

Original Research Article

Effects of Solid Waste Management on Public and Environmental Health in Kano Metropolis

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Abstract: Waste management is the process of treating solid wastes and offers a variety of solutions for recycling items that don't belong in trash. It is about how garbage can be used as a valuable resource. Waste management is something that each and every household and business owner globally needs. Waste management disposes of the products and substances that you have used in a safe and efficient manner. This paper will outline how efficient waste management systems, public health, and the quality of the environment are correlated. Waste management implies every possible way of dealing with waste in an environmentally responsible manner, from its generation to its final disposal. Dealing with waste management requires everyone to be responsible by prioritizing waste minimization, treatment and recycling and then its final disposal. By so doing, both public health and the entire environment are preserved. This paper reviews the impact of waste management on the physical components of the environment, such as water, soil, and air quality, as well as the environment and public health. The various methods involved in handling and disposal of wastes were carefully reviewed against the standard practices with a focus on Kano metropolis. Poor waste management practices in some of the major dumping sites in Kano, the dangerous health challenges and the environmental concerns were assessed, and the best waste management practice was recommended.

Keywords: Solid Waste, Public Health, Environmental Health, Waste Management, Waste Disposal, Landfill

Introduction

Waste management refers to all those activities and actions required to manage waste from the point of generation to its final disposal. These include, amongst other things, collection, transport, treatment and disposal of waste together with monitoring and regulation. It also encompasses the legal and regulatory framework that relates to waste management and guidance on recycling, etc. (United Nations Environmental Program, 2013). There is a real-time correlation between urbanization, population growth, industrialization and the amount of waste generation (Debnath *et al.*, 2015; Minghua *et al.*, 2009). However, management of these wastes is a major problem posing both public and environmental health challenges in the Kano metropolis.

Poor waste management causes degradation of human health, environmental pollution, unpleasant smell, growth and multiplication of insects, rodents, and worms. It leads to transmission of diseases like typhoid, cholera and hepatitis through injuries from sharps contaminated with blood (Babanyara *et al.*, 2019). Improper waste disposal and management causes all types of pollution such as air, soil, and water. Indiscriminate dumping and poor waste management results into contamination of surface and ground water supplies. In urban centers like Kano, solid wastes blocks the drains and drainages, causing stagnant water which results in producing a good breeding ground for mosquitoes and flooding. Uncontrolled burning of solid wastes and improper incineration contributes significantly to urban air pollution. Greenhouse gases are generated from the decomposition of organic wastes in landfills, and untreated leachate pollutes surrounding soil and water bodies. Health and safety issues also arise from improper waste management.

Poor waste management system breeds insects, mosquitoes and rodent vectors which can spread diseases such as cholera and typhoid fever. Direct and indirect consumption of contaminated water or for bathing, food irrigation can also expose individuals to disease organisms and other contaminants. The U.S. Public Health Service identified 22 human diseases that are linked to improper Municipal Solid Waste Management. Waste worker and pickers in developing countries are seldom protected from direct contact and injury, and the co-disposal of hazardous and medical wastes poses serious health threat. Wastes from industrial chimney, exhaust from vehicular activities, dust stemming from disposal practices and the open burning of waste also contribute to overall health problems. People know that poor sanitation affects their health, especially in developing and low income countries like Nigeria, where the people are the most willing to pay for environmental improvements (Rathi, 2016; Sharholy *et al.*, 2015; Ray *et al.*, 2015; Jha *et al.*, 2013; Kansal, 2022; UDSU, 2019; Kansal *et al.*, 2018; Singh *et al.*, 2018; Gupta *et al.*, 2019; Tchobanoglous *et al.*, 2019).

The aim of this paper is to examine the management of wastes generated from domestic and industries towards a sustainable development and also how to manage wastes conversion into reusable resources instead of been a source of threat to public and environmental health and finally the paper will determine whether improper disposal and handling wastes impact on environmental health as well.

STUDY AREA

Kano is the largest city in the Sudan region of Nigeria. It comprises forty-four local government areas. Like many sub-Saharan African cities. Kano is experiencing very rapid urbanization; its population has grown from 4, 931, 789 inhabitants in 1996 to 9, 383, 682 inhabitants in 2006 (Ahmed, 2009). Kano metropolis (the study area) comprises eight (8) Local Governments, Dala, Fagge, Gwale, Kano Municipal, Nassarawa, Tarauni, Kumbotso and Ungogo, covering the total land area of 479 km² with a projected population of 2,828,826 and it lies within the latitude 11° 52'N - 12° 07'N and the longitude 8° 07'E- 8° 22'E. Fig. 1

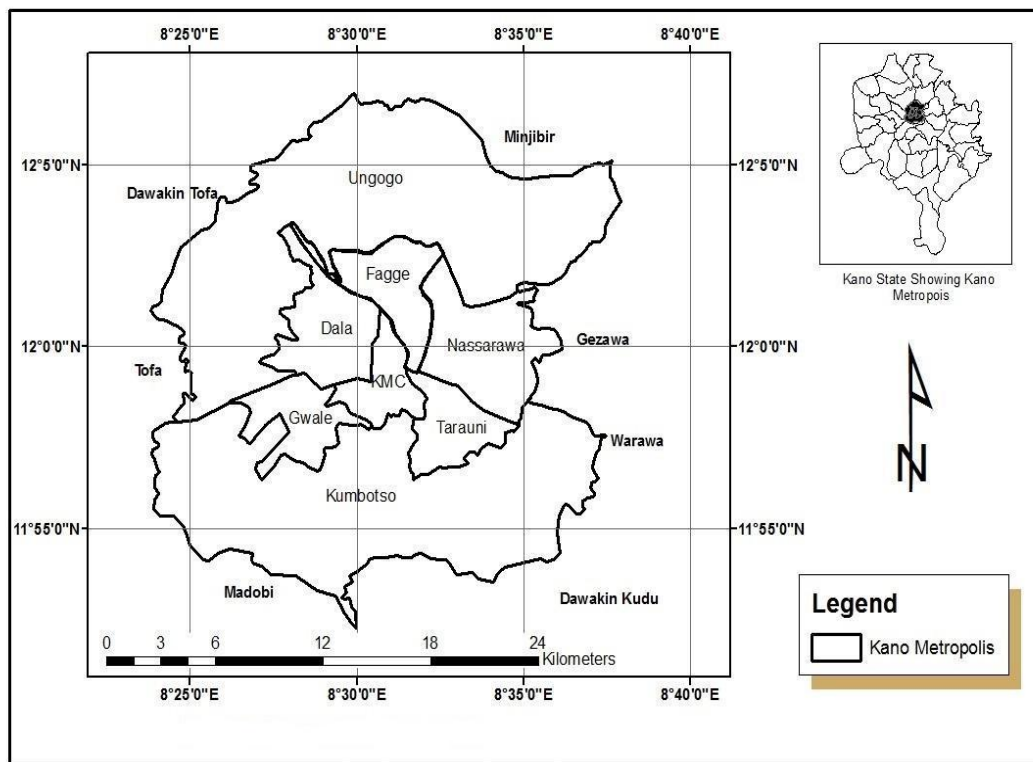


Fig. 1: Study Area

This study was conducted in eight (8) local government areas of Kano metropolis, viz; Dala, Fagge, Gwale, Kano municipal, Kumbotso, Nassarawa, Tarauni and Ungogo.

The waste type from each of the dumpsites consists of organic, non- organic, hazardous and non-hazardous. These wastes may have originated from domestic, agricultures, industrial and electronic wastes.

The solid waste generated for some cities have indicated that the monthly generated and density as well as kilogram per person per day is high in Lagos with 255,056 tonnage/month, 294 kg/m³ and 0.63 kg/person/day but, surprisingly Aba with a population of 784,500 generated about 236,703 tonnage/month closer to Lagos due to high level of

commercial activities in Aba and despite that Kano is a giant commercial city but generate about 256,676 tonnage/month with a density of waste generated of 290 kg/m³ and 0.56 kg/person/day Adeoye *et al* (2011)

Nigeria with the population of over 200 million people (population equivalent to 2.57% of the total world population) is one of the highest producers of municipal solid waste in Africa. The country generates more than 32 million tons of waste annually while only 20-30% is collected and 70% are dumped in unsafe places. 10,000 tons of municipal wastes generated in Lagos per day, translates to an average of 3.65 million tons per year Bakare W (2016). Waste generated in Kano alone within six months is up about 1.83 million tons from several illegal dumping sites Sanusi (2018).

Sources of Waste

1. **Household Waste:** These are wastes that originate from households. It includes paper, food scraps, kitchen wastes, glass, used containers etc.
2. **Garden waste and building rubble:** These type of wastes emanates from gardens, parks, sidewalks and building activities. This includes branches, leaves, grass, soil and building rubble.
3. **Commercial Waste:** This comprises of large quantities of paper and other packing material which originates from shops, offices, hotels and restaurants.
4. **Industrial Waste:** These are residues originating from production processes at industries and refineries. They can be classified as hazardous and non-hazardous waste according to its physical, chemical and biological properties.
5. **Agricultural and forestry waste:** Examples of these wastes include dung, stalks, hay, compost, chaff, branches and sawdust. Basically they are gotten from agricultural and forestry activities.

Waste hierarchy

The waste hierarchy refers to the "3 Rs" Reduce, Reuse and Recycle, which classify waste management strategies according to their desirability in terms of waste minimization. The waste hierarchy remains the cornerstone of most waste minimization strategies. The aim of the waste hierarchy is to extract the maximum practical benefits from products and to generate the minimum amount of waste resource recovery. The waste hierarchy is represented as a pyramid because the basic premise is for policy to take action first and prevent the generation of waste. All wastes form part of what can be referred to as the waste stream. There are many sources that feed the waste stream and these consist of the formal and informal waste streams.

Formal Waste Stream: The formal waste stream consists of all the waste that follows a recognized path of disposal. The formal waste stream can be identified and controlled, although it might involve making difficult decisions.

Informal Waste Stream: These are wastes that do not follow a recognized disposal path. It is more difficult and very expensive to control. Sources of informal waste include

litter, illegal dumping of industrial and household waste, and human waste in areas without sanitation.

Methodology

The Kano State Refuse Management Agency and Sanitation Board (REMASB) is a body of waste management agency is a body of the Kano State government responsible for managing waste generated in Kano state through waste collection, transportation and disposal structure. The goal of setting REMASAB is to improve the quality of the environment with a view to achieving significant changes in the living conditions regarding health condition and sanitation. The will provide an extensive review of several works done waste management and its impacts on both public health and the environment. Generally waste wastes must be managed from the point of generation to its final disposal and in between. The paper described efficient waste management and its benefits, the sources and methods of handling different types of wastes. It also describes the health and environmental hazards of poor waste management in the study area. Finally, recommendations given in order to attain the best waste management practices for healthy living and preservation of the environment.

Ideal Waste Management Practice in the study area

In order to eradicate the harmful effects of waste on both public health and the environment, the issue of waste management and disposal in Nigeria must be a collective effort and responsibility, starting from the households. The government must enact laws to ensure that all parties involved follow the best and international practices on all waste matters. The government must focus on a very good and sustainable waste collection method so as to keep our environment clean and healthy. Indiscriminate dumping of wastes which is the root cause of pollution should be discouraged to avoid environmental pollution and increases the vulnerability of man to infectious diseases.

Recommended Waste Management Methods

Collection

One major problem of waste management in developing countries amongst others is efficient and sustainable waste collection system. Waste matter is normally placed in drums, plastic bags and other containers. These containers are usually found at places of waste generation and are collected using vehicles. Sometimes waste is gathered at central transfer stations from where it is taken to the relevant waste disposal site. (Abd'Razack *et al.* 2013; Nwaka 2005; Omran *et al.* 2007). Sometimes the collection program seems ineffective in some areas as collection vehicle have difficulties in accessing the collection point (Nabegu, 2010; Swapan, 2008)

Transport: This takes place between place of waste generation and disposal site. It is frequently undertaken using dedicated trucks. Special regulation must be followed when transporting hazardous waste.

Recycling: Recycling is a resource recovery practice that refers to the collection and reuse of waste materials such as empty beverage containers, paper, bottles, plastics etc. The waste materials are salvaged and re-used for further benefits.

Treatment: Hazardous waste is treated using different chemical and physical processes to bring properties such as toxicity, reactivity, pathogenicity, corrosivity, flammability and pollution potential within acceptable limits before disposal.

Storage: Waste storage can be short-term or long-term. Storage of wastes in drums, bins, plastic bags, etc., is short-term storage, while the storage of hazardous wastes like radioactive waste for a very long time until effective treatment/recycling or disposal methods have been developed is referred to as long-term storage.

Disposal: The common waste disposal practice includes open dumping (waste dumped in a site not suitable as a waste disposal site, with no compacting or covering of the waste). Sanitary landfill is another disposal method where waste are dumped in layers on a specially prepared disposal site, compacted and covered. These sites can later be used as sport fields, parking area etc. The third method is called encapsulation which involves hazardous non-biodegradable waste being encapsulated in reinforced concrete capsules at a suitable disposal site

Methods of Waste Disposal

Incineration

This is frequently used for the decomposition of organic toxins. Incineration or burning involves burning waste in waste incinerators operating at very high temperatures above 500°C in order to reduce the volume and weight of solid wastes. It typically reduces waste volume by 90 % and mass by approximately 70 % and makes it lighter and less bulky to transport and landfill. Dangerous gases like nitrogen, particulate matters, micro pollutants, sulphur oxides, and hydrogen chloride gases generated are cleaned prior to discharge into the atmosphere.

Solidification

This technique requires reducing the mobility of hazardous constituents in waste by binding them into a solid matrix which prevents leaching due to low permeability of the waste matrix. The common binding agents used may be silicate based, cement based, organic polymer based or thermoplastic based.

Composting

Composting is alternative method of disposing solid waste. It is the controlled aerobic decomposition of putrescible material. It is a easy and natural bio-degradation process that takes organic wastes i.e remains of plants, garden and kitchen waste and turns them into nutrient rich food for the plants. Composting, normally used for organic farming occurs by allowing organic materials to sit in one place for months until microbes decompose it. During composting, the environmental considerations that must be considered include leachate, landfill gas, litter, vermin and noise.

Sources and types of toxic waste in Kano metropolis

Domestic wastewater: this contains ammoniac nitrogen and sulphide at levels up to 50 mg/l concentrations. They can cause damage to aquatic fauna unless if diluted.

Leachate: A good number of harmful toxic substances can leach out of sites where solid wastes are disposed. The amount is usually aggravated if surface water or ground water can access it.

Agricultural waste: A wide variety of materials that are used for fertilizers and pest control. Fertilizers containing oxidized nitrogen can cause human toxicological problems. Pesticides and herbicides are very potent aquatic toxins.

Effect of Poor Waste Management on Public Health

Kano State has witnessed a lot of poor dumping sites and landfills which has adverse effect on human health particularly those living within that vicinity, a case study is the Court road dumping site in Tarauni Local Government area. The frequency of these landfills' failures is very alarming Nabegu (2010).The landfill/dumpsite receive all waste generated (domestic, commercial, industrial, medical waste) in Kano State. The site is where the commercial department destroys all approved obsolete or expired products from companies. Below are locations of some landfill/dumpsites in Kano metropolis

Table 1: Composition of Recovered Waste per month in tons and in (%)

S/N	Type of Waste	K/mazugal		Hajj Camp		Gwale Cem.		H/Jakai		U/Uku		Dakata		C/ Road	
		T	%	T	%	T	%	T	%	T	%	T	%	T	%
1	Polythene products	6.38	7.98	134.14	7.20	44.88	8.50	217.24	8.94	31.44	4.99	309.17	9.04	162.85	10.12
2	Plastics Bottles	3.26	4.07	80.11	4.30	12.41	2.35	118.10	4.86	30.81	4.89	128.25	3.75	198.09	12.31
3	Glass Bottles	3.33	4.16	174.94	9.39	54.96	10.44	127.58	5.25	52.73	8.37	224.35	6.56	83.68	5.20
4	Scraps metal	21.8	27.25	519.59	27.89	159.50	30.21	669.95	27.57	195.36	31.01	1033.18	30.21	505.45	31.41
5	Tins and Cans	16.57	20.71	288.21	15.47	57.29	10.85	213.11	8.77	66.59	10.57	297.88	8.71	171.06	10.63
6	Aluminium Prod.	3.46	4.33	87.37	4.69	16.26	3.08	12.64	0.52	27.66	4.39	147.74	4.32	69.20	4.30
7	Wood	0.95	1.19	51.79	2.78	16.26	3.08	106.68	4.39	13.80	2.19	61.22	1.79	61.15	3.80
8	Paper	1.42	1.78	60.36	3.24	5.44	1.03	11.66	0.48	26.40	4.19	72.50	2.12	119.40	7.42
9	Ceramics	2.99	3.74	10.99	0.59	4.65	0.88	8.51	0.35	13.17	2.09	58.48	1.71	32.18	2.00
10	Textile materials	1.63	2.04	52.91	2.84	4.65	0.88	9.48	0.39	8.19	1.30	26.33	0.77	19.63	1.22
11	Organic materials	1.63	2.04	4.84	0.26	40.23	7.62	86.51	3.56	10.65	1.69	84.82	2.48	122.14	7.59
12	Others	16.57	20.71	397.75	21.35	111.46	21.11	848.31	34.91	153.28	24.33	976.07	28.54	64.37	4.00
Total		80.00		1863.00		527.90		2429.77		630.00		3419.99		1609.20	

Source: Computed from field data collected, 2026

The resulting effect ranges from contamination of the environment with greenhouse gases, volatile organic compounds, toxins, leachates into the rivers and other water bodies, air pollution, and obnoxious smell. At one of its summits in 2000, (Uwaegbulam 2004) revealed that the World Health Organization (WHO 2004) and United Nations International

Children's Education Fund (UNICEF 2004) joint report in August 2004 that about 2.4 billion people will likely face the risk of needless disease, health challenges and possibly death by the target of 2035 because of bad sanitation and problems from poor waste management. The report also noted that bad sanitation, poor waste management decaying or nonexistent sewage system and toilets fuels the spread of diseases like cholera and basic illness like diarrhea, which kills a child every 21 second. The hardest hit by bad sanitation is rural poor and residents of slum areas in fast-growing cities, mostly in Africa and Asia (Napoleon *et al.* 2011).

Impact of Municipal Solid Waste on the Natural Environment

Table 2: Impacts of different solid waste activities on the environment

Activities	Water	Air	Soil	Land	Climate
Landfilling	Leachate (heavy metals)	CO ₂ , CH ₄	Heavy metals, synthetics	Visual effects	Greenhouse gas emission
Composting	Leachate	Bio-aerosols, dust, odour, CO ₂ , CH ₄	Minor impact	Visual effects	Small emission of GHG's
Land spreading	Bacteria, Viruses, PCB's, heavy metals	Bio-aerosols, dust, odor	Bacteria, Viruses, heavy metals	Insect, Vermin	Small emission of GHG's
Recycling	Waste water	Dust, noise	Landfilling residues	Small emission of GHG's	Minor emission of GHG's
Waste transportation	Spills	CO ₂ , SO ₂ , NOX, odor, noise, spills	-	-	Minor contribution of CO ₂
Incineration	Fallout of atmospheric pollutants	CO, CO ₂ , SO ₂ , NOX, HCl, HF, NO ₂	Fly ash, slags	Visual effects	Greenhouse gas emission (GHG'S)

Recommendations

The government should make a good waste management policy and enforce laws that will resonate with the policy in order to ensure good compliance. There should be a good support system to ensure every household and stakeholders involved prioritize waste matters in their daily activities and engagement.

Conclusion

In this paper, we highlighted the correct and internationally recommended waste management practices that are capable of supporting human health, aquatic life, plants and the general environmental condition. The poor and unscientific waste management method is correlated with risks to people and the general environment. Poor municipal waste management has led to toxins and hazardous substances entering the human body and

leaching into soil and water bodies, which cause health failure, a challenge to maintain the quality of water, air, and soil. The quantities and proportions of different constituents of wastes, their handling, transportation, treatment, and disposal methods in different dumping sites/landfills vary. Waste collection and access to some collection points and even disposal methods have been found to be generally inadequate in most of the studies. We therefore conclude that the development of efficient and workable waste management policies, plans, and protocols should be established. Also, training and orientation programs on proper waste management practices for all households and waste collection officers should be considered. The government should set up research centers to convert waste to energy and other useful resources.

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