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ENVIRONMENTAL IMPACT ASSESSMENT: A CASE STUDY OF WASTE MANAGEMENT PRACTICE IN LOKOJA

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ABSTRACT

In Lokoja, waste is collected and dumped in the Crutcher-Felele Dumpsite, which is at close proximity (less than 1 km) to the Federal University Lokoja (FUL) permanent site. Lokoja is rapidly urbanising and its growing population has led to an increase in waste generation. A preliminary Environmental Impact Assessment (EIA) study was done, using reconnaissance survey, to better inform the implementation of a waste management project. During the survey, the study area was observed and a record of its features surroundings such as wind, precipitation, temperature, and humidity was made. These parameters formed the foundation for the baseline description and the evaluation of the expected impacts. The important preliminary result indicates that the prevailing wind at the dumping site is south-westerly. This indicates that if the CO_2 emanating from the proposed incinerator is well directed, then rapid vertical mixing will take place, causing pollutant dispersal and ultimately increases air quality around the dumping site.

Keywords: *Environmental assessment, Waste management, Incineration, Meteorology, Lokoja*

1.0 INTRODUCTION

Environmental impact assessment (EIA) is the evaluation of the effects likely to arise from projects significantly affecting the environment and a systematic process for considering the possible impacts prior to a decision being taken on whether or not a proposal should be given the approval to proceed (Noble, 2015). The main aim is to inform the process of decision making and to reduce the burden of environmental impacts and allows for sustainable development.

At present, all developed countries have environmental laws based on EIA whereas most of the developing countries often view EIA as a bureaucratic stumbling block which impedes development, hence the slowness in accepting and implementing it (Abaza, 2000). However, efforts have been made to institutionalise EIA initiatives in Africa. Such efforts are the result of a number of recent initiatives,

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including the 1995 African Ministerial Conference on Environment and the work of the Pan-African Initiative for Capacity Development and Linkage for EIA in Africa (Li, 2015, Kolhoff et. al., 2018). The need for EIAs has become increasingly important and is now a statutory requirement in many developing countries. EIA is particularly important in the implementation of integrated waste management (IWM) facilities. An IWM system tries to accommodate the waste management needs of a city or a region through a specific mix of available waste management options (Seadon, 2006).

With increasing population and urbanisation, waste management has become the major challenge worldwide. Waste management is the activity dealing with waste from the collection, after generation, to transportation and through to disposal. Humans have always produced waste and disposed of it in some ways, so waste management is not a new issue, what has changed are the types and amount of waste produced, the methods of disposal and the human values and perceptions of what should be done with it. Proper waste management can be costly in terms of time and resources and so it is important to understand what options exist for managing waste in an effective and sustainable manner.

The original aim of regulating waste disposal has been to reduce the introduction of polluting substances into the environment since the protection of the environment has been a major challenge facing developing countries. In waste management, as with other environmental concerns, clear lines do not always exist between the good and the bad for the environment and human health. Because waste management decisions are made within the context of society. Lokoja is an urbanising village, in a national context, and with that, its population is rapidly increasing. Population growth has led to an increase in the amount of waste generated due to a surge in affluence which is normally associated with urbanisation. One of such is the recent establishment of higher learning (Federal University of Lokoja (FUL)). In Lokoja, waste is collected and dumped in the Crutcher-Felele Dumpsite, which is in close proximity (less than 1 km) to the FUL permanent site. Lokoja is rapidly urbanising and its growing population has led to an increase in waste generation. Nevertheless, the Lokoja waste management scheme still remains the same; a land filled dumping site. There is a need for a modified and improved waste management to keep up with these changes, hence the proposal to install an incinerator at the Crutcher-Felele dumping site in Lokoja.

However, waste dumping is not an indefinite solution, especially considering the growing rate of Lokoja and the site close proximity to the FUL main site. This poses a possible outbreak of epidemics at the FUL permanent site in the nearest future. The use of the incinerator plant has been identified as one of the sustainable ways to better manage the waste. An

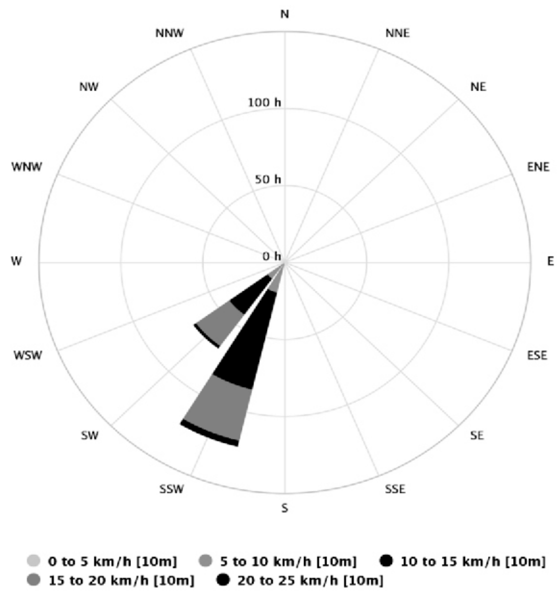

Figure 3: Combined monthly wind rose for the year 2014 – 2016 over Lokoja.

The wind rose for Lokoja shows the number of hours per year the wind blows from the indicated direction. It is apparent that the wind is blowing westerly - a strong west-wind characteristic indicates that crossings from East to West will be nearly impossible. The green shaded portions in Figure 4 provide information regarding the frequency of occurrence of wind speed and direction categories.

The wind direction at a given time determines the general area into which a mass of gas or a cloud of particles will move. Again, Figure 4 shows the average number of days within a month Lokoja can be expected to reach certain wind speeds. As can be seen, the Monsoons (seasonal variation of atmospheric circulation and precipitation associated with the asymmetric heating of land and sea) create steady strong winds from December to April, but calm winds can be seen from June to October. The wind speed closely specifies how rapidly any contaminant will advance into that area. In rough terrain, it cannot be assumed that the wind direction and speed near the source govern the subsequent motion of the contaminant. The mixing caused by the natural turbulence of the wind flow is the only significant agent in atmospheric diffusion (Wang and Wang, 2014). When the wind is very turbulent, diffusion is rapid, in such conditions, the plume of smoke from a stack diffuses so rapidly that it can no longer be seen a short distance downwind. Though the study area is generally characterised by an orographic terrain, the direction and speed of the wind of the area suggest that there will be sufficient dilution and dispersal of the pollutants to maintain good air quality.

3.2 PRECIPITATION ASSESSMENT

In Lokoja, most of the rain falls from June to September; which is the wettest months. This corroborates the study by (Omogbai, 2010). According to Omogbai (2010), Precipitation in Nigeria is highly characterised by geographical variations and eco-climatic conditions. In the southern part of the country depicted known as Humid rain forest, the seasons could be classified as March, April, May (MAM), April, May, June (AMJ) and June, July, August, September (JJAS) while the Sahel (Northern part) region has one rainfall season June, July, August, September (JJAS).

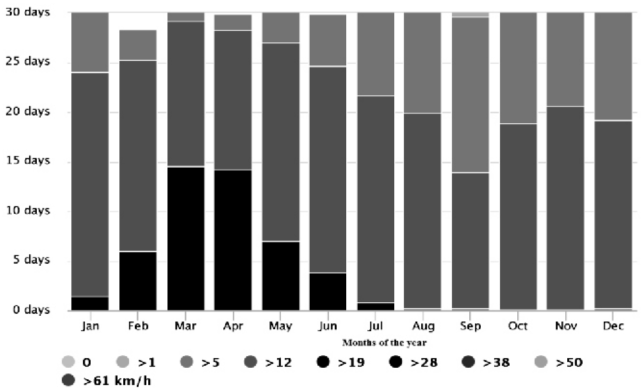

Figure 4: Combined monthly wind speed for the year 2014 – 2016 over Lokoja.

So, the climate of the region under study (derived savannah) is partly influenced by climates in the northernmost and southernmost regions of Nigeria. Lokoja experiences thunderstorms and heavy downpours of rain during this time while the rest of the year receives little or no rainfall. Precipitation washout is one of the major mechanisms for the removal of pollutants in the air. In general, the amount of the air pollutant reduction of precipitation effect can be affected by the amount, duration and intensity of the rainfall. The type of rainfall that characterises the study area shows average precipitation to be 20 mm as presented in Figure 5. This will aid in removing the pollutants through wet deposition, especially during the rainfall.

Similarly, humidity also plays an important role in many thermal and photochemical reactions in the atmosphere. Humidity as shown in Figure 5, is a function of temperature and precipitation and is observed to be lowered (50%) during the wet season when precipitation is at highest. As water molecules are small and highly polar, they can bind strongly to many substances. If the water molecules attach to corrosive gases, the gases will dissolve in the water and form an acid solution which is deposited through wet deposition increasing air quality (Jacobson and Kaufman, 2006).

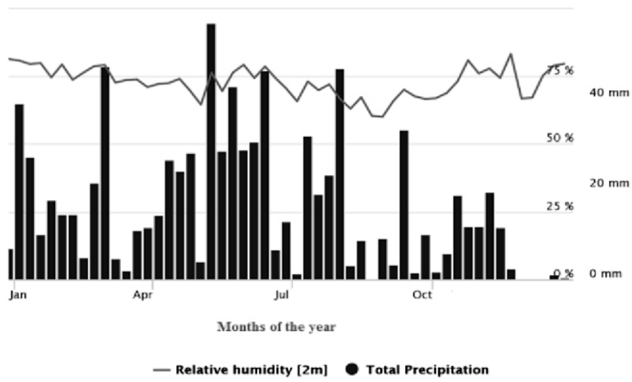

Figure 5: Seasonal precipitation distribution and humidity for the year 2014 – 2016 period. The thick purple line is relative humidity and blue histogram is total precipitation.

3.3 TEMPERATURE ASSESSMENT

The ease with which pollutants can disperse vertically in the atmosphere is largely determined by the rate of change of air temperature with altitude; stability. The vertical stability of the atmosphere is an important factor that helps determine the ability of the atmosphere to dilute emissions. For some temperature profiles as presented in Figure 6, we observed that the air is stable at 2m, that is, air at a given altitude has physical forces acting on it that make it want to remain at that elevation. A comparison with Figure 5 shows clearly that both factors (temperature and precipitation) that determine relative humidity peaks during the wet season (June

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to September) and low during the dry season. Such stability of airflow discourages the dispersion and dilution of pollutants. This means that if the CO2 is well directed, then rapid vertical mixing will take place, causing pollutant dispersal and ultimately increases air quality.

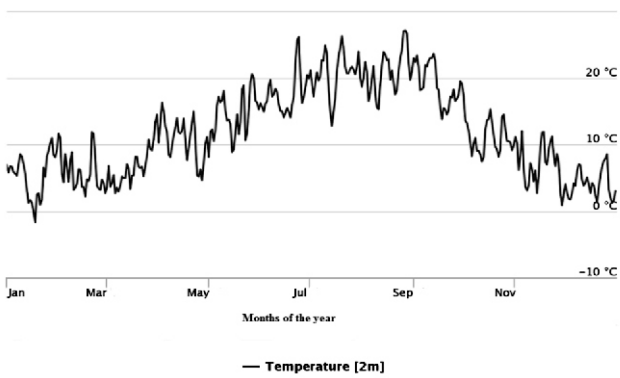

Figure 6: Lokoja average temperature (2014 - 2016).

As the ground heats during the day, the air becomes more turbulent especially in the middle of the day. Air turbulence causes polluted air to disperse as it moves away from its source. The Harmattan (hot season) in Nigeria is characterized by the presence of a pronounced atmospheric inversion layer, which combined with a regional high-pressure system, can trap the pollutants in the lower atmosphere. This usually results in reduced dispersion and a poorer ambient air quality during the Harmattan period and so atmospheric conditions in the Harmattan months are highly unfavorable for the dispersion of atmospheric pollutants. In contrast, the wet season is characterized by an unstable atmosphere which results in the mixing of the atmosphere and rapid dispersion of pollutants.

Up till now, the guidelines on the Atmospheric Pollution (Prevention) in Lokoja is poorly enforced. Persons wishing to carry out an industrial process causing or capable of the emission into the atmosphere of objectionable matter (smoke, noxious or offensive gases, vapors, fumes, grit, and dust) are not adequately regulated. The Ambient air quality-Limits for common pollutants based on the European Union (EU) standards (Directive 2008/98/EC) specify limit values for common air pollutants to ensure that negative impacts of such pollutants on human health and the environment are prevented or reduced. Limit value is defined as the level fixed on the basis of scientific knowledge, with the aim of avoiding, preventing or reducing harmful effects on humans. Table 1 shows the limits for common pollutants as common to Lokoja environs. The pollutants of concern for the waste incineration project are SO_2 and NO_2 and their respective measured amounts from the proposed incinerator (as per EU standards) are shown in Table 2.

From the experiments and measurements that were done on the proposed incinerator (Table 3 shows the proposed incinerator specifications), it was observed that the incinerator has potential to emit 2,4 pg/rn^3 of $S0^2$ and 60 pg/m^3 of NO2 on a half hour average. For better comparison, these values were calculated on an hourly average, according to the EU standards and the values are 4.8 pg / m^3 and 120 pg /m^3 respectively. These values are below the specified standards and so air pollution will not be a problem.

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Table 1: Limit values for common air pollutant (as per EU standards).

ınt	Limit Value	Average	P
ır	350 pg/m^3	1 Hour	24
en e (NO_2)	200 pg/m^3	1 Hour	18

Table 2: Average emissions. EU standards on basic incinerators (with secondary chamber).

·ter	Limits (0.5 on hourly average)	Measured
ır Dioxide	200 pg I m^3	2.4 pg I m^3
,en Dioxide	400 pg / m^3	60 pg / m^3

Table 3: Summary of the incinerator specifications (Technical Specifications)

Fuel	Oil or Gas
Chamber Capacity	1.35 m^3
Burn rate	Up to 150kg per hour
Average Ash Residue	100 mg / m^3
Average Fuel Consumption	14 liters per hour
Length (mm)	2550
Width (mm)	1100
Height incl. Flue (mm)	4190
Weight (kg)	3500

Table 4: Modeled operational requirement for the proposed Incinerator

Minimum Operating Temperature	950 °C
Maximum Operating Temperature	1320 °C
Residency Time in Secondary	2 seconds
Temperature Monitoring	YES

Incineration results in the production of ash from the waste combustion process. Although the exhaustive work is underway, the preliminary experiments carried out on the incinerator model yielded an average ash residue of 100 mg/m3. This amount is very low and so the amount of ash produced will be manageable. The external dimensions (Length, Width, Height, and Weight) of the incinerator were used to calculate the ideal stack height for the incinerator given the prevailing climatic conditions of the study area. The proposed project will likely cause air pollution, considering the modeled operational requirements as presented in Table 4. From the table, it is evident that the incinerator specifications meet the set standards. This means that the best practicable means for pollution control will be applied and the possible negative effects will be prevented or reduced.

An ideal location for the incinerator was found by considering the existing structures in and outside of the Crutcher-Felele dumping site. One of such important structure is the FUL main campus. After considering the physical and environmental set up of the study area, this EIA study suggested that the incinerator be located in the north-western side of the Crutcher-Felele dumpsite. The following factors were considered; the location is at the furthest possible place from the entrance, the main FUL campus is directly adjacent to the study area. Another factor was that the location is in the windward direction, implying that gaseous emissions would be directed away from most of the human activities and would prohibit the transport of the emissions towards the residential areas and FUL main campus. The reconnaissance survey was able to generate an EMP for the incinerator to be placed within the Crutcher-Felele dumping site in Lokoja. It is worth mentioning that this study contributed to the consideration process of the incineration proposal by the Tertiary Trust Fund (Tertfund), University of Lokoja. However, it is recommended that future studies undertake comprehensive testing and examination of the parameters expected to be significantly affected by the proposed project. Due to time and resource limitations, these were not carried out in this study. Another recommendation is that public participation should not be overlooked in the environmental impact assessment process. In issues of waste management, public participation is crucial because waste management is influenced by social and personal behavior and culture is also a major factor in any aspect of its practices and innovations.

4. SUMMARY

In order to manage waste in Lokoja, we have proposed to set up a waste incinerator. The proposed site for the incinerator is within the existing Lokoja council dumpsite (Crutcher-Felele) which is in proximity to FUL main (permanent) campus and hence not the ideal location for the indiscriminate refuse to dump and to burn. This reconnaissance study was to address the potential environmental impacts that could arise from the implementation of this project.

Preliminary wind assessment shows that the prevailing wind around the site is observed south-westerly. Nevertheless, continuous monitoring of the stack emissions and ambient air quality is required during operation. Therefore a proper environmental friendly design for the incineration waste treatment facility can greatly reduce the negative environmental impacts and meet the main objective of managing the waste.
Temperature and precipitation, which determine relative humidity peak during the wet season (June to September) from the year 2014 to 2016 and low during the dry season for the same period. Such stability of airflow discourages the dispersion and dilution of pollutants. This means that if the CO2 emanating from the incinerator is well directed, then rapid vertical mixing will take place causing pollutant dispersal and ultimately increases air quality around the dumping site.

This assessment will provide the solution of the main concern during the operational phase, which is the emission of pollutants into the atmosphere. Another concern is the emission of a noxious odor. This can be controlled, however, by equipping the incinerator with macro-particles and active carbon filter as odor control measures.

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