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CLIMATE CHANGE PARTNERSHIP ACTIONS FOR SUSTAINABLE FUTURE AND RESTORING LIFE ON EARTH

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PREFACE

There is a growing concern on the adverse impacts of climate on biodiversity. This phenomenon is greatly manifested in form of shifting weather patterns threatening global food security, health and species existence. Humanity is at the receiving end of the consequences of climate change hence there is a need to step up actions on all fronts- overtime, everywhere all at once.

This calls for collaboration, partnership and networking to strengthening synergy among relevant stakeholders in a bid to tackling climate change menace. This forms the basis for the theme of this year world Environmental conservation conference: **CLIMATE CHANGE PARTNERSHIP ACTIONS FOR SUSTAINABLE FUTURE AND RESTORING LIFE ON EARTH.** The theme is conceived with a view to create an interface for information sharing and offer opportunities for participants to refine their commitments and pledges in the quest to achieving Sustainability in the face of climate change.

This year World Environmental Conservation Conference is memorable in the sense that it received overwhelming funding from the host - West African Science Service on Climate Change and Adapted Land use). WASCAL is posed to provide information and knowledge at the local, national and regional level to cope with the adverse impacts of climate change. Thus, this conference will offer opportunities for participants to learn from good practices demonstrated and showcase by WASCAL during the course of the conference. It will also strengthen staff-student exchange and provide prospect for Doctorate Research Doctoral Research in West Africa Climate System Programme (DRP WACS) – WASCAL among others.

Special appreciation goes to the management of The Federal University of Technology, Akure the host institution, National Park Service and African Regional Center for Space Science and Technology Education-English (ARCSSTE-E) that co-host this conference. We equally acknowledge other private, individual and corporate organizations that have contributed towards the success recorded in this event.

All the submitted articles were subjected to strict double blind peer-review process by the reviewers that are experts in the area of the particular submitted manuscript. The accepted manuscripts are published in WECC 2023 proceedings and also available for download on the organization website (www.necorng.org).

The accepted manuscripts fall within the underlisted subthemes:

- Climate change adaptation strategies in Agriculture, Forestry and Other Land Use (AFOLU)
- Climate smart city and architectural landscape design
- Retrofitting and decarbonization in tourism and hospitality industry
- Indigenous knowledge and local innovation in climate change adaptation
- Climate risk management, health, safety and hygiene
- Carbon credit-offset marketing/circular economy
- ICT development in environmental conservation (image processing and acquisition, computer vision, graphics, speed, interface technology, HMD devices, GIS: Body Tracking, AI and IOT, VRT, IVE).

We commend our keynote speaker Prof. Douda Kone Director Capacity Building Department, WASCAL Headquarter, Ghana and other guest speakers Prof. Babatunde Rabiu, Director General, Chief Executive Office, African Regional Centre for Space Science and Technology Education-English (ARCSSTE-E) and Dr. Goni I. M., Conservator General National Park Service.

It is hoped that researchers, students and policy makers will find the papers in this book very useful. Even though all the papers were reviewed and edited, the content and option expressed remain essentially that of the authors and not necessarily that of Netlink Environmental Conservation Organization.

Dr. Oladeji S. O.

President Netlink Environmental Conservation Organization

Convener World Environmental Conservation Conference

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PHYSIOCHEMICAL ANALYSIS OF WASTE WATER EFFLUENT FROM AMAGBA AND IYANOMO COMMUNITY ABATTOIR IN BENIN CITY, EDO STATE

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ABSTRACT

In Nigeria, most abattoirs release their untreated waste water directly into the environment. This is a concerning, potentially anthropogenic source of environmental pollution. This study was carried out to determine some physiochemical parameters (pH, Total Disolved Solid-TDS, Dissolved Oxygen-DO, Total Suspended Solids-TSS, Turbidity-NTU, Biochemical Oxygen Demand-BOD and Chemical Oxygen Demand-COD and Salinity as chloride) of waste water effluents from two abattoirs in Benin City, Amagba community abattoir (ACA) and Iyanomo Community abattoir (ICA). Physiochemical properties were analyzed according to USEPA and APHA standard methods and compared with FEPA limits. Results obtained showed that mean pH levels, TDSand Salinityof waste water effluents from both abattoirs studied, were within FEPA limits. Other physiochemical parameters such as TSS(62.165±13.18mg/Lfor ACA and252.2 ± 2.40mg/L for ICA), Turbidity (750.5±0.707NTUfor ACA and1194±2.83NTU for ICA), BOD(1175±7.071mg/Lfor ACA and1745±49.50mg/L for ICA), COD(2663.5±4.95mg/Lfor ACA and2938.5±4.95mg/L for ICA) and DO(2.2±0.141mg/Lfor ACA and for1.7±0.14mg/L ICA) where marginally outside FEPA safe limits. This indicates that continuous untreated effluent discharge from abattoirs directly into the environment (especially into water bodies) can be deleterious to the ecosystem on the long run.

Keywords: *Abattoir; Effluent; Physiochemical; Environment; Nigeria*

INTRODUCTION

Abattoirs in livestock farming sector are essential because they are the site where animals are slaughtered and sold to the general market. Majorityof Nigerian abattoirs are located near surface water bodies in order to have access to the affordable water supply required for processing slain animals and to serve as a sink for runoff from meat processing activities (Omole and Longe, 2008). In Benin City particularly, virtually all the major slaughter houses are located close to a river, stream or running water, which eventually the effluents are channeled into. Before being dumped into the ecosytem, abattoir waste waterare not treated. This waste will eventually seep into the ground or drain into nearby water bodies (Agwa *et al*., 2014). Tainted water quality from unsanitary abattoirs in the livestock industry significantly impacts the environment's water system. Abattoirs often discharge wastewater directly into ecosystems without proper treatment, posing a major environmental hazard (Mittal, 2006). This untreated waste raises biodegradable organic matter, leading to oxygen competition, increased BOD, and reduced dissolved oxygen, harming aquatic life and affecting sediments (Omole and Longe, 2008).

The physiochemical properties of abattoir effluents such as total solids, pH, temperature, turbidity, nitrate, phosphate levels, biochemical and chemical oxygen demands (BOD and COD), can predict their potential to contaminate ecosystems (Cooper *et al*., 2009).
The presence of excessive total solids in effluents can indicate high levels of suspended particles, which might lead to water turbidity. High turbidity can block sunlight penetration, affecting aquatic plant growth and disrupting the food chain (Arimoro and Ikomi, 2008; Patil*et al*., 2012). The pH level of effluents can influence the water's acidity or alkalinity. Extreme pH levels can stress aquatic organisms and alter their ability to thrive (Ogbiye *et al*., 2013). It can also influence the solubility and mobility of various pollutants (Gupta *et al*., 2009).
Elevated temperatures in effluents can impact aquatic ecosystems by causing thermal pollution. Sudden temperature changes can stress or kill aquatic organisms (Patil *et al*., 2012), disrupt breeding and migration patterns, and decrease dissolved oxygen levels.

Turbidity refers to the cloudiness or haziness of water caused by suspended particles. High turbidity can block sunlight, impacting photosynthesis and affect aquatic plants and organisms that depend on light for survival (Arimoro and Ikomi, 2008).
Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD): BOD and COD indicate the amount of organic matter present in the water that microorganisms will decompose (Okwute, 2007). High BOD and COD levels can deplete dissolved oxygen as microbes consume oxygen during decomposition, leading to oxygen-deprived "dead zones" harmful to aquatic life.
Effluents with high BOD can lead to decreased dissolved oxygen (DO) levels in the water. Aquatic organisms rely on dissolved oxygen for respiration, and low DO levels can suffocate and kill fishes and other aquatic life (Patil *et al*., 2012).

By analyzing physiochemical properties, we can predict the potential harm that abattoir effluents might cause to ecosystems. These properties provide insights into how the effluents might alter water quality, disrupt natural processes, and impact various organisms within the ecosystem. Monitoring and managing these properties help mitigate the potential harm and ensure the protection of aquatic environments.

MATERIALS AND METHODS

Study Area

Two separate abattoirs were selected as the sample stations .The first being Iyanamo community abattoir located at Iyanomo community, UhunmwondeLocal Government Area. The second was Amagba community abattoir located at Amagba community, Oredo Local Government Area. Both abattoirs are located in Benin City, Edo State, Nigeria.

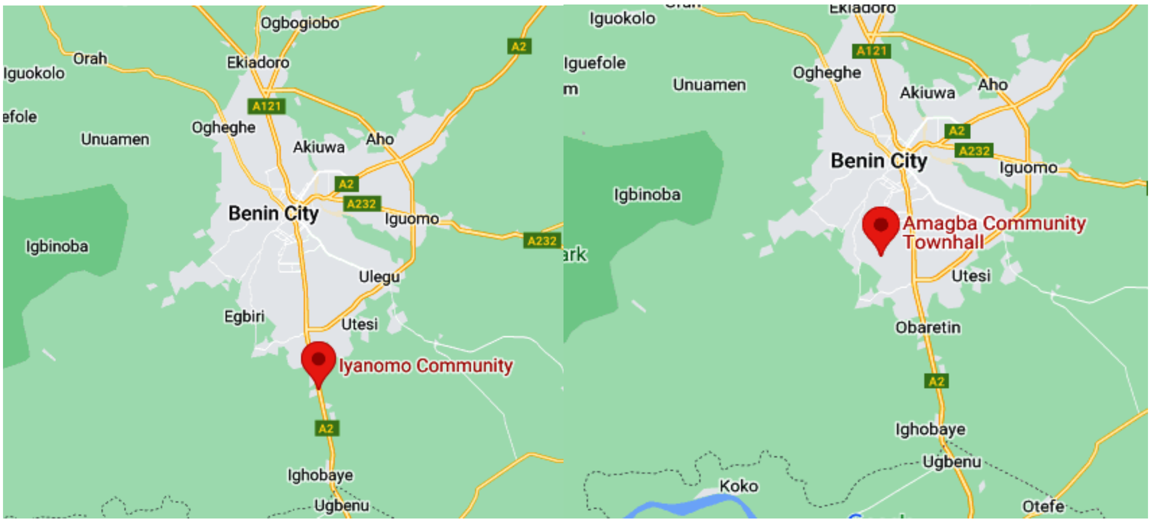

Figure 1.0: Iyanomo and Amagba Community Locations (Google Maps© 2023)

Collection of Samples

Waste water effluent samples were collected using standard method of Ogbonna and Ideriah (2014). Sterile 2.0 litre sample bottles were used to aseptically collect part of the abattoir waste water. The samples were collected at three different points coded A, B and C as the waste water was running off the drainage system. About 500ml of the sample collected from each point were pooled together to get a composite sample.After collection, the samples were placed in a cooler containing ice blocks and transported immediately to the laboratory for analysis.

Determination of pH

The pH of effluent waste water was determined electronically using standard method APHA 4500-H+(APHA, 2017). The pH of the waste water sample was measured by using a pH meter (model PHS-25, Search Tech Instruments, England). The pH meter was calibrated, with three standard solutions (pH 4.0, 7.0, and 10.0), before taking the measurements (USEPA 1996).

Determination of Total Dissolved Solids (TDS) by Gravimetry Method

Total Dissolved Solids (TDS) was carried out using gravimetric method APHA 2540C (APHA, 2017). TDS is reported in mg/L after calculations using the formula below;

$$\text{Total Dissolved Solids (mg/L)} = \frac{(W1-W2) \times (1000)}{\text{Sample volume (ml)}} \quad \ldots\ldots\ldots\ldots(1)$$

W1 = Weight of dried residue + dish

W2 = Weight of empty dish

2.5 Determination of Total Suspended Solids by Gravimetry Method

Total Suspended Solids (TSS) was carried out using gravimetric method APHA 2540D (APHA, 2017).TSS is reported in mg/L after calculations using the formula below;

$$\text{Total Suspended solids (mg/L)} = \frac{(W1-W2) \times (1000)}{\text{Sample volume (ml)}} \quad \ldots\ldots\ldots\ldots(2)$$

W1 = Weight of dried residue + dish
W2 = Weight of empty dish

Turbidity

Turbidity was determined in effluent waste water by Nephelometric method as stated in APHA 2130B. Formazin standards, 5 NTU, 50 NTU and 200 NTU was used in calibrating the portable turbidity meter prior to sample turbidity measurement (APHA, 2017).

Determination of Dissolved Oxygen

This was done using Winkler's method as shown in APHA (2017).The amount of dissolved oxygen is directly proportional to the titration of iodine with a thiosulphate solution.

Calculation:

DO (mg/L) = [16000 x M x V] / [V2/V1 (V1-2)] …………………………..……..(3)

Where

M = Molarity of thiosulpahte used.
V = volume of thiosulphate used for titration
V1 =Volume of bottle with stopper
V2 = Volume of aliquot taken for titration

Determination of Initial Dissolved Oxygen and Biochemical Oxygen Demandby Winkler's Method

Three hundred millimeters (300ml) BOD bottles were filled with the diluted samples previously prepared and the initial dissolved oxygen (DO) was determined using the Winkler's method as seen in APHA (2017).

For BOD, the Day-5 test method APHA 5210B (APHA, 2017) was used. Dissolved oxygen (DO) was measured initially and after incubation the BOD was computed as the difference between initial and final (DO). Because the initial (DO) was determined shortly after the dilutions was added, all oxygen uptake occurring after this measurement was included in the BOD measurement.

BOD (mg/L) = [DO1-DO0] / B ….………………………..(4)

Where

DO0 = initial dissolved oxygen (immediately after preparation)
DO1 = final dissolved oxygen (after 5days of incubation)l
B = Fraction of sample used

Chemical Oxygen Demand (COD) by Closed Reflux Titrimetric Method

Closed reflux titrimetric method APHA 5220C (APHA, 2017) was used in Chemical Oxygen Demand (COD) analysis of effluent waste water samples. COD was used as a measure of the oxygen equivalent of the organic matter content of the sample which was susceptible to oxidation by a strong chemical oxidant.

COD is reported in mg/L after calculations using the formula below:

$$\text{COD (mg/L, as } O_2) = \frac{\text{(Blank Titre - Sample Titre) x Molarity of FAS x 8000}}{\text{Sample Volume}}$$ ………..…………………(5)

Where:

A = mL FAS used for blank
B = mL FAS used for sample
M = molarity of FAS, and
8000 = milli equivalent weight of oxygen x 1000 ml/L

Determination of Salinity (Chloride ion test) by ArgentiometricTitrimetricMethod

Salinity as Chloride was determined using the Mohr's Argentometric method as described in APHA 4500-B (APHA, 2017).

Chloride is reported in mg/L after calculations using the formula below.

$$\text{Chloride in mg/L} = \frac{(A - B) \times (N) \times 35.45 \times 1000}{V}$$ ………………………………(6)

Where:
A = Silver nitrate solution, in ml for sample titration
B = Silver nitrate solution, used for blank titration (in ml)
N = Normality of the silver nitrate solution
V = Sample volume (in ml)

Statistical Analysis

The data obtained was subjected to statistical analysis using SPSS Version 2.0. The results were expressed as mean values ± standard deviation**.**

RESULTS

The result of the physiochemical parameters of waste water effluent from Amagba Community Abattoir (ACA) and Iyanomo Community Abattoir (ICA) is shown in Table 1.0.

The table shows the pH, Total Disolved Solid (TDS), Dissolved Oxygen (DO), Total Suspended Solids (TSS) , Turbidity NTU, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and Salinity(chloride)of the effluents.

From Table 1.0, the values for all physiochemical parameters of ACA effluents were markedly less than that for ICA.

Table 1.0 Physiochemical Parameters of Waste Water Effluent from Amagba and Iyanomo Community Abattoirs.

Physiochemical Parameter	Unit	Amagba Community Abattoir (ACA)	IyanomoCommunityAbattoir (ICA)	FEPA Limit
pH at 25^{0}C	-	7.045±0.007	7.2±0.022	6.0-9.0
Total Dissolved Solids(TDS)	mg/L	335±1.414	582.5±0.71	<2000
Dissolved Oxygen(DO)	mg/L	2.2±0.141	1.7±0.14	>5.00
Total Suspended Solids (TSS)	mg/L	62.165±13.18	252.2±2.40	<30
Turbidity NTU	NTU	750.5±0.707	1194±2.83	1.00-150.00
Biochemical Oxygen Demand (BOD)	mg/L	1175±7.071	1745±49.50	<50
Chemical Oxygen Demand (COD)	mg/L	2663.5±4.95	2938.5±4.95	<80
Salinity(Chloride)	mg/L	78.52±1.457	93.87±0.827	< 600

mg/L = milligram per litre; NTU = Nephelometric Turbidity Unit

Values are expressed as Mean ± SD (n=3)

DISCUSSION

The physiochemical properties of waste water effluents can reflect their potential to pollute the ecosystem. These properties provide insight into the composition, behavior, and potential impact of the wastewater when released into the environment.

From Table 1.0, all physiochemical parameters determined where higher in effluents from ICA compared to that from ACA. This reflects the difference in quantity and quality of animals slaughtered in both abattoirs. Variations in quality and quantity of meat processing activities in both abattoirs is also a major contributing factor to the difference in values observed.

Table 1.0 show that physiochemical parameters like pH, TDS and Salinity where all within FEPA limits for both ACA and ICA. The pH of the waste water effluent from both ACA and ICA were basic and within the range of 7.045 for ACA to 7.20 for ICA.This is in line with what was earlier reported byOgbonna and Ideriah (2014). The mean pH values for both ACA and ICA were within the FEPA tolerance limits of 6.0-9.0 for wastewater discharged into the ecosystem (particularly aquatic bodies). Effluentshaving pH levels outside safe limits can stress aquatic organisms, altering their capability to survive (Ogbiye*et al*., 2013). It can also influence the solubility and mobility of various pollutants in a given ecosystem (Gupta*et al*, 2009). The TDS values of effluent from both station was less than 2000, however effluent from ICA had a higher value of 582.5 mg/L. Excessive total solids in effluents can indicate high levels of suspended particles which can increase turbidity. The result for salinity shows ICA was more saline with a value of 93.87 mg/L although this is significantly below FEPA limit of 600 mg/L.The discharge of untreated high-salinity wastewater may cause serious environmental pollution and damage the aquatic, terrestrial, and wetland ecosystems.

The TSS levels for effluents from both stations (ACA and ICA) were markedly above permissible limits (< 30), this agrees with the studies of Ogbonna and Ideriah (2014). High level of TSS impacts turbidity. High turbidity can block sunlight penetration, affecting aquatic plant growth and disrupting the food chain. The turbidity level for ACA and ICA effluents ranged between 750-1194 NTU, FEPA permissible limit is 1-150 NTU. The cloudiness or haziness of abattoir effluents which is caused by suspended particles can impact photosynthesis, affecting aquatic plants and organisms that depend on light for survival in any ecosystem polluted by the effluent. Such elevated TSS levels in abattoir wastewater could be attributed to various solid waste materials from slaughtered animals.

The Dissolved Oxygen (DO) level of effluent from ACA and ICA (1.7±0.14 and 2.2±0.141 respectively)did not meet the safe level of not less than 5 mg/L for industrial wastewater discharged into rivers (FEPA, 1991) . This finding agrees with the study of Ogbonna and Ideriah (2014) though with different values. DO Concentrations below 5mg/L have a negative impact on biological life especially in aquatic habitat. Concentrations below 2mg/L may result in death for most fishes (Chapman, 1997). Low DO levels is directly linked to high level of Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). BOD and COD indicate the amount of organic matter present in the water (Okwute, 2007). High BOD and COD levels can deplete dissolved oxygen. The higher the BOD and COD levels in abattoir wastewater, the more organic material present.BOD levels in ACA wastewater effluent (1175±7.071 mg/L) andthat of ICA (1745±49.50 mg/L) as well as COD levels for both abattoirs (2663.5±4.95 and 2938.5±4.95 mg/L respectively) were marginally higher than the FEPA (1991) recommended limits for wastewater discharged into surface water.

Both BOD and COD are important physiochemical parameters that must be considered when evaluating quality and environmental impact of waste water discharged into the ecosystem (Chapman, 1997). Effluents with high BOD when discharged untreated into the ecosystem (especially water bodies such as rivers, streams, lakes) can lead to decreased dissolved oxygen (DO) levels in the water. Aquatic organisms rely on dissolved oxygen for respiration hence, very low DO levels couldbe fatal (Patil*et al*., 2012).

CONCLUSION

This study shows that most of the physiochemical parameters of waste water effluent from abattoirs are not within the safe limits, thus suggesting that the continuous discharge of waste water from abattoirs into the ecosystem (especially aquatic environment) is a source of pollution. Particularly worthy of mentioning is the increased Turbidity, TSS, BOD, COD and reduced DO that is caused by the discharge of this untreated abattoir waste water into natural water bodies. This could negatively impact the survival of organisms in that ecosystem.

It is therefore recommended that there should be a proper waste management plan designed for abattoir operations in Nigeria. Abattoirs should be made to abide by certain regulations that must be put in place by environmental regulatory bodies such as the Federeal Ministry of Environment.This should include but must not be limited to proper licensing of abattoirs, provision of Environmental Impact Assessment (EIA) for abattoirs and proposed methodsof abattoir waste treatment before discharge into the environment.There should also be public awareness and enlightenment on the possible impact of pollution from abattoir wastes by appropriate bodies.

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