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An Assessment of Air Quality in and around Gwagwalada Abattoir, Gwagwalada, Abuja, Fct.

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Abstract
This work attempted an assessment of air quality in and around Gwagwalada abattoir. Air samples were collected from six points around the abattoir and recorded insitu for analysis. The following parameters were investigated; Particulate Matter (PM), Carbon monoxide (CO), Sulphur dioxide (SO_2), Nitrogen dioxide (NO_2), Ammonia (NH_3), Chlorine (CL_2) and Hydrogen cyanide. The statistical test employed was the Student t-test in verifying the hypothesis. Based on the data collected and the analysis made, it was observed that the mean values of the parameters varied from points to points and at different time of the day. Also, the mean values of the parameters were compared with the FEPA recommended limits, and it was observed that Sulphur dioxide (SO_2), Nitrogen dioxide (NO_2) and Particulate matter were above the FEPA recommended limit. While Carbon monoxide (CO), Hydrogen cyanide (HCN) and Ammonia (NH_3) are still below the standard limit. Air Quality Index shows that Sulphur dioxide (SO_2), and Nitrogen dioxide (NO_2 have very poor quality index Recommendations include; relocation of abattoir to an area far from residences, inspection of abattoir process by professionals in related fields, proper waste management systems should be made.
Keywords: Air, Quality, AQI, Abattoir, pollution, and Gwagwalada

INTRODUCTION

Man might survive weeks without food and days without water, but he can only last a few seconds without clean air. An average person breathes over 3,000 gallons of air each day. What happens when the air is polluted? Air pollution can make breathing difficult. Children and senior citizens are especially vulnerable, but anyone who inhales deeply can suffer asthma attacks, coughing and wheezing, and shortness of breath. Air pollution causes thousands of illnesses a day, leading to lost days at work and school. In extreme cases, heart attacks, strokes, and irregular heartbeats can occur. And it has been shown that breathing polluted air year-round can shorten life by one to three years. Air pollution also damages our environment. Toxic pollutants and chemicals form acid rain and ground-level ozone that can damage trees, crops, wildlife, lakes and other bodies of water. (http://www.cleanairforce.com, Michael, and Konstantinos 2008; and Miller *et al* 2007)

Recently, in developing countries, enormous environmental problems due to inadequate environmental planning and monitoring have emanated. These problems are often associated with development; Nigeria also faces environmental challenges from air pollution and desertification, with the encroachment of the Sahara desert in North and severe air pollution in overcrowded cities such as Kaduna, Lagos, and Abuja. The atmosphere protects life on earth by absorbing ultraviolet solar radiation, warming the surface through heat retention (greenhouse effect), and reducing temperature extremes between day and night. The variable gases of the atmosphere can be altered by human activities, thereby having effects on the functions of the atmosphere which house the air we break.

Abattoirs are a major source of air pollution worldwide (WHO, 2005). Goats are roasted with kerosene and condemned tyres in the course of processing the meat for marketing leading to the emission of carbon monoxide into the atmosphere. The blood from the slaughtered animals is left flowing on the ground with offensive odor causing pollution in the environment. This leads to pollution of such soils, natural water resources and the entire environment (Adesemoye et al., 2006). Thus, rendering health problems to the people living around.

Clean air is considered to be a basic requirement of human health and well-being. Urban outdoor air pollution is estimated to cause 1.3million deaths worldwide per year. Abattoirs are generally known all over the world to pollute the environment either directly or indirectly from their various processes (Adelegan 2002; Osibanjo and Adie 2007). In Nigeria, however, meat processing activities are mostly carried out in unsuitable buildings and by untrained personnel or butchers who are mostly unaware of sanitary principles (Olanike, 2002).

In the study area, cattle dung are dumped on the surface without evacuation, animal blood is channeled to a soak away which is open and left flowing into the environment constituting nuisances and also drains into the river, goats are roasted with tyre and kerosene. The waste from the burnt tyre also contaminates the soil coloring it black which can also pollute surface and ground water.

These effects can result in to serious health problems that could lead to emergencies or more hospital admissions and premature death. The human health effects of poor air quality are far reaching, but principally affect the body's respiratory system and the cardiovascular system. Individual reactions to air pollutants depend on the type of pollutant a person is exposed to, the degree of exposure, the individual's health status and genetics.

(WHO, 2010)

The most common sources of air pollution include particulate matter, ozone, nitrogen dioxide, and sulfur dioxide. Both indoor and outdoor air pollution have caused approximately 3.3 million deaths worldwide. Children aged less than five years that live in developing countries are the most vulnerable population in terms of total deaths attributable to indoor and outdoor air pollution. Adults above age of 80 years are also highly vulnerable.

The World Health Organization states that 2.4 million people die each year from causes directly attributable to air pollution, with 1.5 million of these deaths attributable to indoor air pollution. A study by the University of Birmingham has shown a strong correlation between pneumonia related deaths and air pollution from burning of fossil fuels. Worldwide more deaths per year are linked to air pollution than to automobile accidents. David et al, (2005) suggests that 310,000 Europeans die from air pollution annually. Causes of deaths include aggravated asthma, emphysema, lung and heart diseases, and respiratory allergies.

The worst short term civilian pollution crisis in India was the 1984 Bhopal disaster. Leaked industrial vapors from the Union Carbide factory, belonging to Union Carbide, Inc., U.S.A., killed more than 25,000 people outright and injured anywhere from 150,000 to 600,000. The United Kingdom suffered its worst air pollution event when the December 4 Great Smog of 1952 formed over London. In six days more than 4,000 died, and 8,000 more died within the following months. An accidental leak of anthrax spores from a biological warfare laboratory in the former USSR in 1979 near Sverdlovsk is believed to have been the cause of hundreds of civilian deaths. The worst single incident of air pollution to occur in the United States of America occurred in Donora, Pennsylvania in late October, 1948, when 20 people died and over 7,000 were injured.

A new economic study of the health impacts and associated costs of air pollution in the Los Angeles Basin and San Joaquin valley of Southern California shows that more than 3800 people die prematurely (approximately 14 years earlier than normal) each year because air pollution levels violate federal standards. The number of annual premature deaths is considerably higher than the fatalities related to auto collisions in the same area, which average fewer than 2,000 per year.

Several research works have been carried out in assessing the effects of abattoir on water and soil. (Patra et al, (2007); Katarzyna et al, (2009); Odoemelan & Ajunwa, (2008). Magaj, and Chup, (2012); Dung-Gwom and Magaji, (2007). Thus, this research work hopes to assess the air quality in and around Gwaagwalada abattoir and its implication on health of the people and the surrounding environment. This research work will help the readers in understanding the level of air pollution caused by the abattoir. It will also create more awareness to the plight of the residences around the abattoir.

MATERIAL AND METHODS

The Federal Capital Territory (FCT) Abuja is located between latitudes $8^0 25^{'}$ and $9^0 25'$ North of the equator and longitudes $6^0 45^{'}$ and $7^0 45^{'}$ East of Greenwich Meridian. It occupies an area of approximately 8,000km^2 and it is bounded by four states; Kaduna state to the North, Nasarawa state to the East, Kogi state to the South-West.

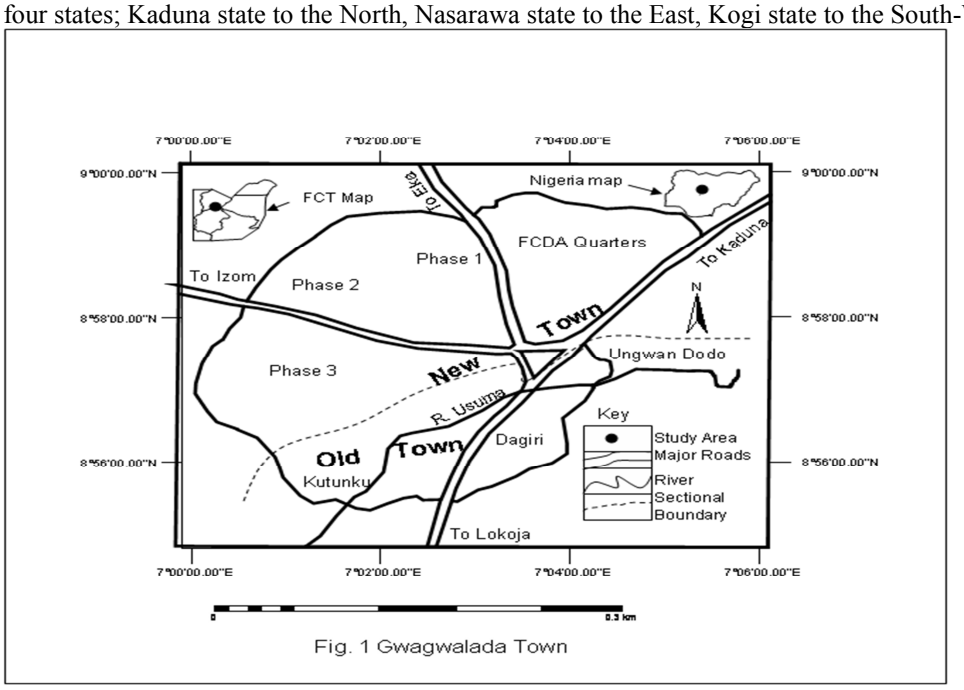

Fig. 1 Gwagwalada Town

Fig 1 Map of the study area

Gwagwalada Abattoir is located between latitude $8^0$55'59''N, 8^0 55'55''N and longitude $7^0$03'54''E, $7^0$03'50''E. It is located in a residential area. The materials used in this study are the Global positioning system (GPS), wind vane and a set of crow can gas dictator meter as directed by the manufacturer. The parameters investigated are Particulate matter (PM), Carbon monoxide (CO), Nitrogen dioxide (NO_2), Sulphur dioxide (SO_2), Ammonia (NH_3), Chlorine (Cl_2), Hydrogen Cyanide (HCN).. The samples were collected from six points at a point 20m from where goats are burnt with tyres and kerosene and the remaining five points at distances of 50m interval with the following coordinates:

Point 1: N 08^0 56' 00.1'', E 007^0 04' 56.1''. Elevation 189m.
Point 2: N 08^0 56' 00.2'', E 007^0 04' 51.8''. Elevation 192m.
Point 3: N 08^0 56' 00.7'', E 007^0 04' 50.5''. Elevation 191m
Point 4: N 08^0 56' 01.0'', E 007^0 04' 49.9''. Elevation 191m
Point 5: N08^0 56' 01.1'', E 007^0 04' 49.4''. Elevation 183m
Point 6: N08^0 56' 00.0'', E007^0 04' 49.8''. Elevation 199m

The AQI is the rating set by USEPA for determining ambient air quality. The results of this research work will be compared with the USEPA ambient air ratings obtained shown in table 1. The ambient air pollutants are classified into categories ranging from very good to very poor. From (0 – 15) AQI rating is A which is very good, (16 – 31) AQI is B which is good, (32 – 49) AQI is C which is moderate, (50 – 99) AQI is D which is poor and (100 or above) AQI is E is very poor, showing critical values.

Table 1: Air quality index for priority pollutants

AQI Category	AQI rating	PM10 μ g/m3	CO (ppm)	NO2 (ppm)	SO2 (ppm)	NH
Very good (0 -15)	A	0-15	0-2	0-0.002	0-0.002	0-50
Good (16 -31)	B	51 – 75	2.1-4.0	0.02-0.03	0.02-0.03	0-50
Moderate (32 – 49)	C	76-100	4.1-6.0	0.03-0.04	0.03-0.04	51-100
Poor (50 – 99)	D	101-150	6.1-9.0	0.04-0.06	0.03-0.04	2O1-300
Very Poor(100 or over)	E	>150	>9.0	>0.06	>0.06	301-500

Source: USEPA 2000

These samples were recorded along the direction of the wind for three consecutive days. The statistical analysis employed was the descriptive statistics such as mean, standard deviation and coefficient of variation. The data was subjected to Student t-test for the comparison of the mean differences between the survey values and the FEPA limit.

RESULTS AND DISCUSSION

Analysis of temporal variation in the concentration of the pollutants.

Readings were taken at different time of the day for three days and the means were calculated as shown in Table 2

Table 2 Mean values of the parameters at different time of the day

Parameters Time		PM mg/m^3	CO ppm	SO_2 ppm	NH_3 Ppm	NO_2 ppm	Cl_2 Ppm	HCN ppm
Morning	8:45am - 10:03am	0.31	1.83	0.43	0.10	0.33	0.27	0.67
Afternoon	1:00pm - 2:05pm	0.33	2.00	0.50	0.12	0.40	0.40	0.83
Evening	4:30pm -5:30pm	0.33	2.17	0.88	0.08	0.78	0.37	0.33

Source: Field survey, 2012

A careful observation of Table 2 shows that the mean of Particulate Matter (PM) is lowest (0.31ppm) in the morning and slightly higher in the afternoon and evening (0.33ppm). That of Carbon monoxide (CO) too is lowest in the morning (1.83ppm), slightly higher in the afternoon (2.00ppm) and highest in the evening (2.17ppm). Sulphur dioxide (SO_2) has its lowest mean value (0.43ppm) in the morning and increases as the day go by, having its highest mean value in the evening (0.88ppm). Ammonia (NH_2) has its lowest mean value (0.08ppm) in the evening unlike the others and slightly higher in the morning and highest in the afternoon (0.12ppm). The mean value of Nitrogen dioxide (NO_2) is observed in the morning (0.33ppm) and increases slightly in the afternoon (0.40ppm), with an increase in the evening (0.78ppm). Chlorine (Cl_2) has its lowest mean value (0.27ppm) in the morning with its highest mean value (0.40ppm) being in the afternoon and a decrease in the evening (0.37ppm). It is observed also that the lowest mean value (0.33ppm) of Hydrogen cyanide is in the evening and highest in the afternoon (0.83ppm).

The concentration of the parameters at different time of the day is highly influenced by the variation in the temperature of Gwagwalada where the study area is located. The temperature of the study area in the month

of November to March is driven by the Tropical Continental Air Mass which brings about the harmattan. The temperature at the time (November) when the field survey was carried out was between $27^0C - 29^0C$. Usually the mornings are characterized by low temperatures, which increases sharply as noon approaches and decreases slowly towards evening. As a result of this, mean values of parameters are all in their lowest in the morning (except Ammonia and Hydrogen cyanide which have their lowest mean values in the evening as 0.08ppm and 0.33ppm respectively) and highest mean values in the afternoon and evening

ANALYSIS OF SPATIAL VARIATION

Table 2: Mean values of the concentration of parameters at different distances.

Parameters/ Sampling points	PM Mg/m^3	CO Ppm	SO_2 Ppm	NH_3 ppm	NO_2 ppm	CL_2 Ppm	HCN ppm
Point 1	0.33	2.00	0.60	0.07	0.50	0.27	0.67
Point 2	0.32	2.30	0.70	0.10	0.60	0.33	0.67
Point 3	0.32	1.67	0.60	0.10	0.50	0.30	1.00
Point 4	0.31	2.30	0.63	0.10	0.53	0.37	0.33
Point 5	0.31	2.00	0.43	0.10	0.33	0.43	0.00
Point 6	0.33	1.67	0.67	0.13	0.57	0.37	1.00
MEAN	0.32	1.99	0.61	0.10	0.51	0.35	0.61
SD	0.01	0.28	0.09	0.02	0.09	0.06	0.39
COV	3.13	14.07	14.75	20.00	17.65	17.14	63.93
REMARK	N	S	S	S	S	S	S

NOTE: N= no significant variation; S = significant variation
Source: Field survey, 2012

The mean values of the concentration of the parameters at different points tend to be low at the starting point which is point 1 compared to the other points. Points 2, 4 and 6 have most of the highest mean values. This is influenced by the law of diffusion of gases, which states that "gases tend to move from areas of high concentration to areas of low concentration". Therefore following the direction of the wind, the gases tend to have moved farther away from the starting point which is the where the pollution is generated.

Using the Co-efficient of Variance (COV), the mean value of the concentration of the Particulate Matter ($3.13mg/m^3$) at different distances has no significant variation as the value is a little more than 0. Carbon monoxide (CO), Sulphur dioxide (SO_2), Ammonia (NH_3), Nitrogen dioxide (NO_2) and Chlorine (Cl_2), while Hydrogen Cyanide varied slightly but the variation is not significant.

Comparative analysis between the observed values and the FEPA recommended limit

Table 3: comparison of observed mean values with FEPA limit

Parameters	Mean values	FEPA limit	Deviation	Remark
Particulate matter(mg/m^3)	0.32	0.25	0.07	AL
Carbon monoxide(ppm)	1.99	10	-8.01	BL
Sulphur dioxide (ppm)	0.61	0.01	0.60	AL
Ammonia (NH_3)	0.10	0.30	-0.2	WL
Nitrogen dioxide (ppm)	0.51	0.06	0.45	AL
Chlorine (Cl_2)	0.35	0.01	0.34	AL
Hydrogen Cyanide (HCN)	0.61	1	-0.39	BL

NOTE: AL means Above Limit , WL means Within Limit, L means Below Limit
Source: Field survey, 2012

The result of the mean values of the observed parameters was compared with the Federal Environmental Protection Agency (FEPA) recommended limit with the view of finding the deviation from the recommended standards, to determine if the activities carried out in the abattoir have significant effect on the air quality within and around the abattoir. Ammonia is still within the FEPA limit and therefore has no negative effect on the air quality so far. Carbon monoxide and Hydrogen cyanide are below the acceptable standard and therefore have minimal impact on the air quality. Particulate matter, Sulphur dioxide, Nitrogen dioxide and Chlorine are above the recommended limits and might pose a threat to people living within and around the abattoir. For instance, the roasting of goats in abattoir with kerosene and tyre results in the emission of sulphur dioxide and if left unattended it will further oxidize in the presence of a catalyst such as Nitrogen dioxide (NO_2), and form hydrogen tetraoxosulphate IV (H_2SO_4), and thus acid rain. Particulate matter if left unattended to can result in

health hazards such as heart disease, altered lung function and lung cancer

THE AIR QUALITY INDEX

Seven air pollutants: Particulate matter (PM), Carbon monoxide (CO), Nitrogen dioxide (NO_2), Sulphur dioxide (SO_2), Ammonia (NH_3), Chlorine (Cl_2), Hydrogen Cyanide (HCN)..were critically monitored as part of the air quality index. The air quality index (AQI) is a rating scale for outdoor air. The lower the AQI value the better the air quality. The regulatory framework put in place by government through FEPA is limited to emission generated through stationary source (Abam and Unachukwu, 2009). In the absence of these standards, this research work used the data provided by the USEPA ambient air quality standards and compared with the results obtained from the field (Table 4).

Table 4: The Air Quality Index of the Analyzed parameters

Parameter	**AQI rating**
Particulate matter(mg/m^3)	Very good (A)
Carbon monoxide(ppm)	Very good (A)
Sulphur dioxide (ppm)	Very poor (E)
Ammonia (NH_3)	Very Good (A)
Nitrogen dioxide (ppm)	Very Poor (E)
Chlorine (Cl_2)	Very Good (A)
Hydrogen Cyanide (HCN)	Very good (A)

Source: Field survey, 2012

Table 4 shows the AQI for the analyzed pollutants. This rating is set by the USEPA for determining the Ambient Air Quality. Results showed are classified into categories ranging from very good to very poor. From (0 – 15) AQI rating is A which is very good, (16 – 31) AQI is B which is good, (32 – 49) AQI is C which is moderate, (50 – 99) AQI is D which is poor and (100 or above) AQI is E is very poor, showing critical values. As it can be observed, only sulphur dioxide and Nitrogen dioxide that were found to be very poor, but the rest were found still within the acceptable range.

The data were further subjected to inferential statistics, the student t-test and the result show that the t-cal. at 0.05 confidence level is -0.62 and the table value is 2.18, that is, the calculated value is less than the table value; we therefore accept the null hypothesis. This implies that the mean values of the observed parameters have no significance difference with that of the FEPA limit.

DISCUSSION OF RESULTS

The result of this study revealed that the concentration of some these pollutants are low in the morning and increases in the afternoon while some reduces in the evening. This probably follows the temperature trend where temperature is lower in the morning and increases in the afternoon while in the evening it falls again. Some of the biological activities are favoured by high temperature, which is why the release of gases becomes higher as a result.

It was observed during the field survey, that in the morning during the slaughtering, the odour in the abattoir is mild. People carry out the activities and transaction with little problems. The sanitary condition of this abattoir is very poor as all the waste generated is left without proper disposal. The blood is not properly drained; even the drain is channeled into an open soakaway, which contributes to the foul odour that pollutes the environment. It is generally accepted according to the law of diffusion of gases that gases move from areas high pressure to areas of low pressure. In the study area the case is not fully the same, this might be due to the fact that the wind speed is very low as such the ability for the gases to move faster and over a long distance is limited, that might have caused the fairly even spread of the gases up to about 250m away from the abattoir. A close observation also shows that the concentration of these gases often might decrease in distance; as the bad odour also decreases with distance even along the windward direction.

Result of the comparison between the survey results and the FEPA limit shows that Particulate matter, Sulphur dioxide, Nitrogen dioxide and Chlorine are slightly above the FEPA limit, this proportion represents about 57.1%. As the data was subject to statistical test, it was discovered that this difference was not statistically significant. This does not mean that there is no problem, as it is with the situation, if care s not taken the menace of this abattoir might not in distance time lead to epidermic. This was also confirmed with the work of Magaji and Chup (2012) on the same study area, but looking at its effect on water quality, results revealed that the water is already contaminated by the activities from the abattoir.

CONCLUSION

Despite the low level of contamination, it can be concluded that all things being equal, if this situation is not checked, it will lead to environmental disaster as nobody selects the air he/she breaths. It is therefore

recommended that Gwagwalada abattoir should be relocated to a place with a minimum distance of 500m from residential areas, provide a good means of disposal facilities and a constant monitoring and inspection of the activities carried out in the abattoir.

REFERENCES

Adelegan, J.A (2002) 'Environmental policy and slaughterhouse waste in Nigeria, proceedings of the 28th WEDC conference Kolkata (Calcutta) India. Pg 3-6

Adesemoye, A. O., Opere, B. O., & Makinde, S. C. O. (2006). Microbial Content of abattoir waste water and its contaminated soil in Lagos, Nigeria. *African Journal of Biotechnology, 5*(20), 1963-1968.

Air quality and health" www.who.int. Accessed July 2012.

Air Quality Index (AQI) "A Guide to Air Quality and Your Health". US EPA. December 2011. Accessed August 2012.

Alo, B (2008) "Contribution of road transportation to environmental degradation in Nigeria's urban cities". Paper presented in Lamata Annual National Conference of public transportation in Nigeria.

David Pennise and Kirk Smith (2010) "Biomass Pollution Basics". WHO, 2010.

Dung-Gwom J.Y. and Magaji, J.Y (2007) 'The Environmental Health Problems Associated with Solid waste Management in Gwagwalada, Abuja. The Abuja journal of Geography and Development. 1(1), pg 110-126.

Katarzyna, R. A., Monkiewicz, J., & Andrzej, G. (2009). Lead, cadmium, arsenic, copper and zinc contents in hair of cattle living in the area contaminated by a copper smelter in 2006-2008. *Bull Vet Inst Pulawy, 53*, 703-706.

Michael Kymisis, and Konstantinos Hadjistavrou (2008). "Short-Term Effects of Air Pollution Levels on Pulmonary Function of Young Adults". *The Internet Journal of Pulmonary Medicine* **9** (2).

Miller K. A., Siscovick D. S., Sheppard L., Shepherd K., Sullivan J. H., Anderson G. L., Kaufman J. D. (2007). "Long-term exposure to air pollution and incidence of cardiovascular events in women. [Research Support, N.I.H., ExtramuralResearch Support, U.S. Gov't, Non-P.H.S.]". *The New England journal of medicine* **356** (5).

Magaj, J.Y and Chup, C.D (2012) 'The Effects of Abattoir Waste on Water Quality in Gwagwalada, Abuja Nigeria. Ethiopian journal of Environmental Management (EJEM) Vol 5 no 4.

Odoemelan, S. A., & Ajunwa, O. (2008). Heavy Metal Status and Physicochemical Properties of Agricultural Soil amended by short term application of animal manure. *Journal of Chemical Society of Nigeria, 30*, 60-63.

Olanike, K. A. (2002). Unhygienic operation of a city abattoir in south western Nigeria: Environmental implication. *AJEAM/RAGEE, 4*(1), 23-28.

Osibanjo, O. and Adie G.U.(2007) 'Impact of effluent from Bodija abattoir on the physio-chemical parameters of Oshunkaye stream in Ibadan city, Nigeria. Retrieved 21 November, 2012. Available on line at http://www.academicjournal.org/AJB

Patra, R. C., Swarup, D., Naresh, R., Kumar, P., Nandi, D., Shekhar, P., Ali, S. L. (2007). Tail hair as an indicator of environmental exposure of cows to lead and cadmium in different industrial areas. *Ecotoxicol Environ.,Saf.,66*, 127-131.

World Health Organization (WHO) report "Public Health and Air pollution" 2005""
http://www.cleanairforce.com/docs/GCAFHealthBenefitsPoster.pdf

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