SOLID WASTE MANAGEMENT IN THE FEDERAL UNIVERSITY OF TECHNOLOGY (MINNA)

(PROBLEMS AND PROPECTS)

BY

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CERTIFICATION

We certify that this research work was originally carried out by RAJI TOYE RAFIU (Reg. No. PGD/Geo/2000/2001/191) and approved as meeting the requirement for the award of Post Graduate Diploma (PGD) in Environmental Management Department of Geography, Federal university of Technology, Minna, Niger State.

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DEDICATION

My dedication goes to Almighty Allah Subhanahu wata'ala for His protection and guidance during the course of my studies, also my dedication goes to my Dear wife Alhaja Fausat Fadeke Toye Kaduna Polytechnic for her patience and constant encouragement and for tolerating my long period of absence from home during the long period of studies in the University.

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ABSTRACT

Solid waste management in Federal University of Technology Minna is a project work that focuses on the laid down solid waste management practices of the institute. Evaluation was made of the waste management practices of institute and was found to be "fairly ineffective" and thus still needing adequate attention. Through source collection and measurements the quantity of solid (office, food, vegetative, labouratory and workshop) wastes generated per day, per capital, was determined. A general survey by use of questionnaire shows the outright disapproved of the waste management system especially by students and staff alike. Results of percentage composition of solid waste generated per day showed that through composition of food wastes collected from hostels and canteens, the amount of organic wastes at the present dump sites could be drastically reduced and compose manure derived could be use for agriculture purposes the effect indiscriminate waste dumps and open burning on the biota, especially, on students and the entire hostel and school environment where discussed. Finally, suggestions were made for effective solid waste management and through application on the four "RS" of solid waste management, a simple solid waste disposal system suitable for use in the Federal University of Technology can be formulated.

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CHAPTER ONE

1.0 INTRODUCTION

"Driving through the big cities in Nigeria, solid wastes often pile up in huge heaps, which spread onto the roads blockings the carriage ways and giving the streets unsightly appearance. The well known attitude of modern cities to drown in sewage is exceeded only by their talent of suffocating of modern a blanket of waste and rubbish" (Weststrate, 1965). In most Nigerian tertiary institutions, the problem of solid waste management has reached a climax. In the federal university of technology, Minna, an erstwhile center of excellence, the problem of solid waste management is fast getting out hand. Amidst the present developments which include a face-lift of most of the institutes facilities, the upsurge in the indiscriminate disposal of solid wastes as a barrier to the attainment of a clean and healthy environment.

1.1 AIM AND OBJECTIVES

The aim of this project is therefore to provide the Federal University of Technology, Minna, with a viable solid waste management procedure which is aimed at not only achieving a cleaner and friendlier environment but also will place Federal University of Technology, Minna, amongst the cleanest campus in the country and thus restoring its true position as "a center of excellence".

According to Petty and Green (1997), pollution prevention has now become the environmental option of this century, whereas typical waste management strategies of the late 1980s concentrated on "end-of-pipe" pollution control, pollution prevention attempts to handle waste at the source (that is source control). As waste at the end disposal costs increase, the application of pollution prevention measures is becoming more attractive than ever before.

The objective of this project therefore includes:

i. Giving useful suggestion for pollution prevention especially by source reduction.

ii. Determining the various kinds of wastes produced, the average per capita production and hence suggesting best handling, storage and disposal methods to make management of waste more effective.

iii. Minimizing the effect of solid waste disposal on public health through effective solid waste management techniques.

iv To provide suggestions on methods of reducing waste bulkiness especially through composting of perishable organic waste and recycling of paper wastes.

1.2 SCOPE AND LIMITATION

This project work covers the areas of solid waste generation in Federal University of Technology, Minna, their types, collection, storage, handling transfer and transportation, processing, recovery and disposal.

The areas of solid waste management such as legal, functions involved in the whole spectrum of solutions to problem of solid wastes are not included. Other waste management procedures involving liquid waste, gaseous waste and generation, handling and disposals were not investigated not discussed. Finally, all chemical analytical methods including chemical charactization of solid wastes are outside the scope of this work.

1.4 SIGINIFICANCE

According to what Whitman in his poem "A song of rolling Earth", "whatever you are! you are he or she for whom the earth is solid and liquid, ... You are he or she for whom the sun and moon hang in the sky".

It is important that man keep his surroundings clean and clear from all factors capable of causing his health problems. Most importantly, learning and other human activities including commerce are best carried out in conducive environments where wastage generated are well controlled and disposed of. It is therefore believe that this project work would help in-still in the Federal University of Technology, Minna, populace especially the school management, the need for effective management of solid wastes.

1.5 STATEMENT OF PROBLEM

While the problems of waste management looms large in many Developing countries, there is hope in that cases of successful experimental, but sustainable approaches, leading to some tangible results have been under taken in some of the developing countries of the world including Nigerian. These cases can be regarded as best practices that are not only sustainable but are also worthy of replication falade 1998.

1.7 THE STUDY AREA

Location:

Federal University of Technology Minna area is located at longitude 6^0 00, 28E and latitude 00^0 4/N of the equator of west to east of axis of Niger State. The University bounded by many villages and towns. Two local government is enveloped by Minna local government that is the Minna metropolis and bounded to be North/East by Shiroro local government are to the South – east Pailkoro local government area and to the south bounded by Bida Local government and lastly to the west by Wushishi local government (Fig, 2.1)

1.7.1 THE HILLS AND HIGHLAND

The character of the site terrain is generally upland, undulating particularly towards the Northern fringe of the settlement while the land shapes gentle towards the South except from the South – west where GajAI- Hill interrupted the low terrain gradient its tributary KUTAAJIDAI on the other side of the town and took its source from Maikunkele hill on the north before flowing south – east wards and North – west. Ka'Bo stream took its source from GAJAI hill when flow from North – west direction before emptying into KUYAJIDAI stream. The development of the terrain varies from altitude 275 meter to 300 above sea level.

1.7.1 WEATHER AND CLIMATE

The climate of the study area is a sub –humid type classified as the tropical wet and dry (Koppen,1971). These two seasons are very dependent on two prevailing air masses over the country at different times of the year. (The dry

tropical continental air mass of the sahara region and the humid maritime air mass from the Atlantic ocean). The two air masses nearly opposite in direction met and create an inter – tropical discontinuity.

However, the ITD reached the southern limit at latitude 5^0 N in January and its northern limit at the vicinity of latitude 20 – 24^0 N in month of August, that is when it reaches the trough. This is the period when groundnuts have the adequate rainfall it needs. The ITD as already explains above reaches the study area at latitude 9^0 35N between the month of March and April and it recedes in October (Oguntoyinbo, 1967). The general significance of climate to the crop include rainfall which is the most important among the factors of climate the crop needs to grow temperature, humidity pressure and sunshine which are already available in the study area will not have any threat to the spatial and temporal variation of these elements within the study area.

1.7.2.1 RAINFALL

Rainfall amount and its temporal variation constitute the most important sets of climate variable, which affect the production of crops in the study area. The temporal and normal variation of rainfall affect the amount, reliability and timing of availability water for the production of crops (Udo, 1970). The climatic parameters such as the seasonality of rainfall, onset date of rains, cessation dates of rains has also contributed to the amount and the quantity of the crops production.

However, university area of Niger State has a tropical climatic. The rainfall pattern in Nigeria is generally governed by the movement of the inter-tropical convergence zone (ITCZ) which shows a steady decrease from south to the north (walter, 1968). The area under study shows the same characteristics and the distinct et and dry seasons with other tropical regions. The mean annual rainfall in the study area ranged from 1000mm to 1500mm. The month of September recording highest rains of 300mm (source Niger State Ministry of Agriculture). The mean annual length of the rainy season (LRS) varies from 190 – 200 days in the local government area. (Kowal and Adeoye, 1973). The rain season starts between 10^{th} of April to 20^{th} of May and extends to October

(Oguntoyinbo, 1967). The dry season starts around the end of October to November and extends to march. During this period most especially in November to January cold dry dusty winds (harmattan) prevails blowing from the Sahara desert.

1.7.2.2 TEMPERATURE

Temperature does not constitute major constraint to the crop production, hence it is suitable for the growth of crop in tropical region. The temperature usually high, sometimes higher than in the south because of distance from the moderating effect of the Atlantic ocean. The highest temperature is usually recorded in April (31^0 C) and the lowest in August (25^0 C) (Yayock et al, 1988). The critical temperature which the crop will not thrive well is 45^0 C and the maximum temperature for the crop (groundnut) to grow into maturity is 35^0 C.

1.7.2.3 RELATIVE HUMIDITY

The relative humidity of the area under study is usually 90% in the month of May – October that is during the wet season very low during the dry season of about 35% in the month of November to March. Owing to the prevalence of tropical maritime air masses which originated from the Atlantic ocean and hence moisture laden across the study area University area from April to October (Nweke, 1988).

1.8 VEGETATION

The area under study is found in the Guinea Savannah where the grasses are found to be very tall as the area receives up to 1000mm of rainfall annually and the rainy season lasts up to six months. Trees are interspersed with the grasses. The trees found in the area are shea – butter tress, baobao trees and acacias. Under seasonal stress with the stunted grasses, this region is not susceptible to the trend, it is real extent is diminishing quite fast. These are associated with the consequences of plantation and agricultural activities. The height of grasses tends to decrease toward the western part of the local

government boundary (towards Wushishi local government area) with the area under study.

1.9 SOIL

Most part of the study area are under the ferruginous tropical soil consists of the most single extensive soil types of the country and it support most of the important food crop and cash crops of the country. They have derived mainly form the basement complex and old sedimentary rocks. The effect of the parent materials (Basement complex and old sedimentary), it is important to speed across an extensive areas of variable climate and vegetation (Areola, 1978). Thus in more or humid forest and dried Savannah to the south, the soil are deeper, more moist and to the process of Laterization. In the Savannah where the study area is being located, the terrain consists of mainly isolated rocky hills, and mselborges which rise above extensive plains dissected by stream and rivers over this terrain or landscape we have soil variation down the slope.

However, the soil contains iron, which gives the soil high water retention capacity which in turn gives an agriculture addy – most important crops are grown on this soil following the climatic variation across the distribution from south to the north. The crops grown on this soil include, maize, yam, millet and groundnut, guinea corn.

CHAPTER TWO

LITERATURE REVIEW

2.0

All around the world, nature has suffered a great deal from the generation disposal of solid waste from the common man to the elite in the society, a variety of waste matters are daily produced and introduced into nature's various receiving channels, - land, Air, and water. The after effects of these wastes on the natural resources of the earth have been of major concern to the governments of the earth, thus, mankind is now confronted with a never ending problem he must continue to proffer solutions to as long as the earth remains.

Andrew porteous (1998), in his "Dictionary of Environmental Science and Technology" defines waste as any substances or object or object which the holder disposes off or is required to dispose of pursuant to the provisions of national law in force.

Nwafor (1999) describes wastes as unavoidable materials resulting from industrial, domestic, or commercial activities for which there are no economic demand by the generator and which must therefore be disposed off.

Since wastes are associated with most aspects of human endeavour, the are as many types of wastes as there are activities that generates them. Thus, wastes can be classified as Agricultural (cassava peels, cut weeds, vegetables, cow dung, etc.), chemical (drugs, paints etc.), Domestic (e.g food wastes, garbage, rang); Commercial (packages, labels, insulators,) and so many others. Wastes can further be categorized as hazardous or non - hazardous depending on their toxicity effect on the physiological system of living things. Wastes generally occur in three basic forms: Solid, Liquid or Gases.

Through waste generation is a continuous process and ".....living things only cease to generate wastes, when they themselves are in a state of being disposed off as wastes" (Adesida and Igbuku, 1998), there is an urgent need to explore possible solutions towards management of this problem in such a way as to guarantee sustainability of our environment. In pursuance of this goal, an effective programme for prevention of a wastes management strategy

must be facilitated to address the factor contribution to this unhealthy and undesirable act in the country.

The American Public Works Association an the World Health Organization Expert Committee (1971) describes solid waste as useless, unwanted, or discarded materials that arise from man's activities and are free living. According to Bameke (1988), a descriptive definition of solid wastes consists of discarded materials generate from domestic and community activities and from industrial, commercial, agricultural operations Perry (1997) defines solid wastes as including all soil or semi – solid materials that are no longer considered of sufficient value to be retained in a given setting. Porteous (1998), however prefers a more definite descriptions, including solid and semi – solid materials resulting from industrial, commercial, mining agricultural operations and domestic activities.

SOLID WASTES IN THE DEVELOPING COUNTRIES

In the words of Bameke (1998), " The generation of solid wastes in the developing countries is continuously increasing: the problem is compounded by the advert of industrialization and urbanization, high population density, intense land use for residential and industrial activities leading to adverse impact on the environment" Scridhar and Ojediran (1983) and Scridhar et al (1985) sited that, "rapid growth rate in size and population of Nigerian cities brings about a great change in the volume and diversity of solid wastes generated and when such changes have no committant increase in infrastructural facilities, the environmental problems are compounded" Indeed, driving through the big cities in Nigeria, solid wastes often pile up in huge heaps, which spread on to the roads blocking the carriage ways and giving the street unsightly appearance. Westrate (1965) has this to say ".....the well known attitude of modern cities to drown in a sewage is exceeded only by their talent of suffocating under a blanket of waste and rubbish".

SOURCES OF SOLID WASTES

Just as solid wastes vary in size, shape and composition, so also do their sources of generation. As human activities tend to increase and diversify so does he human generate from these various fields of human endeavours. According to

the Federal Ministry of Housing and Environment (1982), " some of the facilities generating organic solid wastes are food factories (food processing industries, hotels, canteens), breweries, pulp and paper industries, organic chemical industries, sugar industries, and pharmaceutical industries".

Macharen (1970) emphasized that, " other solid wastes found in large quantities are those from animal farms and slaughter houses, all of which are biodegradable matters. According to him, in the out sketch of several Nigerian cities are found deports for metal scraps of cars, demolition wastes and factories wastes such as spent grains from the breweries. This accessions may still be true only that expansion of settlement have now brought these deports from out sketch right into the middle towns and cities. Macharen further sited the case of some industries that generate and accumulate toxic and hazardous wastes in their premises; a situation, which is even now for more rampant, that it was some decades ago. Finally, Macharen stated that domestic wastes are both organic and inorganic in general and that their inorganic parts contain metals and bottles while the organic matters include paper and paper products, foreign matters, peeling food remains and dead animals. To the list could also be added spoilt computer cartridges now becoming more rampant in modern homes, used clothing's, plastic and polythene bags an wood from broken furniture, just to mention but a few.

One thing that is a determination of the constituents of waste in Nigeria is its source. Oluwande (1974), clearly stated that, " the constituents of wastes in Nigeria are determined by social customs and agricultural wastes".

EFFECTS OF SOLID WASTE ON ECOSYSTEM

An ecosystem according to Allaby (1980) is a community of interdependent organisms together with the environment which they inhabit and with which they interact. Porteous (1998) further defines it as comprising the plants, animals and microbes that live in an defined zone (which can range from a desert to an ocean) and the physical environment in which they live.

Nwafor (1999) however describes an ecosystem as a community of organisms interacting with one another and the chemical and physical factors

making up their environment. Their chemical and physical factors include sunlight, rainfall, soil, nutrients, climate, salinity, etc.

PUBLIC HEALTH IMPACT OF SOLID WASTE GENERATION

According to Dajani and Warner, (1980) form the days of primitive society, humans and animals have used the resources of the earth to support life and to dispose of wastes. In early time, the disposal of wastes (human and others,), did not pose a significant problem, and for population was small and the amount of land available for the assimilation of waste was large. In his words, the problems with the disposal of wastes can be traced from the time when human first began to congregate in tribes, villages, and communities and the accumulation of wastes became a consequence of life. Bameke (1988), inferred that although there Is not much data on the pathogenic nature of municipal solid wastes, the role of solid wastes in the transmission of bacterial, viruses and parasites is well known.

MANAGEMENT OF SOLID WASTES

Nwafor (199) defines solid waste management as involving all activities geared towards inventory, characterizing, segregation, minimizing, tracking transportation, handling, storage, treatment and disposal of wastes in a safe and effective manner that is acceptable to all. Another writer defines it as that discipline associated with the control of generation, storage, collection, transfer and transportation, processing and disposal of the best wastes in a manner that is in accord with the best principles of public health, economics, engineering, conservation, aesthetics, and other environmental considerations, and that also is responsive to public attitudes. Porteous (1998) now defines the management of solid wastes as the management of such wastes at all stages from production, handling, storage, transportation, processing, and ultimate disposal which includes the " Duty of care".

In the Duty of Care, the Royal Communication Environment Pollution 11th report (1985), recommended in paragraph 13.74.

(a) That producers of controlled wastes have a duty of care to take all reasonable steps, having regard to the hazards presented by their wastes, to ensure that their wastes are subsequently managed and disposed off without harm to the environment;

(b) That the steps that is reasonable for the wastes producer to take in different circumstances to discharge his duty of care shall be contained in a code of practice issued by the secretary of state; and

(c) That producers of commercial industries and certain domestic wastes who engage contractors to transport their wastes remain liable of the proper disposal of these wastes transporter in accordance without later recommendation and provide him in writing with an unambiguous indication of the nature of the wastes and clear instructions for their disposal. Bhide and Sundaresan (1983) stressed that " the management of solid wastes must involve resource recovery apart from activities associated with generation, storage, collection, transfer, processing and final disposal". According to them these activities are most principles of economy, aesthetic, energy and conservation. On their part, Munich et al (1963) noted that the variables to be considered in the management of solid wastes are;

(a) The types of wastes to be handled.

(b) The amount of wastes generated per day

(c) The transport distance , and

(d) These variables are invariable that they can not be ignored if the management of solid wastes is to be effective.

In the previous section, we examined the effect of a solid wastes generated on public health. William (1982) suggests that an obvious way of reducing the problems of environmentally induced diseases in Nigeria is to manage solid wastes properly.

Oluwande (1974), pointed out that the collection and transportation of solid waste alone takes up to 75% of the total budget in solid waste management. The functional elements of collection include not only the gathering of solid wastes, but also the hauling of the wastes after collection to the location

where the collection vehicle is emptied. This location may be a transfer station, a processing station, or a land fill disposal site. In small cities where final disposal sites are nearby, the hauling of wastes is not a serious problem. In large cities, however, where the haul to the point of disposal often may be several kilometers away, the haul may have serious economic implications. According to William S. Foster, experiments have been conducted with a system pneumatic (compressed air) tube that carries refuses of in special containers. The compressed air conveys the containers though piping to a central collection point, thus eliminating much hand labour. The method, as he says, appears to have its best prospects for use in hospitals and large apartment complexes. Engineers also hope that the system can be developed for use in homes and industries.

Finally, some industrial wastes are handled like residential wastes; some companies have disposal sites on their own properties that use conveyor belts. Hovsenius (1976), has proved that, waste paper as an energy source, it is possible to synthesize fat or convert inorganic nitrogen into protein to be fed to animals. Similarly, valuable trace elements contained in urban solid wastes can be used to enhance plant growth (Sridhar and Bameke, 1986). Copper for instance, prevents "plant disease" when added to soils which oats, wheat, peas and some higher plants are planted.

Other nutrients, the vitamin big and protein according to Sridhar and Pillai (1973), are recovered during fermentation and from activated sludge systems. The microbial fermentation is a concentrated source of protein. Some organisms have high protein content of 30 – 60% dry weights according to them.

Bameke (1988) siting Linderberge, and Akagi (1974) reported that the maintenance of human condition can only be achieved through swift ride in recycling and survival of the world culture may well depend on a quick and complete shift to the practice of returning materials at the end of production life to nature or to production.

"A sustainable economy for countries, cities and I say establishments may be achieved through recycling" – Bameke O.A.

CHAPTER THREE

METHODOLOGY

3.0 INRODUCTION:

According to Turk and Turk (1984), "perhaps the most noteworthy characteristic of solid wastes is their variety". In the Federal University of Technology, Minna, the variety of solid wastes generated daily is really something to wrote about. It includes such garbage and rubbish such as food scraps, old newspapers, a variety of bottles (glass and plastic), utensils, etc.

In this chapter, the procedures to be adopted in the research work which includes those for ascertaining the quantity of solid wastes generated daily in the institute, the solid waste collection, transportation, processing and disposal methods being practice, and the response of Federal University of Technology, Minna community to the solid waste management system amongst others, shall be discussed.

3.1 RESEARCH DESIGN

The survey design was adopted by the researcher for this study. The method used here was most appropriate as it made it possible for the collection of detailed factual and representative information on the amount of solid wastes generation and the solid waste management system being practiced.

3.2 AREA OF STUDY

The main survey instrument used in these residential area was a structured household questionnaire, a copy which was administered on the head of each household or on his spouse. Where neither head of the house nor his spouse was available, the questionnaire was administered on available member who has sufficient knowledge about the nature of refuse generation and disposal in household. Two hundred copies of the household questionnaire were administered.

Additional, both primary and secondary data were collected from institution involved in SW collection and management Minna.

3.3 SAMPLING AND SAMPLING TECHNIQUES

In the male hostel, there are 2 blocks of 60 rooms each with an average of 8 students per room.

The female hostel consist of four (4) blocks with 2 master rooms adjacent to each other, having a total of 53 rooms with an average of 12 students per room. The entire N block female hostel was sampled as a single unit.5 classrooms, 1 canteens, 2 business centers, 3 workshops, 2 laboratories, the library were also sampled.

3.4 INSTRUMENTS OF DATA COLLECTION

Polybags and plastic bin of negligible weight were used to collect the solid wastes at the different sampling points chosen in 3.3 above. Appropriate weighing apparatus (a 20kg x 50g spring balance) was used to determine the weight of the materials collected in each case.

Structured questionnaires were used to collect in formation on the response of

the Federal University of Technology Community to the solid waste management practice in place. The item in the questionnaire were generated from objectives of the studies.

3.5 METHOD OF DATA COLLECTION

The instruments were personally administered by the researcher with the assistance of cleaners and Students in each of the sampling points as the case maybe. Force response questions were extensively used in the questionnaire in order to make analysis less cumbersome and guide against discretion in response. Open ended questions are only used to obtain general comments by the respondents.

3.6 METHOD OF DATA ANALYSIS

Data of generated solid wastes and individual responses to questionnaire

were tabulated and the findings discussed. Histograms and frequency distribution graphs were handy in analyzing the generated data and the level of effectiveness of the solid waste management system in Federal University of Technology was ascertained.

CHAPTER FOUR

RESEARCH FINDINGS AND ANALYSIS OF REULTS

4.0 INTRODUCTIO:

In this chapter, work was carried out as regards solid waste management in the Federal University of Technology. Analysis is made of the research findings.

(1) The appraisal of solid waste management systems and practice using the prepare questionnaires

(2) The generation rate of solid wastes in the institute for the above findings, a total of one hundred and fifty (150) questionnaires were distributed among the students, staffs and non staffs operating in the institute in the ratio 12:2:1 respectively.

Out of these, only one hundred (100) could be received for the analysis comparing the questionnaire of eighty four (84) students, eight(8) staffs and eight (8) non-staffs. Of all the respondents sixty (60) were males while the remaining forty (40) were females.

The use of statistical table and graphs were employed in presenting the result

4.1 ANALYSIS OF QUESTIONNAIRE

As earlier mentioned, The analysis herein presented represent the response of hundred (100) members of the Federal University of Technology community who directly through their activities contributed to solid waste generation stream. Their response to questions are stated below.

Number of members of university community	Number of Male Respond	Number of Female Respond	Number of Staff Respond	Number of Student Respond	Number of Non-Staff Respond	Number of People who believe their was a problem	Number of people who believe their was no problem
100	60	40	8	84	8	72	4

(i) Out of hundred respondents, sixty were males and forty females.

(ii) Eighty-four were students, eight staffs and eight non -staffs.

(iii) Seventy-two believed there was problem with the solid wastes management system in Federal University of Technology, Minna, while four saw no problem with the system.

(iv) Those who believed the system was fraught with problems gave the following as reasons:

a. Absence of lids for waste bins.

b. That site for waste dump was too close to hostels and classrooms thus causing great discomfort whenever the wastes were being burnt either during the day or night.

c. That waste bins especially the one in the girls hostels were not often disposed thus causing to spillage, disfiguring the immediate environment.

d. That the dump-site constitute not only a health hazard but also is unsightly.

e. Some identified improper waste segregation practice before disposal as a problem while others still fingered the poorly planned or inadequate waste management system as the problem.

f. A last group blamed it all on lack of adequate receptacles and poor waste management techniques.

(v) For those who believed the system was okay, some argued that wastes were disposed off in a separated off area afar off and later burnt while others claimed that the collected wastes were always emptied.

Number of respondent that waste bin are provided, properly used and waste bin are fitted with lids and non properly fixed, number of non student agreed that waste bin are not provided.

YES	NON	Properly used	Non-Properly used	YES provided	Not provided	Fitted with Lids	Not Fitted with Lids
92	8	44	48	12	4	28	68

(vi) Of all the respondents, ninety-two agreed that waste bins were provided in specific points for the collection of refuse while eight believed otherwise.

(vii) Of the ninety-two who agreed that bins were provided for refuse collection, forty-four believed the bins were properly used, forty-eight believed they were not properly used while made no comments on the usage.

(viii) Those who believed the bins were not adequately used sited the following reasons:

a. Nonchalant attitude of majority of Federal University of Technology, Minna, populace towards environmental cleanliness.

b. Dirty habits and indiscipline on the parts of students and staff alike.

c. Wastes from receptacles are allowed to spill over before being considered for disposal.

d. Solid waste matters could still be seen, littering the institute's premises.

e. Absence of waste bins in laboratories and classrooms.

f. Lack of adequate education on waste management and laziness on the part of sanitary staff.

(ix) Twenty-eight respondents believed the waste bins are fitted with lids while sixty-eight believed they were not fitted with lids. Concerning waste bins provided in offices and other establishments apart from those specifically for students' use:

i. Twelve of the non-students agreed that waste-bins are provided in their offices while four said no waste bins were provided. The remaining four made no comments.

ii. Of the twelve that agreed to the provision of waste bins in their offices all agreed the contents were regularly disposed off.

iii. All four a piece agreed that the bins were emptied once, twice, and more than once respectively.

For students hostels, workshops and laboratories:

i. Twenty-four students said waste bins are provided in their classrooms while sixty said waste bins are not provided.

ii. All student respondents agreed that waste bins were provided for in the hostels.

iii. Sixty students believed that waste bins are provided for the workshops while twenty-four believed otherwise.

iv. Sixty students responded that these waste bins were emptied regularly out of which fifty-two believed they were emptied once, four believed they were emptied twice while the rest believed they were emptied more than once, daily.

v. Only twenty-four believed the waste bins were not emptied regularly.

For the final segment;

i. All one hundred respondents believed that the solid wastes generated were not treated in any way before final disposal.

4.2.1 METHOD OF DISPOSAL

No. of People who agreed with disposal	No. of People who disagreed with disposal	No. of People who agreed there is problem	No. of People who agreed proposition
48	22	8	16

ii. On the method of disposal, forty-eight said the collected wastes were disposed by cleaners raw into the dumpsites- close to the hostels. Thirty-two said the wastes were not only dumped raw at the dumpsite but that they were burnt in an indiscriminate manner, thus causing air pollution. Four a piece said the wastes are usually hauled to town or at some other times, burnt, and that the wastes are disposed off on the field on open ground.

iii. Eighty respondents agreed that the solid waste disposal system sure poses some problems to the Federal University of Technology, Minna, community while sixteen agreed with this proposition.

iv. Those who believe the system posed problems said;

a. It can cause health problems through burning.

b. That the smoke generated from the burning was carried by wind to the hostels and classrooms where it caused both aesthetic and somatic problems, not only on human but also on vegetation and materials.

c. Twenty-eight respondents sited the case of offensive odour emanating from the dump as a result of organic waste decomposition thus making the air around filthy and unsafe for breathing.

d. Pathogens, fleas and rodents were reported eight respondents have emanated from these waste dumps.

e. Another set of respondents believe that the indiscriminate disposal system has only helped in making useless, land which would hitherto have been used for other projects.

f. Finally, eight respondents pointed out the possible land pollution effects and also sited the possibility of the seepage from the decomposing organic matter to pollute the ground water supply.

The solid waste management system in place in the Federal University of Technology, Minna, was finally rated by respondents to the questionnaire as follows;

Rating	Very Bad	Bad	Fair	Good	Very Good
Frequency	4	20	61	12	3

The results above is represented below using a frequency distribution table and a frequency distribution graph.

Frequency Distribution showing responses to solid waste management rating in the Federal University of Technology, Minna.

RESPONSES	FREQUENCY	PERCENT FREQUENCY	CUMMULATIVE FREQUENCY
Very Bad	4	4%	4%

Bad	20	20%	24%
Fair	61	61%	85%
Good	12	12%	97%
Very Good	3	3%	100%
Total	100	100%	100%

The graph for the table above is illustrated in Appendix 2.

For the Federal University of Technology, Minna, the staff strength is about 700 while estimated resident student population is 8,600 other regular member of the community (non-staff and non-students) who also contribute to the solid waste stream include some approximately seventy persons from the numerous canteens, relaxation joints, business centers, etc.

The results of the generation rate in each of the sampling points selected in the previous chapter are highlighted below. Each sample point was sampled for a period of four consecutive weeks in the month of October, 2001.

The following are the classes into which the measured solid wastes were divided.

a. F = Food and other organic wastes including vegetative parts of plants, bones, etc.
b. P = Paper and other paper and cellulose products including clothing and toilet rolls.
c. N = Nylon and plastics and other wastes of similar origin and characteristics e.g. plastic, bottles, cups etc.
d. M = Used to represent metals and glass waste products.

4.2.3 SOLID WASTE GENERATION RATE IN THE MALE HOSTELS

WEEK ONE

BLOCK	F	P	N	M	TOTALS
A	6.26kg	1.81kg	0.93kg		9.0kg
E	5.05kg	1.93kg	0.35kg	2.67kg	10.0kg
H	4.57kg	2.04kg	0.97kg	1.92kg	9.5kg
	15.88kg	5.78kg	4.59kg	4.59kg	28.5kg

WEEK TWO

BLOCK	F	P	N	M	TOTALS
A	4.46kg	1.62kg	1.2kg	2.42kg	9.7kg
E	5.56kg	1.62kg	1.81kg	3.11kg	12.0kg
H	4.33kg	2.35kg	1.16kg	1.26kg	9.1kg
	14.25kg	5.59kg	4.17kg	6.79kg	30.8kg

WEEK THREE

BLOCK	F	P	N	M	TOTALS
A	4.94kg	2.89kg	1.5kg	3.27kg	12.6kg
E	5.83kg	1.83kg	0.98kg	1.16kg	9.8kg
H	3.60kg	1.79kg	1.72kg	1.09kg	8.2kg
	14.37kg	6.51kg	4.20kg	5.52kg	30.6kg

WEEK FOUR

BLOCK	F	P	N	M	TOTALS
A	3.26kg	1.29kg	1.42kg	4.33kg	10.3kg
E	4.02kg	2.04kg	1.51kg	1.03kg	8.6kg
H	3.31kg	2.56kg	1.97kg	0.86kg	8.7kg
	10.59kg	5.89kg	4.9kg	6.22kg	27.6kg

From above, the net Average waste produced per block per day can be calculated thus;

Summation of weekly total $\sum T = 28.5 + 30.8 + 30.6 + 27.6 = 117.5kg$

Summation of samples $\Sigma f = 4 \times 3 = 12$

Therefore, Average solid waste $= \frac{117.5 \times 2\text{blocks}}{2} =$ 19.58kg/day

4.2.4 SOLID WASTE GENERATION RATE IN FEMALE HOSTELS

WEEK ONE

ROOM	F	P	N	M	TOTALS
26	0.25kg	0.14kg	0.07kg		0.46kg
4	0.24kg	0.15kg	0.06kg		0.45kg
22	0.16kg	0.08kg	0.04kg	0.06kg	0.34kg
	0.65kg	0.37g	0.17kg	0.06kg	1.25kg

WEEK TWO

ROOM	F	P	N	M	TOTALS
26	0.22kg	0.16kg	0.04kg	0.10kg	0.52kg
4	0.25kg	0.10kg	0.12kg		0.47kg
22	0.20kg	0.13kg	0.09kg	0.06kg	0.42kg
	0.67kg	0.39g	0.25kg	0.10kg	1.41kg

WEEK THREE

ROOM	F	P	N	M	TOTALS
26	0.24kg	0.08kg	0.04kg	0.05kg	0.41kg
4	0.22kg	0.10kg	0.02kg	0.05kg	0.39kg
22	0.22kg	0.05kg	0.03kg	0.04kg	0.34kg
	0.68kg	0.23g	0.09kg	0.14kg	1.14kg

WEEK FOUR

ROOM	F	P	N	M	TOTALS
26	0.20kg	0.17kg	0.03kg	0.09kg	0.49kg
4	0.23kg	0.12kg		0.05kg	0.40kg
22	0.25kg	0.08kg	0.03kg		0.36kg
	0.68kg	0.37g	0.06kg	0.14kg	1.25kg

From the above,

Summation of

$$\text{Weekly Totals } \Sigma T = (1.25 + 1.41 + 1.14 + 1.25)\text{kg}$$

$$= 5.05\text{kg}$$

summation of samples $\Sigma f = 3 \times 4 = 12$

$$\text{Average solid waste generated per day} = \frac{5.05}{12} \times 32 \text{ rooms} = 13.5\text{kg/day}$$

4.2.5 SOLID WASTE GENERATION RATES FOR CANTEENS

WEEK ONE

CANTEEN	F	P	N	M	TOTALS
	3.1kg	-	1.5kg	0.8kg	5.4kg
FEMALE BUTTERY	2.6kg	-	-	0.9kg	3.5kg
MALE BUTTERY	0.5kg	-	0.2kg	0.7kg	1.4kg
ABU CENTER	6.2kg	-	1.7kg	2.4kg	10.3kg

WEEK TWO

CANTEEN	F	P	N	M	TOTALS
FEMALE BUTTERY	5.4kg	-	1.2kg	0.3kg	6.9kg
MALE BUTTERY	3.5kg	-	0.8kg	0.5kg	4.8kg
ABU CENTER	0.5kg	0.6kg	0.2kg	0.4kg	1.7kg
	9.4kg.	0.6kg	2.2kg	1.2kg	13.4kg

WEEK THREE

CANTEEN	F	P	N	M	TOTALS
FEMALE BUTTERY	5.5kg	-	1.2kg	0.4kg	7.1kg
MALE BUTTERY	2.2kg	-	0.4kg	0.6kg	3.2kg
ABU CENTER	0.5kg	0.2kg	0.2kg	0.4kg	1.3kg
	8.2kg	0.2kg	1.8kg	1.4kg	11.6kg

WEEK FOUR

CANTEEN	F	P	N	M	TOTALS
FEMALE BUTTERY	4.5kg	-	1.1kg	0.2kg	5.8kg
MALE BUTTERY	2.5kg	0.2kg	0.2kg	1.2kg	4.1kg
ABU CENTER	0.2kg	0.5kg	-	0.5kg	1.2kg
	7.2kg	0.7kg	1.3kg	1.9kg	11.11kg

Summation of

Weekly Totals $\Sigma = T = (10.3 + 13.4 + 11.6 + 11.1)kg$

$= 46.4kg$

summation of samples $\Sigma f = 3 \times 4 = 12$

Average solid waste produced $= \frac{\Sigma T}{\Sigma f} \times$ No. of canteens

$= \frac{46.4}{12} \times 7 = 27.1kg/day$

$= 27.1kg/day$

4.2.6 SOLID WASTE GENERATION RATE IN BUSINESS CENTRES

WEEK ONE

CENTRES	F	P	N	M	TOTALS
DO- JESS	-	0.3kg	-	-	0.3kg
AUSTIN JOE	-	0.4kg	0.1kg	-	0.5kg
KESBRON	-	0.5kg	0.08kg	-	0.58kg
	-	1.2kg	0.18kg	-	1.38kg

WEEK TWO

CENTRES	F	P	N	M	TOTALS
DO- JESS	-	0.4kg	-	-	0.4kg
AUSTIN JOE	-	0.65kg	-	-	0.65kg
5KESBRON	-	0.6kg	-	-	0.6kg
	-	1.65kg	-	-	1.65kg

WEEK THREE

CENTRES	F	P	N	M	TOTALS
DO- JESS	-	0.4kg	-	-	0.4kg
AUSTIN JOE	-	0.5kg	-	0.1kg	0.6kg
KESBRON	-	0.7kg	-	-	0.7kg
	-	1.6kg	-	0.1kg	1.7kg

WEEK FOUR

CENTRES	F	P	N	M	TOTALS
DO- JESS	-	0.41kg	-	-	0.41kg
AUSTIN JOE	-	0.6kg	0.05kg	-	0.65kg
KESBRON	-	0.6kg	-	-	0.6kg
	-	1.6kg	0.05kg	-	1.66kg

Summation of

Weekly Total ΣT = (1.38 + 1.65 + 1.7 + 1.66)kg

= 6.39kg

Summation samples $\Sigma f = 4 \times 3 = 12$

Ave. solid wastes produced per day by business centers $\frac{\Sigma T}{\Sigma f}$ x No. of centers

$= \frac{6.39}{12} \times 10 = \frac{63.9}{12}$

=5.33kg/day

4.2.7 SOLID WASTE GENERATION IN ADMINISTRATION BLOCK

WEEK 1

ADMIN BLOCK	F	P	N	M	TOTALS
1	0.3kg	1.8kg	-	-	2.11kg
2	0.1kg	1.1kg	-	-	1.2kg
3	0.5kg	1.9kg	0.8kg	0.4kg	3.5kg
	0.9kg	4.8kg	0.8kg	0.4kg	6.8kg

WEEK 2

ADMIN BLOCK	F	P	N	M	TOTALS
1	0.5kg	0.9kg	0.4kg	-	1.8kg
2	-	0.95kg	0.45kg	0.2kg	1.6kg
3	-	1.6kg	0.6kg	1.0kg	3.2kg
	0.5kg	3.45kg	1.46kg	1.2kg	6.6kg

WEEK 3

ADMIN BLOCK	F	P	N	M	TOTALS
1	-	1.1kg	0.44kg	-	1.54kg
2	-	0.95kg	-	-	0.95kg
3	-	2.5kg	0.5kg	0.4kg	3.4kg
	-	4.55kg	0.94kg	0.4kg	5.89kg

WEEK 4

ADMIN BLOCK	F	P	N	M	TOTALS
1	-	0.95kg	0.4kg	0.32kg	1.67kg
2	-	0.8kg	0.1kg	-	0.90kg
3	-	2.1kg	0.5kg	0.9kg	3.5kg
	-	3.85kg	1.0kg	1.22kg	6.07kg

From above, summation of weekly totals

$\sum T = (6.8 + 6.61 + 5.89 + 6.0)kg$

$= 25.36$

summation of frequency $\sum f = 3 \times 4 = 12$

Therefore, Average solid waste produced day by Admin Blocks =

$$\frac{\sum T}{f \sum} = \frac{25.36}{42}$$

$= 6.3kg/day$

4.2.8 SOLID WASTE GENERATION RATE IN CLASSROOMS

WEEK 1

CLASSROOM	F	P	N	M	TOTALS
ENVIRONMENTAL AUDITORIUM	-	0.15kg	0.05kg	-	0.2kg
GEOGRAPHY LABORATORY	-	0.3kg	0.03kg	-	0.33kg
F.2 CLASS	-	0.19kg	-	-	0.19kg
	-	0.64kg	0.08kg	-	0.72kg

WEEK 2

CLASSROOM	F	P	N	M	TOTALS
ENVIRONMENTAL AUDITORIUM	-	0.15kg	0.01kg	-	0.16kg
GEOGRAPHY LABORATORY	-	0.25kg	0.01kg	0.03kg	0.29kg
F.2 CLASS	-	0.2kg	0.01kg	-	0.21kg
	-	0.6kg	0.03kg	0.03kg	0.66kg

WEEK 3

CLASSROOM	F	P	N	M	TOTALS
ENVIRONMENTAL AUDITORIUM	-	0.2kg	0.01kg	-	0.21kg
GEOGRAPHY LABORATORY	-	0.35kg	-	-	0.35kg
F.2 CLASS	-	0.2kg	0.01kg	0.02kg	0.23kg
	-	0.75kg	0.02kg	0.02kg	0.79kg

WEEK 4

CLASSROOM	F	P	N	M	TOTALS
ENVIRONMENTAL AUDITORIUM	-	0.2kg	0.01kg	0.04kg	0.25kg
GEOGRAPHY LABORATORY	0.1kg	0.25kg	0.07kg	-	0.42kg
F.2 CLASS	0.15kg	0.23kg	-	-	0.38kg
	0.25kg	0.68kg	0.08kg	0.04kg	1.05kg

Summation of weekly totals $\sum T = (0.72 + 0.66 + 0.79 + 1.05)kg$

$= 3.22kg$

summation of frequency $\sum f = 3 \times 4 = 12$

Average solid waste produced per day by classrooms $= \frac{\sum T}{\sum f} \times$ No. of classrooms

$= \frac{3.22}{12} \times 28$

$= 7.51kg/day$

CHAPTER FIVE

5.0 FINDINGS CONCLUSION AND RECOMMENDATION

From the analysis of the questionnaire, it is evident that the solid waste management system in place still needs adequate attention. The problem of indiscriminate disposal of waste is even a more serious issue considering the fact that Federal University of Technology, Minna, ought to be a community known for promoting environmental cleanliness. As reported, this waste when not properly disposed of can be a major source of pathogenic public health diseases. A clear evidence of this is the rampant case of typhoid fever amongst Federal University of Technology, Minna, students in recent times. The poor hygienic condition of some of the institute's (canteen) where rodents and diseases vectors such as rats, cock-roaches and flies move about with reckless abandon also contributes to the health problems by helping to propagate pathogen they had acquired from the waste dump site.

The closeness of the dumpsite to the hostels as shown in the picture below, confirms the report by 72% of respondents that the dumping, process not only constitutes a nuisance to the environment but also poses to be a health hazard due to the contamination of the air by foul smelling pollutants and the release of ashes, fumes, poisonous acidic gases and heat energy during open combustion of the wastes. A good example of the effect of open combustion of solid wastes near the hostel is the event of the night of 7th February 2001, when the air contamination was so much that occupants of Nicon and Sheraton blocks had to either abandon their rooms or sleep with their windows fully lucked. The next morning member of the Society of Environmental Management Students had to put out fire from the dump which had been smoking for well over two months. Other effects that could easily be noticed due to the combustion of the wastes include the cracking of the hostel fence, constant litter of the compound with ashes and cloth-stains from settling particulates. As for the effect on vegetation, a few of the tree growing around the waste dump have died due to constant exposure to intense heat from the burning waste heap.

Also, reports were made that most times, receptacles are left to overflow with wastes before they are considered for disposal. Fig. 4.5 above confirms this statement such condition disfigure the immediate surroundings.

While a vast majority, 92%, agreed that waste bins are provided in specific points, only about half the number believe the bins were properly used hence the need for adequate education of the Federal University of Technology, Minna, community on the need for a proper waste disposal culture.

Concerning responses on solid wastes generated in classrooms and offices, a majority of student respondents, 64% said bins for refuse collection were not provided in their classrooms, thus encouraging littering of paper, food-wraps and other wastes. Land-use and land pollution problems were also sited as consequences of poor solid waste management (disposal) system in Federal University of Technology, Minna. The odour, tastes and particles which usually characterizes the back up waster supply system in the hostels is suspected to be partly influenced by leachates from the waste dumpsite.

From the result of the solid waste generation rate within the institutes, the results show that the male hostel, female hostel, canteen, business center, library, offices, classrooms and respectively generate (88.135, 27.1, 5.33, 1.52, 6.34, 7.51, and 4.3)kg/day of solid wastes.

Figure 4.3 showed that the variation in the generation rate of solid wastes in the month of July and a careful analysis showed that :

a. Food wastes and other organic waste constitute the highest percentage of solid wastes generated per day with about 46.14%.
b. This is closely followed by paper waste; Glass and Metal wastes, and nylon and plastic wastes with 25.73%, 15.61%, and 12.52% respectively.

The estimated animal solid waste generation rate showed that a total of fifty-six thousand and eighty-five kilogram (about 56tons) of solid waste is generated annually, a figure which could cause much problem, especially of land-space of this quantity, however, about 2tons and 1ton respectively of organic waste and paper wastes are generated monthly.

Such quantity of organic waste could be subjected to composting to regain useful nutrients while the paper wastes properly sorted out could be recycled.

Both processes mentioned above would not only help in reducing the bulk waste but also could be a source of income.

Getting to obtain information on the quantity of solid wastes generated by a community like Federal University of Technology, Minna was Herculean task, considering the barriers, such as having to convince individuals especially those operating different business outfits that they shall not be indicted with the information they were needed to provide.

The solid waste management system from the research findings could as well be rated as being less than fair and thus needing adequate attention. Also, the survey showed that the institute's management system hence ensuring the development of a healthier, cleaner and safer environment.

Finally, the best way to achieve success in effecting a positive change in the waste management system is to enlighten the populace and this includes the students and staff in general. The following recommendations would also go a long way in ensuring these much need changes.

1. Through special training sessions and seminars, both academic and non-academic staffs should be enlightened on solid waste management.
2. Environmental studies should be introduced in the school curriculum and all students should be taught the need for a safe and clean environment.
3. Adequate waste baskets and plastic bins with lids should be provided in offices, classrooms and strategic locations around the school premises.
4. Receptacles around the school should be properly labeled to aid segregation of wastes while bins with bad lids should have their lids or the entire bins, replaced with new ones.
5. Cleaners and those responsible for disposing off all solid wastes should be provided with necessary equipment such as push-charts or wheel-barrows to enable easy transportation and disposal system and thus discouraging the act of pouring collected wastes over hostel walls as is the practiced, presently.
6. Proper supervision of activities of not only the cleaners but also non-staffs operating within the institute should be ensured.

7. The disposal site should be relocated to a farther location away from the hostels and classrooms and a better option of ultimate disposal rather than open incineration should be established.
8. The management should invest in better environmental friendly, waste disposal technology. The use of wet incineration could help reduce atmospheric pollution levels.
9. Through application of the 4RS of waste management (Reduction, Recovery, Reuse, and Recycling), the waste generated would be reduced and those generated would be effectively handled.
10. A solid waste treatment and recycling facility should be provided. This facility would not only help in properly handling the waste generated thus preventing environmental pollution, but, it will also provide employment opportunity especially for students who may wish to work in such facilities for specified wages.
11. The compost manure and shredded paper bales generated from such treatment facilities could be a good source of income to the school management.
12. Through periodic "Awards" to deserving staffs, students and/or business enterprise(s), the cleanliness of the institute's environment could be better enhanced. Organizations/associations such as the Society of Environmental Students should be encouraged both morally and financially in educating the student populace on the need for effective waste management and also in carrying out projects geared towards this noble cause.

APPENDIX 1

Showing quantity of various types of solid waste generated per day (August, 2001)

SOURCES	F(kg)	P(kg)	N(kg)	M(kg)	TOTALS(kg)
MALE HOSTELS	47.64	17.34	6.75	13.77	85.5

FEMALE HOSTELS	6.93	3.95	1.81	0.64	13.33
CANTEENS	14.47	-	3.97	5.6	24.04
BUSINESS CENTERS	-	4.8	0.6	-	4.6
OFFICES	0.9	4.8	0.8	0.4	6.9
CLASS ROOMS	-	5.97	0.75	-	6.72

From the tables above, the average total of the various types o solid waste generated per day in the month of August, 2001 can be calculated as follows

i. Average Total food/organic = Total generated/day in the four weeks

Waste generated per day = $\frac{72.84 + 73.43 + 70.41 + 66.93}{4}$ kg/day

= $\frac{283.61}{4}$ kg/day

= 70.9 kg/day

ii. Average Total paper waste produced/day = $\frac{\text{Total generated/day in the four weeks}}{4}$

= $\frac{37.46 + 37.75 + 42.49 + 40.44}{4}$ kg/day

= $\frac{158.14}{4}$ kg/day

= 39.54 kg/day

iii. Average Total Nylon/plastic waste generated /day = $\frac{\text{Total generated/day in the four weeks}}{4}$

= $\frac{14.78 + 21.27 + 18.48 + 22.39}{4}$ kg/day

= $\frac{76.92}{4}$ kg/day

= 19.23 kg/day

iv. Average Total metal and Glass

waste generated/day = $\frac{\text{Total generated/day in the four weeks}}{4}$

$= \frac{21.01 + 26.19 + 24.05 + 24.69}{4}$ kg/day

$= \frac{95.94}{4}$ kg/day

= 23.99 kg/day

v. Summing up i – iv above, average total solid waste generated per day in the federal University of Technology.

= (70.9 + 19.23 + 39.54 + 23.99) kg/day

= 153.66 solid waste/day

From 4.3

Approximate staff population = 900

Approximate student population =

Approximate Non-student/Staff = 1000

Approximate Total population community

Using the available data above, the solid waste generation rate in the federal university of technology can be calculated thus.

$\frac{\text{Average total solid waste generated/day}}{\text{Estimated population}}$

$= \frac{153.66 \text{ kg/capital/day}}{2370}$

0.065 kg solid waste/capital/day

APPENDIX 2

The total quantity of the various types of solid wastes generated from various sources per day in the four weeks of August are shown I tables 4.39 below.

5.39

Showing the quantity of the various types of solid waste generated per week August, 2001

TYPES SOLID WASTES

SOURCES	F(kg)	P(kg)	N(kg)	M(kg)
1	72.84	37.46	14.78	21.01
2	73.43	37.75	21.27	26.19
3	70.41	42.49	18.48	24.05
4	66.93	40.44	22.39	24.69

The various in the generation rate of each types of solid wastes per day in the four weeks of August, 2001 is illustrated in the Appendix 3.

Using the data in 4.39 (i-iv) and the average total composition of solid wastes generated per day in the month of August, 2001 by the Federal University of Technology, Minna community save the staff quarters, c an be calculated.

a. Percentage composition of food and other organic waste per day in August = $\frac{70.9}{153.66} \times 100\%$

= 46.14%

b. Percentage composition of paper waste generated per day in August in August,2001 = $\frac{39.54}{153.66} \times 100$

= 25.73%

c. Percentage composition of Nylon and plastic waste Generated/day in August 2001 = $\frac{19.23}{153.66} \times 100$

= 12.52%

d. Percentage composition of metal and Glass waste generated/day in August, 2001 = $\frac{23.99}{153.66} \times 100$

= 15.61%

Table 1.0 **Percentage Composition of Solid Waste in August 2001**

	TYPES OF SOLID WASTES		
F(%)	P(%)	N(&)	M(%)
46.14	25.73	12.52	15.61

Table 1.1

Estimated Annual Solid Waste Generation Rate in Federal University of Technology

	TYPES OF SOLID WASTES			
F(%)	P(%)	N(&)	M(%)	Total (kg)
25,878.5	14.432.1	7,081.95	8,756.35	56,085.9

Table 1.2

Estimated Monthly Solid Waste Generation Rate in The Federal University of Technology, Minna

	TYPES OF SOLID WASTES			
F(%)	P(%)	N(&)	M(%)	Total (kg)
2,127	1,i86.2	576.9	719.7	4,609.8

Table 1.3

Estimated Weekly Solid Waste Generated Rate in Federal University of Technology, Minna

	TYPES OF SOLID WASTES			
F(%)	P(%)	N(&)	M(%)	Total (kg)
496.3	276.78	134.61	167.93	1,075.62

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