EFFECTS OF PIG PRODUCTION ON AMBIENT AIR QUALITY OF EGBEADA IN MBAITOLI LOCAL GOVERNMENT AREA OF IMO STATE, NIGERIA

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ABSTRACT

The study of air quality was carried out in Egbeada, Mbaitoli, Owerri, Imo state during January, 2011, to ascertain impacts of piggery production on human environment. Air quality samples were taken at distant that ranged from 50m, 100m, 150m, and 200m using appropriate procedures. Air quality indices considered include odour, NO_2, SO_2, NH_3, CO, H_2S, CH_4, and PM. The results indicated that, concentrations of air quality indices decreased with an increased distant from piggery that was influenced by wind speed of 0.2 m/s. Apart from methane, all other indices were above the WHO/FMENV, Standards for ambient air quality. These were found to have very serious epidemiological implications on human health and his environment. This then lead to recommendations: implementation of air quality standard to observe compliance, relocations of piggery and using of helmet by workers for sustainable piggery production.

Keywords: Ambient, Air Quality, Pig, Pollutant

INTRODUCTION

Modern animal production is increasingly regarded as a source of air pollutants which can be both aggravating and environmentally harmful. The pollutants can give cause for concern for several reasons. There is epidemiological evidence that the health of farmers working in animal houses may be harmed by regular exposure to air pollutants such as gases, dust, microorganisms and endotoxins [12].This is mostly experienced in the tropics [8]. The most troublesome sources of pollution are large commercial rearing farms with several thousand animals, which can be defined as "industrial". The concentrations of pollutants in livestock environments and their emission rates have been studied extensively in developed economies and several comprehensive reviews have been published [13].The potential effects of air quality on livestock productivity involve complex interactions between physiological behavior and diseases [24].There is also very strong evidence for occupational respiratory disease in those who work with livestock [5]. This is believed to arise from chronic exposure over several years to complex mixtures of aerial pollutants in livestock pens. For example, the physiological and psychological effects of extended ammonia exposure on man may include nausea, headache, depression and dizziness [5]. Furthermore, there is evidence that poor air quality influence the incidence and severity of common endemic respiratory diseases of pigs [3].

The problem of air pollution is directly related to the number of people living in the area and the kinds of activities in which they are involved. Odour emitted from confined swine facilities are primarily derived from anaerobic decomposition of protein waste materials including faeces, urine, skin cell, feeds and possibly bedding and volatile organic compounds (VOCs) [17]. The principal gases generated from pig production include ammonia, carbon dioxide, hydrogen sulfide and methane, and at least 50 percent of dust emissions are believed to be respirable odour and endotoxins [25]. Annoyance and

depression were observed from people suffering from swine odour [15]. Swine workers health problems have been linked to air contaminants such as ammonia [11,27]. Such information are however lacking for most tropical farming environments. Concentrations of these gases vary widely and depend on animal species, housing, and manure handling systems. In high concentrations, some of these gases may pose a threat to human, animal, and ecosystem health. From this extensive list, hydrogen sulfide and ammonia are the most commonly monitored and extensively studied. Many other gases are odorous and/or potential irritants, but are not typically found at high enough concentrations in animal buildings to be a concern. From the observation, it is pertinent that Egbeada community is suffering from the effects of livestock production such as pig production that emits odour other gases at a high concentrations to the atmosphere, causing worries in the community and its environ in Mbaitoli Local Government as a whole. This paper then focuses on the effect of pig production on ambient air quality (AAQ) as regards to human health implications.

MATERIALS AND METHOD

The Study Area

Imo state is situated in the southern rain forest region of Nigeria. It lies between latitude 5^0 and 6^0 3'N and longitude 6^0 15' and 7^0 34' E. The area is dominated by plains 200m above sea level except for elevations associated with the Okigwe. It has an annual rainfall of about 1700 mm to 2500 mm, which is concentrated almost entirely between March and October. Average relative humidity is about 80% with up to 90% occurring during the rainy season. The mean daily maximum air temperature range from 28- 35^0C, while the mean daily minimum range from 19^0c to 24^0c. In this rainforest zone, smallholder livestock production predominate with over 80% of rural families keeping west African Dwarf (WAD) ruminants and mixed breeds of local and exotic chicken [6,26],primarily as source of investment, manure and meat at home or during festivals. The study area is Egbeada autonomous community, Mbaitoli Local Government of Imo State. It is located between latitudes 05^0 30' and 05^0 45' N and longitudes 6^0 56' and 7^0 10' .And Federal College of Land Resources Technology, Owerri is worst affected by odour because of its proximity to the pen. Even noise from piglets is another major problem that disturbs learning environment.

Methods of collection of Air Quality (AQ) samples

Air samples were collected at a height of 2 metres above the ground level at each of the graded distances of 50m, 100m, 150m, and 200 m respectively, this collection was done at the windward direction. Air sample was taken in by 12noon, 12 midnight and in 8 am, and the collection was onsite. Ambient air load (AAL) were surveyed to include: Odour, Nitrogen dioxide (NO_2), Sulphur dioxide (SO_2), Carbon monoxide (CO), Hydrogen sulphate (H_2S), Methane (CH_4) , Ammonia (NH_3), and Suspended particulate matter (SPM). Above all, wind speed, wind direction and ambient temperature were equally determined.

Air Pollutants Measurement Techniques

Odour concentration was measured using human –based sensory method. Measurements of the concentrations of ambient air pollutants such as ammonia NH_4, nitrous oxide (NO_2), Flammable gas (methane, CH_4), carbon monoxide (CO), hydrogen

sulfide (H_2S) and sulfur dioxide (SO_2) were made in Egbeada in Mbaitoli L.G. A. in the Owerri State. The procedure described by [23], which involves taking representative readings at different locations, was adopted. Concentrations of gases were measured in parts per million (ppm) as well as using the Gasman hand held personal gas detector (Crowcon, Instruments Ltd. England) that employs a catalytic bead sensor for flammable gas and electrochemical sensors for other gas measurements. During the gas measurements, these hand held equipments were held at about 2.5m above the litter level and the readings were recorded within 10 seconds. Airborne particulate matter was collected on a Whatman glass fibre filter. All analyses were calibrated for zero and span before and after reading. All the results of air quality collected and analyzed were compared with FMEV/WHO standards.

Wind Speed and Directions: Digital hand held ELE Model 460-050 was used to determine wind speed. And compass Model M-73 was used to determined the direction of wind. **Temperature:** The prevailing ambient temperature was measured with a thermometer with a range of $0\text{-}100^0$ C.

Model : Distance decay model by [1] was used to explain the diffusion of parameters at graded distances and the results of air quality were compared with WHO/FMEV.

RESULTS AND DISCUSSIONS

Table 1. Ambient Air Pollutants from Pig Production in Egbeada at Graded Distance.

Air Pollutants	Unit	50m	100m	150m	200m
Odour	_	Abnormal	Abnormal	Fair	Fair
Nitrogen Dioxide (NO_2)	**Ppm**	0.45	0.41	0.35	0.23
Sulphure Dioxide (SO_2)	**Ppm**	0.6	0.5	0.3	0.2
Carbon Monoxide (CO)	**Ppm**	5.4	4.1	3.9	3.2
Hydrogen Sulphate (H_2S)	**Ppm**	0.24	0.2	o.o1	0.001
Methane (CH_4)	**Ppm**	0.4	0.3	0.2	0.1
Ammonia (NH_3)	**Ppm**	3.0	2.2	0.2	0.1
Total Suspended particulate (TSP)	**Ppm**	6.9	5.2	3.1	1.5
Mean	**Ppm**	**2.4**	**1.8**	**1.2**	**0.8**

Source: Fieldwork, 2011

From Table 1, it is observed that ambient air parameters such as odour, nitrogen dioxide, sulphur dioxide, carbon monoxide, hydrogen sulphate, methane, ammonia and total suspended particulate all decreased at increased distances ranging between 50m – 200m (Fig.1). The mean values range between 0.8 – 2.4 ppm at graded distance between 50 - 200 m These compounds arise from the aerobic and decomposition of swine wastes [17]. The result is in conformity with the law of distance decay model by [1] which shows a reduction in contaminants levels away from the source of production which is aided by the prevailing south west trade wind with the wind speed of 0.2m/s (Table 2).

Table 2.Wind and Temperature Characteristics of the Study Areas

Location	Wind Speed (m/s)	Wind Direction	Ambient Temp. (^{0}C)
Egbaeda	0.2	SWTW	34

Source: Fieldwork, 2011.

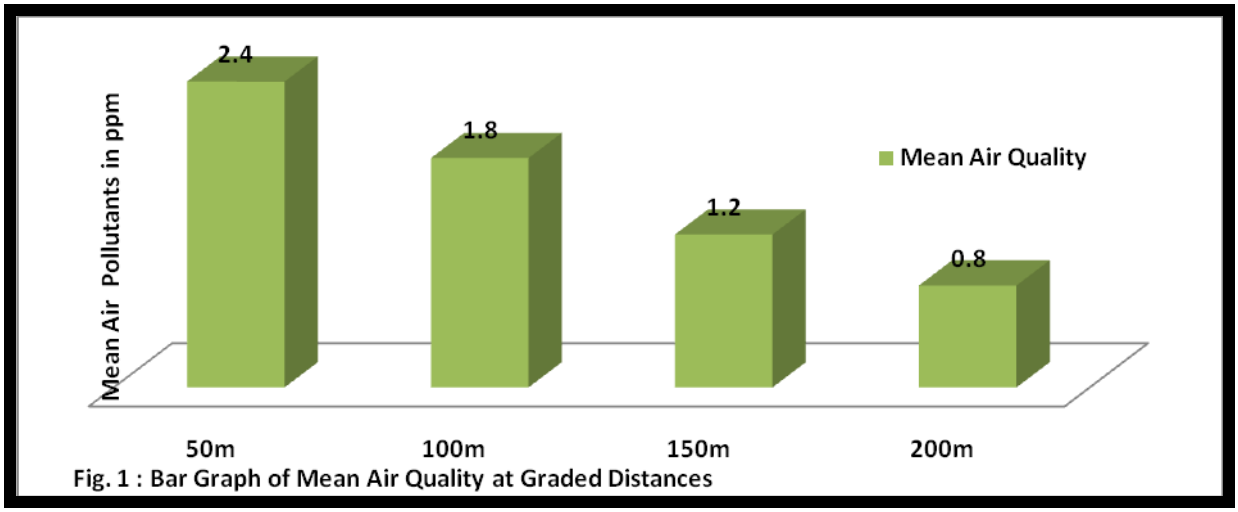

Fig. 1 : Bar Graph of Mean Air Quality at Graded Distances

Table 2. Ambient Air Pollutants from Pig Production at different time of the in Federal College of Land Resources Technology , Egbaeda.

Pollutants	UNIT	12 Noon	12 Midnight	8 Am	FMENV/WHO
Odour	**Ppm**	Fair	Odourous	Abnormal	Normal
NO_2	**Ppm**	0.53	0.54	0.59	0.4
SO_2	**Ppm**	0.3	0.4	0.6	0.1
CO	**Ppm**	6.2	6.5	6.8	1.0
H_2S	**Ppm**	0.26	0.29	0.31	0.008
CH_4	**Ppm**	0.2	0.3	0.4	0.5
NH_3	**Ppm**	2.6	2.8	3.0	0.2
TSP	**Ppm**	5.1	4.8	6.5	NS
Mean	**PPM**	2.1	2.2	2.6	-

Source: Fieldwork, 2011.

Odour Concentration

From table 2, it is also observed that , odorous gases that make up pig odors are by-products of anaerobic decomposition of livestock wastes by microorganisms which was observed to be above FMENV/WHO. In Egeada, and Federal College of Land Resources Technology, Owerri, student /people around attributes numerous health effects to bad odors, including headaches, nausea, eye, nose and throat irritation, and depression. The odour also could reduce property values within the vicinity [2,14]. Odors are typically mixtures of several different gases and concentrations of these gases. The result is consistent with the findings of [4].

Nitrogen Dioxide (N_2O): It is observed that nitrogen oxides can combine with haemoglobin to reduce the oxygen carrying capacity of blood, and can equally irritates

alveoli of the lungs[16]. From the results, nitrogen dioxide varied between 0.53 – 0.59 ppm above the 0.4 ppm WHO/FMENV STD for air quality.

Sulphur Dioxide (SO_2): The results indicated that, sulphur concentrations ranged between 0.3 – 0.6 ppm above the 0.1 WHO/FMENV. STD. Possible effect of SO_2 on human include cardio-respiratory illness, severe distress, and tightness of chest [9,12, 22].

Carbon Monoxide (CO): Carbon monoxide at certain levels can lead to impairment of time interval discrimination, visual acuity, brightness discrimination and psychromotor [21,22]. The result of CO indicated that, the concentration ranged between 6.2 – 6.8ppm above the 1.0 ppm WHO/FMENV for ambient air quality.

Hydrogen Sulphide (H_2S): Hydrogen sulfide (H2S) is a product of the anaerobic decomposition of organic (primarily manure) material. It is a colorless gas that is heavier than air, highly soluble in water, and has the characteristic odor of rotten eggs. Liquid manure storage pits (inside buildings) or basins (near barns) are the primary sources of hydrogen sulfide in animal production [10].High concentration in ambient air may cause dizziness, irritation of the respiratory tract, nausea, and headache while paralysis of the respiratory system can occur with little or no warning [7].The result shows that hydrogen sulphide varied between 0.26 – 0.31 ppm above the 0.008 ppm WHO/FMENV STD.

Methane (CH_4): The animal husbandry industry is a major emitter of methane, which is an important greenhouse gas. The decomposition of livestock manure, under anaerobic conditions, produces methane [20].The result indicated that, methane concentration in ambient air ranged between 0. 2 -0.4 ppm above the 0.5 ppm WHO STD air quality.

Ammonia (NH_3): Ammonia emissions to the atmosphere are an environmental concern because they can contribute to odor, the eutrophication of surface water[20].Urine is the primary source of ammonia (NH_3) and is released during manure storage and decomposition. NH_3 gas is an irritant, colorless, lighter than air, and highly water soluble. It has a sharp pungent odor becoming detectable at levels as low as 0.7 ppm. Ammonia is a strong irritant: eye irritation can occur at levels as low as 4 ppm, and at 25 ppm respiratory irritation may develop [10].The result indicated that ammonia concentration ranged between 0.26 – 3.0 ppm above the 0.2 ppm WHO/FMENV.

Particulate Matter (pm) or Dust: Particulate matter (PM) or dust in and around animal facilities includes bits of feed, dried skin, hair or feathers, dried feces, and endotoxins (cell wall of gram-negative bacteria). High concentration of SPM can lead to chronic respiratory disease[21,22]. The result of Pm in ambient air quality indicated that, the concentration ranged between 4.8-6.5 ppm with no standard.

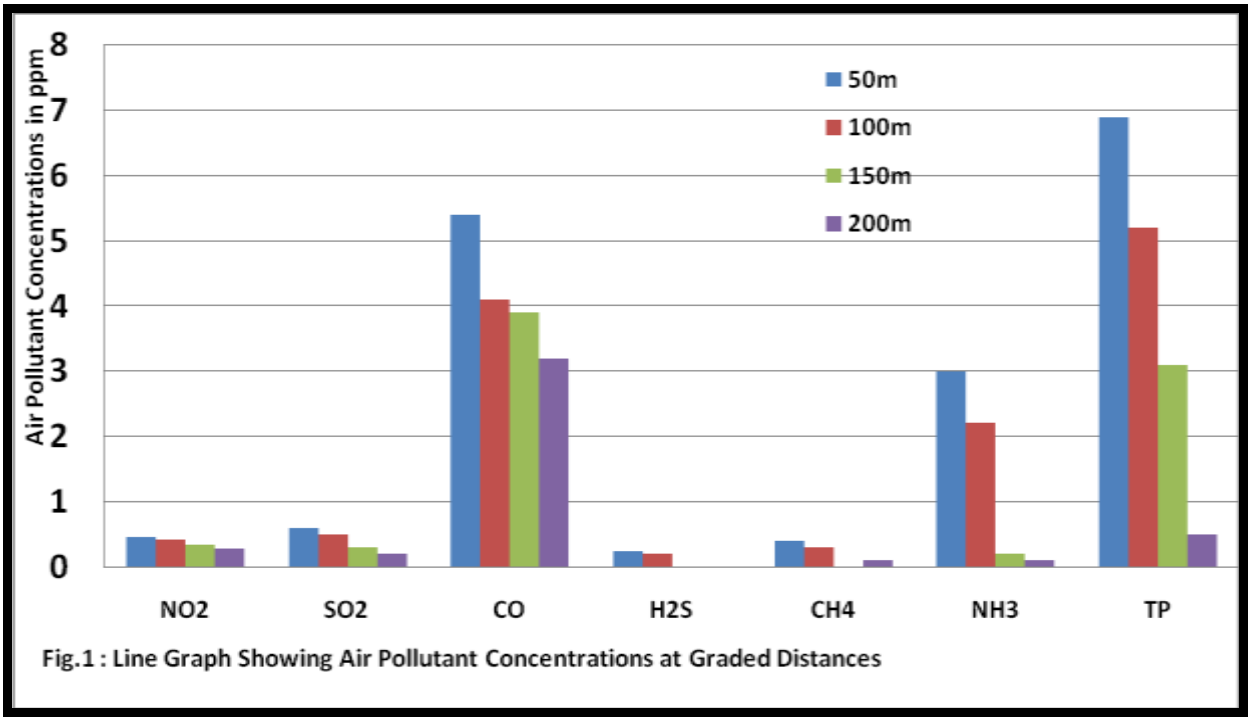

Fig.1 : Line Graph Showing Air Pollutant Concentrations at Graded Distances

From the Table 1 and 2, it is then observed that Odour and other gaseous pollutants are diluted with increase in distant according to distance decay model by [1],and pollution concentrations are higher in the morning than afternoon and midnight due to wind and temperature variation of 34° C that dewatered dumpsites (Table 2). Gases found in high concentrations due to pig production are harmful to health [18,19].

CONCLUSION

From the results, the pollutants were observed to be severed during the morning hour of 8am followed by midnight when the weather is damned and fair in afternoon, which is caused by temperature inversions in the morning, trapping emissions and preventing pollutants from dispersing into ambient environment. Apart from methane, all other pollutants are above the Federal Ministry of Environmental and World Health Organization Standards, and particulate matter has the highest concentration originating from mixture of coarse and fine organic and inorganic substances from pig production. And morning hour has the highest mean value of pollutants followed by 12 midnight and 12 noon respectively. It is then concluded that, since Egbeada is a rural setting with very low vehicular flow and no chemical factory that could have polluted environment, except pig production.

RECOMMENDATIONS

Due to the prevailing environmental pollution caused by pig production in Egbeada Mbaitoli Local Government Area of Imo State, Nigeria. It is then recommended that:

(1) State Ministry of Environment should regularly inspect the firm in order to ensure compliance with the regulation of air pollution act.

(2) Pig production in the place should be relocated to an isolated place.

(3) Piggery worker are expected to cover their faces with transparent helmet

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