MAYFEB Journal of Civil Engineering
Vol 1 (2017) - Pages 15-24

Modeling trace gas pollution from Ebute-Ikorodu abattoir dumpsite, Nigeria using Integrated Waste Management (IWM) tool

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Abstract - **Animal wastes are valuable resources as fertilizer and suitable to be applied to crops and pastures. Excess application of animal wastes to crops and pastures can result in an enhanced emission of greenhouse gases to the atmosphere resulting in global warming and destruction of the ozone layer. Monitoring gas pollution for attenuation in a period of economic recession ensures a healthy living and indirectly conserves funds for residents. This paper focuses on detecting the amount of trace gas emission from Ebute Ikorodu abattoir, Nigeria analyzing and modeling the data obtained with Integrated Waste Management (IWM) tool, with a view to mitigating air pollution emanating from the study area.**

The method of study include field work which involves taking sample at different section of Ebute Ikorodu abattoir where they dump animal faeces, horns and remains to detect the emission of NH_3, CO_2, CO and CH_4. Quantities of emission of trace gas were collected in the morning, afternoon and evening for a week using Toxi RAE Pro gas monitors. Data obtained for this five days were fed into IWM software for analysis and simulation of the full components of the waste. The pollution levels of the wastes were determined, thereby providing baseline data for their abatement.

The result obtained shows that CO_2 was in abundance due to the high population and burning of bones, horns and hooves in that environment. Also CH_4 which was not detected by the monitor was present in small qualities during simulation because methane is emitted during anaerobic decomposition of manure. NH_3, and CO concentrations were noted to range alternately between 1 and 5 ppm. Findings also show that the emission of gases from the animal waste increases with increasing temperature and the waste volume.

It is thus concluded that CO_2 emission from Ebute Ikorodu abattoir, Nigeria is immense and can easily contribute to global warming, NH_3, and CO not constituting environmental nuisance while CH_4 is in negligible quantity. It is recommended that planting of trees should be encouraged in the study area while de-emphasizing open air burning of animal products and fossil fuel.

Keywords: **Pollution, Trace gas, Integrated Waste Management, Abattoir dumpsite**

I. INTRODUCTION

Waste products are valuable resources as fertilizer and suitable to be applied to crops and pastures. However, when concentrated into relatively small geographical area or applied in excessive amounts, waste can have detrimental environmental effects. This can result in enhanced CO_2, CH_4 and N_2O emission to the atmosphere influencing global warming and destruction of the ozone layer [1]. Our atmosphere is made up of nitrogen and oxygen, in a respective volume of 78 and 21%. The remaining 1%, or less, of the atmospheric gases is known as trace gases. They are usually so referred as they are present in small concentrations. The most common one is noble gas argon; others include carbon dioxide, methane, nitrogen oxides, ozone, and water vapor. Several are chemically reactive factors of air quality at a regional level, and others are important greenhouse gases [2]. These gases have long atmospheric lifetimes, are consequently fairly well mixed and therefore of global as well as local or regional importance. They represent a most serious threat to global climate in terms of greenhouse effect and their overall radioactive forcing from pre-industrial time to date were estimated at 1.85, 0.15 and 0.12 Wm^{-2} respectively . Anthropogenic sources account for 70% of the total annual release of CH_4, 16% of which coming from production of waste [3]. Soil microbial processes account for 65% of the total N_2O source strength (5 to 5 Tg $year^{-1}$).

Abattoirs, or slaughterhouses are a major source of water and air pollution worldwide [4]. Animal wastes include livestock and poultry manure, bedding and litter, plus such things as dairy parlor waste water, feedlot runoff, silage juices from trench silos and even wasted feed. These wastes can affect water quality if proper practices are not followed. These protective practices are very often referred to as Best Management Practices (BMPs) and include facilities or structures, management practices or vegetative cover. Animal wastes should be considered a valuable resource which, when managed properly, can reduce the need for commercial fertilizer. Such waste can add organic matter which improves water holding capacity and improves soil tilt. Animal wastes can provide an economical source of nitrogen, phosphorus and potassium as well as other nutrients needed for plant growth. Waste from animal concentrations and/or manure storage areas which are not protected can wash into streams. Such overland flow of animal waste is commonly referred to as a Non-Point Source (NPS) since the waste does not enter the streams from a point source or pipe. Such wastes in surface waters reduce oxygen in water and endanger aquatic life. The added nutrients produce excessive algae growth causing unpleasant taste and odors. Likewise, when this waste is allowed to seep into ground water the water quality is jeopardized. Nitrates in well water can be particularly dangerous to infants due to oxygen depletion in the blood.

In agriculture, the three main greenhouse gases (GHG) of concern include methane (CH_4), nitrous oxide (N_2O), and carbon dioxide (CO_2). GHGs impact the earth through their ability to trap heat, which depends on their capacity to absorb and re-emit radiation and on how long the GHG remains in the atmosphere. Most scientists agree that increasing levels of GHGs are caused by fossil fuel combustion, land use changes, and agricultural and industrial activities all of which contribute to climactic changes in temperature and precipitation patterns, which could impact agricultural production. Primarily, agricultural sources of GHGs originate from livestock and fertilizer sectors. According to the 2001 GHG Emissions Inventory for Alberta Agriculture, methane emissions from manure accounts for 9% and livestock methane emissions are approximately 28% of the total GHG emissions in Alberta [5].

During anaerobic decomposition of manure, methane is emitted. The amount of methane produced from manure depends on: the amount of manure, which depends on the number of animals, the amount of feed consumed, and the digestibility of the feed, animal type, the condition of the digestive tract, and the quality of the feed consumed, the manure handling method (liquid versus solid storage). Liquid manure management systems, such as ponds, lagoons, and holding tanks lead to anaerobic conditions, which can emit up to 80 percent of manure based methane emissions, while solid manure emits little or no methane, and, environmental conditions (temperature and moisture).

The general management practices for mitigation of methane emissions from manure are by avoiding addition of straw to manure because straw acts as a food source for anaerobic bacteria, resulting in higher methane emissions; applying manure to soil as soon as possible because storing manure for long periods can encourage anaerobic decomposition and result in increased methane emissions; avoidance of manure application when the soil is extremely wet, as this leads to anaerobic conditions and increased methane emissions.

Ammonia (NH_3) is a common by-product of animal waste due to the often inefficient conversion of feed nitrogen into animal product. Livestock and poultry are often fed high-protein feed, which contains surplus nitrogen, to ensure that the animals' nutritional requirements are met. Nitrogen that is not metabolized into animal protein (i.e. milk, meat, or eggs) is excreted in the urine and feces of livestock and poultry where further microbial action releases ammonia into the air during manure decomposition. NH_3 is a corrosive, colorless gas with a very distinct odor. In the United State the largest ammonia emission sources is livestock operations for production of milk, meat and eggs [6]. Ammonia gas volatilization from animal houses not only impairs the manure value as fertilizer due to N loss. But also causes considerable environmental and health concerns. Various studies have shown that the high ammonia concentration can cause the following consequences: Ammonia can also be directly absorbed by vegetation surface [7]. The introduction of nitrogen surplus to ecosystems might disturb the ecosystem and change biodiversity. The possible adverse effects of ammonia on plants such as foliar injury, growth and productivity alterations, and change in responses to insect pests and pathogens may reshape the biodiversity of the entire ecosystem [8].

Ammonia gas itself is not a greenhouse gas, but it participates in nitrous oxide (N_2O) generation during oxidization to nitrite [9]. Also, ammonia gas reduces air quality by the formation of particulate matter of diameter 2.5 or less Ammonia gas formation and volatilization from animal houses depends on several factors related to animals (e.g. diet and animal activity), animal wastes (e.g. moisture content, pH, temperature, and surface area, environment (e.g. indoor and outdoor temperature, ventilation flow, and air velocity over the manure surface), and other site-specific factors like the type of bedding materials [10].

The concentration of livestock in factory farms leads to a buildup of animal waste in the area where these livestock operations reside. The enormous volumes of waste cannot be assimilated by natural processes, and therefore require special treatment. In the majority of case, the systems used to treat animal waste are inadequate. Waste is pumped into open air pits called *"lagoons"*, and from there, liquid manure is sprayed onto fields. The amount of waste applied often exceeds what the crops can take up, leaving the rest to escape into the air or runoff into surface water. Such outdated and improper treatment of animal waste can lead to serious pollution problems. Improper collection and disposal of untreated animal waste can harm underground and human health. Nutrients and bacteria from animal waste can cause fish kills and harm shell fish in contaminated streams, creeks, and estuaries. In addition dangerous and offensive odors and other air pollutants are also emitted, often making life for farm neighbors intolerable. Because antibiotics are routinely used on factory farms (to compensate for unsanitary growing conditions to promote slightly faster livestock growth), they promote the development of antibiotic resistance in bacterial that are present in animals.

This paper has a central aim, which is to model trace gas pollution from Ebute Ikorodu abattoir animal waste dumpsite. The objectives of this research work are to detect the amount of NH_3, CO_2 and CO gas emission from Ebute Ikorodu abattoir animal waste dumpsite using Toxi RAE Pro gas monitors, and to analyze by modeling the data obtained from Toxi RAE Pro gas monitors using Integrated Waste Management (IWM) tool with a view to attenuating air pollution.

II. METHODOLOGY

(a) Description of the study area: Lagos state is situated in the south western corner of Nigeria and spans the Guinea coast of the Atlantic Ocean for over 180 km, from the Republic of Benin on the west to its boundary with Ogun state in the east. It lies approximately between latitudes 6° 25' N and 6° 40' N and longitudes 2° 45' E and 4° 15' E, with a total area of 3577 km^2, out of which approximately 787 km^2 or 22% is covered by water. Generally, it is a zone of coastal creeks and lagoons [11]. Ikorodu is a city and Local Government Area in Lagos State, Nigeria. It is located along the Lagos Lagoon. It shares boundary with Ogun State. Its geographical latitude is 6° 36' 3"N and geographical longitude 3°29'17"E [12].

(b) Waste disposal in the study area: The method of waste disposal adopted in Ikorodu abattoir is open dumping. Open dumps refer to uncovered areas that are used to dump solid wastes of all kinds. It includes indiscriminate refuse dumping into undeveloped plots, river banks, uncompleted buildings, and other unapproved sites. The waste is untreated and uncovered, and therefore habours disease vectors harmful to human.

(c) Field work: This involves measuring the concentration level of NH_3, CO_2 and CO gas at the at the Ebute Ikorodu abattoir dumpsite using a Toxi RAE Pro gas monitors. Sampling was done at different locations of the dumpsite viz: animal faeces dump, animal horns and animal remains to know their level of NH_3, CO_2, CO and CH_4 gas concentration. The coordinates of those locations were noted. The volume of wastes being generated was also estimated. The mode of collecting samples was three times a day (i.e. morning, afternoon and evening) for five days in order to compare the concentration levels of the selected trace gases. The temperatures at collection points were equally noted.

(d) Modeling of the gases: the data obtained from the field was fed into the Integrated Waste Management (IWM) tool developed by the Environment and Plastic Industry Council (EPIC) and Corporations Supporting Recycling (CSR), Canada. It is Environmental Analysis Modeling software. IWM is a tool being employed to determine the most energy efficient, least polluting ways to deal with the various components and items of a community's solid waste stream. The software simulates the data and analyzed the full components of the wastes.

III. RESULTS AND DISCUSSION

(a) The field data

The data obtained from the field work are presented in Tables I to Table XV. The compressed field value results in part per million (ppm) is presented in Table XVI, while compressed field value results in Tonnes is presented in Table XVII. Generally it was observed from the field results that the higher the temperature the more emissions of gas from the animal waste. Again, the more the volume of waste the higher the emissions of trace gas that are released into the atmosphere.

DAY 1

Table 1: Data obtained for Morning

PRODUCTS – BONES, HOOVES AND HORNS

Time	Temp.	Coordinates	NH_3	$C0_2$	C0	CH_4
8:05 am	27^{0}C	Lat. 6^{0}36'	5ppm	400ppm	4ppm	0ppm

		Long. $3^{0}29'$				
8:17 am	$27^{0}C$	Lat. $6^{0}36'$ Long. $3^{0}29'$	3ppm	600ppm	3ppm	0ppm
8:30 am	$27^{0}C$	Lat. $6^{0}36'$ Long. $3^{0}29'$	4ppm	400ppm	4ppm	0ppm
		WASTES-FAECES				
8:40 am	$27^{0}C$	Lat. $6^{0}36'$ Long. $3^{0}29'$	2ppm	400ppm	3ppm	0ppm
8:50 am	$27^{0}C$	Lat. $6^{0}36'$ Long. $3^{0}29'$	3ppm	400ppm	3ppm	0ppm
9:10 am	$27^{0}C$	Lat. $6^{0}36'$ Long. $3^{0}29'$	2ppm	400ppm	3ppm	0ppm

Table II: Data obtained for Afternoon

PRODUCTS – BONES, HOOVES AND HORNS

Time	Temp.	Coordinates	NH_3	$C0_2$	C0	CH_4
1:00 pm	$25^{0}C$	Lat. $6^{0}36'$ Long. $3^{0}29'$	3ppm	400ppm	3ppm	0ppm
1:25 pm	$25^{0}C$	Lat. $6^{0}36'$ Long. $3^{0}29'$	1ppm	300ppm	3ppm	0ppm
1:38 pm	$25^{0}C$	Lat. $6^{0}36'$ Long. $3^{0}29'$	2ppm	300ppm	3ppm	0ppm
		WASTES-FAECES				
1:50 pm	$25^{0}C$	Lat. $6^{0}36'$ Long. $3^{0}29'$	1ppm	300ppm	2ppm	0ppm
2:10 pm	$25^{0}C$	Lat. $6^{0}36'$ Long. $3^{0}29'$	1ppm	300ppm	2ppm	0ppm
2:30pm	$25^{0}C$	Lat. $6^{0}36'$ Long. $3^{0}29'$	1ppm	300ppm	3ppm	0ppm

Table III: Data obtained for Evening

PRODUCTS – BONES, HOOVES AND HORNS

Time	Temp.	Coordinates	NH_3	$C0_2$	C0	CH_4
4:50 pm	$26^{0}C$	Lat. $6^{0}36'$ Long. $3^{0}29'$	2ppm	400ppm	3ppm	0ppm
5:10 pm	$26^{0}C$	Lat. $6^{0}36'$ Long. $3^{0}29'$	4ppm	300ppm	4ppm	0ppm
5: 25 pm	$26^{0}C$	Lat. $6^{0}36'$ Long. $3^{0}29'$	1ppm	300ppm	3ppm	0ppm
		WASTES-FAECES				
5:40 pm	$26^{0}C$	Lat. $6^{0}36'$ Long. $3^{0}29'$	2ppm	300ppm	3ppm	0ppm
6:00 pm	$26^{0}C$	Lat. $6^{0}36'$ Long. $3^{0}29'$	1ppm	300ppm	3ppm	0ppm
6: 15 pm	$26^{0}C$	Lat. $6^{0}36'$ Long. $3^{0}29'$	1ppm	300ppm	3ppm	0ppm

DAY 2

Table IV: Data obtained for Morning

PRODUCTS – BONES, HOOVES AND HORNS

Time	Temp.	Coordinates	NH_3	$C0_2$	C0	CH_4
8: 15 am	$25^{0}C$	Lat. $6^{0}36'$ Long. $3^{0}29'$	4ppm	400ppm	3ppm	0ppm
8: 33 am	$25^{0}C$	Lat. $6^{0}36'$ Long. $3^{0}29'$	3ppm	300ppm	4ppm	0ppm
8: 45 am	$25^{0}C$	Lat. $6^{0}36'$ Long. $3^{0}29'$	1ppm	400ppm	3ppm	0ppm
		WASTES-FAECES				
8: 50 am	$25^{0}C$	Lat. $6^{0}36'$ Long. $3^{0}29'$	2ppm	300ppm	2ppm	0ppm
9:05 am	$25^{0}C$	Lat. $6^{0}36'$ Long. $3^{0}29'$	1ppm	400ppm	2ppm	0ppm
9:20 am	$25^{0}C$	Lat. $6^{0}36'$ Long. $3^{0}29'$	1ppm	400ppm	1ppm	0ppm

Table V: Data obtained for Afternoon

PRODUCTS – BONES, HOOVES AND HORNS

Time	Temp.	Coordinates	NH_3	$C0_2$	C0	CH_4
1:00 pm	25^0C	Lat. $6^0 36'$ Long. $3^0 29'$	3ppm	300ppm	4ppm	0ppm
1:20 pm	25^0C	Lat. $6^0 36'$ Long. $3^0 29'$	3ppm	400ppm	4ppm	0ppm
1:35 pm	25^0C	Lat. $6^0 36'$ Long. $3^0 29'$	3ppm	400ppm	4ppm	0ppm
		WASTES-FAECES				
1:45 pm	25^0C	Lat. $6^0 36'$ Long. $3^0 29'$	1ppm	300ppm	2ppm	0ppm
2:05 pm	25^0C	Lat. $6^0 36'$ Long. $3^0 29'$	1ppm	300ppm	3ppm	0ppm
2:20pm	25^0C	Lat. $6^0 36'$ Long. $3^0 29'$	1ppm	300ppm	3ppm	0ppm

Table VI: Data obtained for Evening

PRODUCTS – BONES, HOOVES AND HORNS

Time	Temp.	Coordinates	NH_3	$C0_2$	C0	CH_4
5:00 pm	24^0C	Lat. $6^0 36'$ Long. $3^0 29'$	2ppm	400ppm	3ppm	0ppm
5:13 pm	24^0C	Lat. $6^0 36'$ Long. $3^0 29'$	1ppm	400ppm	3ppm	0ppm
5: 30 pm	24^0C	Lat. $6^0 36'$ Long. $3^0 29'$	2ppm	400ppm	2ppm	0ppm
		WASTES-FAECES				
5:47 pm	24^0C	Lat. $6^0 36'$ Long. $3^0 29'$	1ppm	300ppm	3ppm	0ppm
6:00 pm	24^0C	Lat. $6^0 36'$ Long. $3^0 29'$	1ppm	300ppm	3ppm	0ppm
6: 15 pm	24^0C	Lat. $6^0 36'$ Long. $3^0 29'$	1ppm	400ppm	4ppm	0ppm

DAY 3

Table VII: Data obtained for Morning

PRODUCTS – BONES, HOOVES AND HORNS.

Time	Temp.	Coordinates	NH_3	$C0_2$	C0	CH_4
8: 00 am	26^0C	Lat. $6^0 36'$ Long. $3^0 29'$	4ppm	500ppm	3ppm	0ppm
8: 20 am	26^0C	Lat. $6^0 36'$ Long. $3^0 29'$	3ppm	600ppm	3ppm	0ppm
8: 35 am	26^0C	Lat. $6^0 36'$ Long. $3^0 29'$	2ppm	300ppm	4ppm	0ppm
		WASTES-FAECES				
8: 50 am	26^0C	Lat. $6^0 36'$ Long. $3^0 29'$	2ppm	400ppm	3ppm	0ppm
9:10 am	26^0C	Lat. $6^0 36'$ Long. $3^0 29'$	2ppm	300ppm	3ppm	0ppm
9:27 am	26^0C	Lat. $6^0 36'$ Long. $3^0 29'$	1ppm	300ppm	3ppm	0ppm

Table VIII: Data obtained for Afternoon

PRODUCTS – BONES, HOOVES AND HORNS

Time	Temp.	Coordinates	NH_3	$C0_2$	C0	CH_4
1:15 pm	27^0C	Lat. $6^0 36'$ Long. $3^0 29'$	5ppm	600ppm	4ppm	0ppm
1:30 pm	27^0C	Lat. $6^0 36'$ Long. $3^0 29'$	4ppm	400ppm	5ppm	0ppm
1:47 pm	27^0C	Lat. $6^0 36'$ Long. $3^0 29'$	3ppm	300ppm	3ppm	0ppm
		WASTES-FAECES				
1:59 pm	27^0C	Lat. $6^0 36'$ Long. $3^0 29'$	2ppm	400ppm	3ppm	0ppm
2:08 pm	27^0C	Lat. $6^0 36'$ Long. $3^0 29'$	2ppm	400ppm	3ppm	0ppm
2:25pm	27^0C	Lat. $6^0 36'$ Long. $3^0 29'$	2ppm	300ppm	3ppm	0ppm

Table IX: Data obtained for Evening

PRODUCTS – BONES, HOOVES AND HORNS.

Time	Temp.	Coordinates	NH_3	$C0_2$	C0	CH_4
4:50 pm	24^0C	Lat. $6^0$36’ Long. $3^0$29’	1ppm	400ppm	3ppm	0ppm
5:12 pm	24^0C	Lat. $6^0$36’ Long. $3^0$29’	3ppm	300ppm	3ppm	0ppm
5: 30 pm	24^0C	Lat. $6^0$36’ Long. $3^0$29’	2ppm	400ppm	3ppm	0ppm
		WASTES-FAECES				
5:45 pm	24^0C	Lat. $6^0$36’ Long. $3^0$29’	1ppm	400ppm	3ppm	0ppm
5:50 pm	24^0C	Lat. $6^0$36’ Long. $3^0$29’	1ppm	300ppm	2ppm	0ppm
6: 10 pm	24^0C	Lat. $6^0$36’ Long. $3^0$29’	1ppm	300ppm	3ppm	0ppm

DAY 4

Table X: Data obtained for Morning

PRODUCTS – BONES, HOOVES AND HORNS.

Time	Temp.	Coordinates	NH_3	$C0_2$	C0	CH_4
8: 00 am	24^0C	Lat. $6^0$36’ Long. $3^0$29’	1ppm	300ppm	3ppm	0ppm
8: 15 am	24^0C	Lat. $6^0$36’ Long. $3^0$29’	2ppm	300ppm	3ppm	0ppm
8: 25 am	24^0C	Lat. $6^0$36’ Long. $3^0$29’	2ppm	400ppm	3ppm	0ppm
		WASTES-FAECES				
8: 35 am	24^0C	Lat. $6^0$36’ Long. $3^0$29’	1ppm	300ppm	2ppm	0ppm
8:50 am	24^0C	Lat. $6^0$36’ Long. $3^0$29’	1ppm	300ppm	2ppm	0ppm
9:10 am	24^0C	Lat. $6^0$36’ Long. $3^0$29’	1ppm	300ppm	3ppm	0ppm

Table XI: Data obtained for Afternoon

PRODUCTS – BONES, HOOVES AND HORNS.

Time	Temp.	Coordinates	NH_3	$C0_2$	C0	CH_4
1:05 pm	26^0C	Lat. $6^0$36’ Long. $3^0$29’	3ppm	500ppm	4ppm	0ppm
1:20 pm	26^0C	Lat. $6^0$36’ Long. $3^0$29’	3ppm	400ppm	4ppm	0ppm
1:30 pm	26^0C	Lat. $6^0$36’ Long. $3^0$29’	3ppm	400ppm	3ppm	0ppm
		WASTES-FAECES				
1:45 pm	26^0C	Lat. $6^0$36’ Long. $3^0$29’	2ppm	300ppm	2ppm	0ppm
2:00 pm	26^0C	Lat. $6^0$36’ Long. $3^0$29’	2ppm	400ppm	2ppm	0ppm
2:10pm	26^0C	Lat. $6^0$36’ Long. $3^0$29’	1ppm	400ppm	1ppm	0ppm

Table XII: Data obtained for Evening

PRODUCTS – BONES, HOOVES AND HORNS.

Time	Temp.	Coordinates	NH_3	$C0_2$	C0	CH_4
5:00 pm	26^0C	Lat. $6^0$36’ Long. $3^0$29’	3ppm	400ppm	2ppm	0ppm
5:15 pm	26^0C	Lat. $6^0$36’ Long. $3^0$29’	3ppm	400ppm	2ppm	0ppm
5: 23 pm	26^0C	Lat. $6^0$36’ Long. $3^0$29’	2ppm	400ppm	3ppm	0ppm
		WASTES-FAECES				
5:30 pm	26^0C	Lat. $6^0$36’ Long. $3^0$29’	1ppm	300ppm	3ppm	0ppm
5:45 pm	26^0C	Lat. $6^0$36’	1ppm	300ppm	3ppm	0ppm

		Long. 3^{0}29’				
6: 05 pm	26^{0}C	Lat. 6^{0}36’ Long. 3^{0}29’	1ppm	300ppm	3ppm	0ppm

DAY 5

Table XIII: Data obtained for Morning

PRODUCTS – BONES, HOOVES AND HORNS.

Time	Temp.	Coordinates	NH_3	$C0_2$	C0	CH_4
8: 10 am	25^{0}C	Lat. 6^{0}36’ Long. 3^{0}29’	1ppm	400ppm	3ppm	0ppm
8: 25 am	25^{0}C	Lat. 6^{0}36’ Long. 3^{0}29’	1ppm	400ppm	3ppm	0ppm
8: 35 am	25^{0}C	Lat. 6^{0}36’ Long. 3^{0}29’	2ppm	300ppm	4ppm	0ppm
		WASTES-FAECES				
8: 40 am	25^{0}C	Lat. 6^{0}36’ Long. 3^{0}29’	1ppm	400ppm	3ppm	0ppm
8:55 am	25^{0}C	Lat. 6^{0}36’ Long. 3^{0}29’	1ppm	400ppm	3ppm	0ppm
9:10 am	25^{0}C	Lat. 6^{0}36’ Long. 3^{0}29’	1ppm	400ppm	3ppm	0ppm

Table XIV: Data obtained for Afternoon

PRODUCTS – BONES, HOOVES AND HORNS.

Time	Temp.	Coordinates	NH_3	$C0_2$	C0	CH_4
1:00 pm	28^{0}C	Lat. 6^{0}36’ Long. 3^{0}29’	4ppm	500ppm	3ppm	0ppm
1:15pm	28^{0}C	Lat. 6^{0}36’ Long. 3^{0}29’	5ppm	400ppm	3ppm	0ppm
1:25 pm	28^{0}C	Lat. 6^{0}36’ Long. 3^{0}29’	3ppm	600ppm	3ppm	0ppm
		WASTES-FAECES				
1:30 pm	28^{0}C	Lat. 6^{0}36’ Long. 3^{0}29’	3ppm	400ppm	3ppm	0ppm
1:45 pm	28^{0}C	Lat. 6^{0}36’ Long. 3^{0}29’	2ppm	300ppm	4ppm	0ppm
2:00pm	28^{0}C	Lat. 6^{0}36’ Long. 3^{0}29’	1ppm	300ppm	3ppm	0ppm

Table XV: Data obtained for Evening

PRODUCTS – BONES, HOOVES AND HORNS.

Time	Temp.	Coordinates	NH_3	$C0_2$	C0	CH_4
5:00 pm	24^{0}C	Lat. 6^{0}36’ Long. 3^{0}29’	2ppm	400ppm	4ppm	0ppm
5:15 pm	24^{0}C	Lat. 6^{0}36’ Long. 3^{0}29’	3ppm	400ppm	4ppm	0ppm
5: 30 pm	24^{0}C	Lat. 6^{0}36’ Long. 3^{0}29’	1ppm	400ppm	3ppm	0ppm
		WASTES-FAECES				
5:35 pm	24^{0}C	Lat. 6^{0}36’ Long. 3^{0}29’	1ppm	300ppm	3ppm	0ppm
5:50 pm	24^{0}C	Lat. 6^{0}36’ Long. 3^{0}29’	1ppm	400ppm	2ppm	0ppm
6: 10 pm	24^{0}C	Lat. 6^{0}36’ Long. 3^{0}29’	2ppm	300ppm	3ppm	0ppm

Table XVI: COMPRESSED FIELD VALUE RESULTS (IN PPM)

Day	NH_3 (ppm)	$C0_2$ (ppm)	C0 (ppm)	CH_4 (ppm)
1.	2.17	383.33	3.06	0
2.	1.78	355.56	2.94	0
3.	2.27	383.33	3.17	0
4.	4.13	455.56	2.67	0

5.	1.94	388.89	3.17	0

Table XVII: COMPRESSED FIELD VALUE RESULTS IN TONS

Day	NH_3 (Tons)	$C0_2$ (Tons)	C0 (Tons)	CH_4 (Tons)
1	0.22	38.33	0.31	0
2	1.18	35.56	0.29	0
3	0.23	38.33	0.32	0
4	0.41	45.56	0.27	0
5	0.19	3.8.89	0.32	0

From Tables I to III where the data obtained for day 1 in the morning, afternoon and evening are presented it is found that the values obtained for NH_3 (5ppm) and CO (4ppm) in the morning were higher than those of the afternoon: NH_3 (3ppm) and CO (3ppm). The values for NH_3 (4ppm) and CO (4ppm) in the evening were higher than those of the afternoon: NH_3 (3ppm) and CO (3ppm) for both products and wastes. Also CO_2 in the morning for both products and waste have higher value than that of the afternoon while the value for CO_2 in the afternoon and evening are constant. For day 2 (Tables IV to VI), the temperature in the morning and afternoon remain constant at 25^{o}C compare to the evening at 24^{o}C. The value for NH_3 and CO_2 in the morning (4ppm) and (400ppm) are higher than that of the afternoon (3ppm) and (400ppm), while values obtained in the evening for NH_3 (2ppm) are lower than that obtained in the afternoon. The value of CO_2 is constant in the morning and afternoon but CO_2 in the evening (400ppm) is slightly higher than that of the afternoon and morning. The result of day 2 field result shows that the point where samples were taken are of different volume of waste which deduced that the higher the volume the more the heat absorb the more the emissions. The results obtained for day 3 (Tables VII to IX) shows that the value of CO_2 in the morning and afternoon are higher, perhaps due to increase in population at the abattoir being a Saturday. While the value of NH_3 obtained in the afternoon is higher than the value obtained in the morning and evening, possibly owing to increase in temperature.

From Table X to XV, it is deduced that the value obtained for CO_2 in the afternoon is higher than both the morning and evening due to increase in temperature, likewise for NH_3. While the value of CO obtained in the afternoon is greater than that of morning and evening but the value in the morning is greater than the evening. This may be attributed to more vehicular movements into or from the abattoir during the morning traffic peak hour that the noon period. However, it was deduced from all the Tables that significant amount of CH_4 was not detected in the wastes. This may be due to the constant presence of oxygen capable of reacting with it to release CO_2 and H_2. It is to be noted that methane is usually being emitted more during anaerobic decomposition of manure. The lower values of CO observed where there were higher CO_2 corroborates an earlier finding of [13] that low CO emission during combustion is an indicator of high CO_2 emission.

It is thus generally noted from the findings that the higher the temperature the more the rate of emission of gas. The more the population at the abattoir the more the CO_2 in the environment, and the more the volume of waste, the higher the rate of gas emissions.

(b) Comparison of simulated output and field results

Tables 18 to 22 show the simulated result from IWM tool and compressed value of field results. From all the Tables, it is observed that the concentration of CO_2 from the field measurement results in the abattoir is higher than the results from the software output. Consequently, it has a significant impact on global warming. Also from all tables, there is absence of CH_4 in the environment from the field results compared to the simulated values from IWM. This shows that the environment is relatively safe from CH_4 effect. The field and modeled values for methane, 0 and 1 respectively indicate a correlation in both outputs. It can also be deduced from all the tables that field value for CO in this environment is very small compare to the simulated value from the software which makes the environment safe from CO_2 equivalent (CO).

TABLE XVIII: COMPARISON OF OUTPUT FOR DAY 1

Gas	Simulated result from IWM (Tonnes)	Field measurement	Comparison
$C0_2$	0	38.33	Since field value is more than the simulated value therefore, the concentration of $C0_2$ in this environment is high
CH_4+$N0_+$	1	0	Due to the absence of CH_4 in the environment as compare to the

			simulated value therefore, the environment is safe from it effects
$C0_2$ equivale (C0)	30	0.31	The field value is very small compare to the simulated value. As such the environment is very safe from $C0_2$ equivalent (C0)

TABLE XIX: COMPARISON OF OUTPUT FOR DAY 2

Gas	Simulated result from IWM (Tones)	Field measurement	Comparison
$C0_2$	0	35.56	Since field value is more than the simulated value therefore, the concentration of $C0_2$ in this environment is high
CH_4+$N0_+$	1	0	Due to the absence of CH_4 in the environment as compare to the simulated value therefore, the environment is safe from it effects.
$C0_2$ equivale (C0)	30	0.29	The field value is very small compare to the simulated value. As such the environment is very safe from $C0_2$ equivalent (C0)

TABLE XX: COMPARISM OF OUTPUT FOR DAY 3

Gas	Simulated result from IWM (Tones)	Field measurement	Comparison
$C0_2$	0	38.33	Since field value is more than the simulated value therefore, the concentration of $C0_2$ in this environment is high
CH_4+$N0_+$	1	0	Due to the absence of CH_4 in the environment as compare to the simulated value therefore, the environment is safe from it effects.
$C0_2$ equivale (C0)	30	0.32	The field value is very small compare to the simulated value. As such the environment is very safe from $C0_2$ equivalent (C0)

TABLE XXI: COMPARISON OF OUTPUT FOR DAY 4

Gas	Simulated result from IWM (Tones)	Field measurement	Comparison
C0	0	45.56	Since field value is more than the simulated value therefore, the concentration of $C0_2$ in this environment is high
CH_4+$N0_+$	1	0	Due to the absence of CH_4 in the environment as compare to the simulated value therefore, the environment is safe from it effects.
$C0_2$ equivale (C0)	30	0.27	The field value is very small compare to the simulated value. As such the environment is very safe from $C0_2$ equivalent (C0)

TABLE XXII: COMPARISON OF OUTPUT FOR DAY 5

Gas	Simulated result from IWM (Tones)	Field measurement	Comparison
$C0_2$	0	38.89	Since field value is more than the simulated value therefore, the

			concentration of $C0_2$ in this environment is high
CH_4+$N0_+$	1	0	Due to the absence of CH_4 in the environment as compare to the simulated value therefore, the environment is safe from it effects.
$C0_2$ equivale (C0)	30	0.32	The field value is very small compare to the simulated value. As such the environment is very safe from $C0_2$ equivalent (C0)

IV. CONCLUSION

Monitoring gas pollution for attenuation in a period of economic recession ensures a healthy living and indirectly conserves funds for residents. In this research, the Integrated Waste Management (IWM) tool was employed to analyze the full component of the waste and it indicated that CO_2 is in abundant at Ebute Ikorodu abattoir having a tendency of triggering global warming. Toxi RAE Pro gas monitor could not detect the presence of CH_4 due to the abundance of oxygen for the aerobic process. With the findings from the use of IWM tool, Ebute Ikorodu abattoir is safe from the effects of NH_3 and CO pollution. Planting of trees should be encouraged so as to reduce the buildup of CO_2 in the atmosphere since growing trees store carbon dioxide through photosynthesis. This shall definitely reduce the air pollution in the study area. In addition, to further keep the environment safe from pollution, indiscriminate open air burning of bones, hooves, horns and fossil fuel in should be discouraged.

ACKNOWLEDGMENT

The authors are highly grateful to Alabaster Blessed Consultants Limited, Akobo, Ibadan, Nigeria for all-round support leading to the success of this research and its publication. We equally thank Mrs. Olubunmi Ojoawo for her assistance on computer works.

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