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IMPACTS OF POULTRY FARM AT THE ABUBAKAR TAFAWA BALEWA UNIVERSITY, BAUCHI, NIGERIA ON THE ENVIRONMENT

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The need for an impact assessment is a derivative of the necessity for environmental protection and conservation measures, if properly carried out, the action will not only curtail degradation of environment but will serve as a tool upon which many sustainable environmental policies can be made. The research was carried out to determine the concentration of the organic and inorganic water quality parameters on surface and ground water around the poultry farm and the socio-economic impact of the poultry farm on the environment. Analysis of the impact of the poultry farm on the environment was conducted by determination of the water quality of selected water sources, determination of the distance of the selected water source from the poultry farm, analysis of the activities from the farm on the immediate environment, prediction of expected outcome from activities and recommendation of measures for mitigation of negative impact. Physical parameters: Total Suspended Solids, Total Dissolved Solid, Temperature and Chemical Parameters: Copper, Calcium, Magnesium, Sodium, Lead, Cadmium, Phosphate, Nitrate and pH were measured. It was found that Nitrate levels in the wells had a direct correlation with the distance of the well to the farm, the values of the parameters of Lead, Cadmium and Magnesium of up to 0.3mg/l, 0.1mg/l and 1.46mg/l respectively were recorded, it was recommended that waste stabilization ponds should be constructed on the farm to handle the fresh wastewater generated from the farm while absorbers and scrubbers should be installed on the farm to reduce air pollution from the farm and on the environment.

INTRODUCTION

The Environment encompasses the physical, social, economic, cultural, aesthetic and political dimensions of a community. Impact assessment allows for the assessment of adverse and beneficial effects of a project by identifying measures for mitigating adverse effects and promoting the beneficial ones (Agunwamba, 2001). Thus the assessment is used to address the potential damage activities relating to a project can cause on the environment, management ensures the non-reduction of the carrying capacity of the environment by pollutants which may produce effects that lead to mutagenic and toxic outcomes; as may continuously be revealed (Liu, 2016). The need for an impact assessment is a derivative of the need for environmental protection and conservation measures, if properly carried out, the action will not only curtail degradation of environment but will serve as a tool upon which many sustainable environmental policies can be made.

The main impacts from poultry rearing are the effects of ammonia, odour and dust emissions from the poultry housing and spread of poultry litter on surrounding land. Other activities such as inappropriate waste utilization from animal waste and poor management of the site can result in contaminated run-off entering watercourses and contaminating soil and water, this can led to chemical pollutants being found in the aquatic environment due to impact of waste generation sites on groundwater quality (Ibitola et al, 2011, Oyelami et al, 2013).

Activities in a poultry farm that is associated with generating a variety of pollutants include emission of ammonia gas, nitrogen, phosphorus, and other trace elements, have been shown to produce impacts across multiple media as follows:

Surface water impact - Impacts associated with poultry waste contribute to eutrophication and associated blooms of toxic algae in surface waters. Rivers are among the most vulnerable water bodies to pollution because of their role in carrying municipal and industrial wastes and runoffs from agricultural lands in their vast drainage basins (Kemetse, 2017), anaerobic digestion of the wastewater before disposal into surface water has been shown to limit negative impacts on surface water bodies. (Edward et al, 2013)

Groundwater impact – Waste water from poultry farm that infiltrates to ground water table results in contamination of the groundwater, groundwater resource is a major source of domestic water supply, the high dependence on groundwater places undue pressure on this resource (Omole, 2016) on the one hand while contamination from sources as poultry waste places more pressure on the need for safe water on the other hand.

Air/atmosphere impact - Impacts include those on human health (caused by ammonia, hydrogen sulphide, other odour-causing compounds, and particulates), the effect of particulate matter depends on their chemical composition and particle size, finer particles linger in the atmosphere for a longer time and penetrate the human respiratory tract more easily (Agu, 2014), management of particulate matter from poultry farm is paramount. Additionally, volatilized ammonia can be re-deposited and contribute to acidification and damage to vegetation and sensitive ecosystems.

Soil impact - Nutrients and trace elements in animal manure can accumulate in the soil at over bearing quantities and become toxic to plants, the area of influence not limited as water movement in soil occurs increasing the radius of impact (Ruslan, 2015), treatment to reduce the concentration of pollutants to the level where discharge will not adversely affect the environment is therefore required (Nduka et al, 2007).

Other indirect impacts include ecosystem destruction and biodiversity erosion associated with the expansion of feed crop production in natural habitats and the over exploitation of low rate-renewable resources for feed production, limiting the ability of the earth's atmosphere to absorb greenhouse gas emissions (Dunlap and Jorgerson, 2012).

Research Goal and Objectives:

The Impact Assessment is conducted with a view to proposing solutions either in terms of mitigation of their impacts or outright prevention. The primary concern of the impact of the project on the environment is to ensure the avoidance of environmental damage or reducing such to the barest minimum/ tolerable levels while accelerating the pace of development that supports economic growth.

The research is to determine:

1. The concentration of the organic and inorganic water quality parameters in surface and groundwater around the poultry farm.
2. The socio-economic impact of the farm on the environment.

The findings from the impact assessment will provide guidance on decision on the operations and management of the poultry farm and the possibility of the use of data from the research on minimizing negative environmental impacts and maximizing potential benefits.

THE STUDY AREA

Abubakar Tafawa Balewa University (ATBU) (Yelwa Campus) is located in Yelwa town of Bauchi Local Government Area in Bauchi State of Nigeria with coordinates 9.845^{o}E and 10.329^{o}N (Ndububa and Nwafor, 2015). The area experiences five months of wet season between May and September with the remaining months of the year as dry season. The annual rainfall ranges between 900mm and 1000mm with a temperature range of 18^{o}C and 35^{o}C. Although in extreme weather conditions, the temperature can be as low as 12^{o}C during the harmattan and as high as 40^{o}C in March/April periods when the weather is often hot. The water-table level varies between be less than 5 m below ground level during the wet season and as deep as 30m below the ground level during the dry season.

The geological formation of Bauchi State made up of crystalline basement complex and of coarse foliated granite of the older granite suite formation and of Palaeozoic age. Prolonged geological activities of chemical weathering have made the residues of these rock types predominantly silty clays and quartz particles, therefore, with such prolonged geological activities, basement complex became favorable to groundwater storage, and can be tapped through boreholes and hand dug wells. The occurrence of two aquifer units namely; the unconsolidated weathered overburden aquifer unit and the fractured basement aquifer unit exists with the hydraulic parameters of the aquifer that ranging between 0.93 x 10-3 m/s to 8.93 x 10-3 m/s and a mean value of 3.47 x 10-3 m/s. An average linear groundwater velocity of 3.80 m/yr and a specific discharge of about 1.71 m/yr (Obiefuna and Nur, 2003).

The poultry farm is located on a space of land about 2 hectares on the campus bounded by a river on the Southern part of the farm, residential area on the Eastern part and academic areas on the West and Northern parts. The farm at maximum capacity houses about 1,000 birds with numerous activities taking place on the farm from bird dressing and packaging to operation of mechanical plants. The impact of the activities is hereby studied towards achieving the sustainability of the farm.

Figure 1. Map of Nigeria showing Bauchi State in Northeast. (www.mapsofworld.com)

MATERIALS AND METHODS

Analysis of the effect of the poultry waste on surface and groundwater sources in the immediate environment of the poultry farm was done by collecting water samples from the immediate surrounding and within the poultry farm. The following steps were taken to determine the impact of the poultry farm on the environment:

1. Determination of the water quality of selected water sources.
2. Determination of the distance of the selected water source from the poultry farm.
3. Analysis of the activities from the farm on the immediate environment.
4. Prediction of expected outcome from activities and recommendation of measures for mitigation of negative impact.

Water samples were taken from the surface water by the poultry farm (River Sambo) and from four hand dug wells in the immediate surroundings in Abubakar Tafawa Balewa University (ATBU) campus. Locations of selected sampling points are shown in the Table 1.

Table 1. Location of Sampling Points and Distances of sources from the Poultry Farm.

Sample Point(Pt)	Location	Water Table Level (m) (approx below ground level)	Distance from the Farm
Well Pt1	ATBU Farm	3.0	Within the Poultry Farm
Well Pt2	School of Environmental Studies	4.0	300m
Well Pt3	School of Engineering	3.0	390m
Well Pt4	University library	3.0	410m
Stream Pt5	Stream (River Sambo)	-	100m

Sampling was carried out by ensuring that:

1. Suitable plastic sampling bottles were sterilized prior to collection of the water samples.

2. The sample bottles were clearly labelled for easy identification.

3. Care was taken to avoid accidental contamination of the samples during collection and subsequent handling before the analysis, lids were tightly placed on the sampling bottles.

4. The samples taken were not exposed to light, kept cool in an insulated container to maintain a constant temperature and transported to the laboratory.

The following parameters were measured:

Physical Parameters: Total Suspended Solid (mg/l), Total Dissolved Solid (mg/l), Site Temperature (^{0}C)

Chemical Parameters: Copper (mg/l), Calcium (mg/l), Magnesium (mg/l), Sodium (mg/l), Lead (mg/l), Cadmium (mg/l), Phosphate (mg/l), Nitrate (mg/l) and pH.

All water quality analysis were carried out in accordance with the 'Standard Methods for the Examination of Water and Wastewater' (APHA,1999)

Impact of the socio-economic activities of the farm was carried out by onsite study of the environment and documenting the outputs from activities.

RESULTS

The laboratory experimental results obtained are presented in Table 2. These results were compared with the Nigerian Standard for Drinking Water Quality (NSDWQ, 2007). The results from the analysis of the impact of the poultry farm is presented in table 3.

Analysis of Results:

Results obtained from the water quality analysis showed the presence of total suspended solids in all the samples, the samples therefore cannot be used for domestic purposes without prior treatment. Dissolved solids content are within standards for drinking water; a high content of dissolved solids in water elevates the density of water and reduces the solubility of gases such as oxygen (Saxena and Sharma, 2017) which is not desirable in domestic water. Poultry manure contains considerable amounts of nutrients such as nitrogen, phosphorus, and other excreted substances (FAO, 2006). Nitrogen emissions from manure take four main forms: ammonia (NH_3), dinitrogen (N_2), nitrous oxide (N_2O)

Table 2. Results of Physical and Chemical Parameters

S/N	Parameter	Well Pt1	Well Pt2	Well Pt3	Well Pt4	Stream Pt5	NSDWQ
1	Total Suspended Solids (mg/l)	3.87	3.33	3.67	3.33	4.05	-
2	Total Dissolved Solids (mg/l)	29.29	26.67	27.27	30	33.58	500mg/l
3	Temperature °C	20	18.5	19.2	20.2	20.2	Ambient
4	Copper (mg/l)	0.75	0.99	0.92	1.0	0.8	1.0
4	Calcium (mg/l)	1.2	0	5.5	22.4	3.3	-
5	Magnesium (mg/l)	0.77	0.03	1.1	1.46	1.06	0.2
6	Sodium (mg/l)	32	29	25	30	31	200
7	Lead (mg/l)	0	0.1	0	0.1	0.3	0.01
8	Cadmium (mg/l)	0.02	0.1	0	0	0.1	0.003
8	Phosphate (mg/l)	0.021	0.015	0.21	0.075	0.045	-
9	Nitrate N (mg/l)	44	43	39	-	48	50
10	pH	6.6	7.3	7.2	7	8	6.5-8.5

and nitrate (NO_3-) analysis of water samples shows that Nitrogen Nitrate were present in all the water samples, the level of the parameter in wells in relation to the distance is presented in figure 2 which shows a correlation with a coefficient of 0.8 from R^2 given as 0.648, a correlation exists between the generating source of the Nitrogen Nitrate and distance (Spiegel and Stephens, 1999).

The highest value of Nitrogen Nitrate was found in the surface water within the campus. Only well point 2 had Magnesium level below recommended value for drinking water, while Cadmium and Lead values were higher that recommended values for drinking water in all the sources except in well points 3 and 4 for Cadmium and well point 3 for lead.

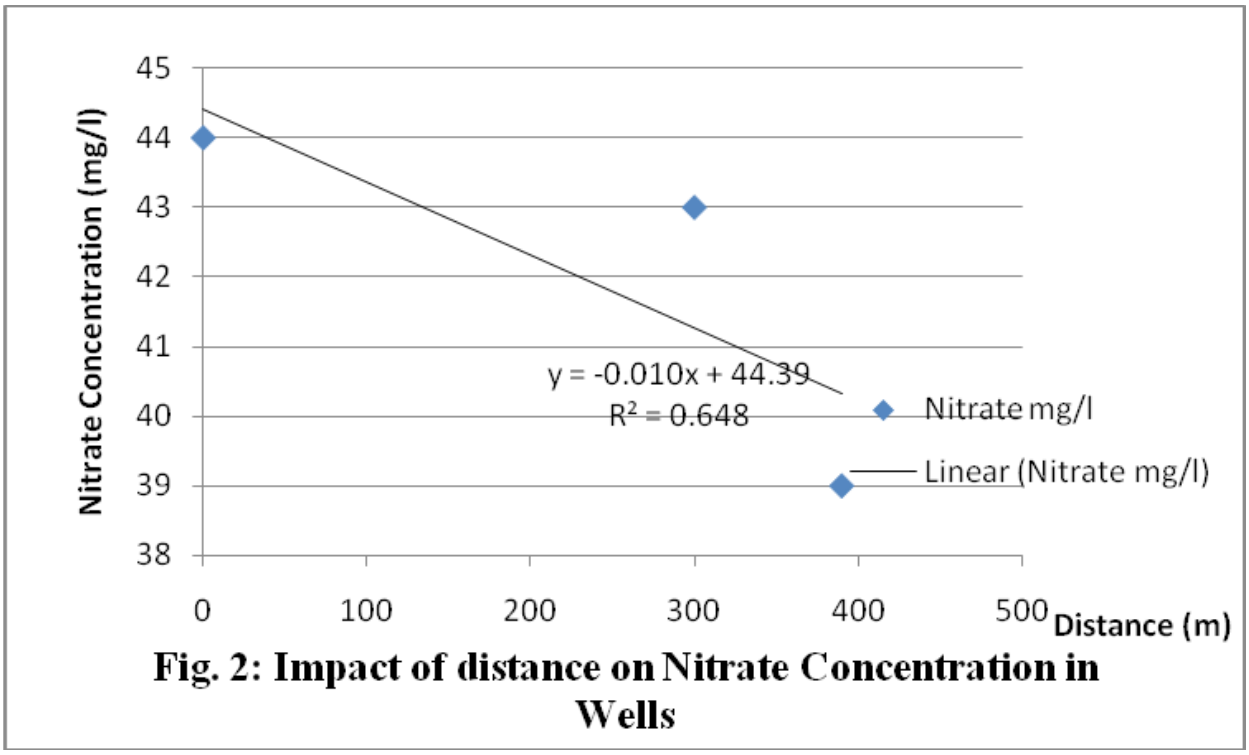

Fig. 2: Impact of distance on Nitrate Concentration in Wells

Socio-Economic Impacts:

Various activities in the poultry farm were considered and the effect on the environment is presented in Table 3.

The positive impacts of the poultry farm on the socio-economy of the community for which the farm was designed to achieve include:

- A steady supply of poultry farm products in Bauchi and environs is maintained.
- Employment opportunities are generated, increase in the farm capacity increases job opportunities.
- Commercial activities in the environment are boasted by the trading and marketing on the campus in particular and Bauchi State in general.
- Capacity development for youths on poultry farming and related activities.
- Development of the construction industry based on requirements on the farm.

These positive impacts must be sustained by mitigating the adverse impacts.

An Environmental Action/ Management Plans are drawn out in Table 4. This section sets out the mitigation measures needed for environmental management, both in short and long term.

CONCLUSION AND RECOMMENDATIONS

The adverse and the beneficial effects of the ATBU poultry farm has shown that the adverse effects can be mitigated as the beneficial effects are promoted to meet the future needs as designed, it is therefore concluded from the results of the research that:

Table 3. Impact of Poultry Farm on the Campus

Activities from poultry farm	**Effect on air, water, soil, people, ecosystems etc.**
Rearing of birds in poultry housing	Emission of ammonia, odours and dust to atmosphere and subsequent deposition on land.
Washing and cleaning of poultry farm	Contaminated run-off infiltrates and surface runoff enter watercourse.
Burning of waste from carcasses	Stack emissions to the atmosphere.
Generation of Solid waste and litter.	Emissions of ammonia and odours to atmosphere; surface run-off to watercourses; nutrient enrichment of soil; nitrate leaching from soil, increase in soil mineral and metal content possible.
Emission of Ammonia Gas into the atmosphere	Possible direct toxic effect on trees close to farm. Increased acidification of soil close to farm due to ammonia gas. Changes to sensitive ecosystems such as natural woodland. Reduced biodiversity. Contributes to greenhouse gases emission. Contributes to climate change. Contributes to odours in the environment.
Transport operations	Increased traffic, noise and disturbance.
Noisy operations (feed deliveries, mechanical operation of plants on the farm)	Noise creating nuisance for local residents and altering the character of environments.
Storage of fuel	Potential contaminants for soil and water
Disposal of disinfectants	Potential sources for soil and water contamination
Odours	Nuisance to residents and other users of the locality when at concentrations uncharacteristic of the area.
Dust	Potential for damage to plants and trees close to farm. Potential nutrient enrichment of water. Potential impacts on air quality
Leachate from solid waste	Increased biochemical oxygen demand (BOD) of watercourses. Nutrient leaching to watercourses and groundwater. Eutrophication (nutrient enrichment) of Watercourses and ground water. Increased potential sources for mineral and metal content in soils
Fuel/chemical spillage	Contamination of watercourses or soil

Table 4. Environmental Action/ Management Plan for the Poultry Farm.

Averse Effect of Poultry on Environment	Mitigating Measures to Maximize benefits						
	Install absorbers/ scrubbers for air pollution control	Construct stabilization ponds to reduce strength of waste	Reduce pollution level by treatment of wastewater	Separate farm from sales outlet	Channel Chemically polluted waste water to separate chamber	Install Incinerator on farm	Promote use of Bio-Fuel
Emission of ammonia, odours and dust							
Contaminated run-off infiltrates and surface runoff enter watercourse							
Increased acidification of soil close to farm due to ammonia gas							
Increased traffic, noise and disturbance							
Disposal of disinfectants to surface water results in contamination of soil and water							
Odour creates a nuisance in environment							
Leachate from solid waste as possible groundwater contaminant							
Fuel spillage as possible groundwater contaminant							

1. The emission of ammonia, dust and odour must be handled via air pollution control measures.
2. The strength of wastewater generated can be reduced to acceptable limits before treated before disposal to surface water courses.
3. Noise pollution from the increased traffic must be reduced by separating the farm from sales outlets.
4. Disposal of wastewater containing disinfectants should be handled separately from the disposal of raw wastewater generated from the farm. This will prevent a negative impact on the aquatic life of the surface water.
5. Leachate from solid waste has the potential of contaminating the groundwater sources.
6. The use of bio-fuel should be promoted to reduce the use of inorganic fuel.

It is recommended that:

- The poultry farm requires the construction of waste stabilization ponds to handle the fresh wastewater generated from the farm. Based on research, industrial effluent can be treated by the use of two stage biological waste water treatment (Nur et al, 2016)
- A septic tank should be constructed to separately handle chemical wastes which can have adverse effect on surface water if disposed off through the stabilization ponds.
- Absorbers and Scrubber should be installed on the farm to reduce air pollution from the farm and on the environment.
- Incinerator specifically designated to serve the farm will prevent leachate from solid waste to infiltrate into the ground.
- Regular monitoring of impact on environment is required, minimum of bi-annual interval is recommended by designated personnel. The purpose of monitoring is to compare current impact with planned targets.
- Capacities of the operators of the farm should be built to support the sustainability of the project.
- Provision of support services such as increasing access to safe water sources as water quality analysis from the sampled wells did not meet the requirement for drinking water.
- Creating enabling environment that will support increase in investment in the community by policy formulation and control measures.
- There is need for further research to determine the levels of the emissions from the poultry farm on the environment to support the design and construction of recommended treatment units.

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