

An Appraisal of Solid Waste Generation and Management in Jalingo City, Nigeria.

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Abstract

Solid waste has become one of the greatest menaces in the world over, but the situation in the developing countries such as Nigeria has become pathetic. This paper looked at the relationship between the level of waste generation and management in Jalingo city, Nigeria. The result of the analysis indicated that there is tremendous growth in the population of the city due to its changing role from a town 1980 to the capital city of Taraba State in 1996. The National Population Commission of Nigeria put the population of the town as 62,252 in 1991 and had risen to 196,509. The volume of waste generated rose from 2,017.35 tonnes monthly in 2000 to about 2,519.01 tonnes monthly in 2008. The management of the waste has been fluctuating over the same period due to political factor, inadequate manpower, and obsolete equipment, socio-economic and cultural factors. The level of waste collection reached its peak in 2006 (1,296.17 tonnes) and at its lowest ebb in 2005 (953.75 tonnes). The analysis of the waste generated indicated that the mean monthly collection is 2,254.98 tonnes and the mean monthly collection is 1,150.94 tonnes. The regression analysis shows that the F calculated is 1.796 while the F-table is 3.890. The P-value is 0.183 which indicated that there is no relationship between the level of waste generation and management in the city. The implication is that the city is fast becoming garbage city as heap of waste is found round the city. There should be adequate provision of waste management strategies that will include private sector participation in the management.

Keywords: Solid Waste, Management, Municipal, Environment, Waste Generation.

1. Introduction

The improper management of municipal solid waste is one of the challenging environmental problems facing urban centres worldwide, particularly in developing countries (APO., 2007; Bruce, 1998). Little attention is given to waste management practices as it is common to see heaps of waste in the major cities littering the streets, dumped indiscriminately in drainages, vacant plots and open space especially in the developing world. This has contributed not only to the spread of communicable diseases in the affected areas; it has effect on flooding and other environmental problems (Babalola *et al*, 2010, Wilson *et al*, 2009). A typical solid waste management system in developing countries displays an array of problems among which include low collection coverage and irregular collection services (Nwoke, 2005, Omran *et al*, 2007). It is fast becoming a difficult task which must be surmounted by developing countries especially Nigeria if she is to realize the reduction of solid waste in the cities by 75% as proposed by Millennium Development Goals (MDGs) in 2015 (Nwoke, 2005). The growth of human population couple with increased economic activities has resulted into high rate of solid waste generation, this call for careful planning and adequate resource allocation to bridge the gap between the rate of waste generation and that of collection and disposal. The ways to handle and dispose waste varies considerably within and between cities, regions and nations; therefore, waste is a matter of place and time (Ojemudia and Ojigi, 2006).

The practice of indiscriminate and improper dumping of Municipal Solid Waste (MSW) is on the increase in Jalingo in particular and Nigeria in general and it is compounded by a cycle of poverty, population explosion, decreasing standard of living, poor governance and low level of environmental awareness, and the end product of it all is the dumping of these waste in any available open space (Rachel, *et al*, 2009). It has been observed that because of poor or improper land use planning in some part of many organically developed cities has results into the creation of informal settlement with narrow streets, which makes it difficult for waste collection trucks to access such areas (Nabegu, 2010, Swapan, 2008).

Waste are dumped into the drainages that block the free flow of runoff water and this practice gives rise to flooding and the communities are adversely affected, some people dumped their waste to the road side, thereby reducing the width of the road and aesthetics of the cities especially in Nigeria. This is evident as one walk across the nook and the crannies of Nigeria; you find heaps of refuse littering the entire landscape, road sides, parks, gardens, commercial centres and other land use (Danbuzu, 2011, Imam *et al*, 2007). Okpala (2000) put the

city of Port Harcourt know as garden city in the 1980s as garbage city in 1990s.

The uncollected or illegally dumped wastes constitute a starting point for disaster of human health and the environmental degradation. Apart from the increasing quantities, the waste composition and characterization evolves, incomes and changing consumption habits have also been affected by globalization (EPA, 2011). Globalization is seen as an economic transformation, a breakthrough to poverty alleviation and inflation reduction, it is thus expected to help narrow the gap between and within nation or individuals (Pett, 2000, Swift, 2008). Globalization has been identified as playing a negative role in solid waste management; impacts include the transfer of globalized or international waste management methods and ideologies together with an increased volume and variety of waste, resulting from increased flows of goods and services, and changing lifestyle and consumption pattern (Abd'razack *et al*, 2013, Eisenberg and Schmidt, 2009, Mukhtar, 2011, Okewole and Afon, 2007).

Many parts of Taraba state especially high activity areas do not benefit from any organized waste management services, waste are unattended to, waste are either buried, burnt without taking into consideration the consequences thereof, (UN-Habitat, 2010, Nilson-Djef and McDouglass, 2000, Sanchez *et al*, 2003). Adefemi and Awokunmi (2006) emphasized that the reason for the burning of solid waste is economic and affordability on the part of households, but the act is environmentally unfriendly for the ecosystem. Another reason for solid waste burning is to lower critical hygienic problems, but its implication is more than mere burning, it causes the emission of toxic substances to the air such as dioxins and furans a cancer inducing compound is released into the atmosphere and other ozone depleting and greenhouse gases (Hassan *et al*, 2010, Sakawi, 2011). In some areas where the authority does the collection, it is often not regular. The method used for collection, transportation and final disposal is unsatisfactory. Waste when left unattended to for a long time constitute some serious health hazards, causes offensive odour, pollute underground water sources and decreases environmental aesthetics and quality.

Municipal Solid Waste (MSW) are waste that are generated from residential, commercial, industrial, institutional, construction and demolition process and Municipal services (Rechel *et al*, 2009). A mixture of these constituents or types of municipal solid waste are fine dust, metal, glass, paper, cardboard, textiles, putrescible vegetable materials, plastics, rice husk, tyres, cans, etc. (Furedy, 1990, EPA, 2011). These wastes can be further classified into biodegradable and non-biodegradable waste or grouped into organic and inorganic waste. Organic waste is referred to waste that are combustible, it contain matters such as animal and vegetative matter, refuse, animal excreta, tree leaves, sticks, rags etc. The implication is that this class of waste can decay with time and is highly detrimental to human health and the environment. When the waste comes into contact with stagnant water it produces an irritating odour, surface and ground water are contaminated, soil contamination and air pollution. It serves as a breeding ground for insect such as mosquitoes and other dangerous insect that transmit deadly diseases. Inorganic waste referred to waste that are non-combustible, it contain matters and element such as plastics, broken glass, tiles, metals, grit etc. These matters cannot decay and therefore stay as long as they remained solid (Wright, 2004, Byron and Brandshaw, 1991, EPA, 2011).

Jalingo town is located at longitude 8° 00' N and latitude 10° 30' E with a total population of about 62,252 in 1991 and 165,987 in 2008 at a growth rate of 4.8% (NPC, 2011). Jalingo is the administrative headquarters of Jalingo Local Government and Taraba state capital. Historically, the disposal of solid waste did not pose a significant problem in the town because of the relatively moderate population and the land available for assimilation of waste was relatively large, the majority of the waste collected are dumped in open spaces (open dump) and is mostly transferred from one location to the other rather than being treated and disposed of in a sanitary manner (Mabogunje, 1980).

There has been steady increase in the population of Jalingo town after it was made a state capital in 1991 mainly due to influx of people from the villages and other parts of the state. The rate of waste generation in the city is more than what the Ministry of Environment can manage leading to a decline in the handling and management of solid waste in the city. The mode of solid waste collection in the city shows disparity in collection system, in the low density areas provision waste bins and drums are done whereas in the high density area there is no such provisions. Furthermore, the Ministry of Environment often failed as waste bins are not evacuated as at when due leading to overflowing with waste and some of which are found directly in front of most houses thereby constituting environmental hazards, the case of the high density area is pathetic as no collection and disposal is done and the residents found the open spaces as necessity to dump their solid waste whether designated as dump site or not. This implies that the city presents paradox in waste collection as low density areas are clean and provided with waste bin whereas in high density areas waste are not collected and no waste bin provided.

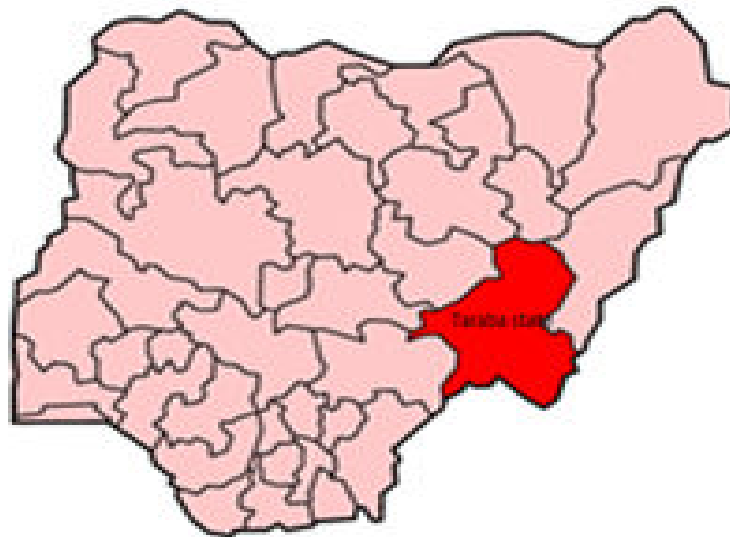


Figure 1: Map of Nigeria showing Taraba State.

Waste is something or any moveable material that is no longer wanted or useful to the owner at a particular point in time (Agunwamba *et al*, 1998; Andrew and Julie, 1996, Hammed, 2006). The World Health Organization defines waste as something which the owner no longer wants at a given time and that it is perceived to be of no market value. The issue of value cannot be ruled out completely since we still have waste materials which can be recycled while others can be reused.

Working definition for municipal solid waste simply put is waste generated from household (residential) and waste of similar nature generated by commercial and industrial premises, by institutions such as schools, care homes, prisons and public places such as streets, markets, slaughter houses, public toilets, bus stop, parks and gardens. This working definition include most commercial, business, construction and demolition wastes as municipal solid waste with the exception of industrial process and other hazardous wastes (UN-Habitat, 2010).

Differences in the wealth of communities and countries degree of urbanization and industrialization, and intensity of agricultural activities account for the significant differences in waste treatment and disposal problems faced by developed and developing countries, and between urban and rural areas. Knowledge of the sources of solid waste along with data on the composition and rates of generation is basis to the design and operation of the functional element associated with the management of solid waste. To avoid confusion, the term refuse is often used interchangeably with the term solid waste which is not in use in this context. As a basis for subsequent discussion, it will be helpful to define the various sources of solid waste that are generated, it is important to be aware that the definition of solid waste terms and the classification vary greatly in the literature and in the profession, consequently the use of published data requires considerable care, judgment, and common sense. The following definitions are intended to serve as a guide and are not meant to be precise in a scientific sense; types of waste according to their sources are described in detail below (Tchobanoglous *et al*, 1985, Adefemi and Awokunmi, 2009, Adebola, 2006).

Residential and commercial solid waste, excluding special and hazardous wastes discussed below, consist of the organic (combustible) and inorganic (non-combustible) solid waste from residential areas and commercial establishments. Typically the organic fraction of residential and commercial solid waste consist of materials such as food waste (also called garbage), paper of all types, textiles, and rubber leather, wood, and yard waste. The inorganic fractions consist of items such as glass, crockery, tin, cans, aluminum, ferrous metals, and dirt's. If the waste components are not separated when discarded, then the mixture of this waste is also known as commingled residential and commercial municipal solid waste (MSW).

Waste has always been created by mankind since prehistoric times (Udoessien, 1998).waste is a thing of concern in the world today, the developed and the developing nations of the world are all looking at strategies and measures in which this menace called waste can be tackled. The situation is better in the developed world some of these countries have battled with waste for the past forty years and attention now is on higher technology of handling waste and emphases is also place on the resource in waste management for national development (Cunningham and Cunningham, 2008). The worst of it all is the developing countries and to be more specific Nigeria.

Waste is everyone's business, since we have the ability to alter and modify the environment, all these activities involves the production of waste (Danbuzu, 2011).waste can be in different forms, it can be gaseous, liquid or solid, the concern about solid waste gives us a moment of thought to consider the extra ordinary natural world that we inherited and that we hope to pass on to further generation in a good or perhaps even better condition than when we arrived (Cunningham and Cunningham, 2008, Danbuzu, 2011). Waste creation by man is inevitable as far as the manipulation of the environment continue, the worries of environmentalist is the quality and the toxic level posed by the waste we produce (Danbuzu, 2011, Adewole, 2009). As a result of our daily activities to survive, we produce waste in millions of tons annually (Hammed, 2006, NBS, 2011). It must be reemphasized that the volume of solid waste generated does not invariably measure the degree to which the environment will be polluted. Thus, if the waste can be evacuated and disposed of satisfactorily and as fast as it is generated, there would be no accumulation and hence no insult, abuse and pollution. It is when evacuation and disposal perpetually lag behind the rate of generation that solid waste becomes an environmental nuisance. The summary of waste generated in Jalingo is thus presented in table 1 thus:

Table 1: Sources and Types of Solid Waste in Jalingo City

Sources of waste	Typical facilities, activities or location where wastes are generated.	Types of solid waste
Residential	Single family and multi-family dwellings Low, medium and high-rise apartment.	food waste, rubbish, Ashes, special waste
Commercial	Store, Restaurants, Market, Office Buildings, Hotels, Motels, Schools, Print Shops, Auto Repair Workshops, Medical facilities.	Food wastes, rubbish, ashes, paper.
Special waste	Streets, alleys, parks, vacant lots, playgrounds, beaches, highways, recreational areas.	Street sweepings, roadside litter, rubbish and other special waste.

Source: Adapted from Tchobanoglous, *et al* 1985.

2 Methodology:

The survey uses secondary data; the first stage of data collection was obtained from Taraba State Ministry of Environment, the agency responsible for the management of solid waste in the state as a whole. There are also collections of data from other sources which include physical observation, interview with the staff of the ministry. Other sources of information of this paper include journal papers, reports (especially the state report on waste generation and management), books and internet materials. There was survey of the solid waste collection points in the town and the dump site whether officially located or organically derived by the people due to their need. The name and location of both legal and illegal dumpsites were recorded which was coded into excel for manipulation for assessment. There was only data for monthly collection from 2000 to 2008.

The data collected include the areas of waste collection points, the personnel of the ministry charged with responsibility of collecting the waste. The equipment and management style employed in the collection process. The disposal methods, number of vehicles and disposal area. The analysis also involves the collection of population data and estimation of the waste generated in the city.

Data analysis was carried out using SPSS for the correlation of rate of collection of waste and level of management of the waste in the city. The correlation also uses Analysis of Variance (ANOVA) to show the relationship between waste collection and management.

Based on research by (Ogwueleka, 2009) that it is on average of 0.48 kg of solid waste generated per person per day was used in the research. This data was analyzed using ANOVA and simple regression analysis. This involve the estimation of the waste generated, the waste collected by the responsible agency and determining if there is significant relationship between the waste generated and waste collected in the city. The analysis was presented in tabular form.

3 Result

The result of the research is to compare if there is a significant differences between the amount of solid waste generated and collected in Jalingo between year 2000 and 2008. This was done by simple regression analysis and ANOVA to determine if there are differences or not in the survey.

The analysis of the research indicated that by considering the solid waste generated was a function of population and lifestyle. Ogwueleka (2009) has proved that the rate of solid waste generation in the Northern Nigeria is 0.48 kg per person per day and that was used to determine the amount of waste generated monthly and annually. Though there maybe variation due to peculiarity of specific cities in the solid waste generation, this was not put into consideration because of dearth of adequate data on solid waste generation in the city of Jalingo. The Northern Nigeria value was adopted because of territorial location and the characteristic of the Northern

Nigerian people which have similar socio-cultural, political and economic characteristics. Taking the standard of this weight of solid waste in the city with the population, it implies that the mean solid waste generated in Jalingo ranges between 2,017.35 tonnes in the year 2000 and 2,519.01 tonnes in 2008. This implies that as the year roll by and population increases due to urbanization, the rate of solid waste been generated increases tremendously. The analysis of the range of the solid waste generated is thus represented in table 2.

Table 2: Regression table for solid waste generated in Jalingo

Year	N	Mean monthly Generated (Tons)	Std. Dev.	Std. error	Sample Variance	Range	95% CI	
							Max	Min
2000	12	2017.35	44.59	308.00	1988.59	132.29	2050.42	1918.13
2001	12	2068.17	61.22	266.68	3748.30	240.00	2107.84	1903.84
2002	12	2122.05	62.81	302.15	3945.61	209.30	2162.54	1953.45
2003	12	2186.44	64.34	277.74	4132.23	215.57	2227.52	2011.95
2004	12	2252.95	49.80	300.29	2479.88	147.73	2289.88	2142.15
2005	12	2310.38	68.39	340.01	4677.13	227.88	2354.69	2126.81
2006	12	2375.51	71.06	381.77	5049.01	237.32	2421.32	2184.00
2007	12	2442.99	72.31	281.43	5229.11	240.95	2489.84	2248.89
2008	12	2519.01	55.68	304.45	3100.50	165.18	2560.30	2395.12

Source: Author's Field Survey, 2012

The standard deviation from the analysis indicated that there are little differences in the deviation. It ranges between 44.59 in the year 2000 and 73.31 in 2007. This implies that the level of waste generated increases with increase in population.

Waste generation is a factor of population, lifestyle and nature of consumption in a city shows that the situation in Jalingo is the use of plastics (Polythene bag) that not biodegradable and has contributed to the heap of refuse in the city. There is also variation in the months of June, July and August because of availability of farm produce in excess and storage been a problem in Africa. The waste from these farm produces though biodegradable are not managed well, which make it to litter the city. The rural lifestyle imported to city has not help matter as well. Also the analysis of waste collected in the city within the same period (between 2000 and 2008) shows that the mean waste collected ranges between 953.75 tonnes in 2005 and 1267.92 tonnes in 2000. This shows that as the year roll by the level of waste collection decline due to deterioration in operational efficiency, obsolete equipment and inadequate manpower to handle waste management in the city despite increase in the population and level of waste generated. This operational efficiency has been the major bane of waste collection in Nigeria as the manpower remains the same between the research periods.

Furthermore, the polarization of the process by political class had made the whole activities cumbersome. The basic procedure of solid waste collection in Jalingo city and all major towns and cities in Taraba State is through the Ministry of Environments. This agency faces mirage of problems in the collection of solid waste. The solid waste in the city are not separated or sort out into different types, rather everything is dump together (both biodegradable and non-biodegradable). This makes the process more tasking. There is no specific waste management strategy employed in the process of collection of the waste to reduce it such as sorting out of the waste to different categories. There is no sorting of solid waste to remove the recycle products from the non-recyclable one. This has been a factor in making the solid waste to become a bane of the society as heap of waste are seen in every nook and crannies of the city. The analysis of waste collected within the period is shown in table 3.

Table 3: Regression table for solid waste collected in Jalingo

Year	N	Mean monthly collected (Tons)	Std. Dev.	Std. error	Sample Variance	Range	95% CI	
							Max	Min
2000	12	1267.92	318.71	308.00	101576.27	966.00	1680.00	14.00
2001	12	1249.50	261.19	266.68	68221.36	749.00	1561.00	12.00
2002	12	1160.92	341.30	302.15	116483.90	987.00	1547.00	60.00
2003	12	1031.33	264.90	277.74	70170.97	770.00	1442.00	72.00
2004	12	1163.00	293.25	300.29	85949.91	833.00	1354.00	21.00
2005	12	953.75	341.92	340.01	116906.21	868.00	1484.00	16.00
2006	12	1296.17	421.30	381.77	177494.33	1393.00	2100.00	07.00
2007	12	1170.75	277.17	281.43	76824.21	784.00	1533.00	49.00
2008	12	1065.17	321.73	304.45	103573.24	1001.00	1414.00	13.00

Source: Author's Field Survey, 2012

The Analysis of Variance (ANOVA) of the waste generated and collected in Jalingo city between year 2000 and

2008 as shown in table 3 indicated that the F calculated value ranges between 0.006 and 1.779 are less than the F table value (critical value) of 4.844 at 0.05 alpha levels. This implies that the null hypothesis has to be accepted and the research hypothesis rejected thus: there is no significant differences between waste generated and waste collected in Jalingo city over the research period. This is shown in table 3 thus:

Table 4: ANOVA Analysis

Year	Sum of Square	df	Mean Square	F Cal.	F table	P-value
2000	1117338.92	11	166724.76	1.779	4.844	0.000
2001	750435.00	11	39229.85	0.552	4.844	0.000
2002	1281322.92	11	368404.78	4.035	4.844	0.000
2003	771880.67	11	487.09	0.006	4.844	0.000
2004	945944.00	11	44176.26	0.490	4.844	0.000
2005	1285968.25	11	129904.38	1.124	4.844	0.000
2006	1952437.67	11	494939.32	3.396	4.844	0.000
2007	845066.25	11	53043.36	0.670	4.844	0.000
2008	1138645.67	11	211768.20	2.285	4.844	0.000

Source: Author's Field Survey, 2012

Considering the relationship between the wastes generated and collected between these years (2000 and 2008) shows that the mean waste generated is 2254.98 and the mean of waste collected is 1150.94. The standard deviations for generated and collected are thus 173.33 and 325.79 with standard error of 324.59 as shown in table 4. The ANOVA result using simple regression analysis, it shows that the F calculated is 1.796 while the f critical at 0.05 alpha levels is 3.890. The p-value at the alpha levels is 0.183. This implies that there is no significant relationship between waste generation and waste collected in Jalingo between the study years as proved in table 5.

Table 5: Regression Analysis for Solid Waste Generated and Collected in Jalingo between 2000 and 2008

Waste	N	Mean monthly collected (Tons)	Std. Dev.	Std. error	Sample Variance	Range	95% CI	
							Max.	Min
Generated	108	2254.98	173.33	324.59	30043.18	656.46	2560.30	1903.84
Collected	108	1150.94	325.79	324.59	106141.21	1687.00	2100.00	413.00

Source: Author's Field Survey, 2012

Table 6: ANOVA Analysis

	Sum of Square	df	Mean Square	F Cal.	F table	P-value
Regression	189172.69	1	189172.69	1.796	3.890	0.0013
Residual	1.117E7	106	105357.90			
Total	1.136E7	107				

Source: Author's Field Survey, 2012

4 Discussion:

The analysis presented above indicated that there is no significant relationship between the level of solid waste generated and collected in Jalingo city due to several factors: there has been population growth in the city because of its announcement as state capital in 1991 by president of Nigeria then, the population of Jalingo before it becomes the state capital was about half of the present population (NPC, 2006). Many people have migrated to the city after the pronouncement this has changed the waste management from simple method of dumping of waste along streams and smaller quantity generated to a more complex situation.

Also the lifestyle has changed from ordinary to a complex one as the income of the people increases and lifestyle also changes, this has brought the consumption of highly processed good to high level compared to consumption of natural produce before it was made the state capital. The availability of white collar job after the creation of the state has brought influx of people to the city with many rural populaces bringing the rural lifestyle to bear in the city whereas the rural way of dumping of waste indiscriminately was then institutionalized. The research by Ogwueleka (2008) proved that on the average the waste generated by individual is about 0.48kg per person per day.

Also the solid waste management employed by people in the city does not help matter as waste are been indiscriminately dump everywhere in the city, whether designated or not. In fact the research shows that there

are about 6 legal dump collection points and about 92 illegal dump sites as people dump their waste to any available open space and stream channels. The authority responsible for the waste management in the state (Taraba State Ministry of Environment) have not fared well, they have not collect the waste at the appropriate time and poor management. The agency uses simple method of management of collection of the waste and dumping it in the dump site. They have not treats the waste and no sorting of the waste to reduce its size.

The equipment used is obsolete and inadequate. The employment of crude technology in the management does not help also. The available manpower in the Ministry does not have the capacity to cope with the rate of the waste generated in the state. There are about 213 line staff for the collection of the waste which is put about 82.59 tonnes per day. The number of vehicles available also proved to be inadequate for the management of the waste generated. There are about 4 vehicles which have the capacity of 7 tonnes per trip and can only make 2 trips per day. They are often grounded and out of service for days.

5 Conclusion

The result and analysis of solid waste generated and collected in Jalingo city implies that despite the population increase, changing lifestyle and consumption. The methods, mode of waste collection and manpower responsible for evacuation of waste in the city have not performed optimally since the turn of the new millennium. The agency responsible for the management of the waste (Taraba Ministry of Environment) has been deteriorating in discharge of their duties and the level of politics has not also help matter. There are many bottlenecks to waste management of waste in Jalingo ranging from ineffective and inefficient management to attitude of the people in the waste management practice in the city. There is need for implementation of Public Private Partnership in the municipal Solid Waste handling and management in the city to provide proper collection and disposal of waste to forestall the outbreak of epidemics which can place burden on health of people in the city.

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