

**ASSESSMENT OF THE IMPACT OF LAFENWA MARKET WASTE ON THE
ZOOPLANKTON AND PHYTOPLANKTON DIVERSITY IN OGUN RIVER,
ABEOKUTA, OGUN STATE, NIGERIA**

BY

ALARA FOLASADE ABIDEMI

B. Sc. (ZOOLOGY)

SCP10/11/R/0012

**A THESIS SUBMITTED TO THE INSTITUTE OF ECOLOGY AND
ENVIRONMENTAL STUDIES, OBAFEMI AWOLOWO UNIVERSITY, ILE-IFE,
NIGERIA, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE
AWARD OF THE DEGREE OF MASTER OF SCIENCE DEGREE IN
ENVIROMENTAL CONTROL AND MANAGEMENT.**

2014

CERTIFICATION

This research project was supervised and approved in accordance with the partial fulfilment for the award of Master of Science (M.Sc.) Degree in Environmental Control and Management, ObafemiAwolowo University, Ile-Ife, Nigeria.

Prof. I. E. Ofoezie
(Supervisor)

Date

Prof. A.A. Awotoye
Director

Date

DEDICATION

I dedicated this work to God almighty, my creator, the one that knows the beginning and the end of this research work and has never cease to be there for me

AND

To my ever supportive parents, Mr and Mrs J.O Alara. You are the best

ACKNOWLEDGEMENTS

My profound appreciation goes to my supervisor, Prof. I.E. Ofoezie, for his untiring assistance rendered to me and his rigorous corrections made during the course of this research work. I am sincerely grateful sir.

I also appreciate my director Prof. O.O. Awotoye, and all my lecturers Dr. M.B. Adewole, Dr. A.A. Okoya, Dr.Omodanisi, Dr.Kayode for their assistance and impacting more knowledge into me

To my wonderful parents Mr and MrsAlara and lovely siblings Funmilayo, Bukola, Yewande, Monisola and Frances thank you very much for your unending word of encouragement, prayers and financial support. I love you all.

My gratitude also goes to Mr.Akinola of Central Science Laboratory, Mr.Aduwo of Zoology Department, Mr.Olayiwola chairman canoe drivers, Ogun River and to all the technologist of central science laboratory and zoology department for dedicating their time and energy to me during the course of this research work.

I want to appreciate my friends David Ossai, Ife Daramola, AdelabiOlolade, TomiOjo and colleagues especially AdesanyaMicheal and OlorunfemiTitilayo for always being there for me and never letting me down. I really appreciate you guys.

And to everyone that their names has not been mentioned and has contributed immensely to the successful completion of this research work. Thank you all very much

TABLE OF CONTENTS

TITLE PAGE	i
CERTIFICATION	ii
DEDICATION	iii
ACKNOWLEDGEMENT	iv
TABLE OF CONTENTS	v
LIST OF TABLES	xi
LIST OF FIGURES	xiv
ABSTRACT	xvi
CHAPTER ONE: INTRODUCTION	1
1.1 Background of the Study	1
1.2 Specific Objectives of the Research	3
1.3 Statement of the Research Problem	3
1.4 Expected Contributions to Knowledge	3
CHAPTER TWO: LITERATURE REVIEW	4
2.1 Socio-Economic Importance of Markets	4
2.2 Effect of Waste on Freshwater Bodies	4
2.2.1 Types of waste	6

2.2.1.1 Effluent	6
2.2.1.2 Solid waste	6
2.3 Water Quality	7
2.3.1 Water quality degradation	8
2.3.1.1 Human processes affecting water quality	8
2.3.1.2 Natural processes affecting water quality degradation	8
2.4 Planktons	9
2.4.1 Zooplankton	9
2.4.2 Phytoplankton	11
2.5 Physical Parameters of Water	13
2.5.1 Water temperature	13
2.5.2 Transparency	14
2.5.3 Odour	14
2.5.4 Total solid	14
2.5.5 Total dissolved solids (TDS)	15
2.5.6 Total suspended solids (TSS)	15

2.6 Chemical Parameter	16
2.6.1 Hydrogen ion concentration (pH)	16
2.6.2 Alkalinity	16
2.6.3 Acidity	17
2.6.4 Electrical conductivity (EC)	17
2.6.5 Hardness	18
2.6.6 Total organic matter	18
2.7 Major Ions	18
2.7.1 Calcium	18
2.7.2 Magnesium	19
2.7.3 Potassium	19
2.7.4 Chloride	20
2.7.5 Sulphate	20
2.8 Oxygen Parameters and Nutrient Compounds	20
2.8.1 Dissolved Oxygen	20
2.8.2 Biochemical Oxygen Demand	21
2.8.3 Nitrate	21

2.9 Waste Effects on Planktons	23
CHAPTER THREE: MATERIALS AND METHODS	24
3.1 Description of Study Area and Location	24
3.2 Market Survey Analysis	24
3.3 Sampling Collection and Field Determination	25
3.4 Physico-chemical Analysis of Water Samples	27
3.4.1 Physical parameters	27
3.4.3 Plankton analysis	27
3.4.3.1 Calibration of microscope	27
3.4.3.2 Construction of plankton counting chamber	27
3.4.3.3 Identification of phytoplankton and zooplankton species	27
3.4.3.4 Estimation of zooplankton and phytoplankton abundance	32
3.5 Statistical Analysis of Data	32
CHAPTER FOUR: RESULTS	33
4.1 Demographic Characteristics of Respondents	33

4.2 Distribution of Waste Type by Goods and Services	33
4.3 Pattern of Waste Disposal by Good and Services	36
4.4 Spatial Variations in Physical Parameters	38
4.5 Chemical Parameters of Water Quality	39
4.6 Major Ions	44
4.7 Oxygen Parameters and Nutrients Compounds	44
4.8 Mean Seasonal Variations in Physical-chemical, Major Ions and Oxygen Parameters	51
4.9 Taxonomic Composition and Outline of Recorded Phytoplankton	58
4.10 Taxonomic Composition and Outline of Recorded Zooplankton	78
4.11 Mean Density of Phytoplankton in the River	85
4.12 Phytoplankton Diversity Indices (Dominance, Shannon, Evenness, Margalef) at Different Stations in Ogun River (March-December 2012)	96
4.13 Relationship between Physico-chemical Water Quality Parameters and Phytoplankton	99
4.14 Mean Density of Zooplankton in the River	102
4.15 Zooplankton Diversity Indices (Dominance, Shannon, Evenness, Margalef)	

at Different Stations in Ogun River (March-December 2012)	107
4.16 Relationship between Physico-chemical Parameters of Water Quality and Zooplankton	110
CHAPTER FIVE: DISCUSSION	112
5.1 Waste Generated and Pattern of Waste Disposal	112
5.2 Physico-chemical Parameters	112
5.3 Phytoplankton	114
5.4 Zooplankton	115
CHAPTER SIX: CONCLUSION	117
REFERENCES	119
APPENDICES	130

LIST OF TABLES

Table	Page
3.1 Methods for the physical analysis of water quality parameters	38
3.2a Titrimetric methods used in the chemical analyses of water quality Parameters	29
3.2b Instrumentation methods used in the chemical analysis of water quality parameters	30
3.3 Results of the calibration of the microscope	31
4.1 Demographical Analysis of Respondents in the Market	34
4.2 Distribution of Goods Sold in Relation to Measured Waste Weight in the Market within 6 Days by Sector and Types of Waste Generated	35
4.3 Methods of Waste Disposal by Respondeen	37
4.4 Mean Variation in Physical Parameters at the Sampling Sites (All seasons combined)	41
4.5 Mean Variations of Chemical Parameters at the Sampling Sites (All seasons)	42
4.6 Mean Variations in Major Ions (Cations and Anions) at the Sampling Sites (All seasons)	45
4.7 Mean Variation in Oxygen Parameters and Nutrient Compound at the Sampling Sites (All Seasons)	46

4.9a Phytoplankton Species Classification	59
4.9b Phytoplankton Species Diagnostic Characteristics	62
4.10a Zooplankton Species Classification	79
4.10b Zooplankton Species Diagnostic Characteristics	80
4.11a Mean Variation of Phytoplankton in the Sampling Sites (Org/m ³)	89
4.11b Mean Variation of Phytoplankton at the Upstream, Market, Downstream (Org/m ³)	92
4.11c Mean Seasonal Variation of Phytoplankton of the Water Quality (Org/m ³)	94
4.12a Species Dominance	97
4.12b Shannon Weaner	97
4.12c Species Evenness	97
4.12d Margalef Species Richness	98
4.13 Correlation Coefficient (r) Values between Physico-chemical Parameters and Phytoplankton Species	100
4.14a Mean Variation of Zooplankton in the Sampling Sites (All seasons combined) (Org/m ³)	104
4.14b Mean variation of Zooplankton at the Upstream, Market and Downstream (Org/m ³)	105

4.14c Mean Seasonal Variation of Zooplankton of the Water Quality (Org/m ³)	106
4.15a Species Dominance	108
4.15b Shannon Weaner Index (H^1)	108
4.15c Species Evenness (j)	108
4.15c Margalef Species Richness (d)	109
4.16 Correlation Coefficient (r) Values between Physico-chemical Parameters and Zooplankton Species	111

LIST OF FIGURES**Figure**

3.1 Map of Ogun State Showing Location of Sampling Sites	26
4.1 Mean Variation in Temperature, Depth, Transparency, Turbidity, Conductivity, at Upstream, Market and Downstream	47
4.2 Mean Variation in TS, SS, TDS, TOC, TOM, Odour at Upstream, Market and Downstream	48
4.3 Mean Variation in pH, Acidity, Alkalinity, Hardness, DO, BOD ₅ at Upstream, Market and Downstream	49
4.7 Mean Variation in Ca ²⁺ , Mg ²⁺ , Na ⁺ , Cl ⁻ , SO ₃ ²⁻ and NO ₃ ⁻ at Upstream, Market and Downstream	50
4.8a Mean Seasonal Variation in Temperature, Depth, Transparency, Turbidity, and Conductivity	54
4.8b Mean Seasonal Variation in TS, SS, TDS, TOC, TOM and Odour	55
4.8c Mean Seasonal Variation in pH, Acidity, Alkalinity, Hardness, DO and BOD ₅	56
4.8d Mean Seasonal Variation in Ca ²⁺ , Mg ²⁺ , Na ⁺ , Cl ⁻ , SO ₃ ²⁻ and NO ₃	57
4.9a Bacillariophyta Species	66

4.9b Chlorophyta Species	69
4.9c Cyanophyta Species	72
4.9d Dinophyta Species	74
4.9e Euglenophyta Species	75
4.9f Rhodophyta Species	76
4.9g Chrysophyta Species	77
4.10a Rotifera Species	81
4.10b Copepoda Species	82
4.10c Insecta Species	83
4.10d Cladocera Species	86

ABSTRACT

This study investigated types of waste generated and patterns of waste disposal in relation to activities in Lafenwa market, Abeokuta, Ogun State, Nigeria. It also characterised the abundance of plankton species and physico-chemical properties in the adjoining Ogun River. This was with a view to determining the impact of market waste on the physico-chemical and biological quality of the receiving river.

A preliminary survey of the market was carried out to determine patterns of daily activities in different sectors of the market. A structured questionnaire was administered on 5% of randomly selected individuals from each sector to collect information on the type of waste generated, and patterns of disposing such waste. Polythene bags were assigned to each selected individual to collect waste generated for six consecutive days. The bags were retrieved each morning and waste weighed using a standard weighing balance. Plankton samples were collected from eight sampling stations (two upstream, three within the market, and three downstream) once every three months for 12 months and analysed for plankton species diversity and number. Twenty litres of each water sample was strained through a fine meshed plankton net (mesh size = 45 μm) to a concentrate volume of 30 ml and preserved with 5% formalin solution. Water samples for the analysis of physico-chemical properties were collected in 2-L plastic bottles and returned to the laboratory and analysed using both instrumentation and non-instrumentation methods. Data were analysed using ANOVA and correlation coefficient.

Ninety-nine of 150 selected respondents (66.0%) disposed their waste directly to dumpsite and 22.7% directly to Ogun River. The major types of waste generated were polythene, vegetables, food waste, smoke/ashes, paper/carton, waste water and chaff. Rice milling sector generated the heaviest mean waste weight of 1,527.5 kg and saloon sector the least (6.95 kg).

The differences were statistically significant at $p < 0.05$. Seven genera and thirty-seven species of phytoplankton recorded were Bacillariophyta and Chlorophyta (14 species each), Cyanophyta (5 species), Chrysophyta, Dinophyta, Euglenophyta, and Rhodophyta (1 species each). The most abundant phytoplankton was *Skeletonemacostatum* ($54.68 \pm 19.49 \text{ org/m}^3$), while the least was *Gyrosigmafasciola* ($1.56 \pm 1.56 \text{ org/m}^3$). Similarly, four genera and 10 species of zooplankton were recorded namely, Rotifers (4 species), Copepoda (3 species), Insecta (2 species), and Cladocera(1 species). The most abundant zooplankton were *Chaoborus* sp ($31.25 \pm 10.4 \text{ org/m}^3$), while the least was *Eudiaptomus* sp ($4.69 \pm 2.62 \text{ org/m}^3$). Phytoplankton species abundance decreased from upstream to downstream while zooplankton followed an inverse direction. The peak abundance of biological indicators of pollution (*Oscillatorias* sp $87.5 \pm 37.5 \text{ org/m}^3$, *Nitzchias* sp $62.5 \pm 36.29 \text{ org/m}^3$, *Brachionusdimidiatus* $41.67 \pm 14.86 \text{ org/m}^3$ and *Euglena* sp $6.25 \pm 6.25 \text{ org/m}^3$) was recorded at the market area while the least upstream ($29.17 \pm 37.5 \text{ org/m}^3$, $33.33 \pm 17.77 \text{ org/m}^3$, $0 \pm 0 \text{ org/m}^3$, $4.17 \pm 4.17 \text{ org/m}^3$) respectively. Mean biochemical oxygen demand ranged from $2.90 \pm 0.40 \text{ mg/l}$ (upstream) to $6.80 \pm 1.92 \text{ mg/l}$ (market) while the dissolved oxygen ranged from $3.80 \pm 0.41 \text{ mg/l}$ (upstream) to $5.00 \pm 0.73 \text{ mg/l}$ (market). The correlation coefficients showed both negative and positive statistical significance between plankton species and some physico-chemical parameters.

The study concluded that the peak abundance of biological indicators of pollution at the market area was a clear indication of pollution due to direct waste disposal to the river.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Man in an attempt to satisfy his daily needs, engages in the production of goods and services, in the process waste is generated. Man has always generated waste materials which are either by-products of his activities, for which he could not find any use, or products which have reached the end of their useful life (Syed, 2006). Although this has been the trend throughout the ages, it was seen not as a problem until recently when human production wastes seem to have surpassed natural purification processes. Nature has the capacity to deal with waste through dispersion, dilution and degradation processes. For instance, wastes dumped into rivers are washed away quickly and diluted to a point where they constitute no threat to water quality. Also wastes left on land, decay by spontaneous chemical and physical degradation processes. However, as the dump persists in quantity and frequency, natural balance becomes adversely affected. This is because the natural degradation processes are slow and can take care of only limited amounts and specific kinds of wastes (Syed, 2006). Many items considered as waste include household rubbish, sewage sludge, packaging items, discarded cars, old television sets, garden waste, old paint containers etc. These are generally classified as commercial, municipal, manufacturing, construction and demolition, electrical and electronic and agricultural waste depending on their origin. Wastes from market are very variable because nearly all materials are sold and bought in different markets. Market waste may either be biodegradable e.g vegetable, food waste, paper, cardboard, animal, and wood waste e.t.c, or non-biodegradable for example, tyres, plastic, electronic component, polythene nylon and metals e.t.c.

In Nigeria, there are several markets which generate all kinds of waste, most of which are disposed off indiscriminately into drainage systems, dumpsite or nearby water body. According to Eludoyin *et al.*, (2004) various types of waste generated from Oja titun market include fresh vegetable, plastic bags, animal dung, decaying food stuff, metal scraps, meat waste, and waste water from grinding and washing of various items. Lafenwa market is also one of the numerous markets in Nigeria that engages in all kinds of trading activities such as food stuff, tailoring, abattoir, vegetables, fruits, electrical and electronics appliances e.t.c, each of these generate different types of waste ranging from polythene, plastics, cans, papers, vegetables, fruits, decayed food, electrical, and meat waste. These are mostly disposed off into dumpsites, an adjoining river or directly into the river (Olalekan *et al.*, 2012). Dumping of waste into water bodies has the potential to seriously affect the natural characteristics of the river. For instance abattoir waste produces large amounts of suspended solid, liquid waste and odour generation in water bodies (Gauri, 2006). The ecological implications of waste disposal into surface water such as rivers include alteration of water quality parameters from environmental background levels which in turn result in upsetting the ecological equilibrium of water bodies and exerting acute toxic and chronic effects on resident organisms. Chemical toxicants directly and/or indirectly affect the life processes of flora and fauna of a water body (Kumari *et al.*, 2006; Krishnan *et al.*, 2007). Planktons are very sensitive to the environment they live in and any alteration in the environment leads to change in the plankton communities in terms of tolerance, abundance, diversity, and dominance in the habitat. Therefore, plankton population observation maybe used as a reliable indicator for bio-monitoring studies to assess the pollution status of aquatic environment. The planktons comprises of microscopic plants and animals known as phytoplankton and zooplankton respectively. They are the primary producers and consumers in water, and are therefore very essential for the maintenance of population stability in the aquatic

environment. Their growth, distribution and abundance area affected by some biotic and abiotic factors such as temperature, salinity, food availability, predation, competition, and presence of hazardous substances (Beyst *et al.*, 2001). Thus changes in these factors will affect their ecological balance. Since waste dump in water which may be biodegradable or hazardous can facilitate changes in the physico-chemical properties of water as well as factors that affect planktons in water. Therefore, it is important to determine the type of waste potentially dumped in rivers and its effects on planktons and water quality. Hence, this study was designed to determine the effect of waste from Lafenwa market on the plankton of Ogun River.

1.2 Specific Objectives of the Research:

The specific objectives of the study are to:

- (a) determine the types of waste generated in Lafenwa Market;
- (b) determine the pattern of waste disposal in the market;
- (c) characterize the abundance of plankton species in the river water, upstream and downstream Lafenwa Market;
- (d) characterize the physico-chemical properties of the river; and
- (e) examine the relationship between plankton diversity and physico-chemical quality of the river water.

1.3 Statement of the Research Problem:

Dumping of waste in flowing water has detrimental effect on the chemical and biological characteristics of receiving waters. Municipal wastes are biodegradable and may contain hazardous substances that may affect plankton species diversity and distribution. Information on the effect of waste generated from Lafenwa market on the biological quality of the receiving Ogun River in Abeokuta, Ogun State, Nigeria is not readily available, hence this study.

1.4 Expected Contributions to Knowledge

The study will provide information on waste generation and management in the study area, and the effect of these wastes on the biological quality of Ogun River

For more information, please contact ir-help@oauife.edu.ng

OBAFEMI AWOLOWO UNIVERSITY