Assessment of the environmental effect of Cattle Market in Nigeria (A case study of Okigwe Area) South-Eastern Nigeria

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Abstract
It was observed that cattle waste- blood, meat, urine and faeces litter the environment of cattle market in Nigeria producing objectionable odour and environmental pollution. Based on this, it becomes necessary to examine the impact of cattle wastes on the groundwater and soils of the areas of cattle market. A total of three (3) water and three (3) soil samples were collected from boreholes and soils within and outside the cattle market at a distance of 500 metres. The samples were analyzed in accordance with the standard. The element considered and analyzed include ph, calcium (Ca^{2+}) magnesium (Mg^{2+}), Chlorine (Cl^{-}), Sodium (Na^{+}), Potassium (K^{+}), Iron (fe^{2+}), Nitrate (NO_3^{-}), Coliform count, organic matter and organic carbon. Analytical procedures for physical, chemical and bacteriological parameters are also in accordance with the specification of American Public Health Association, (1985). Physical parameters like temperatures, conductivity and ph were measured insitu in the field with mercury thermometer, conductivity and ph meters. Ca^{2+} and Mg^{2+} were determined with EDTA titrimetry, Na^{+} and K^{+} were determined using flame photometer, Nitrate concentration was estimated using spectrophotometer, total iron (Fe^{2+}) was estimated by atomic absorption spectrometry (AAS) while coliform counts were estimate by the most probable number (MPN) technique. The result shows that ph has a value of 8.46 and 7.58 within and outside the market for soil 5.0 and 4.2 for water. Also within the water and soil medium sodium (Na^{+}) recorded 90mg/L and 50mg/L, Calcium (Ca^{2+}) recorded a common value of 1.5mg/L. The total coliform measured a zero value for water both within and outside the market. Organic carbon for soil recorded 0.34% and 2.27% within and outside the, while for the water it recorded 0.33% and 0.27%. The organic matter recorded within the market 0.58% and 0.48% for soils. These findings indicate accumulations of the elements of cattle wastes. Absence of coliform bacteria is due to appreciable depth of borehole 60.98m (200ft). The analyzed parameters have inflated values within the market due to leaching. High rate of nitrate oxidation improves soil fertility. High concentration of sodium (Na^{+}) can have adverse effects on soil fertility while potassium (K^{+}) improves the soil fertility. Excess nitrate can affect oxygen content of the blood leading to methemoglobin and blue baby symptom. Organic carbon and organic matter improves soil fertility. It is recommended that biogas plant should be established in the area, borehole within the cattle market environment should be of appreciable depth at least 60.98-91.46 (200-300ft). Agricultural activities involving crops/ plant should be set up within the environment of the cattle market.
Keywords: Cattle market, pollution, Nigeria, soil, ground water, SE Nigeria sedimentary Basin.

Introduction

The existence of cattle market in Nigeria has been accompanied with population growth due to human search for greener pasture (Hayami and Ruttan 2000). Despite huge amount of money spent by government to improve cattle market in Nigeria, people are adversely affected by contaminated water supply and poor plants harvest (Moll, 1997). Water running in rivers and streams, though largely available, is not portable due to faecal and nitrate contamination, and therefore do not meet the health need of the people (Gauley and Krone 1966). Land which is also available in Nigeria and good enough for planting is unproductive since much treatment has not been fully developed to make it easily available (Guar, 1984).

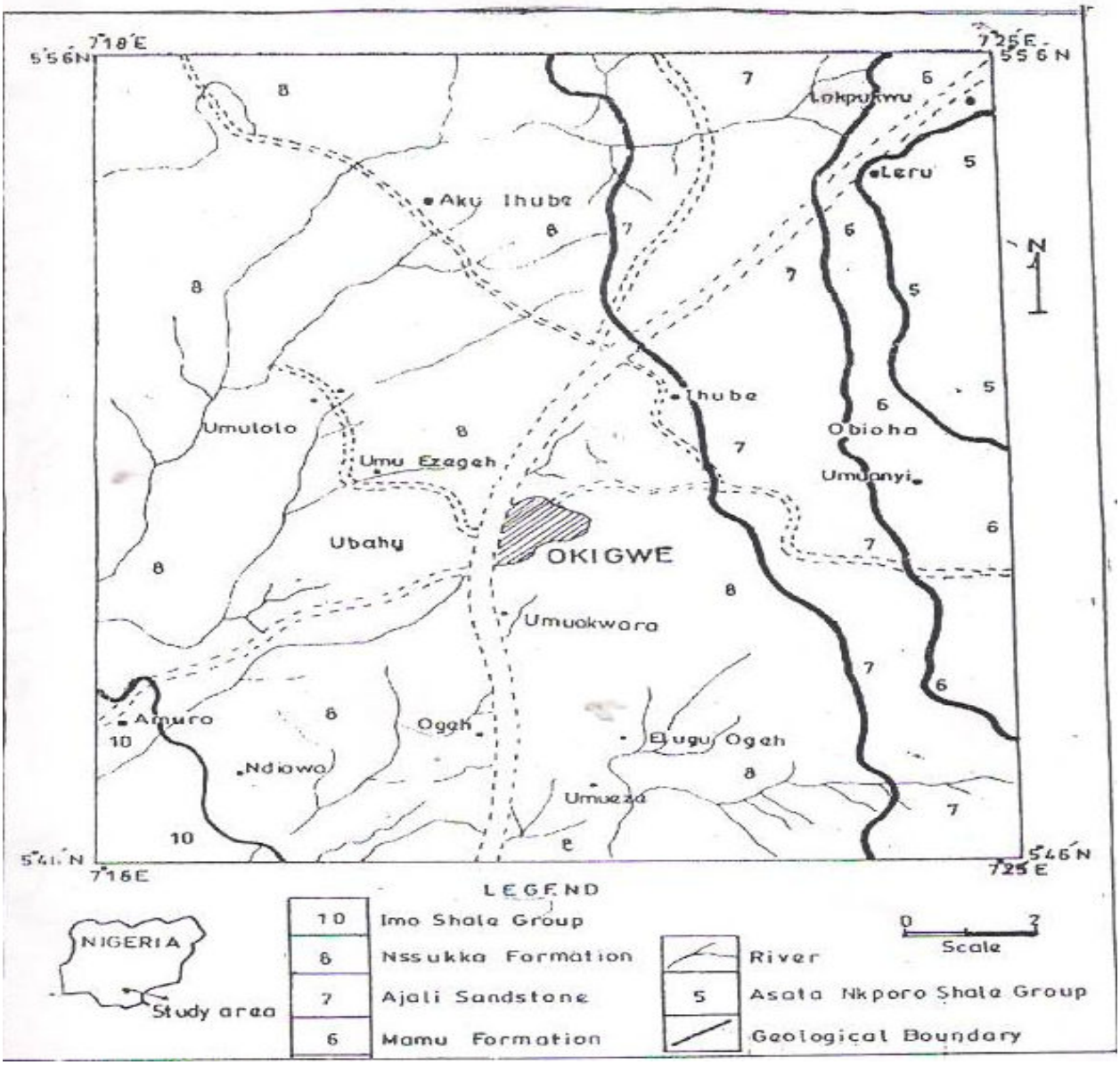
Flacken and Van (1997) have observed that livestock free area has surface soils that are more friable than areas where livestock graze and compact. This reduces porosity, permeability and the existence of soil micro organism. Cattle excreta and urine are sources of Nitrogen for plants. However excess Nitrogen to the soil can exceed plants requirements and hence reach the groundwater or immobilized on soil organic matter (Javiset et al 1989, Lockyer and white head, 1990 Williams and Hayes 1994). Cattle urine is a major contributor of Nitrate contaminant Flackten and Van (1997).

According to Deenew (1992), total Nitrogen content of urine varies between 2.5 to $13gkg^{-1}$. Faecal coliform bacteria are associated with animal faeces, and their presence in water indicates that the water has been contaminated by coliform bacteria and this is associated with cattle faeces (Gerhadt et al 1981).

Materials and methods

Description of the study area:

Okigwe area is situated between latitude 7 °18' N to 5° 54'N and longitude 5o 46' E and 7o 2'E. The physiography is dominated by Cuesta topographic features made of rolling plains and valley (Ofomata, 1985) Fig 1



The cuesta is on an asymmetrical ridge starting from Ida in Kogi State of Nigeria at the left bank of River Niger to Okigwe from where it veers southeast and terminate at Arochukwu in Abia State of Nigeria at the right bank of Cross River (Rayment,1965). The area falls within the rain forest belt of Nigeria, and has an average annual rainfall of about 1100mm a year (IIoeje 1981). According to the author, the rainy season lasts from April to October with heavy down pour which results in heavy flooding and soil erosion.

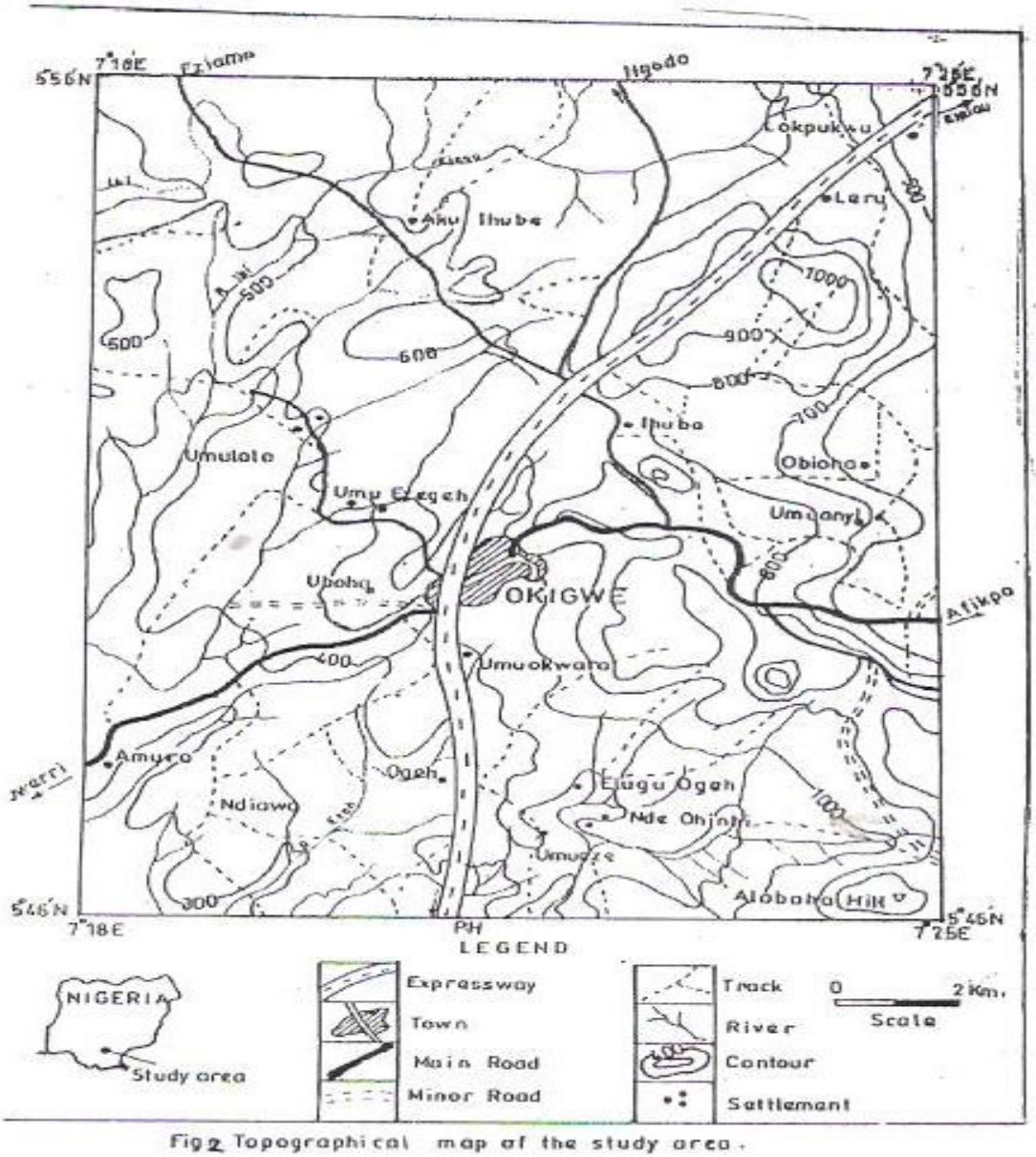


Fig 2 Topographical map of the study area.

The dry season which lasts from November to March is characterized by dry and dusty hamattan winds causing high evaporation rate. High temperature and low relative humidity prevail during the period (Mananu 1995).
The wet season is associated with low temperature of around 30^{o}C and high humidity of around 90%, while the dry season temperature is about 32^{o}C with humidity between 60-70%, Mananu, (1995).
Geologically, the study area in underlain by sedimentary sequence of Imo sedimentary basin of Southeastern Nigeria, with stratigraphic unit as shown in table 1.

Table 1: Stratigraphic sequence within Okigwe area (Reyment, 1965)

Age	Formation	Lithology
Miocenen-recent	Benin formation	Medium-coarse grained, poorly consolidated sands with clay lenses and stringers
Oligocene-miocene	Ogwashi Asaba FM	Unconsolidated sands with Lignite seams.
Eocene	Ameki FM Nanka Sands	Grey clayey sandstone and sandy clay stone.
Paleocene	Imo Shale	Laminated clayey shale
Mastritchian	Nsukka FM	Sandstones intercalating with shale
	Ajalli Sandstone	Poorly consolidated sandstone, typically cross bedded with minor clay layers.
Lower masstritchian	Mamu FM	Shale, sandstone mudstones and coal seams.
Campanian 78-82myrs	Mkporo/ Enugu shale	Dark grey shale clayey shale with clay lenses
Tutonian	Ezeaku Formation	Black shale with clay and limestone lenses.

Ajali Formation is the only aquiferous unit in the area (Offodile, 1972).
Okigwe cattle market lies within the Ajali Formation. Ajali sandstone consists of thick poorly consolidated medium to coarse sands interlayered with thin clay bands, silty clay and fine grained sands, (Rayment, 1965). This shows that the formation is prone to pollution due to high porosity and permeability (Offodile, 1992).

Methods of Study
A reconnaissance survey was carried out to locate the area of cattle market, the major receptors of cattle waste effluents, underground water situation, geological water boundaries and soil conditions. A study of literature was undertaken using internet and texts as to verify the works of similar nature done in different parts of the world and to access major contaminant to be considered. A total number of three (3) water and three (3) soil samples were collected within and 500m outside the cattle market. The water samples were collected from boreholes within and outside the cattle market using clean plastic container where soil samples were collected at the depth of one meter using soil auger. The samples were transported to the laboratory for analysis in accordance with the specification of the World Health Organisation guild lines (1991). The elements considered and analysed include: ph, Calcium (Ca^{2+}), Magnesium (Mg^{2+}), Chlorine (Cl^{-}), Sodium (Na^{+}), Potassium (K^{+}), Iron (Fe^{2+}), nitrate (NO_3^{+}), coliform count and organic carbon. Analytical procedures for physical, chemical, and bacteriological parameters are in accordance with the specification of the America public Health Association 1985. Physical parameters like temperature, conductivity dissolved oxygen and Ph were measured insitu in the field using standard method Ca2+ and Mg 2+ were determined by EDTA titrimetry, Na+ and K+ were determined using flame photometer, Nitrate concentration was estimated using spectrophotometer, total iron was estimated by pipette into calorimetric tube and acidified with 2ml of nitric acid and 0.02g of ammonium Molybdonate while total coliform counts were estimated by the most probable number (MPN_) technique.

Result and Discussion
The result of the study is shown in tables two (Water analysis), 3 (Soil analysis), and 4 (Bacterial colony count)
Table 2: Water Analysis Result

Sample location	NO_3 Mg/l	Ca^{2+} Mg/l	Mg^{2+} Mg/l	Ph	Na^{+} mg/l	K^{+} Mg/l	Organic carbon %	Fe^{2+}	Temp ^{o}C	Cl^{-} Mg/l
Within the market	**0.9**	**1.5**	**1.2**	**5.00**	**70**	**0.06**	**0.33%**	**0.07**	**26**	**6.09**
Outside the market	**0.05**	**1.5**	**0.9**	**4.2**	**50**	**0.06**	**0.27%**	**0.05**	**21**	**3.37**

Table 3: Soil Analysis Result

Sample location	No3 Mg/l	Ph	Organic Carbon %	Organic Matter
Within the market	**0.13**	**8.46**	**0.34**	**0.584**
Outside the market	**0.05**	**7.58**	**2.27**	**0.484**

WHO Standard 2001	Location	Plate count CFU/100ml	Dilution factor	Heterotrophic plate count cpu/100ml	Coliform count MPN/100ml
Nil/100ml	Within the market	25	10^{-2}	$2.8*10^{2}$	Nil
Nil /100ml	Outside the market	36	10^{-2}	$3.6*10^{2}$	Nil

The result of physiocochemical analysis of water sample collected from borehole within the market indicates that Ph has acidic value of 5.0 within the market and 4.2 for sample outside the market. For soil samples, the value is 8.46 and 7.58 showing that the soil has become alkaline (WHO,1992). The nitrate level within the market was recorded as 0.09mg/l and 0.05 outside the market. Iron has the highest value of 0.007 mg/l for borehole within the cattle market and lowest value of 0.05 for the boreholes outside the cattle market. For sodium, highest value was recorded as 90mg/L for water within the market and 50mg/L outside the market. Potassium recorded 0.06mg/l for both within and outside the market. The highest value for magnesium recorded 1.2mg/L but gives 0.9mg/l outside the market. Calcium recorded common value of 1.5mg/L in both cases. For coliform analysis result, the total coliform count was nil in both cases. For organic carbon, the highest value of 0.339% was recorded within the market and the lower value of 0.27% was recorded outside the market. In terms of organic matter, the highest value of 0.58% was recorded within the market and 0.481% outside the market. These findings indicate that increased deposition of cattle waste materials (urine, blood, meat and faeces) have adversely affected the soil and water quality of the area as a result of leaching (Hayami and Ruttan, 1985). This makes underground water within the vicinity of cattle market unfit for human consumption and also has a negative environmental impact in the soil. The absence of coliform bacteria in water is as a result of appreciable depth of 60.98m (200ft) of the boreholes within the area (Rayment, 1979). The physicochemical analysis results on both water samples shows a conformity of Ph, colour and temperature, but a disparity in nitrate, potassium, sodium and iron. These parameters have inflated values for samples from within the market leading. Reasons for this trend are obvious considering the contents of cattle waste which have nitrogen, magnesium, calcium, potassium and sodium as their major constituents (Gauley and Krone, 2001). These materials as a result of microbial activities are reduced to their constituent element which leach and percolate into the underground water (Raymond, 1979). The distance between the cattle market and site of the second collection make room for dilution of the physiocochemical parameters in the second sample. The increased nitrification activities represent rate of ammonia oxidation to nitrate (Alcomo, 2002) and this has a positive agricultural impact on agricultural lands. High concentration of sodium can harm soil permeabilities, while the salt of potassium is highly soluble in water and readily incorporate into mineral structure and improves soil fertility as an essential nutritional element (Pearce and Turner,1990). Nitrate is known to remove hydrogen ion from the soil thus increasing alkaline (Chengliu and Brett, 2000). Nitrate is amajor water containment as it reacts with haemoglobin in human blood to produce methamoglobin. This destroys the ability of red blood cell to transport oxygen (Donne and Leopold, 2003). Nitrate can also cause “blue baby” symptoms (Freeman, 2000). Organic carbon (0.339-0.27%) is a reflection of catabolic degradation under aerobic condition (Freeze and Cherry, 1979). This shows a high microbial activity and high material recycling level. The organic carbon and organic matter levels of both sites have been reported to affect agricultural activity positivity (Griffiths, 1981). While the acidic accumulation affects adversely biodiversity (activity) of micro organisms. Though the elements analyzed are not presently in excess amount, in future they may accumulate to toxic proportions.

Recommendation and Conclusion

Since percolation of physiocochemical parameter of the waste material from the cattle market is leaching into the underground water of the host community and is likely to increase adversely, proper disposal method should be practiced to minimize the trend. The establishment of biogas plant is one of the solutions handle the waste material and yet yields revenue to the government. Boreholes intended for portable water and other domestic application within the cattle market environment should be of appreciable depth of at least $\geq$ 60.98m (200ft); and should be located some distance away from the market. Agricultural activities should be encouraged within the area of cattle waste since plant uses most of the elements of cattle waste as macro nutrients; this reduces heavy percolation of the element into the underground water.

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