degrees Celsius (Ajileye et. al, 2019).

MATERIALS AND METHODS

Primary and Secondary data were used for the study. The primary data was collected through field observation using a GNSS receiver to capture coordinates and administration of questionnaires. SPSS was used to analyse the questionnaires and Geospatial analysis of the coordinates was done using ArcGIS 10.4 software. Four groups of structured questionnaires were administered to four categories of respondents, which are the respondents close to the dumpsite, staff in OAU staff quarters, students in the halls of residence and solid waste management staff respectively. A total of 199 questionnaires were administered in which 195 questionnaires were retrieved. Also, the coordinates of the various waste collection points and open dumpsite in the study area was collected using the Global Navigation Satellite System (GNSS) receiver, Garmin 72 Global Positioning System (GPS) with a resolution of ± 3 meters to determine the pattern and spread of the solid waste collection points. Waste quantification was carried out on weekly basis to determine the quantity of the different categories of waste generated by students and staff. These were sorted and separated at the sampling sites for clarity based on basic waste categorisation.

The secondary data used for this study is a shapefile of the study area gotten from African Regional Institute for Geospatial Science and Technology (AFRIGIST), population data of students in the hall of residence sourced from the Division of Student Affairs (DSA), Obafemi Awolowo University (OAU), hall of residence layout (including number of blocks and rooms) sourced from Capital Project Development (CPD) OAU, population data of staff in staff quarters sourced from the Housing Unit OAU, population of solid waste management staff gotten from the Environmental Health Unit of OAU Health Centre and online books and journals. The Statistical Package for Social Sciences (SPSS) software was used to analyse the data from the questionnaire administration. Descriptive statistics which involved the use of frequencies and percentages was used in analysing the results of the data gotten and the result of the analysis was shown on tables and charts. Also, inferential statistics involving Chi-square was used in the analysis of this study. Geospatial analysis of the coordinate points collected from the solid waste collection points was done using ArcGIS to determine the pattern of distribution of the waste collection points.

The average nearest neighbour of the spatial statistics tool in ArcGIS was used, this measures the distance between each feature centroid and its nearest neighbour's centroid location. It then averages all these nearest neighbour distances. If the average distance is less than the average for a hypothetical random distribution, the distribution of the features being analysed is considered clustered. If the average distance is greater than a hypothetical random distribution, the features are considered dispersed. The average nearest neighbour ratio is calculated as the observed average distance divided by the expected average distance (with expected average distance being based on a hypothetical random distribution with the same number of features covering the same total area). Dispersed patterns are perfectly uniform. $R_n > 1$ which means that each point is equidistant. Random distributions occur where there is no pattern at all. $R_n = 1.0$. The Random pattern has a tendency for clustering or regularity. Clustering occurs when all the points are very close to the same point. $R_n < 1$ and dispersed pattern occurs where the points are far away from each other.

RESULTS AND DISCUSSION

Assessment of Waste Collection Points in Obafemi Awolowo University Campus Ile-Ife

Seventeen (17) waste collection points including the open dumpsite, Asunle Dumpsite was identified and located during the field survey of this research in the study area. Figure 2 shows the distribution of the waste collection points including the open dumpsite.

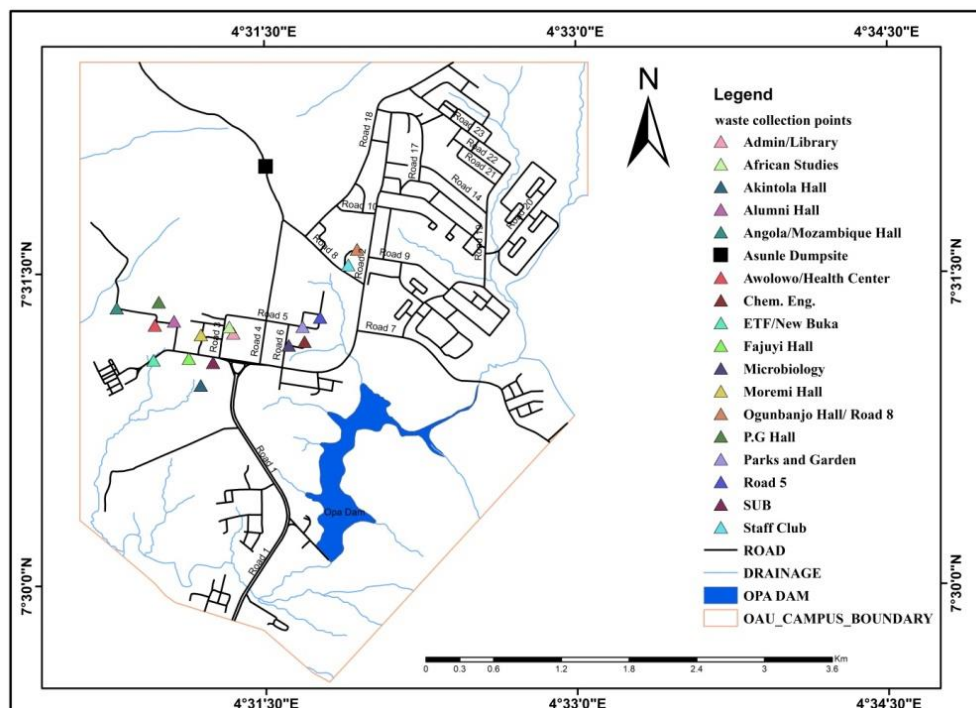


Figure 2: The Spatial Distribution of Waste Collection Points and Asunle Dumpsite

Pattern of Distribution

The pattern of distribution of the waste collection points was determined using the average nearest neighbour of the spatial statistics tool in ArcGIS. The observed distribution pattern is the dispersed pattern and this is shown in Figure 3. Dispersed patterns are perfectly uniform ($R_n > 1$) which means that each point is equidistant, also dispersed pattern occurs where the points are far away from each other. Dispersed pattern of distribution of the waste collection points gives room for easy off-lifting of the waste to the dumpsite; however, it also means that individual persons will have to walk (or drive) a distance to empty their bins.

Average Nearest Neighbour Summary

Nearest Neighbour Ratio: 1.2217

z-score: 1.7996

p-value: 0.0719

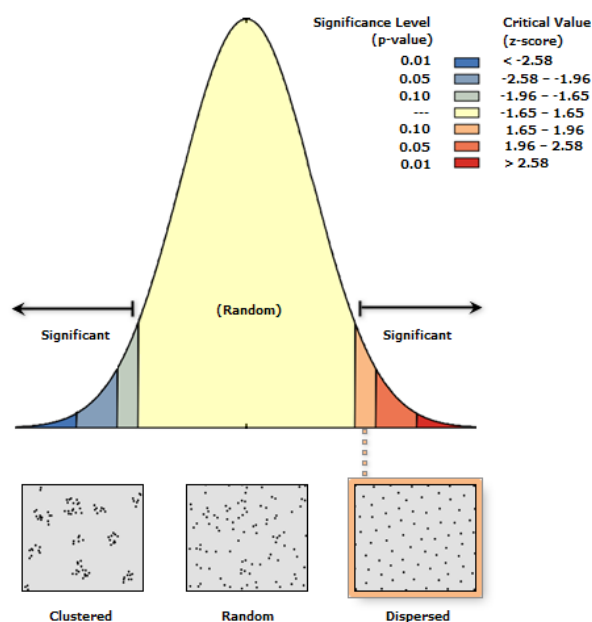


Figure 3: The Average Nearest Neighbour (NNR = 1.2217; Z = 1.7996; p = 0.0719) of the waste collection points and open dumpsite in OAU which is Dispersed Pattern

Given the z-score of 1.80, there is less than 10% likelihood that this dispersed pattern could be the result of random chance.

Categories of Waste and Method of Waste Disposal

This section discusses the categories of waste in the study area and its method of disposal as well as management from the students and staff of OAU points of views. This analysis is based on their level of awareness, attitude and disposition towards disposal and management as well as their perception on collection in the study area. Table 1 presents the summary of different variables on solid waste collection, disposal and management through respondents’ awareness and attitudinal disposition towards disposal and management.

The three categories of solid wastes that were identified at the staff quarters were paper and carton (48.1%); plastic, can and tin (22.2%) and food waste (7.4%) while they were 26.6%, 24.7% and 48.7% at the students’ hostels (Table 1). In addition, the weekly generated wastes that were sorted, were dominated by paper and carton wastes at both locations (3190.24 kg per week at the staff quarters and 32938.32kg per week from the students’ hostels), being 51.3% and 38.7% at the staff quarters and students’ hostels, respectively (Table 2). The perception that food wastes made up the 7.4% of the total wastes at staff quarters and 48.7% at the students’ hostels was not however supported by the results of the sorting (which showed that it was 28.3% and 37.8% at staff quarters and students hostels, respectively). Whereas the true explanations of this phenomenon may not be clear for now, especially as about 22.2% of the respondents at the staff quarters did not respond to the question relating to this, further research will be useful for the understanding of the psychology of food wastes. Nonetheless, the study of Neff et al. (2015) suggest that people may be concerned about confessing that they waste foods, and this may thus explain the 22% that overlooked the question on food wastes in this study.

Table 1: Solid Waste Categories, Collection and Disposal

Variables	Frequency	Percentage
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	<i>Staff</i>	<i>Students</i>	<i>Staff</i>	<i>Students</i>
<i>Types of Waste Produced</i>				
Paper and carton	13	41	48.1	26.6
Plastic, cans and tins	6	38	22.2	24.7
Food	2	75	7.4	48.7
No response	6	0	22.2	0
Total	27	154	100	100
<i>Number of Waste Collection Bin</i>				
1-2	4	77	14.8	50
3-4	22	61	81.5	39.6
≥5	1	16	3.7	10.4
Total	27	154	100	100
<i>Locations of Waste disposal Facilities</i>				
In the waste bin in your residence /hall	16	136	59.3	88.3
In the waste bin of your residence/hall waste collection point	4	14	14.8	9.1
By the hall way of your hall of resident	0	3	0	1.9
Others	7	1	25.9	0.6
Total	27	154	100	100
<i>Times the waste bin is emptied</i>				
Daily	2	129	7.4	83.8
Twice daily	3	3	11.1	1.9
Twice a week	4	7	14.8	4.6
Weekly	16	12	59.3	7.8
Others	1	3	3.7	1.9
No response	1	0	3.7	0
Total	27	154	100	100
<i>Length of waste collection</i>				
Daily	2	118	7.4	76.6
Weekly	3	0	11.1	0
Twice a week	2	6	7.4	3.9
Monthly	2	22	7.4	14.3
Others	1	8	3.7	5.1
No response	17	0	63	0
Total	27	154	100	100

Source: Authors' field survey, 2021.

On the number of waste collection bins, 81.5% of the staff members in staff quarters had 3 to 4 waste bins while 50% of the sampled students who lived in hall of residence had 1 to 2 solid waste bins per room. Similarly, the largest proportion of the respondents disposed their solid waste in the provided bin. It was discovered that 59.3% of the resident staff disposed their waste in the bins while 88.3% of the students disposed it in the waste bins provided in halls of residence. Also, it was revealed that 59.3% of the staff indicated that their waste was emptied or collected weekly while 83.8% of the students indicated daily collection of their generated waste. However, on the length of waste collection, largest proportion of the staff gave no

indication that their waste was collected while 76.6% of the students indicated daily collection of their generated waste (Table 1).

In general, there are evidences that the staff quarters are probably inadequately supplied with waste collection points or that wastes are inappropriately collected, as residents of staff quarters were recently stopped from bringing wastes to the waste collection facilities in the academic area (University Memo, 2022). Only 11% of the residents of the University quarters agree that the wastes are collected weekly as against 88.3% of those who attested to daily collection and transportation from the collection facilities in the students' area. The collection frequency of waste shows the reason why most staff bring their waste to dispose in the academic area.

In the perception study using questionnaire, the plastic, can and tins were lumped together as a single category (see Table 1) whereas during the quantification, these were sorted and separated at the sampling sites based on basic waste categorisation. In terms of the quantity of wastes generated, the results of the weekly weighing of wastes per student hostels and staff quarters, revealed that paper and cartons constituted 51.3% of the total wastes generated from the staff quarters, while food wastes were 28.3%. The students' hostels generated 38.7% of paper and cartons, and 37.4% of food wastes. Plastics wastes were the third most prominent in both the staff quarters and students' hostels; 12.6% and 15.9%, respectively (Table 2). Also, the wastes were not separated as the disposal method practised does not discriminate waste types and they are not sorted by the people. The wastes were however sorted at the sampling points by the researcher for improved information. In all, the University campus generated an estimated 91,430.12kg per week within the study period.

Table 2: Quantities of waste generated

Type of Waste	Staff quarters			Students' hostels		
	kg per household	Estimated total weight/week (kg)	% Waste type	Students (kg)	Estimated total weight/week (kg)	% Waste type
Paper and carton	5.08	3,190.24	51.3	4.26	32,938.32	38.7
*Plastic	1.25	785	12.6	1.75	13,531	15.9
*Cans and Tins	0.78	489.84	7.9	0.89	6,881.48	8.1
Food	2.8	1,758.40	28.3	4.12	31,855.84	37.4
Total wastes generated	9.91	6,223.48	100	11.02	85,206.64	100

* These were separated at the sampling sites based on basic waste categorisation

The sorting was at the researchers' discretion and not based on the practice of the respondents (refer to Table 1).

Awareness on Methods of Solid Waste Disposal

The result of the analysis showed that in staff quarters, residents are aware of more than one disposal method such that open dumping and burning of waste were the commonest. However, it was discovered that in the halls of residence, the largest proportion of the sampled students are aware of open dumping and this accounted for 66.9% while burning of waste was the next in magnitude to this proportion which accounted for 14.9% (see Figure 4).

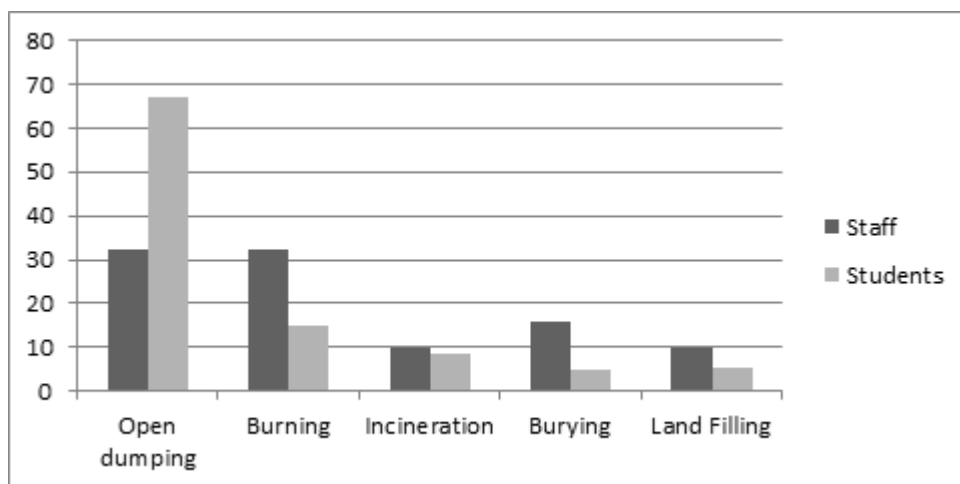


Figure 4: Awareness on Methods of Solid Waste Disposal for Staff and Students

Importance, Problems and Solutions of Solid Waste Management

On the importance of solid waste management, the largest proportion of the students indicated that their desire to clean and healthy environment as well as diseases prevention underlined their importance of solid waste management in their respective halls of residence and staff quarters. This perceived response of students accounted for a relative larger proportion of 39.6% and 29.2% for the clean/healthy environment and diseases prevention respectively, while the staff accounted for 44.4% and 25.9% respectively as shown in Table 3. Similarly, majority of the students indicated water pollution and diseases as major perceived emanated problems of improper solid waste disposal in their respective hall of residents. These responses accounted for 32.5% and 31.8% respectively. However, staff indicated air pollution and land pollution as their major perceived forms of improper waste management in the university staff quarters. This accounted for 33.3% and 25.9% of the entire sampled staff respectively.

Solid waste is a key element in the protection of public health because improper solid waste disposal and management exposes the students and staff to increased risk of infectious diseases which affirms the findings of Adetokunbo et al. (2003) and Nwankwo (2004). Also, improper disposal and management of solid waste has led to different levels of environmental issues such as air, water and land pollution, and health issues such as diseases which agree with the findings of George (2010).

Besides, 40.3% and 29.9% of the students respectively suggested that creation of awareness and recycling of solid waste is the major solution to these prevailing problems of improper solid waste disposal; while, 48.1% of the staff members suggested organization of seminars and programmes on waste management to curb or ameliorate the perceived waste disposal problems in staff residence. This magnitude accounted for the view of the largest proportion of the residence compare to other submissions. However, next in magnitude to this proportion was the percentage of those who suggested creation of awareness and this accounted for relative large proportion of 22.2% (see Table 3).

Table 3: Importance, Problems and Solutions of Solid Waste Management

Variables	Frequency		Percentage	
	Student	Staff	Student	Staff

<i>Please explain why solid waste disposal and management is important to you?</i>				
Clean and healthy environment	61	12	39.6	44.4
Friendly environment	34	5	22.1	18.5
For diseases prevention	45	7	29.2	25.9
For prevention of injuries	14	3	9.1	11.1
Total	154	27	100	100
<i>What problems do you think would exist in your hall of residence as a result of improper waste management?</i>				
Air pollution	26	9	16.9	33.3
Water pollution	50	5	32.5	18.5
Land pollution	29	7	18.8	25.9
Diseases	49	6	31.8	22.2
Total	154	27	100	100
<i>How do you suggest the school management correct solid waste disposal problems?</i>				
Creation of awareness				
Organization of seminars and programmes on waste management	62	6	40.3	22.2
Recycling of solid waste	31	13	20.1	48.1
Enforcement of effective waste management policies	46	4	29.9	14.8
Total	154	27	100	100

Source: Authors' field survey, 2021.

Also, information provided by students in Table 3 was subjected to chi-square statistics for further analysis. From the result of the chi-square analyses of the importance of solid waste management to students, their perceived problems in their halls of residence in OAU as a result of improper solid waste disposal and their perceived suggestions on the solutions to solid waste disposal problem in the halls to school management. Evidence suggested that these perceived variables were all significant at ($P < 0.01$). Similarly, the result presented in Table 4 showed that perceived responses of staff indicated in Table 3 were significant at either ($P < 0.01$) or ($P < 0.05$) with the exception of variables that explained the importance and problems of solid waste disposal in staff quarters.

Table 4: Importance, Problems and Solution of Solid Waste Management

Variables	Students in Halls of Residence	Staff in Quarters
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	<i>df</i>	<i>Chi-Square</i>	<i>Asymp. Sig.</i>	<i>df</i>	<i>Chi-Square</i>	<i>Asymp. Sig.</i>
Please explain why solid waste disposal and management is important to you?	3	30.364 ^a	0.000**	3	6.630 ^a	0.085
What problems do you think would exist in your hall of residence as a result of improper waste management?	3	12.701 ^a	0.005**	3	1.296 ^a	0.73
How do you suggest the school management correct solid waste disposal problems?	3	36.610 ^a	0.000**	3	8.111 ^a	0.044*

** *Significant Level at 0.01*

**Significant Level at 0.05*

The Effects of Obafemi Awolowo University Solid Waste Disposal Dumpsite

The result of the analysis showed that 85.7% of the residents within the community close to the dumpsite indicated that they had experienced discomfort owing to their proximity to the dumpsite. Besides, 71.4% of the respondents indicated air pollution as the type of discomfort they experience due to the proximity to dumpsite while 28.6% of the residents indicated land pollution and water pollution. However, 28.6% indicated that they had made attempt to report their discomfort, while 71.4% of the respondents who failed to report their discomfort revealed that they were not aware of any waste management agency (Table 5).

Table 5: Effects of OAU Solid Waste Disposal Dumpsite on the Community

Variables	Frequency	Percentage
<i>Discomfort experienced due to proximity to the dumpsite</i>		

Yes	6	85.7
No	1	14.3
Total	7	100
<i>Type of discomfort experienced due to proximity to the dumpsite</i>		
Air pollution	5	71.4
Water pollution	1	14.3
Land pollution	1	14.3
Soil contamination	0	0
Total	7	100
<i>An attempt to report discomfort</i>		
Yes	2	28.6
No	5	71.4
Total	7	100
<i>Reasons for not reporting</i>		
Not aware of any waste management agency	5	71.4
Too busy to report	0	0
Less concerned	0	0
Others, specify	0	0
No response	2	28.6
Total	7	100

Source: Authors' field survey, 2021.

Operational Information of the University Solid Waste Management Staff

This information was gathered from the staff of the university waste management unit to determine their disposal and management of solid waste from the management point of view. The essence of this information is to validate findings obtained from the residents' point of view. Findings showed that there are 36 waste collection points in OAU where the management staff covered to collect the waste for disposal. However, 29 waste collection points were seen and only 28 are functional as observed from the field survey. Similarly, lorry tractors, mobile dustbins and box-type dustbin were equipment identified by the management staff as the disposal facilities available for them for waste collection and disposal. Similarly, the respondents indicated that the type of waste services they rendered was solid waste collection and disposal.

Also, evidence suggests that newspapers, bottles, cans, cartons, green waste/organic and containers among other solid waste items were not recycled. It was also discovered that burning (at the dumpsite) and dumping were the prominent solid waste management practices adopted by the management staff. The respondents, therefore identified increasing population of the residents of the university and other members of the university environment, external waste and lack of fund as major challenges mitigating against their proper waste management practice and suggested provision of funds and modern equipment, employment of more staff and imposing levy or fine for external waste dumping as ways to solve solid waste management problems in the Obafemi Awolowo University Campus.

CONCLUSION

Over the years, the amount of the solid waste generated in Obafemi Awolowo University Campus has grown steadily as a result of the continuous increase in the population, and also due to the external waste being dumped by non-residents of the university. These have been the major challenges mitigating against the proper solid waste management practice including lack of funds, lack of the use of improved modern equipment and not enough working staff, hence, the resulting effect of the lack of proper waste management. The aim of this study is towards achieving sustainable development and creation of awareness, organization of seminars and programmes on solid waste management and recycling of solid waste were the suggestions made by the respondents to achieve this aim.

To work towards achieving a clean, healthy and sustainable environment, proper deliberate and adequate planning should be done by the solid waste management authorities and the authorities should ensure that the solid waste disposal and management problems are solved. It is therefore recommended that, Obafemi Awolowo University authority should organize solid waste disposal and management programmes to create awareness and further enlighten the students and staff of the university on the effect of improper solid waste disposal, provide more solid waste management equipment and facilities to complement the ones in use and to cater for the increasing population. Funds should be made available to the solid waste management staff and more staff should be employed in the solid waste management sector to aid efficient and effective solid waste management system. Formulation and enforcement of solid waste management laws should be put into practice to prohibit illegal dumping of refuse and also reduce bringing in of external waste in the university environment. Also, the university authorities should invest in latest technology of solid waste management system to enhance environmental sustainability, thus, reducing solid waste, creating more employment and also creating wealth through the process. Recycling and incineration method can also be adopted to reduce waste and be converted to energy which can be used to generate electricity; the incinerators at the dumpsite should be modified to aid the success of this process.

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