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Storage and treatment system of solid waste as strategy for sustainable environmental development in Ilorin Metropolis, Nigeria

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ABSTRACT

An analysis of the activities of the Kwara Waste Management Company (KWMC) was carried out with particular emphasis on the storage and treatment of wastes for sustainable environment in Ilorin. The types of data collected for the study include types and sources of waste generated in Ilorin, methods of storing waste, types and sizes of containers used in storing waste, ways and types of treatment embarked upon, types of insecticides or disinfectants, and legislations on storage and treatment of solid waste in Ilorin. The land use system was adopted for the purpose of gathering relevant data and information. The most recent prevalent land use system was used while houses, shops, offices, hospitals, and schools were selected at random for interviews and administration of questionnaires. 250 questionnaires were randomly distributed to the land use areas considering the population strength and activities in each of them. The findings of the study rated Ilorin at 55% and recommendations are presented.

Key words: Wastes, Management, Sustainable Environment, Storage, Treatment Legislative.

INTRODUCTION

Of utmost importance in the management procedures of solid waste is an efficient and proper system of storage, coupled with an appropriate disinfectant treatment at points or places being generated from. Though, waste has been described as rubbish or materials that are not needed and are economically unusable without further processing; the constituents may be in liquid, gas or solid form and originate from a wide range of human operations, such as industrial commercial, transportation, agricultural, medical, and domestic activities (Agunwamba, 2003).

In every society, people have their traditional ways of storing and keeping waste being generated from residential, industrial and commercial activities. This obviously has resulted in the designing of containers of various materials and capacities. Consequent upon this, most wastes generated go through some biological and chemical reactions, which lead to the breeding and attracting of micro organism, insects and rodents, with usual fowl odor emanating there from. All these resultant effects can be attributed to the sizes and types of containers used or where the stored wastes are being kept. Also, separation or sorting of waste largely affects the degree of reactions that take place where the waste are stored.

The points highlighted above, informs the need for this paper, with the hope that it will be of an immense contribution to the body of knowledge. The recommendations will no doubt help in better policy formulation, and result oriented awareness creation.

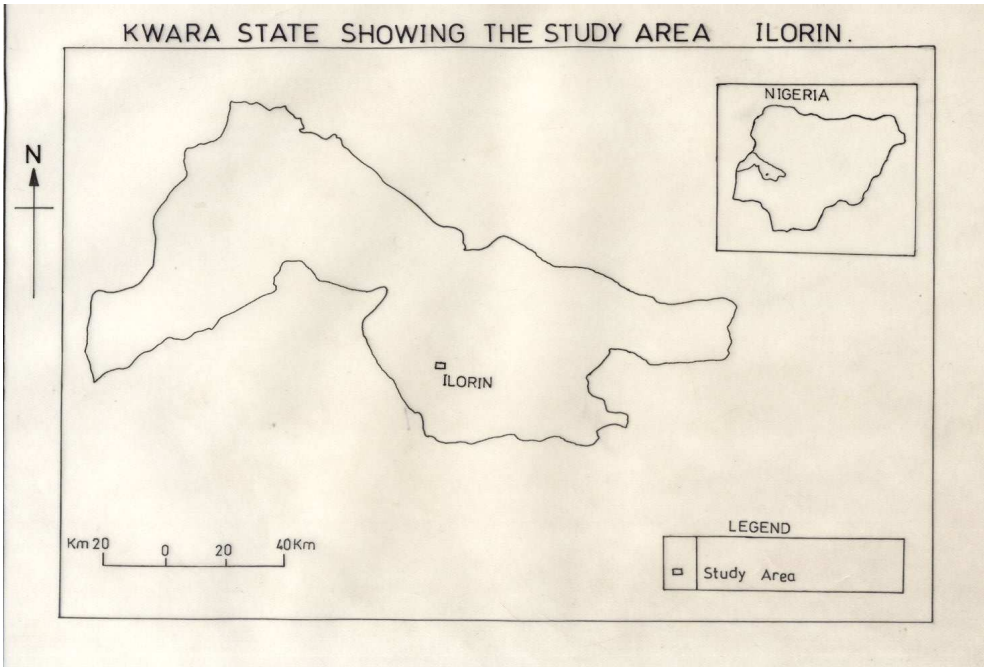

Fig. 1: Map of Kwara State, showing Ilorin the study area.
Source: Authors' fieldwork .

ILORIN LAND USE

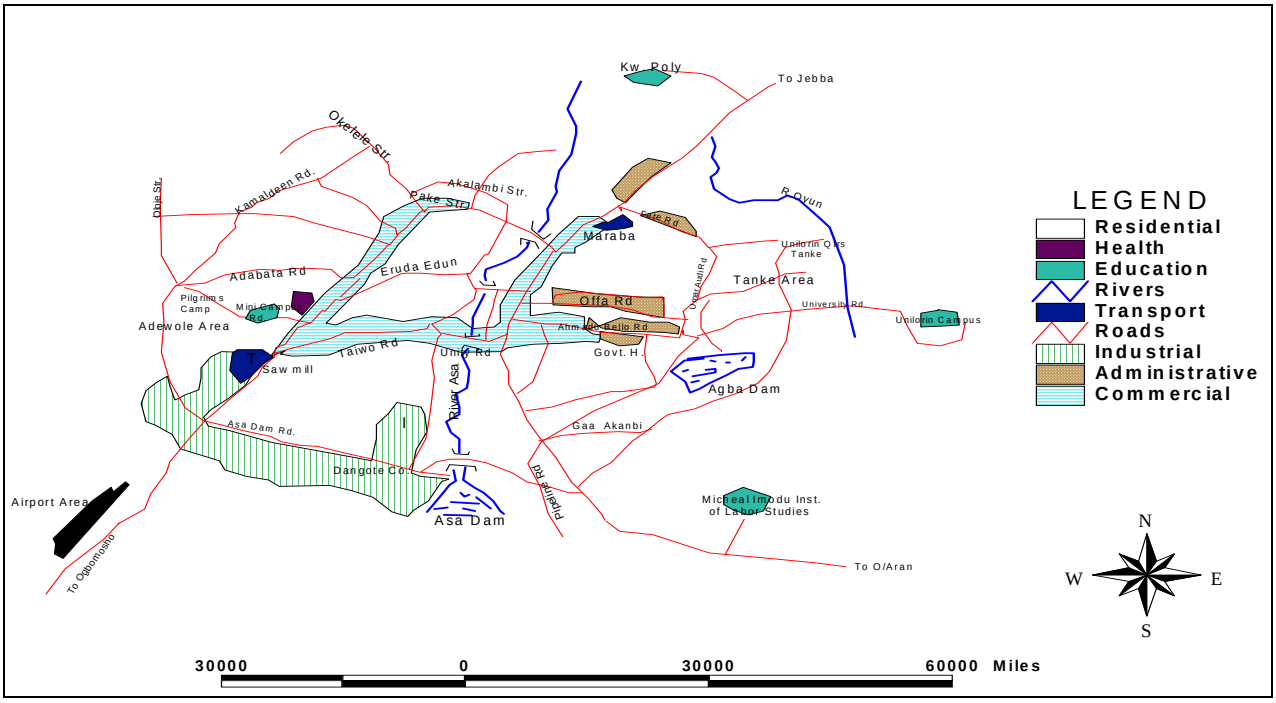

Fig. 2: Most Prevalent Land Uses in Ilorin
Source: Author's fieldwork

Study area

Ilorin is located on latitude $8^0$30'N and Longitude $4^0$35'E with an area of about 100km^2 (Kwara State Diary 1997). The city is situated in the transitional zone between the forest and savanna region of Nigeria (figure 1). The geology

of Ilorin consists of Pre-Cambrian basement complex with an elevation that varies from 273m to 333m in the West having an isolated hill (Sobi hills) of about 394m above sea level and 200m to 364m in the East. Oyegun, 1983 further asserted that a large part of Ilorin town is laid by sedimentary rock, which contains both primary and secondary laterites and alluvial deposits. The major river in Ilorin is Asa, which flows North-South direction dividing the plain into two, Western and Eastern parts. The eastern part is generally steeper than the western part with height ranging from 900 – 1200 feet in some part and peaking at isolated landforms.

The climate of Ilorin is humid tropical type and it is characterised by wet and dry seasons. The wet seasons of Ilorin begins towards the end of March when tropical air mass is prevalent and ends in October. Dry season in the town begins with the onset of tropical continental air mass. This is a type of dusty wind, which carries no moisture commonly referred to as harmattan. This wind is usually predominant between the months of November and February with the mean annual total rainfall at 1,200 mm. The vegetation of Ilorin is characterized by scattered tall tress shrubs, of between the height of 10 and 12 feet. Some of the notable trees include butter trees, Acacia, Locust beans, Baobab, Akee-apple, etc. The city is covered mainly by ferruginous soil on crystalline acidic rock. The most prevalent land use classes are: Residential, Administrative, Institutions (Health & Educational), Commercial (Stores/Services & Markets), Transportation (Motor park), Industrial (Manufacturing/Workshop) as shown in figure 2.

As Ilorin city grew over time, particularly after it gained the status of a state, social-economic activities and physical development doubled, and thus affected inflow of people. This population and social-economic activities increase resulted into daily increase in waste generated by the dwellers. Hence, of the intervention strategy of the state government was the establishment of government agencies backed by legislation to take up the challenges of waste management in the state. Amongst the numerous agencies set up by the government to tackle waste management problems is Kwara Waste and Environment Protection Agency (KWEPA) under the Ministry of Environment and Tourism. KWEPA met an untimely death due to fund restriction, government policies continuity, and un-professionalism in her operations. Despite all these, the site of heaps of waste in the city became unbearable especially in the neighborhood of commercial areas such as open markets, and motor garages. In a bit to maintain the scenic view, and sanitation of the environment, another agency was established by the present democratic government named Kwara Waste Management Company (KWMC) still under the Ministry of Environment and Tourism. KWMC was established in August 18th 2003, given legal backing and empowered with the Environmental Sanitation Law and Offences, No 5.

The company is saddled with the following responsibilities:

1. The cleaning and maintenance of the streets.
2. The collection and disposal of Waste.
3. Maintenance of all Waste dump sites.
4. Planting and maintenance of flowers in the state (Gardening).

Some of the equipments used by KWMC are Trailer trucks 10 (Plate 2), 6 Dyno trucks (Plate 1), 108 Ro-Ro bins (waste containers as shown in Plate 1), shovels, brooms, among others. A total of 28 routes were designed by KWMC for the purpose of efficient waste management in the city.

Plate 1: Dyno Truck lifting a Ro-Ro bin.

Plate 2: Trailer Truck loading waste around the commercial center
Source: Authors' fieldwork.

Ilorin Waste Composition Quantity at a Glance

Table 2: Waste composition range in Ilorin.

Refuse type	Frequency Percentage (%)
Food remnant, and leaves/vegetables	62
Cotton cloth/rags	5
Plastics/nylons	27
Metal scraps (tin etc)	13
Paper	50
Glass/bottles	8
Dust	21
Ink pad	5
Writing pen/packages	17
Needle & syringe	5
Bandages	3
Body fluids	0
Used chemicals	10
Discarded medicine	2
Swabs	2
Used spare parts	5
Packaging materials	8
Wood	7
Total	**250**

Source: Authors' fieldwork .
From Table 2, Solid waste generation per capita per day is put at 0.48 kg. This was done by using result analysis from questionnaires, carrying capacity of the vehicles, and Ro-Ro bin containers. Food remnants, which are highly biodegradable, have the highest quantity in refuse composition, closely followed by paper waste. According to a research monitored on the internet, food remnants take between one to two weeks to degenerate, while paper waste takes 10-30 days to degenerate (http://edugreen.teri.org). Nylon materials, writing packages, and metal scraps, which all take years to degenerate, alongside used chemicals, bottles, and wood also compete in quantity, size, and refuse composition. Evidently, it is noted that none sorting or separation of these wastes seems to be of great disadvantage to professionalism and the economy as a whole because, biodegradable has high manure content for farming, while papers can be reused for packaging things bought at the market or for wrapping books. Nylon and used chemical materials can be reused into gums, while metal scraps can be molded to lots of domestic materials like baking pans; but when not sorted or separated from source, degenerating chemical materials tend to keep depreciating the values of all these. Also, these consequently weaken the metal RO-Ro bins since they are not galvanized. In emphasizing the need for recycling, Ajibade (2007) proposed that the indigenous knowledge of waste management should be promoted. He further stressed that the pertinent materials that can easily be traditionally recycled are animal bones, horns and tusk, agricultural waste, food and yard waste, organic waste, ash, and metal waste; adding these are waste generated with possibility of easy reuse.

Generally, the management of solid waste in Ilorin is rated above average, precisely about 55%. This performance is rated based on the comparison of the world standardized management system with what presently obtains in Ilorin.

Beyene (1999), and Harry (1991), observed that satisfactory disposal of solid waste requires a highly integrated and professionally operated system which will include three processes: generation/storage, collection and transportation, and disposal on or in the earth's mantle and disposal at the bottom of the ocean. From the findings made thus far, generation of waste in Ilorin differs from different land uses. However, the storage system from the different land uses have not been well harnessed due to non-uniformity or regulated medium of storage from homes or places being generated from.

Sustainable development and Sustainability Strategies

Modern society gives emphasis to disposal rather than recovery and recycling of solid waste materials. Exponential growth of this waste problem in our affluent, disposal-oriented society now makes it obvious that recycling should be our goal. It is therefore necessary for scientists and technologists to examine all aspects of fabrication and processing techniques to facilitate the reuse of materials in the environment. Sustainable solid wastes management adopts processing techniques to recover usable materials and prepare such materials for converting products or energy. The techniques include compaction, thermal volume reduction and manual preparation of waste components. Treatment and recycling plants such as bailing, shedding, milling and crushing to handle variety of wastes. These machines reduce large volume of waste and turn them into relatively homogenous products with resemblance to the original wastes material. In recent years the problem posed by solid waste mismanagement in urban cities appeared intractable. Through a combination of initiatives, the solid waste problems are tackled with a view to provide lasting solution to it and in so doing yield more immediate and tangible poverty reduction outcomes for sustainable environment.

MATERIALS AND METHODS

The need for various data on waste for the purpose of detail analysis in this research cannot be overemphasized. Amongst the numerous data sourced are types and sources of waste generated in Ilorin, methods of storing waste, types and sizes of containers used in storing waste, ways and types of treatment embarked upon, types of insecticides or disinfectants, and legislations on storage and treatment of waste in Ilorin. Consequent upon these, the data were sourced primarily and secondarily. The methods of the primary source include observation by the researcher, interviews and administration of questionnaires; while the secondary sources includes government/KWMC archives, internet facilities and journals. In addition, these data were analyzed with the descriptive statistics for the purpose of analysis, presentation, decision making, and generalization. Above all, the land use system was adopted for the purpose of gathering relevant data and information. The most recent prevalent land use system was used while houses, shops, offices, hospitals, and schools were selected at random for interviews and administration of questionnaires. 250 questionnaires were randomly distributed to the land use areas considering the population strength and activities in each of them as presented in tables 1& 2 contains waste composition quantity at a glance in Ilorin.

Table 1: Questionnaire Distribution and Interview Respondents per Land Use

Land use types		No of questionnaires (%)	No of interview respondents
Residential		75%	10
Administrative		25%	5
Institution	Health	25%	5
	Education	50%	7
Commercial	Stores /Services	25%	5
	Markets	25%	5
Transportation		15%	3
Industrial (Manufacturing/Workshop)		10%	2
Total		**250%**	**42**

Source: Authors' fieldwork.

RESULTS AND DISCUSSION

The gender variation of the respondents are as follows; sixty-five percent (65%) are females, while thirty-five (35%) are males. In addition to this gender differences, eighty-five percent (85%) are adults of an age range between thirty to fifty (30-50) years of age; while the other fifteen percent (15%) are between the ages of eighteen to thirty (18-30)

years of age. The ratio of the literacy of the respondents is 55% (learned) to 45% (unlearned). A major percentage of the unlearned resides in traditional residential, and market areas.

Storage Pattern of Waste on each Land Use

1) Residential

In the residential land use, food remnants, which are biodegradable rates higher amongst all other waste type generated. Others include, leaves/vegetables, nylon materials, cotton cloth/rags, and little or plastic materials.

Information from the entire respondents shows that they do not engage in sorting. They claimed they never heard about it and do not know if anything of such exist, although this happens to be the same response in most developing countries. Investigations further reveal that there is no uniformity in waste containers used for storage prior to disposal. The different types of containers used include plastic waste containers (about $0.4m^3$), waste bags and old/used buckets and are mostly kept outside the house, while some uses numerous waste baskets usually kept in their kitchens, bathrooms, and bedrooms. All waste disposed are not treated in any form; in this case some claim ignorance of such while others do not see any reason for embarking upon such an exercise.

2) Administrative and Educational institutions

The highest rate of waste generated in the Administrative land use is paper (30%), followed by writing pens and packages (15%) with wooden (7%) and nylon materials (6%) ; Cotton-cloths\rags has the least with (2%).

The entire respondents do not sort waste generated from their establishment or institution. Apart from the fact that they are not aware of sorting, they have paper materials as the largest of waste being generated and the easiest thing that comes to their mind is to burn them. They all responded to have similarity in waste containers because their establishments provided this for them. They all claim that no treatment is given to waste prior to disposal since they rarely generate wastes that are biodegradable.

3) Health institution

The sector seems to be a highly enlightened one, and for that reason, the rate at which waste is being generated differs, with their form of management also showing some degree of difference. One reason for this is that not all medical waste can be disposed off where all other types of waste; are being disposed because, some of them are very contagious and highly infectious. Nevertheless, results obtained from the questionnaires shows that Needle and syringes has the highest percentage of 5%, paper, bandages, nylon materials and used chemicals following closely with 3% each, while food remnants, discarded medicine, swabs, and writing materials have the least with 2% each.
Investigation reveals that, there is an appreciable level of sorting, and this can be attributed to the fact that, the health institutions are conscious of the negative impact of waste generated, and disposed into their immediate environment. For example, body fluids and some used hazardous chemicals are being separated from other waste. Their waste containers are the same, featuring mainly plastic waste baskets and bigger containers of sizes between $0.4m^3$ – $<1m^3$ while there is no form of treatment accorded waste generated.

4) Commercial (market) institution

Waste composition in the market areas in Ilorin has dust particles as the highest with 7%, nylon\plastics as 5%, closely followed by packaging materials, leaves\vegetables, glass\bottles all sharing 3% each; while food remnants has the lowest percentage at 2.

The total numbers of respondents claim ignorance of sorting waste but store waste generated in different containers and waste bags, while these waste are finally disposed off in the KWMC Ro-Ro bins without any treatment. The frequency of when these wastes are being emptied depends on the obvious need, but all the respondents claim that they experience seasonal floods due to blockage of the drainage along the market areas; this can be traced to indiscriminate dumping of refuse in the drainage.

5) Commercial (Stores & Services)

Store and Services land use has paper materials as the highest in its waste composition, totaling 10%, paper and food remnants with 5%, while metal scrap has 3%, and dust particles has 2%.

Despite the high literacy level of those that occupy this land use, it is sadden to note that there is no form of sorting of refuse that takes place here; although, this can be linked to the fact that there seems to be no public awareness on

waste sorting prior to disposal. Waste storage in these areas is done in different containers, while the final disposal is done personally into the KWMC Ro-Ro bins at interval of days as necessary without treating all waste generated.

6) Transport and Manufacturing\Workshop

In the Industrialized regions, used chemicals with 7% has the highest quantity, while used spare parts and food remnants follows closely with 5% each. Metal scrap and nylon materials shares 3% each; also, dust particles have the least with 2%.

Those in motor garages do not sort their waste except for those in the industries who separate their used chemicals that are highly inflammable from other wastes. Their containers for waste storage vary from different sizes to types, they include large bins ($<1m^3$), and big metallic containers (1 to $40m^3$). Some of the respondents empty their waste into the Ro-Ro bins without any treatment done, while others resolved to burning.

CONCLUSION

This piece of work shows efforts by individuals in storing waste. Although, despite the non-availability of regulations on waste storage in Ilorin, people use containers of various sizes and types. Amongst the most commonly used containers are old buckets, old drums, plastic containers and paper waste baskets. In most places, amount of waste generated exceeds the container types used in storage, which usually leads to the littering of the surroundings with waste, thereby attracting rodents and insects. In some other cases, due to poor aeration of these containers, excessive heat leads to the breeding of organic organisms, both crawling and flying. Apart from these, unbearable fowl odors oozes from them because of long stay, and all forms of chemical and biological reaction that have taken place.

One would have expected that a very good way to remedy all these is to apply some form of insecticides or micro/bacteria/fungus organisms disinfectant, but it is shocking to note that, it is far from being so; also, it is pathetic to note that except for the hospital areas, no form of sorting or waste separation is being embarked upon. In every other place apart from the health institution, they claim ignorance of waste sorting. The reason given why they embark upon such in the health institution areas is that if they do not separate the waste before storing, most of them with different chemical constituents will react to one another in the storage containers. Based on these therefore, it is recommended that there should be legislations on the types of waste containers to be used in Ilorin. These uniformly produced containers should be designed to cater for reduction in insects breeding. Also, awareness should be created on the importance of treating waste during storage, while disinfectants should be made readily available at cheaper rates to members of the public. In the same vein, awareness should also be created on the need for sorting or separation of waste while attempting to store. In a related development, Ajibade (2000) also suggested eleven practical techniques that are useful in creating environmental awareness among Nigerian people. Some of these include:-

- Legislation
- Training programme
- Indigenous education
- Discussions
- Environmental education and lots more.

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