

WORLD ENVIRONMENTAL CONSERVATION CONFERENCE 2023

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

*Proceedings of the 6th edition of World Environmental Conservation Conference
18th – 21st October, 2023*

EDITORS: Agele, S. O. (PhD), Balogun, I. A. (PhD), Oluleye, A. (PhD) and Oladeji S. O. (PhD)

Copyright © 2023 World Conservation Environmental Conservation Conference: “Reimagining Contemporary Environmental Conservation Issues in Sustainable Development Goals”.

All rights reserved: No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic magnetic tape, mechanical photocopying, recording or otherwise, without permission from the President, Netlink Environmental Conservation Organization (NECOR).

Production of Proceedings

Netlink Environmental Conservation Organisation
Room 21 Abubakar Adamu Building
Federal University of Technology, Akure.
Design and Printing of Proceedings
Maryj Printing Press
ACAD Fagbote Filling Station Akure-Ilesha Expressway
Phone number: +23407063411658

Copies of Proceedings

Dr. S. O. Oladeji
President, Netlink Environmental Conservation Organisation (NECOR),
Room 21 Abubakar Adamu Building
Federal University of Technology, Akure.
P. M. b. 704, Akure, Nigeria
E-mail: sooladeji@fita.edu.ng.
sooladeji@necorg.org
info@necorg.org.
www.necorg.org.
ISSN: 2705-2850

Scientific Review Committee

Prof. S. O. Agele- Chairman Scientific Committee
Department of Crop, Soil and Pest Management, FUTA
+2348035784751
soagele@futa.edu.ng

Prof. I. A. Balogun
Department of Meteorology,
Federal University of Technology,
Akure.
iabalogun@futa.edu.ng.

Prof. A. Oluleye
Department of Meteorology,
Federal University of Technology,
Akure.
aoluleye@futa.edu.ng.

Dr. S.O. Oladeji
Department of Ecotourism and Wildlife Management, FUTA.
Executive Director, NECOR
+2348030698896
sooladeji@futaedu.ng.
sooladeji@necorn.org

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.necorn.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 Rabi, 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

TABLE OF CONTENT

Cover Page	i
Preface	iv
Presented Scientific Papers	
CLIMATE CHANGE AND FOOD SECURITY: RISKS AND RESPONSES Olaifa K.A., Agbeja A.O., Akindolu D.R., Akinlade M.S. and Majolagbe M.O.	1-5
GENDER ANALYSIS OF FISH FARMERS' VULNERABILITY AND ADAPTABILITY TO CLIMATE CHANGE IN IDO LOCAL GOVERNMENT AREA OF OYO STATE Ajayi Olusina Tunde¹ Moyib, Taiwo Oluwasesan² Leramo Georgina Fiyinfoluwa³	6-12
GROWTH RESPONSE OF <i>Nauclea diderrichii</i> SEEDLINGS TO ORGANIC MANURE APPLICATION Majolagbe, M. O^{1*}, Ogunwande, O. A¹, Kazeem-Ibrahim, F¹, Olaifa K.A¹, Omidiran Mobolaji O¹, Dahunsi, O.M.²	13-17
ECOLOGICAL VARIATION AND VARYING WATERING REGIMES ON SEEDLING GROWTH PERFORMANCES OF <i>Annona muricata</i> L. Majolagbe, M. O^{1*}, Ogunwande, O. A¹, Williams O. A¹, Olaifa, K.A¹, Kazeem-Ibrahim, F¹, Alagbada O. R¹ and Dahunsi, O. M.²	18-22
URBAN HOME GARDEN PRACTICE AS BIODIVERSITY CONSERVATION STRATEGY IN BENIN CITY, EDO STATE, NIGERIA. Osadolor, N.	23-28
POTENTIAL RESOURCES AND PERCEPTION OF LOCAL COMMUNITIES TOWARDS MOUNTAIN TOURISM DEVELOPMENT: A CASE STUDY OF IYAMOPO MOUNTAIN IN IGBETI, OYO STATE, NIGERIA ¹Odewumi, O. S., ¹Odofin. M. L. and ²Obateru, F. B.	29-38
VALUE CHAIN ANALYSIS OF TILAPIA (<i>Oreochromis niloticus</i>) FOR SUSTAINABILITY AND INCLUSIVENESS OF COMMERCIAL Tilapia CAGE PRODUCTION IN OYAN RESERVOIR, OGUN STATE NIGERIA Olaniyi, A. A., Adeleke, M. L., Fagbenro O. A. and Ayodele I. S.	39-50
MORPHOLOGICAL VARIATIONS IN FRUITS AND SEEDS OF <i>Gambeyaalbida</i> (Don) IN SOUTHWESTERN, NIGERIA Aruwajoye, D. A and Ale, O.O	51-55
ASSESSMENT OF COLLAGEN COMPONENT OF NILE TILAPIA (<i>Oreochromis niloticus</i>) COLLECTED FROM IGBOKODA RIVER, SOUTH-WEST NIGERIA Akinola, J. M., Abidemi-iromini, O. A., and Igejongbon T. F.	56-60
SOIL MOISTURE VARIABILITY OF LAND USE SYSTEMS OF OAU, ILE IFE, SOUTHWESTERN NIGERIA Adewole, A. O.¹, Eludoyin, A. O.¹, Newete, S. W.² and Chirima, G. J.^{2*}	61-67
EMERGENCY PREPAREDNESS MEASURES ADOPTED BY FISH FARMERS TO CLIMATIC HAZARDS IN SOUTHWEST NIGERIA Ayodele T. Awolala¹, Taye T. Amos², O.O. Akinrinola³, D.O. Awolala⁴ and O.A.Thompson⁵	68-72

DETERMINANTS OF HOUSEHOLDS FISH FARMERS' VULNERABILITY TO CLIMATIC HAZARDS IN SOUTHWEST NIGERIA	73-78
Ayodele T. Awolala¹, Taye T. Amos², O.O. Akinrinola³, D.O. Awolala⁴ and O.A.Thompson⁵	
IMPACTS OF SMALLHOLDER FARM PRACTICES ON SOIL CARBON STORAGE POTENTIAL IN AN AGRICULTURAL LANDSCAPE	79-85
Fawole, O. A¹., Olunloyo, O. O²., Adesida, O. A²., Ibiyeye, D. E² and Smart, M. O²	
CLIMATE RISK MANAGEMENT STRATEGIES AMONG SMALLHOLDER FARMERS IN LAGOS STATE, NIGERIA	86-91
*Aminu, F. O., Morakinyo, A. F. and Balogun, E. O.	
BUILDINGS AND CLIMATE CHANGE: INTEGRATING SHADING DEVICES TO SOLAR SYSTEMS	92-98
Fashuyi, S. O.^{1*} & Owolabi, B. O.²	
SPECIES COMPOSITION OF ORNAMENTAL PLANTS IN SELECTED HORTICULTURAL GARDENS IN AKURE SOUTH AND NORTH LOCAL GOVERNMENT AREAS OF ONDO STATE, NIGERIA.	99-106
¹Alonge, O. V. ²Obateru, F. B. and ^{1*}Ogunjemite, B. G.	
DEVELOPMENT OF MATK MARKERS FOR <i>COLA GIGANTEA</i> A. CHEV IN AKURE FOREST RESERVE, ONDO STATE, NIGERIA	107-113
Lawal A.	
HOUSEHOLD PARTICIPATION IN THE CONSERVATION AND UTILIZATION OF NATURAL RESOURCES IN ONDO STATE, NIGERIA	114-122
Shotunde, M. D., Fasina, O. O. and Faloye, A. O.	
ECOSYSTEM CONSERVATION BENEFITS AND FUNCTIONALITY OF SMALLHOLDER AGRICULTURAL LAND USE SYSTEMS OF THE HUMID TROPICS	123-139
Ogunleye¹, Abel, Agele², Samuel & Bolarinwa, Ayodeji	
PHYSIOCHEMICAL ANALYSIS OF WASTE WATER EFFLUENT FROM AMAGBA AND IYANOMO COMMUNITY ABATTOIR IN BENIN CITY, EDO STATE	140-145
^{1,2*}Egharevba, MarvinEwaen.,¹Nwondo , Nonso.Shalom.,¹Uwadiae, Eseosa and ²Wokoma, FridayAdaba	
ASSESSING THE EFFECT OF LANDUSE /LAND COVER CHANGES ON CARBON EMISSION AND ABSORPTION: A CASE STUDY OF AKURE AIRPORT ONDO STATE NIGERIA	146-155
Ogunlade, Simeon Oluwole (PhD)	
FOOD AND FEEDING HABIT OF FLATHEAD GREY MULLET <i>MUGILCEPHALUS</i> (LINNAEUS, 1758) IN ILAJE COASTAL WATERS OF ONDO STATE, NIGERIA	155-160
Amadu, N. O.*, Abidemi-Iromini, A. O., Oladipupo, T. M.	
EVALUATION OF BAMBARA GROUNDNUT (<i>VIGNASUBTERRANEA</i> (L.) VERDC.) ACCESSIONS FOR YIELD PERFORMANCE IN THE RAINFOREST AND SAVANNA AGRO-ECOLOGIES OF NIGERIA	161-166
Sajo A. K*, Afolayan G. O. and Atoyebi O. J.	

REGIONAL IMPACTS OF AEROSOL RADIATIVE FORCING ON WEATHER AND CLIMATE EXTREME EVENTS IN WEST AFRICA ¹ Akinyoola A. Julius, ² Olueye A., and ² Gbode E. Imoleayo	167-171
ADAPTATION STRATEGIES FOR GROUNDWATER RECHARGE IN A CHANGING CLIMATE: AUCHICASE STUDY Oluseyi Adunola Bamisaiye* ^a	172-178
ANALYSIS OF HEAVY METALS QUALITY OF SURFACE WATER IN THE COASTAL AREAS OF MBO LGA., AKWA IBOM STATE Essang Mfonobong Shaineze ¹ and Adigun Adepoju Ibraheem ²	179-184
PRIORITIZATION OF PROTECTED AREA DEVELOPMENT IN THE ADJOINING COMMUNITIES TO IDANRE FOREST RESERVE, ONDO STATE, NIGERIA ¹ Grace Oluwatosin Amoo*, ¹ Martins Chibuzor Anyanwu	185-192
HOTEL LOCATION AS A KEY DETERMINANT OF HOTEL PERFORMANCE E .A. Akintade ^{1*} , O. O.Olowookere-Ayodele ² . O. B Gbadamosi ³	192-200
ANALYSIS OF LOCAL ECOLOGICAL KNOWLEDGE AND THREAT FACTORS OF TESTUDINE SPECIES IN THE RIVERINE AREAS OF ONDO STATE, NIGERIA Odewumi, O.S. and Eniomodun, I. E.	201-210
MITIGATING THE URBAN HEAT ISLAND EFFECT THROUGH GREEN BUILDING DESIGN IN IBADAN, NIGERIA Lawal, Kolawole Adebayo and OLAGUNJU, Deborah Kemi	211-219
PHYSICAL AND CHEMICAL PROPERTIES OF SOILS OF SELECTED FOREST RESERVES. OYO STATE, NIGERIA. ¹ Olusola, J. A., ² Adeduntan, S. A., ² Agbi, G. R. and ² Akinsuroju, S. D.	220-227
THE INFLUENCE OF CLIMATE CHANGE AND TOPOGRAPHY ON GROUNDWATER AVAILABILITY. Oluseyi Adunola Bamisaiye* ^a	228-233
MONITORING SOWING SEASONS AND WINDOWS FOR SUSTAINABLE SWEET PEPPER PRODUCTION IN OKITIPUPA COASTAL AGROECOLOGY Titilayo O. Oladitan	234-240
INTEGRATED ASSESSMENT MODELING OF CLIMATE CHANGE MITIGATION AND URBAN TREE PLANTING IN FUNAAB AND ITS ENVIRONS, NIGERIA ^{1,2} Ogunlade Babatunde, ¹ Oyerinde O. V., and ² Akande, S.O.,	241-251
ASSESSMENT OF FLOOD VULNERABILITY IN LAGOS STATE, SOUTHWESTERN NIGERIA. Aderotoye, D. A. and Akinbobola, A.	252-259
PERFORMANCE EFFICIENCY OF CONSTRUCTED WETLAND (CW) PLANTED WITH COMMON REED (<i>Phragmites australis</i>) IN THE TREATMENT OF GREYWATER IN AKURE, NIGERIA Alao, Femi ¹ (Ph.D), Olanrewaju, Olugbenga Olawale ¹ (Ph.D) and Oloruntade, Ajayi Johnson ² (Ph.D)	260-263
GREEN HYDROGEN: A SUSTAINABLE ENERGY SOLUTION IN NIGERIA Omeh O. W., Olanrewaju O. O. and Ajayi A. E.	264-269

ASSESSING FARMERS' USE OF CLIMATE CHANGE ADAPTATION PRACTICES AMONG YAM FARMERS IN OSUN STATE, NIGERIA Afolabi, O. O. and Arifalo, S. F.	270-275
AWARENESS OF WILDLIFE CONSERVATION PRACTICES IN HOST COMMUNITIES OF OLD OYO NATIONAL PARK, NIGERIA Olugbenga Mayowa AGBOOLA, Ph.D.	276-283
SIMULATION AND PROJECTION OF EXTREME PRECIPITATION OVERWEST AFRICA USING MULTIMODEL ENSEMBLE IN COUPLED MODELINTERCOMPARISON PROJECT PHASE MODELS (CMIP6) Odunmorayo, M. T.	284-291
INVESTIGATING THE SPATIO-TEMPORAL CLIMATOLOGY OF SAHELIAN RAINFALL OVER WEST AFRICA REGION Balogun, I. A. and Arowolo, A. V.	292-295
MODELLING THE IMPACT OF CLIMATE CHANGE ON OSUN OSOGBO SACRED GROVE Oladeji S. O., Lawal O. Y., Akande S. O. and Salami O. M.	296-304
AOD SPATIAL-TEMPORAL VARIABILITY OVER WEST AFRICA: AN EOF-BASED INVESTIGATION Ayomide Victor Arowolo	305-311
MODELLING THE IMPACTS OF CLIMATE CHANGE ON GROUNDWATER POTENTIAL ZONES IN NORTHERN NIGERIA ^{1,2}Raphael, A.E., ^{2,3}Akande, S.O., ³Akintola O.A, ¹Popoola, O.J., ^{2,3}Olajire, O.O., ^{1,4}Adeseko, A.A., and ²Aregbesola, O. J.	312-321
CLIMATE CHANGE IMPACT AND RISK ASSESSMENT OF LASSA FEVER PREVALENCE IN PART OF EDO AND ONDO STATES OF NIGERIA ¹Ibikunle, T.F., ²Akande, S.O., ³Olajire, O.O., ⁴Aderotoye D.A⁵ Abioye V.O	322-330
EFFECTS OF DROUGHT AND REHYDRATION ON THE GROWTH AND BIOCHEMICAL ATTRIBUTES OF CITRUS PROVENANCES: IMPLICATIONS FOR SEEDLING MORTALITY AND SURVIVAL Agele, Samuel; Sajo Adeola; Akinnagbe, Opeyemi & Oladele, Iyanuoluwa	331-341
MITIGATING THE CLIMATE CHANGE EFFECTS THROUGH TREE SPECIES CONSERVATION AND URBAN GREEN SPACE PLANNING IN AKURE, NIGERIA. ¹Abioye V. O., ²Akande S. O., ³Akinwonmi F. C.	342-351
ASSESSMENT OF URBAN HEAT ISLAND IN AWKA, ANAMBRA STATE Olajire Olabanji O.^{1&2}, Nwachukwu, Edmond I.^{2&3}, Akande Samuel O.¹, Akintola O. A., Balogun, I. A.²	352-365
BIODEGRADATIONTRAITS OF BIOPLASTICS BLENDS, LOW-DENSITY POLYETHYLENE, AND CELLULOSE IN TROPICAL SOIL UNDERCONTROLLED HOME COMPOSTING CONDITIONS ¹Dada, O. E. and ²Akintoye, P. O.	366-370

MODELLING SOIL LOSS AND IDENTIFICATION OF EROSION HOTSPOTS USING THE RUSLE MODEL AND MULTI-CRITERIA DECISION ANALYSIS IN ODO WATERSHED, ANAMBRA STATE *Olabanji Odunayo Aladejana¹; Ebimaro, Jessica Onuwamagbe¹	371-376
WILLINGNESS OF VISITORS TO PAY FOR INCREASED WILDLIFE POPULATION IN T. A. AFOLAYAN WILDLIFE PARK AND OBAFEMI AWOLOWO UNIVERSITY ZOO *Adetola, B. O. and Atansuyi A. P.	377-388
ASSESSMENT OF STRUCTURAL INTERVENTION FOR FLOOD MANAGEMENT IN THE CORE OF AKURE, NIGERIA *Afolami, A. J.¹, Owolabi, B. O.² & Salaudeen, O. A.¹	389-395
PERFORMANCE EVALUATION OF LANDSAT 8 AND SENTINEL 2A FOR SURFACE WATER AREA MAPPING AT A LOCAL SCALE: A CASE STUDY OF ISE FOREST RESERVE, NIGERIA *Olaniyi, O. E., Komolafe I., Ajayi, S. R., Aderonmu E. A., and Adeola, A. J.	396-404
INVESTIGATION OF PHYSICO-CHEMICAL WATER QUALITY OF FISH FARM IN FEDERAL UNIVERSITY OF TECHNOLOGY AKURE, NIGERIA *¹Aderonmu E. A, Aderonmu O. A² and Akinbuwa O³.	405-410
ASSESSMENT OF NOISE POLLUTION AND THE POTENTIAL HEALTH EFFECTS ON MARKETERS' IN ARAKALE ROAD, AKURE, NIGERIA. *Adewale James Afolami¹, Kolawole Opeyemi Morakinyo², David Tonaoluwa Akinloye¹, & Oluwatimilehin Ayobami Adeyemi¹	411-422
ECOLOGICAL IMPACT OF GRANITE QUARRYING ACTIVITIES ON VEGETATION IN TWO QUARRY SITES IN AKURE, ONDO STATE, SOUTHWESTERN NIGERIA ¹Agbede, I.K.; ²Muoghalu, J.I, ¹Agbede, Y. E.	423-435
EFFICACY OF TANNIN EXTRACT FROM CAPE GOOSEBERRY ROOT <i>Physalisperuviana</i> AS EGG DE-ADHESION AGENT DURING ARTIFICIAL PROPAGATION OF AFRICAN CATFISH <i>Clariasgariepinus</i> Alo, O. F.¹; Adebayo, O.T.¹	436-444
GENDER DIFFERENTIALS IN THE ADAPTATION STRATEGIES EMPLOYED BY YAM FARMERS IN COMBATING CLIMATE CHANGE IN KWARA STATE, NIGERIA Ayodele Omowunmi Veronica¹ and Ayodele Omotayo Samuel²	445-451
NUTRIENT ASSESSMENT AND FERTILITY CAPABILITY CLASSIFICATION OF SOILS IN RAIN FOREST AGROECOLOGICAL ZONE OF SOUTHWEST NIGERIA Fawole, O. A¹., Olunloyo, O. O²., Smart, M. O²., Adesida, O. A²., Ibiyeye, D. E² and Isola, J. O²	452-458
ASSESEMENT OF CLIMATE CHANGE EFFECTS ON TOMATO YIELD IN EDO STATE, SOUTH SOUTHERN NIGERIA Olotu, Y.¹, Ikhazuagbe, O.², Rodiya, A.A.³ and Olarinde, O.⁴	459-470
THE UTILITY OF PARTICIPATORY GEOGRAPHIC INFORMATION SYSTEM FOR ASSESSING COMMUNITY-LEVEL RESILIENCE TO FLOOD DISASTERS Felix N. BUBA* and Tobie C. MBARGA MBARGA**	471-477
ADOPTION OF CUSTOMIZED BIODEGRADABLE MULCH FILMS FOR ADVANCING FOOD SECURITY AND SAFETY IN NIGERIA *Dada, Omotola Esther, Omotoriogun Taiwo Crosby, and Osulale, Olayinka Olayemi	478-482

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

^{1,2*}Egharevba, MarvinEwaen.,¹Nwondo, Nonso.Shalom.,¹Uwadiae, Eseosa and ²Wokoma, FridayAdaba

¹ Department of Biological Sciences (Biochemistry Unit), Faculty of Science, Benson Idahosa University, P.M.B 1100, Benin City, Edo State.

² Department of Biochemistry, Faculty of Science, University of Port Harcourt, Rivers State .

*Corresponding author: ewynilla@gmail.com, eegharevba@biu.edu.ng

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 Dissolved Solids-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, TDS and Salinity of waste water effluents from both abattoirs studied, were within FEPA limits. Other physiochemical parameters such as TSS ($62.165 \pm 13.18 \text{ mg/L}$ for ACA and $252.2 \pm 2.40 \text{ mg/L}$ for ICA), Turbidity ($750.5 \pm 0.707 \text{ NTU}$ for ACA and $1194 \pm 2.83 \text{ NTU}$ for ICA), BOD ($1175 \pm 7.071 \text{ mg/L}$ for ACA and $1745 \pm 49.50 \text{ mg/L}$ for ICA), COD ($2663.5 \pm 4.95 \text{ mg/L}$ for ACA and $2938.5 \pm 4.95 \text{ mg/L}$ for ICA) and DO ($2.2 \pm 0.141 \text{ mg/L}$ for ACA and for $1.7 \pm 0.14 \text{ mg/L}$ 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. Majority of 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 ecosystem, abattoir waste water are 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.

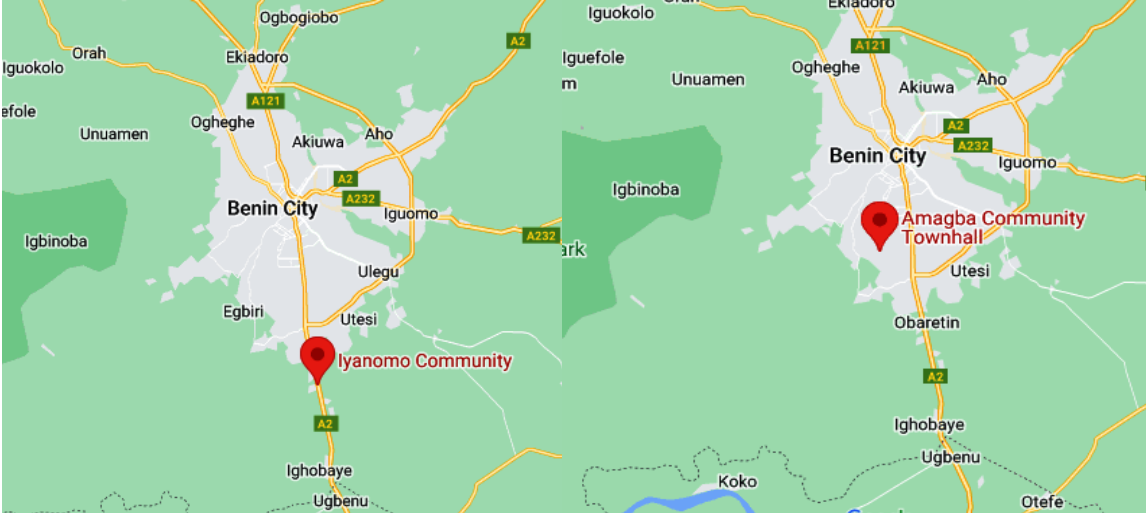


Figure 1.0: Iyanomo and Amagba Community Locations (Google Maps© 2023)

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;

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

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;

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

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:

$$DO \text{ (mg/L)} = [16000 \times M \times V] / [V2/V1 (V1-2)] \dots\dots\dots(3)$$

Where

M = Molarity of thiosulphate 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.

$$BOD \text{ (mg/L)} = [DO1-DO0] / B \dots\dots\dots(4)$$

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:

$$COD \text{ (mg/L, as O}_2\text{)} = \frac{(\text{Blank Titre} - \text{Sample Titre}) \times \text{Molarity of FAS} \times 8000}{\text{Sample Volume}} \dots\dots\dots(5)$$

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 ArgentometricTitrimetricMethod

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.

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

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 \pm 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 Dissolved 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 \pm 0.007	7.2 \pm 0.022	6.0-9.0
Total Dissolved Solids(TDS)	mg/L	335 \pm 1.414	582.5 \pm 0.71	<2000
Dissolved Oxygen(DO)	mg/L	2.2 \pm 0.141	1.7 \pm 0.14	>5.00
Total Suspended Solids (TSS)	mg/L	62.165 \pm 13.18	252.2 \pm 2.40	<30
Turbidity NTU	NTU	750.5 \pm 0.707	1194 \pm 2.83	1.00-150.00
Biochemical Oxygen Demand (BOD)	mg/L	1175 \pm 7.071	1745 \pm 49.50	<50
Chemical Oxygen Demand (COD)	mg/L	2663.5 \pm 4.95	2938.5 \pm 4.95	<80
Salinity(Chloride)	mg/L	78.52 \pm 1.457	93.87 \pm 0.827	< 600

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

Values are expressed as Mean \pm 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 were 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 were 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 by Ogbonna 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). Effluents having pH levels outside safe limits can stress aquatic organisms, altering their capability to survive (Ogbiyeet *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) and that 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 could be fatal (Patilet *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 Federal 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 methods of 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.

REFERENCES

- Agwa, O.K., Neboh, H.A., Ossai-Chidi, L.N. and Okoli, M.C. (2014). Cultivation of microalgae using cassava wastes as a growth media. *Journal of Algal Biomass Utilization*. 5 (2): 8-19.
- APHA. (2017). American Public Health Association, American Water Works Association, Water Environment Federation, Standard methods for the examination of water and wastewater
- Arimoro, F.O. and Ikomi, R.B. (2008). Response of macro invertebrate communities to abattoir wastes and other anthropogenic activities in a municipal stream in the Niger Delta, Nigeria. *The Environmentalist*. 28 (2): 85-98.
- Chapman, L.J. (1997). Papyrus swamps and faunal diversification: Geographical variation among populations of the African cyprinid *Barbus neumayeri*. *Journal of Fish Biology*. 54: 310-327.
- Cooper, R.N., Hoodle, J.R. and Russel, J.M. (2009). Characteristics and treatment of slaughterhouse effluent in New Zealand. *Progress in water technology*. 11 (8): 55-68.
- Federal environmental protection agency (FEPA) (1991). National Interim Guidelines and Standard for industrial effluents, gaseous emission and hazardous waste management in Nigeria. 3-7.
- Gupta, D. P., Sunita and J. P. Saharan. (2009). Physicochemical Analysis of Ground Water of Selected Area of Kaithal City (Haryana) India, *Researcher*. 1(2): 1-5.
- Mittal, G.S. (2006). Treatment of wastewater from abattoir before land-application. *Bio-resource Technology*. 97 (7): 1119-1135.
- Ogbiye, A.S. and Omole, D.O. (2013). An evaluation of slaughterhouse wastes in south-west Nigeria. *American Journal of Environmental Protection*. 2 (3): 85-89.
- Ogbonna, D. N. and Ideriah, T. J. K. (2014). Effect of Abattoir Waste Water on Physicochemical Characteristics of Soil and Sediment in Southern Nigeria. *Journal of Scientific Research & Reports*. 3(12): 1612-1632.
- Okwute, L.O. (2007). The environmental impact of palm oil mill effluent (pome) on some physico-chemical parameters and total aerobic bioload of soil at a dump site in anyigba, Kogi State, Nigeria. *African Journal of Agricultural Research*. 2: 656-662.
- Omole, D.O. and Longe, E.O. (2008). An assessment of the impact of abattoir effluents on River Illo, Ota, Nigeria. *Journal of Environmental Science and Technology*. 1 (2): 56-54.
- Patil, P.N., Sawant, D.V. and Deshmukh, R.N. (2012). Physio-chemical parameters for testing of water. *International Journal of Environmental Sciences*. 3 (3): 1194-1207.
- United States Environmental Protection Agency (USEPA) (1996). Method 3630C, Silica Gel Cleanup, Washington: US EPA.