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Municipal Solid Waste Management Practices and Impact on the Environment in Nasarawa Local Government Area, Kano State.

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Abstract
This study examined municipal solid waste management practices and its impact on the environment in Nasarawa LGA of Kano state through collection of data from field surveys and interviews. Findings from this study reveals organic wastes, nylons and plastics as bulk of municipal solid wastes generated with increase in daily volume of generation and disposal by inhabitants. The most practiced method of waste disposal is the open dumping method. Also, activities of government agency such as REMASAB in waste management do not conform to sustainable waste management strategies and has resulted in series of environmental and health problems. Therefore, it is recommended that residents sort their wastes before disposing to enable effective municipal solid waste management practices. Non-governmental, private organizations and the REMASAB within the state should be encouraged by providing necessary manpower, funds and equipment to aid the management of municipal solid waste.

Keywords: Biodegradable, Non-Biodegradable, Municipal Solid Waste, Waste Management, Environment, Solid Wastes.

Introduction
Solid waste is referred to the non-liquid waste agricultural, municipal, commercial and industrial activities within the environment [1,2]. These wastes comprise of waste produced from enterprises, hospitals, households, industries, construction and waste generated from marine zones [3]. It can also be referred to as an unwanted, unusable and discarded materials by humans and production sources [4]. [5] stated that solid wastes are generated from residential, businesses, manufacturing, agricultural and administrative sources, where the greatest amount of solid waste which are mostly difficult to manage are from industrial and residential areas.

Garbage waste from homes, roadsides, non-toxic solid waste from commercial, industrial and institutional establishments are referred to as municipal solid waste and are largely composed of wastes from papers, organic matter, polyesters, metals, fabrics, rubber, and glass [6]. The main environmental problem in Nigeria can be attributed to the proliferation of urban solid wastes due to the increase in commercial and industrial activities within the country since the 1970s, thereby evolving urban centers with high population influx [7]. The waste engendered by individuals and other anthropogenic activities is significantly on the increase in cities and urban centers, while the solid waste management capabilities of individuals, private sector and government agencies remains unfortunately low in handling wastes generated [8,9]. These wastes may litter the environment when they are not properly managed thereby causing severe environmental degradation and aesthetic nuisance [10].

Municipal solid waste management ensures sustainability in protection of the environment, its health and aesthetics in any urban structure [11]. It is a global problem that is a major source of concern in developed and under developed nations due to urban sprawl and industrialization which directly influence waste production and accumulation [12]. The rapid increase in world population growth and the massive influx of inhabitants into urban centers

in search of better living has significantly contributed to economic growth, increase in waste production and accumulation together with waste management issues [13,14,9,15]. However, the principle of waste management is saddled with the mandate of protecting the environment by repairing, reusing and recycling of waste, while proper disposal should be the last option [16]. Solid waste management is aimed at forestalling the resultant effect of waste disposal and accumulation on wellbeing of man and his environment [17,18,19].

In Nasarawa LGA, the littering of refuse in open spaces, alleys and drainages are common around some households. This could be attributed to high rate of waste generation due to increase in population growth and influx, and poor waste management operations in terms of handling, storing, collecting and disposing by the individuals, private organizations and the Refuse Management and Sanitation Board as well as the Ministry of Environment in Kano state.

Several studies may have been undertaken by various researchers on waste management in Kano State; [20] examined the operations of agencies responsible for waste management in the Kano metropolis. The result showed a substantial percentage of the population (80%) to not have access to waste collection services and considers the waste management service within the metropolis very poor. [21] carried out a study on household solid waste in Kano metropolitan area which showed that majority of the urban waste accounts for 62.5%, while institutions and industries located within residential areas contributed about 5.8% and 2.9% respectively. [7] also carried out a similar study on solid waste disposal and its resultant environmental issues in Kano metropolis, which showed the waste to comprise decomposable and non-biodegradable materials which are mostly left in unauthorized dumpsites along road sides and open spaces. The study further showed that the unchecked urban expansion and population growth rate can be attributed to the rate of refuse heaps which sometimes block drainage channels, become good breeding grounds for insects, rodents and reptiles. Also, the wastes may cause adverse physical and health hazards due to accumulation and deterioration of certain toxic chemical elements. From most of these studies, the management of urban solid waste in Nasarawa LGA of Kano state is given little consideration. This paper attempts to fill this gap by providing data on the nature and amount of waste produced, method of waste collection and disposal together with perception of residents on solid waste management practices and its resultant effect on the environment. From the forgoing, this study examines municipal solid waste management practices and impacts in Nasarawa Local Government Area, Kano State with a view to making useful policy options for the improvement of the situation by environmental managers and key stakeholders.

Study Location

Nassarawa Local Government Area of Kano State is located between latitude 11º57'53" and 12º02'30"N, longitude 8º30'50" and 8º34'20"E (Figure 1). The Local Government Area has an extent of 34km². It is bounded by Ungongo LGA in the north central, Gazewa LGA in north-east, Warawa LGA in the South-east, Kumbotso and Tarauni LGAs to the south-west and Fagge LGA to the north-west. It has eleven wards, namely, Dakata, Gama, Gawuna, Giginyu, Gwagwaruwa, Hotoro North, Hotoro South, Kawaji, Kauragoje, Tudunmurtala, and Tudunwada.

The local government area has a population of 596,699 which constitutes about 21.1% of the metropolitan population [22]. Influx of people and natural growth rate of 3% is expected to continue to increase the population of the state. This population increase will thereby significantly increase waste generation in Nasarawa LGA and its management would require innovative strategies.

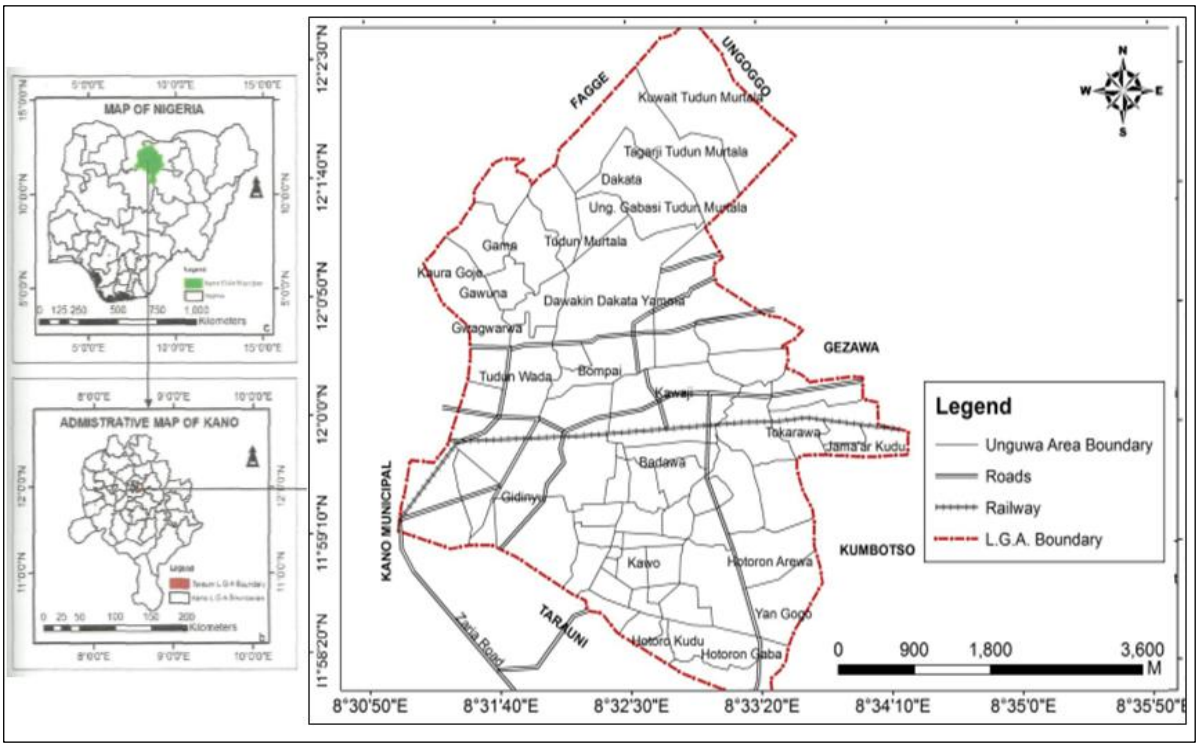

Fig. 1: Location of the Study Area
Source: Kano State Geographic Information System

The climate of the study area is the tropical wet and dry Aw by Koppen's classification. Climate dynamics plays a critical role waste management of the study area. For example, waste accumulated over time increases in weight due to increase in moisture content. Also, the organic aspect of the waste decomposes quickly under high humidity and heat leading to problems in management and getting rid the waste which directly affects the health of inhabitants and waste workers [21].

Material and Methods

This research adopted stratified sampling technique to select the study area out of the eleven wards within the local government area. The local government area was divided into four strata: North-West, North-East, South-West and South-Eastern part of the LGA. Convenient sampling technique was employed to select one ward from each of the four strata; Gwagwaruwa, Tudunmurtala, Giginyu and Hotoro South respectively, where 160 head of households were drawn from the population. Therefore, a total 160 questionnaires were randomly administered to the respondents from each of the selected wards proportionately. The sample size was distributed such that equal number of households were drawn from the selected wards. This is to reduce costs, simplify management and control of the quality of the interviews. Therefore, the sample size was kept within reasonable limits.

Questionnaire research instrument was deployed and administered to the sampled population in different location within the LGA. The questionnaire schedule was well-designed as open-ended structured questions which includes the respondent's socio-demographic attribute, solid waste management practices and environmental impact of the solid waste. The data were collected with the aid of four well trained research assistants. Prior to the data collection, a trip to the study area was made in other to have a better understanding of the problems relating to municipal solid waste within the LGA.

The data from field survey were descriptively analyzed deploying Statistical Package for Social Sciences (SPSS) software Version 25. Also, four-point likert scale ranging from Strongly Agree (SA), Agree (A), Disagree (D) and strongly Disagree (SD) was used to weight the responses for the purposes of analysis and was used to calculate the benchmark mean.

4. Results and Discussion

4.1. Socio-demographic Profile

Table 1 shows the socio-demographic profile of the respondents which includes; age, gender, household size, educational qualification, occupation and average monthly income.

Table 1: Socio-demographic profile of the respondents

Variables	Frequency	Percentage (%)
Age-Group		
20-30	62	39
31-40	50	31
41-50	27	17
51 and above	21	13
Total	160	100
Gender		
Male	128	80
Female	32	20
Total	160	100
Household Size		
1-5	43	27
6-10	87	54
Above 10	30	19
Total	160	100
Education Attainment		
Tertiary	61	38
Secondary	58	36
Primary	19	12
Non-formal	22	14
Total	160	100
Occupation		
Unemployed	29	18
Farmers	16	10
Traders	52	33
Civil Servants	44	28
Private Sector Employee	19	12
Total	160	100
Monthly Income		
Less than 15,000	46	29
15,000-45,000	29	18
45,000-60,000	33	21
Above 60,000	52	33
Total	160	100

Source: Fieldwork 2020

The result from Table 1 revealed that majority of the respondents 67 (38.8%) are aged between 20 -30 years. Concerning the gender of respondents, the table shows that males were dominant among the respondents 128 (80%). In terms of the household size, the finding shows that household with 6-10 persons are the majority 87(54.4%). Furthermore, the finding revealed that majority of the respondents 61 (38.1%) are with tertiary education level, while only 19(11.9%) had primary level of education. The table further showed that trading is the major occupation representing about 52(32.5%) of the respondents, while about 16 (10%) are into farming. Lastly, majority of the respondents earn an average monthly income of above N60,000 which has a way of influencing the consumption pattern of individuals vis-a-vis waste generation.

4.2. Characteristics of Solid Waste Produced

The various types of municipal solid waste produced by the residence in the study area as shown in Table 2 include the following; organic, textile materials, papers, metal scraps, nylon and plastic materials.

Table 2: Types of municipal solid waste generated

Type of Waste	Frequency	Percent (%)
Organic	97	61
Textile materials	13	8
Paper/cardboard	9	6
Metal scraps	7	4
Nylon and plastic materials	34	21
Total	160	100

Source: Fieldwork 2020

It was deduced from Table 2 that 61% of the waste generated were mainly organic wastes, followed by nylons and plastics 21%. Also 8%, 6%, 4% were from textile materials, paper/cardboard and metal scraps wastes respectively. The organic waste from the study area comprise mostly of food waste and vegetables which

microbes' acts on to cause decomposition of the waste. Also, nylon and plastic materials are mainly composed of pure water sachets and polythene bags. The entirety of the waste are sometimes burnt and decomposed which are mostly bagged and sent to farms to boost soil organic content. This result is similar to the study of [21] who establish that municipal solid waste in Kano metropolis consists mainly of biodegradable materials.

4.3. Amount of Municipal Solid Waste Generated

Table 3: Weekly Volume of Waste Generated

Rate	Frequency	Percent (%)
Half Bucket	2	1
One Bucket	5	3
Two Buckets	33	21
Above Two buckets	120	75
Total	160	100

Source: Fieldwork 2020

The amount of municipal solid waste produced by inhabitants is dependent on the population of each household and their socioeconomic prominence. Table 3 shows that majority (75%) of the residents generates above two buckets of waste per week followed by 21% of respondents who generates two buckets per week, while 3% and 1% generates one and half bucket respectively. This implies that majority of the inhabitants within the study area frequently generates high amount of waste.

4.4. Waste Management Practices

Based on the common method of refuse disposal by residents from figure 2, majority of the residents responded that, they were used to open dumping (76%) and burning (11%) which are normally done along roadsides or open spaces within the environment. Furthermore, 6% of the residents used REMASAD bins for disposing their waste, 4% used authorized dump sites, while 3% used burying method for disposing municipal solid waste.

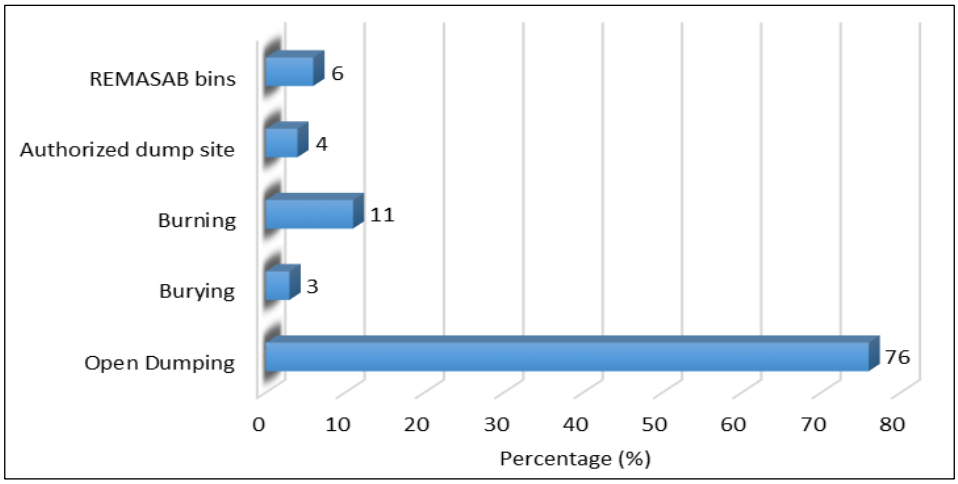

Fig. 2: Common Municipal Solid Waste Management Techniques

From the result, it can be deduced that the most common technique for refuse disposal are the open dumping, and burning of refuse. This result agrees with the study of [23] and [21] who reported indiscriminate open dumping method of solid waste disposal by inhabitants. Examples of such disposal methods are shown in Figure 3, 4 and 5 from Giginyu and Hotoro within the LGA.

Fig. 3: Open Dump Site in Giginyu

Fig. 4: Open Dump Site in Hotoro

Fig. 5: Open Drainage Refuse Dump in Hotoro

4.5. Frequency in Waste Generation and Disposal

The rate of waste production and subsequent disposal within an environment go hand in hand as environmental management and sanitation practices. Figure 6 shows graphical representation of the waste generation and disposal frequency within the LGA.

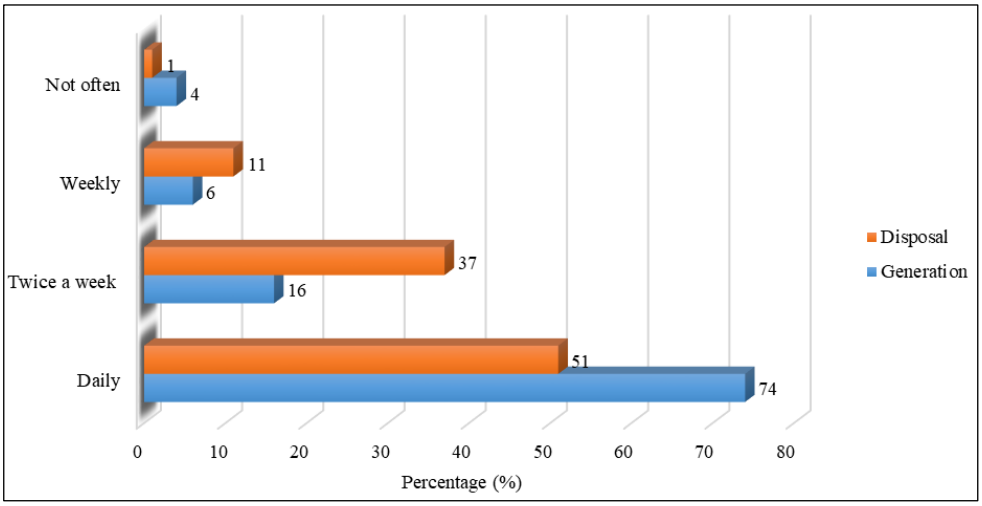

Fig. 6: Rate of Municipal Solid Waste Generation and Disposal

The result showed that majority (74%, 51%) of the inhabitants generates and dispose their waste daily, 16%, 37% generates and dispose their waste twice a week, 6%, 11% generates and dispose weekly, while 4%, 1% don't often dispose their waste. This implies that the rate of daily waste generation is greater than the rate of waste disposal which explains the reason behind the bulk of waste seen around the study area. Also, areas within and around the government residential areas experience more waste disposal than other locations within the LGA. This result conforms to the study of [24] who reported that bulk of their residence generates and disposes their solid waste on a daily basis.

4.6. Capacities of Solid Waste Management Agencies in Tackling Challenges Municipal Solid Waste

Figure 7 shows the agencies responsible for managing municipal solid wastes within the study area where individuals, Non-governmental, governmental organizations were considered.

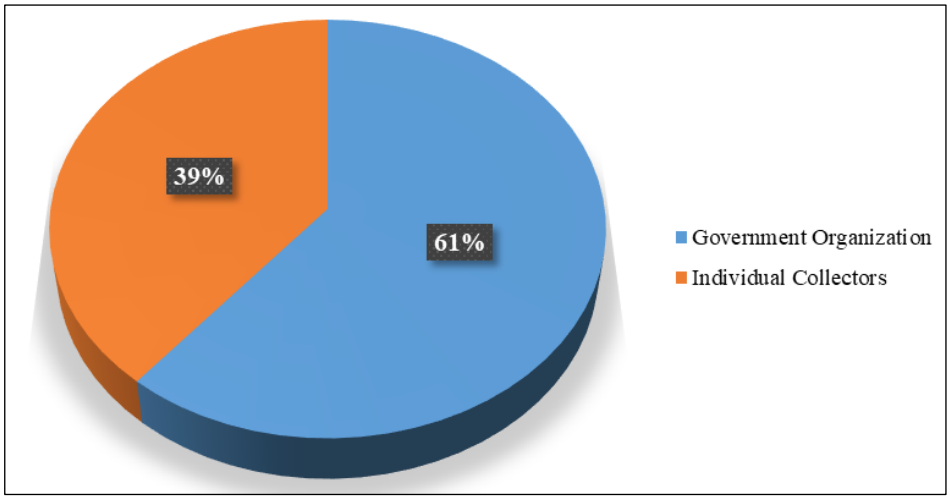

Fig. 7: Establishments Responsible for Managing Municipal Solid Waste

The result showed about (61%) of the respondents reported that government agencies plays a key role in managing solid waste through the Refuse Management and Sanitation board (REMASAB) as well as the State Ministry of Environment. while about (39%) of the respondents reported that individual households manage their domestic solid waste either by burning, burying or transferring to a secondary dumpsite within the LGA. Also, this result shows none existence of private organizations in managing solid waste in the LGA. This result is similar to the findings of [24] who reported that government agencies are solely responsible for urban solid waste management in Kaduna north LGA.

4.7. Perception of Residents on Waste Management Practices

From table 4, about 58% of the respondents reported a low satisfaction level in the management of household solid wastes by individuals and the responsible organizations as it relates to collection and disposal, 35% of the respondent reported medium satisfaction, while very few respondents 7% reported high satisfaction in level in the management of solid wastes which are those were those that have access to relatively good management of waste with respect to government residential areas and road sides.

Table 4: Household Satisfaction Level in Municipal Solid Waste Management

Level of satisfaction	Frequency	Percent (%)
High	11	7
Medium	56	35
Low	93	58
Total	160	100

Source: Fieldwork 2020

This level of satisfaction by the residence in this study implies that urban solid waste management practices by individuals and responsible organizations do not conform to sustainable waste management strategies. This agrees with the findings of [25] that the agencies in charge of managing solid waste in Gombe were inefficient and could attributed to poor funding, manpower and lack of equipment, together with the negative attitude of the households towards waste management.

4.8. Environmental Impact of Waste Accumulation

Based on the four-point likert scale, table 5 showed the perception of the residence on the effect of solid waste on the environment. The respondents agreed that flash floods ($\bar{x}$=3.73), malaria ($\bar{x}$=3.60), cholera ($\bar{x}$=3.44), water pollution ($\bar{x}$=3.23), rodent infestation ($\bar{x}$=2.61), and air pollution ($\bar{x}$=2.50) are the resultant effect of solid waste on the environment with their mean scores greater than or equal to the bench mark mean of 2.50. While the respondents disagree that solid waste accumulation affects traffic congestion due to garbage dumps on road sides ($\bar{x}$=2.28).

Table. 5: Effect of Municipal Solid Waste on the Environment

Indicators	Mean	Interpretation
Flash floods	3.73	Agree
Air Pollution	2.50	Agree
Water Pollution	3.23	Agree
Malaria	3.60	Agree
Cholera	3.44	Agree
Rodent infestation	2.61	Agree
Traffic congestion due to garbage dumps	2.28	Disagree
Weighted Mean	3.05	

(Decision Mean = 2.50)

Mean	Interpretation
> 2.50	Agree
< 2.50	Disagree

This result implies that buildup of municipal solid waste on the environment causes; flash floods due to blockage of water channels during the wet season, malaria and cholera as a result of pathogenic organisms breeding in such surroundings, water pollution by leaching of pollutants into the water table, rodent infestation, and air pollution as a result of burning of municipal waste and releasing of toxins into the atmosphere within the environment. This result conforms to the study carried [26] who concluded that domestic solid wastes results in substantial threats to the health of the population and the entire environment. This also conforms to the study [2] who concluded that blocking of drainage channels with garbage is a major cause of urban flooding.

5. Conclusion and Recommendations

Sustainable environmental health, protection and aesthetics in any society can be achieved through proper solid waste management best practice. This research has provided a detailed knowledge on solid waste management practices and its impact on the environment in Nasarawa local government area of Kano state. The characteristics and amount of waste produced, method of collection and disposal waste together with perception of inhabitants on waste management practices and its resultant effect on the environment were considered. The result from this study revealed that organic wastes (food, lawn and kitchen waste), nylons and plastics form the bulk of the wastes produced and amounts to over two buckets in volume generated per week per household. Also, there is an

increase in daily amount of waste produced and disposed by inhabitants of the LGA, where open dumping is the most practiced method of disposal and are mostly burnt to extract ash for agricultural purpose. The activities of the governing agency (REMASAB) responsible for in managing solid waste do not conform to sustainable waste management strategies and has resulted in an increase buildup of waste scattered around the study area causing urban flash floods due to blockage of water channels, malaria and cholera vector breeding in such surroundings, water pollution by leaching of pollutants into the water table, air pollution as a result of burning municipal waste thereby releasing toxins into the atmosphere, and rodent infestations.

From the findings of this research, it is therefore recommended that residents should sort their wastes before disposing them to enable proper and effective management of waste so as to enhance the re-use and reduction in volume of wastes for other purposes such as composting for farm organic manure to improve crop yield. The government should encourage private organizations and NGOs to join in managing solid waste considering the increasing number of inhabitants within the LGA and the state at large. Also, the government in conjunction with the local government authority should provide agencies like (REMASAB) with necessary manpower, funds and equipment to aid the management of municipal solid waste. Well-designed incinerators and evacuated bins should be provided at designate locations so as to avert the indiscriminate waste disposal and burning. The relevant authorities and individuals should ensure frequently cleaning of drainage channels to prevent recurrent urban flash floods. Finally, dumpsites should be disinfected regularly to reduce the breeding of rodents and vectors such as mosquitoes (malaria), houseflies (cholera).

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