ASSESSMENT OF AMBIENT AIR QUALITY AND NOISE LEVELS IN AJEGUNLE FARM SETTLEMENT, ABEOKUTA, OGUN STATE

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ABSTRACT

The assessment of ambient air quality and noise levels in Ajegunle Farm Settlement was carried out with a view to providing information for improved farming activity. Randomly selected sampling farms were done using MultiRae lite© gas meter, Aerotrack© particulate counter and Intelsafe® digital sound meter to collect data at different farms in the study area. Descriptive survey design method was used for this research and Geographical Positioning System was used to obtain spatial attribute of every farm where data was collected. Mean value were recorded and Pearson Correlation Coefficient was used to analyzed the data. The result showed high concentration of CO_2 (348-412.67 ppm); Suspended Particulate Matter SPM (0.54-1.29 mg/m^3); noise level (51.83-71.17 dB) while NH_3 (0.00-0.33 ppm) was extremely low in concentration. Correlation which reveals relationship is weak but positive for SPM and NH_3 (0.290), also SPM showed weak and positive relationship (0.119) with CO_2 while SPM and Noise showed very weak and negative relationship (-0.057). Some of the Noise values collected were higher than the maximum noise permissible limit. The study concluded that in order to mitigate the noxious impact of pollutants generated during farming activities, a routine assessment of the air quality and noise levels of farm settlement is imperative so as to safeguard public health and livestock production.

Keywords: Pollutants, Permissible limits, Mitigate, Routine assessment, Public health.

INTRODUCTION

Air quality is a measure of the amount of pollutants in our atmosphere, which includes indoor and outdoor air. It was reported in 2012 that about 3 million deaths were attributed solely to ambient (outdoor) air pollution (WHO, 2016). Air pollution affects all regions – both urban and rural areas alike (Oguntoke *el al.,* 2009). Particulate matter reduces the air quality within the livestock buildings compromising the health of farmers and animals (Hinz *et al.,* 2007). Commercial livestock production facilities are always associated with some level of airborne particles. High concentrations of airborne particles could affect the external environment, production efficiency, health and welfare of humans and animals (Banhazi and Seedorf, 2007).

Commercial livestock production facilities are always associated with some level of airborne particles which could affect the atmosphere, production efficiency, health and welfare of humans and livestock (Banhazi and Seedorf, 2007). Farmers in animal houses are exposed to airborne microbes like salmonella as well as a wide range of air pollutants some of which are suspended particulate matter (SPM), CO_2, NH_3 among others (Mitchell *et al*., 2004). Livestock farmers are exposed to dust concentrations inside their animal houses that are a factor of 10 to 200 times higher than those of the outside air (EhabMostafa, 2012; Aarnink and Ellen, 2007). Today in animal husbandry, noise has become a salient danger. Noise produced in animal housing by ventilation system, feeding and excrement lines and by the animals themselves is a major stressor that affects not only the animals but also the tending personnel irrespective of how short the noise could be (Venglovsky *et al*., 2007).

Long term exposure to air pollution represents a serious threat to health in developed and developing countries (Mannucci and Franchini, 2017). Certain farming activities expose farmers to various health risks and also cause environmental damage to their immediate surroundings. Hence, the need for this study, with the objective of examining the concentration of air pollutants and assessing noise quality in a selected farm settlement.

MATERIAL AND METHODS

Study Area

This study was carried out at Ajegunle Farm Settlement in Abeokuta, Ogun State, Nigeria. Ajegunle in Abeokuta is located in the sub-humid tropical region of Southwestern Nigeria (Latitudes 7º 5′ N to 7º 20′ N and Longitudes 3º 17′ E to 3º 27′ E). The town is about 81km south-west of Ibadan and 106km North of Lagos and at an altitude of about 157m above sea level, the landscape has undulating characteristics due to the formation of granite rocks. The city enjoys a tropical climate with distinct wet and dry seasons with dry period of about 130 days (Orebiyi *et al.*, 2008). The mean annual rainfall and temperature are about 1,270 mm and 28 ºC respectively while the estimated mean annual potential evaporation is 1,100 mm. The city is underlain by crystalline pre-Cambrian Basement complex of igneous and metamorphic origin noted for their rather poor groundwater bearing properties (Orebiyi *et al.*, 2008). The city is drained mainly by River Ogun which passes through and divides the city into two, and the drainage pattern is dendritic. The study area which covers a geographical area of 1,256 square kilometers has a population of about 605, 461 and comprise of Abeokuta South, Abeokuta North, parts of Odeda and Obafemi-Owode Local Governments of Ogun State, Nigeria. The main occupations of the indigenes are farming, local textile making (Adire), trading, pottery and fishing.

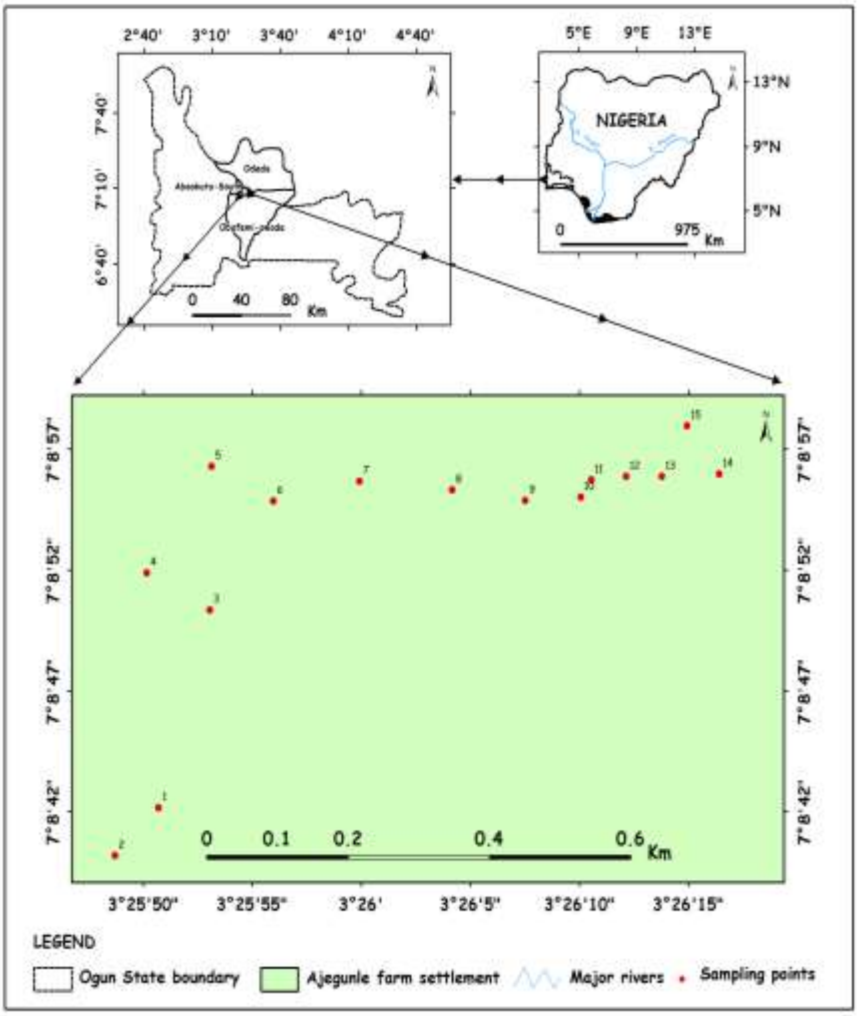

Figure 1: Map of Ajegunle Farm Settlement in Abeokuta.

Experimental Design

Descriptive survey research design was used for this study. This type of design according to Sanni (2001) as stated by Oladipupo-Okorie and Adeyeye (2012) is best used to gather, organize, present and analyze data for the purpose of describing the occurrence of an event or phenomenon within a particular people. The study area is a dedicated farm settlement from which 15 active poultry farms were sampled.

Table 1: General Description of Selected Farms in Ajegunle Farm Settlement.

S/N	Name	Latitude	Longitude	Altitude (m)	Environmental condition	Scale
1	Farm 1	N7.145048	E3.430750	175.7	Source of water: not available. Dirty environment with choking smell. Presence of accommodation for staff	medium
2	Farm 2	N7.144500	E3.430192	160.4	Source of water: available. Fish farm with neat environment.	small
3	Farm 3	N7.147318	E3.431402	162.7	Source of water available, bushy environment and choking smell	Small
4	Farm 4	N7.147744	E3.430597	154.9	A micro-earth dam with phytoplanktons on water surface. There is presence of aquatic organisms on water.	Small
5	Farm 5	N7.148972	E3.431422	153.6	Source of water: available, neat environment	Small
6	Farm 6	N7.148800	E3.432212	160.5	Source of water available, bushy environment and choking smell	Small
7	Farm 7	N7.148800	E3.433307	164.5	Source of water: not available, bushy environment and choking smell	Large
8	Farm 8	N7.148702	E3.434488	164.1	Borehole available, bushy environment with choking smell.	Medium
9	Farm 9	N7.148575	E3.435422	167.1	Source of water, not available. Bushy environment with choking smell	Small
					Source of water: available, the environment is not bushy but has choking smell	
10	Farm 10	N7.148615	E3.436127	174.0	Source of water: available, neat Environment with choking smell	Small
					Source of water available, neat environment with choking smell	
11	Farm 11	N7.148818	E3.436260	169.0	Source of water available.	Small
12	Farm 12	N7.148857	E3.436707	175.0		Small
13	Farm 13	N7.148857	E3.437162	175.0		Small
14	Farm 14	N7.148882	E3.437892	160.4		Small
15	Farm 15	N7.149437	E3.437483	160.2		Large

Determination of Location Attributes

Geographical Positioning System was used to obtain spatial attribute of every farm where data was collected.

Air quality sampling Procedure

The air pollutants CO_2, NH_3, SO_2, NO_x and SPM were sampled with MultiRae lite© gas meter. Aerotrack© particulate counter (Aerotrack 8220) was used to determine the particulate concentrations before comparing all measurements with the World Health Organisation Standard (WHO, 2016). The concentration of the air pollutants was determined by the detector held at about 2 m above ground level, readings were carefully documented. Data were collected three times from each sampling points. All equipment and meters were properly pre-calibrated before each usage for quality assurance.

Noise Level Assessment

Noise Level was measured within selected farms in the study area and at varying distance (20 m, 40 m). Hand-held Intelsafe® Digital Sound meter (Model JTS1357) was used to take noise levels by positioning on a flat surface to prevent vibration. Readings were then taken twice and the average was recorded (Okedere and Elehinafe, 2011).

Data Analysis

Noise, particulate and air quality data collected were analyzed using mean separation and Pearson correlation coefficient. The data analysis was carried out using SPSS package.

RESULTS

Table 2 showed the mean values of SPM, NH_3 and CO_2 as collected from the study farms. Farm 3 has the highest SPM (1.29 mg/m^3) followed by Farms 1, 6 and 9 which have a mean value of 1.26 mg/m^3 and farm 4 has 1.25 mg/m^3. Farm 2 (0.54 mg/m^3) has the lowest SPM, closely followed by farm 5 (0.56 mg/m^3) and Farm 12 (0.58 mg/m^3). Farms 1, 3, 4, 7, 8, 9, 10 and 13 have the highest NH_3 value (0.33 ppm) while the remaining farms recorded 0.00 ppm. Farm 6 (412.67 ppm) and Farm 14 (405.00 ppm) recorded highest CO_2 mean values while Farm 11 (373.33 ppm) recorded lowest CO_2 value.

Table 2: Mean values of SPM, NH_3 and CO_2 in the study farms.

Location	SPM (mg/m^3)	NH_3 (ppm)	CO_2 (ppm)
Farm 1	1.26	0.33	397.00
Farm 2	0.54	0.00	382.67
Farm 3	1.29	0.33	382.33
Farm 4	1.25	0.33	383.67
Farm 5	0.56	0.00	383.67
Farm 6	1.26	0.00	383.67
Farm 7	1.01	0.33	383.67
Farm 8	1.24	0.33	348.00
Farm 9	1.26	0.33	395.67
Farm 10	1.20	0.33	364.33
Farm 11	1.24	0.00	373.33
Farm 12	0.58	0.00	374.33
Farm 13	1.24	0.33	374.00
Farm 14	1.19	0.00	405.00
Farm 15	0.75	0.00	379.00
***Permissible level**	**0.25**	**25**	**250-400**

*Source: World Health Organisation Air Quality Guideline, 2016.

Table 3 showed the mean values of Noise recorded in the study farms in decibel (dB). Farm 9 (75.27 dB) has the highest value, followed by Farm 3 (71.17 dB) and Farm 7 (69.67 dB) respectively. Farm 1 (51.83 dB) recorded the lowest mean value of noise followed by farm 6 (53.83 dB).

Table 3: Mean values of Noise in the study farms.

Location	Noise level (dB)
Farm 1	51.83
Farm 2	59.60
Farm 3	71.17
Farm 4	61.27
Farm 5	63.00
Farm 6	53.83
Farm 7	69.67
Farm 8	53.73
Farm 9	75.27
Farm 10	57.20
Farm 11	54.27
Farm 12	63.10
Farm 13	53.57
Farm 14	62.33
Farm 15	55.93

Table 4 revealed the relationship that exists between SPM, NH_3, CO_2 and Noise in study farms. SPM and NH_3 showed weak positive correlation (0.290), also SPM and CO_2 showed weak positive correlation (0.119) while SPM and Noise showed very weak negative correlation (-0.057). Weak negative correlation (-0.128) was shown between NH_3 and CO_2 while NH_3 and Noise showed very weak positive correlation (0.044). Meanwhile, the correlation between CO_2 and Noise is weak and positive (0.102).

Table 4: Table showing correlations between SPM, NH_3, CO_2 and Noise in the study farms

	SPM	NH_3	CO_2	Noise
SPM	1	0.290	0.119	-0.057
NH_3		1	-0.128	0.044
CO_2			1	0.102
NOISE				1

DISCUSSION

The continuous improvement of farm animals' health is germane in ensuring proper livestock production and sustainability. Apart from management factors, the internal environmental conditions play a key role in ensuring the well-being of intensively housed livestock and farm workers. In all the farms, SPM were higher than those considered safe by World Health Organisation (WHO) air quality guidelines (WHO, 2016). According to Richard *et al.* (2002), SPM can be detrimental to human health in high concentration as it plays a major role in the causation of asthma, lung cancer, cardiovascular issues and premature death even at a relatively low concentration. In reference to the report of Banhazi and Seedorf (2007), the SPM value recorded in the studied farms could affect the external environment, production efficiency, health and welfare of both the Farm workers and the poultry birds.

Ammonia was detected in some of the farm units in very low concentrations while other farms did not record traces of it at all, this is in contrast with the study of Rajashekar *et al*. (2007) who detected high level of ammonia in poultry houses. The low level of ammonia in this study can be attributed to zero tolerance for feacal waste accumulation which is capable of causing burning sensation of eyes in workers, reduced feed intake thereby impeding birds growth rate (Deaton *et al*., 1984), decrease egg production (Charles and Payne, 1966), respiratory tract damage (Nagaraja *et al*., 1983) among other associated hazards.

Noise, according to Bies and Hansen (1996) is defined as disagreeable or undesired sound or disturbances. The data collected from this study ranged from moderate to high values. This is supported by Castelhano-Carlos and Baumans, (2009), who reported ranges of noise population that occur inside the animal facility. According to Venglovsky *et al.* (2007), short-lasting but intensive noise can have harmful effect not only on animals but also on personnel and this requires monitoring and attention. The sources of this harmful noise pollution in animal housing include; feeding, mating, high-pressure cleaning, feed mixing, movement of animal and workers among others (Venglovsky *et al*., 2007) and hygienic limit are sometimes exceeded during these activities (Šistova *et al*., 2010). The exposure of farm animals to noise has been identified as a potential stressor and thus have effect both in health and in their productivity (De la Fuente *et al*., 2007).

Some of the relationships between SPM with NH_3, CO_2 and Noise show positive correlations. This agrees with the report of Takai *et al.* (1998) who reported that farmers in animal houses are exposed to gases and a complex aerosol of bacteria, fungi, endotoxin and organic dust, which are linked to the development of respiratory diseases in farmers' lungs. Thus, the air quality requires frequent monitoring in order to ensure safety of the birds and the workers employed in the poultry farms. Since air quality directly reflects on the sanitary and hygienic status of the poultry house, its assessment from time to time can be taken as an indicator for scheduling manure removal operations and assessing the ventilation requirements.

CONCLUSION

The study concluded that the noxious impact of pollutants generated during farming activities is attributable to lack of regular routine assessment of the air quality and noise levels of the farm settlement which is imperative in the safeguarding of public health, sustainable livestock production and also ensures prompt quality control. Furthermore, the zero tolerance to feacal waste accumulation contributes in no small measure to the significant reduction of ammonia build up and concentration in the study farms.

RECOMMENDATIONS

From this study, to reduce health hazards associated with suspended particulate matter, ventilation system should be improved and burning of agricultural wastes should be discouraged. Also, regular removal of feacal matter which controls ammonia buildup should not be compromised. Furthermore, workshops/seminar on environmental education should be promoted among farmers and farm workers so as to create awareness among them on the hazards they may possibly suffer or create during farming activities. Therefore, a routine monitoring of the air quality and noise level assessment of farm settlement should be carried out on a regular basis as this will aid the abatement of pollutants emission and safe guard public health.

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