CONSEQUENCES OF PETROLEUM POLLUTION ON EYES OF NIGER DELTA INHABITANT- A CASE STUDY OF OGBITE COMMUNITY IN OGBA/EGBEMA NDONI LOCAL GOVERNMENT AREA OF RIVERS STATE

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AUGUST, 2023.

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A RESEARCH THESIS WRITTEN IN THE DEPARTMENT OF OPTOMETRY AND SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTERS IN OCULAR HEALTH OF THE UNIVERSITY OF BENIN, BENIN CITY

DEPARTMENT OF OPTOMETRY
FACULTY OF LIFE SCIENCES
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AUGUST, 2023

CERTIFICATION AND APPROVAL

This is to certify that this project work titled "**CONSEQUENCES OF PETROLEUM POLLUTION ON EYES OF NIGER DELTA INHABITANT- A CASE STUDY OF OGBITE COMMUNITY IN OGBA/EGBEMA NDONI LOCAL GOVERNMENT AREA OF RIVERS STATE"** was carried out by Celestine Chukwuma Okoye, in partial fulfillment of the requirements for the award of Masters in Ocular Health, in the Department of Optometry, University of Benin, Benin City.

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LETTER OF CERTIFICATION

This is to certify that CELESTINE CHUKWUMA OKOYE with Matriculation Number PG/LSC9500520 with research topic "**CONSEQUENCES OF PETROLEUM POLLUTION ON EYES OF NIGER DELTA INHABITANT- A CASE STUDY OF OGBITE COMMUNITY IN OGBA/EGBEMA NDONI LOCAL GOVERNMENT AREA OF RIVERS STATE"** has been seen ad approved by me.

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DEDICATION

This project work is dedicated to the Almighty God for his mercies and grace to begin and complete this arduous task.

ACKNOWLEDGEMENT

I wish to express my profound gratitude to my project supervisor for his guidance, counselling and for taking his time out to read through my manuscript. My thanks go to my parents, Chief and Mrs Ben Obi Okoye for their support and prayers. I want to say a big thank you to all the lecturers and staff of Optometry Department, University of Benin.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

BOD	–	Biochemical Oxygen Demand
COD	-	Chemical Oxygen Demand
pH	-	Potential Hydrogen
EC	-	Ethylene Carbonate
Sal	-	Salinity
Col	-	Colour
Turb	-	Turbidity
EIA	-	Environmental Impact Assessment (Not EIA – Enzyme immunassay!)
EPA	-	Environmental Protection Agency
Org C	-	Organic Chemicals
Org M	-	Organic Mineral Substances
TN	-	Total Nitrogen
TSS	-	Total Suspended Solid
TDS	-	Total Dissolved Solids
TOC	-	Total Organic Carbon
HCO_3	-	Carbonate
Na	-	Sodium
Potassium		K^+
Ca^{++}	-	Calcium
Mg	-	Magnesium
P	-	Phosphorus
Cl	-	Chlorine
Fe	-	Iron
Mn	-	Manganese
Zn	-	Zinc
Cu	-	Copper
Cr	-	Chromium
Cd	-	Cadmium
Ni	-	Nickel
Pb	-	Lead
V	-	Vanadium
No_2	-	Nitrite
NO_3	-	Nitrate
NH_4N	-	Ammonium
SO_4	-	Sulphate

ABSTRACT

The Niger Delta region, located in the Atlantic coast of southern Nigeria is an area covering about 70000km^2 (27000 square miles). More than 25% of Nigeria's population inhabit this region profoundly rich in petroleum resources- crude oil, natural gas, asphalt and tar. Exploration and exploitation of these petroleum resources have downgraded the diversified environment of the region whose consequence is pollution due to 4200 oil spillages and 250 gas flaring sites. The aim of this study was to investigate the impact of petroleum exploration and exploitation induced air, soil and water pollution on the eyes of the inhabitants of the Ogbite community in Rivers state of the region. This research is a cross sectional investigative study which investigated petroleum explorative and exploitational processes producing hazardous chemicals induced oculovisual perturbations. With a sample size of 115 respondents, data collected were subjected to statistical package for social sciences (SPSS) version 22.0 to highlight compromises of the oculovisual tissues of the Ogbite community.
Descriptive statistics were presented in the form of pie chart tables, bar charts and graphs. The relationship between petroleum pollution and consequences on the eye were explored using Pearson's chi-square test and statistical relevance of $P<0.05$. The findings indicated huge external adnexia perturbations, indicating compromise of the oculovisual tissues of the people of Ogbite Community which included visual perceptual description, external examinations, internal examination, signs and symptoms presented and environmental impact assessment of water and soil. Visual acuity at distance showed 54 (47%) $\pm$ 2.836 from 6/24 to no light perception while 61 (53%) $\pm$ 2.901 had visual acuity of 6/5 to 6/18. For near v.a N5-N10 had 61(53%) and N12-N24 had 19 (16.5%) and 28(24.35%). were uncooperative Visual perceptual description showed: blur vision 48 respondents (41.74%) $\pm$ 2.121, cloudy/hazy vision 15 (12.18%) $\pm$ 0.726 and 50 (43.37%) $\pm$ 2.025 had normal vision. External examinations had pterygium 20(17.4%) $\pm$ 2.121 red eyes/ redness 16(13.90%) $\pm$ 1.41. The total number of respondent with external problems were 60(52.17%) which included penguecula, conjunctivitis, allergic conjunctivitis, corneal ulcer and chalazion. Internal examination indicated cloudy/opaque media 19(16.52%)$\pm$2.038, age related macular degeneration 19(16.52%) $\pm$2.038. Signs and symptoms presented include: tearing 35(30.43%) $\pm$ 2.076, foreign body sensation 30 (26.09%) $\pm$ 2.037, pain 30(26.09% $\pm$ 2.037), itching 25 (21.74%) $\pm$ 0.707 and headache 19 (16.52%) $\pm$ 0.508.
For water samples, RV1 had high iron, 0.353 $\pm$ 0.104mg/L, Zinc 0.150 $\pm$ 0.048mg/L, Cadmium 0.011 $\pm$ 0.004mg/L and Lead 0.17 $\pm$ 0.005mg/L. Egbem 2 had high COD 23.3 $\pm$ 8.02mg/L, salinilty 52 $\pm$ 0.023mg/L, TDS 57.3 $\pm$ 25.7mg/L and Cl 88.6 $\pm$ 30.26 mg/L. For soil samples, SSC2 had high EC 1118.0 $\pm$ 507.4mg/k, Cl 1173 $\pm$ 800.1 mg/k and SSS had high Fe 156.02 $\pm$ 65.76 mg/K, Zinc 104.30 $\pm$ 41.67mg/k, Cu 56.30 $\pm$ 22.499 mg/k. The chemical analysis of the soil and water samples indicated changes from normal especially the heavy metals and other parameters for assessment of samples. From the findings, the oculovisual systems of some of the people of Ogbite have been compromised by crude oil and gas exploration and exploitation and the consequences of these are the manifestation of increased internal and external eye problems.

CHAPTER ONE

INTRODUCTION

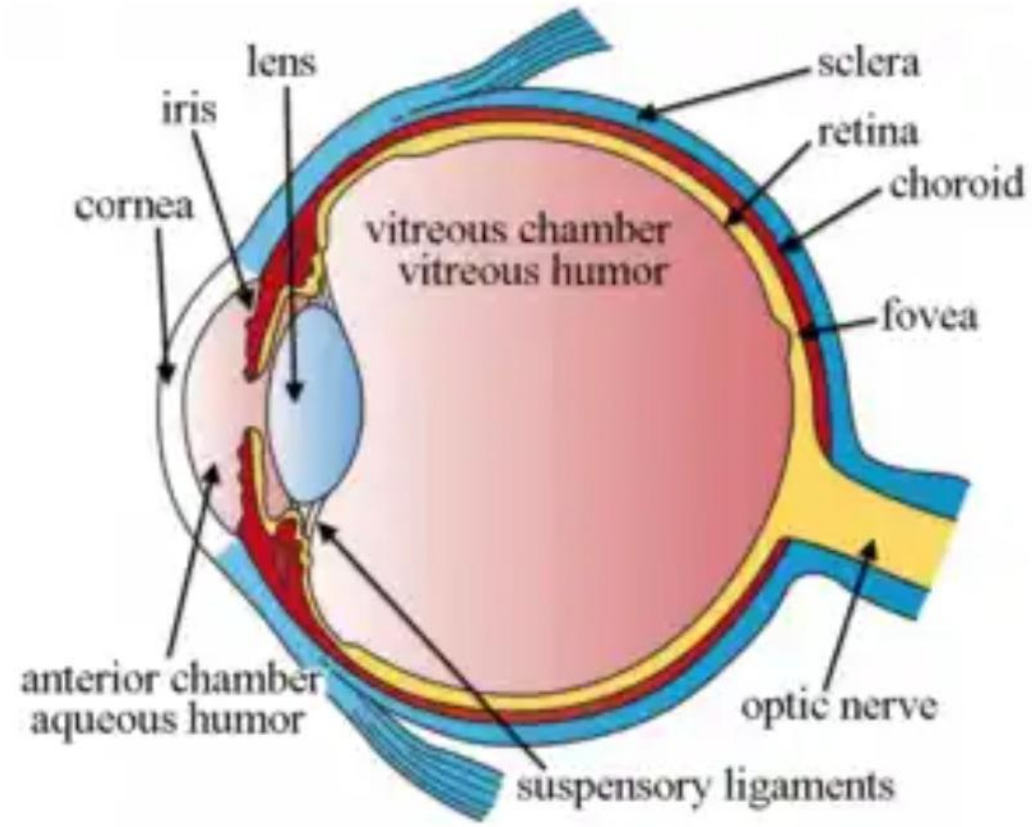


Fig. 1.1: Diagram of the eye

Source: http//harvardeye.com/uncategorized/diagram of the eye

1.1. THE ANATOMY OF THE HUMAN EYE

Normally, humans possess a pair of eyes and each eye is a cystic structure that is kept distended by the pressure inside it (Khurana and Khurana, 2012). The eyeball is truly an oblate spheroid. The central point on the maximal curvature of the eyeball is referred to as the Anterior Pole and the posterior curvature is the Posterior Pole. The human eyeball possesses three main layers which can be peeled out like peeling of onions, anatomically. They include the following:

(1) The Outer (fibrous) coat that provides most of the tensile strength.

(2) The Middle vascular coat consisting of the uveal tissue which interconnects the outer and inner layers

(3) The Inner Nervous Coat housing the retina and other nervous tissues that connect directly to the brain.

(1) **The Outer Fibrous Layer:** This is a dense and strong layer that provide the tensile strength of the eyeball, thereby protecting the inner contents. Anteriorly, there is a strong, stable and transparent aspect of the fibrous coat, referred to as the CORNEA which occupies $1/6^{th}$of the outer fibrous coat. To imagine the strength of the cornea, it sustains vision throughout the lifetime of any person even at 120 years or more. The remaining $5/6^{th}$of the fibrous coat consists of opaque but stronger tissue called the Sclera. Moreover, at the transition between the cornea and the sclera is a tiny circular mass of tissue called the LIMBUS. This limbal area is located posteriorly and rounds up frontally. It is made up of the outer conjunctiva whose major characteristic is the white part of the eye connected with a network of vasculature. The cornea is very important because the transparent characteristic gives it the ability to reflect and refract light. Anatomically the transition area between the conjunctiva and cornea, which is the limbus is sort of a boundary between the cornea and the conjunctiva. The limbus attaches firmly into the conjunctiva posteriorly and the cornea anteriorly. This anatomical essence, provides the eyeball with stability of intra ocular pressure. The limbus is very vital because also it helps to stabilize intraocular pressure by providing a fulcrum between the cornea and conjunctiva.

(2) **The Middle Vascular Layer:** This layer is also referred to as the uveal tissue which is made up of a meshwork of vascular tissues. This coat/ layer is the mainstay of the entire coating system because it provides nutrients to the other two layers. The middle

layer is made of 3 major tissue components, all of which are massively filled with blood vessels. This layer consists of the iris, the ciliary body and the choroid. Nutrients are sent in and the wastes derived thereof are brought out. It is therefore quite significant for this layer to be located in the middle of the eyeball so as to spread nutrients appropriately and simultaneously collect waste products. The vasculatures are made of arterial and venous systems for bringing in nutrients and removing waste products respectively.

(3) **The Inner Nervous-Retinal Coat:** This is the direct extension of the nervous tissues of the eye into the brain. These specialized tissues are involved in the process of vision, which is the most important sensory organ for the survival and existence of most living organisms. The nervous coat consists of a complex interconnection of nerves all serving the purpose for the manifestation of vision. In this layer, the retina is the major tissue containing photosensitive chemicals which respond to light sensation whose stimulation raises nervous sensation which is transmitted to the higher centres for interpretation and subsequently the manifestation of vision.

1.1.1 The Segments of the Eye Ball

There are two major segments of the eyeball which are the Anterior and Posterior segments.

(1) **THE ANTERIOR SEGMENT:** This consists of the tearfilm, cornea, some parts of the conjunctiva, anterior chamber, pupil, iris, ciliary body, posterior chamber and anterior part of the crystalline lens. Both the anterior and posterior chambers are spaces filled with aqueous humour.

(2) **THE POSTERIOR SEGMENT:** This segment is made of the posterior aspect of the crystalline lens, the vitreous humour, the retina, the choroid and the optic disc.

1.1.2 The Accessories or the Appendages Or The External Attachments of the Eye Ball.

These are also called the attachments of the eyeball. These tissues, as referred to above, are the eyebrows, eyelids, eyelashes, lamina apparatus and the extra ocular muscles. These tissues are necessary because the eye as an organ is fragile, vulnerable, delicate and susceptible to general perturbations. These appendages are therefore provided to complement the fibrous layers so as to enhance the protection of some tissues in the organ of vision which are located internally. These are mostly attached in a bony cavity called the ORBIT. Many of these accessory tissues and appendages attach between the eye ball itself and the orbit. This also further gives strength and stability for the eyeball and enhances mobility for the eyeball. This is very important as a protective mechanism for humans and other primates. (Khurana and Khurana, 2014)

1.1.3 The Eyebrows

The eyebrows are made of double arched hairy ridges of the frontal bones in the super orbital margins. Eyebrows function like a shade which prevent sweat, falling water such as rainwater, dust and other foreign bodies from falling directly on the anterior segment of the eyeball (Agarwal et al, 2012). It sort of provides a miniature but effective protective canopy to the eye. The eyebrow picks up these foreign particles instead of their falling directly on the corneo conjunctival surface of the eye.

1.1.4 The Eyelids

These are a pair of movable folds of tissues that are located superiorly and inferiorly, capable of covering the eye, whose opening capacity can be controlled. The superiorly located section is the upperlid and the inferior portion or section is the lower lid.

Moreover, the eyelids consists of the following tissues:

- A thin fragile covering of skin

- Three underlying muscles that regulate the movement of the eyelid. The muscles are:
- The orbicularis oculi, the levatorpalbebrasuperioris and Mullers muscle.
- A sheet of strong and concentrated layer of connective tissue called the Tarsal Plate.
- The lining of the continuous conjunctiva that gives the eye the roundish structure and morphology.

All these tissues are designed to ensure rapid movement of the eyelids so as to provide protection from intense sunlight, heat/cold and foreign body which might come as a projectile towards the corneoconjunctival areas. The eye lids are shut close when the eyeballs are at rest especially during sleep.

1.1.5 The Lacrimal Apparatus

These are made of glands, ducts, sacs that are involved in the production of tear film and the apparatus responsible for tear flow. The lacrimal apparatus include:

- The lacrimal gland and the connecting ducts
- The accessory lacrimal glands
- The lacrimal canaliculi
- The lacrimal sac
- The nasolacrimal duct

The lacrimal apparatus provides the fluid and cleansing material for the eyeball. The apparatus also provides moisture so as to enhance mobility both internally between the lids and externally where the lids acts like the cleansing mechanism similar to the wiper of the windscreen of a car.

1.1.6 The Extraocular Muscles

The process of movement of the entire eyeball is controlled and enhanced by six extrinsic muscle mechanical systems all connecting at one end with the eyeball and at the other end with the walls of the orbital cavity. These muscles consist of four (4) straightly placed

muscles and two (2) obliquely placed muscles. All of the muscles are made of striated muscle fibres. The movement of the eye is controlled by two mechanisms using these muscles. Both eyes must move together in synergy hence the system model of visual coordination. This is a very important system for the manifestation of single binocular vision of the two eyes. The control mechanism include the following:

(1) Voluntary control – movement to gaze at a particular direction voluntarily

(2) Autonomic control – coordinated movement for convergence and accommodation for near and divergence for distance vision are controlled by autonomic mechanisms. The extraocular muscles are the following:

The Lateral Rectus muscle rotates the eyeball outwards

The Medial Rectus muscle rotates the eyeball inwards

The Superior Rectus muscle rotates the eyeball upwards

The Inferior Rectus muscle rotates the eyeball downwards

The Superior Oblique muscle which rotates the eyeball downwards and outwardly

The Inferior Oblique which rotates the eyeball upwards and outwardly.

These muscles provide the eyeballs the capability to move up and down and side wards.

The muscles also give the eyeball extraordinary stability while the visual process is taking place. These muscles are very important because when any of them is incapable of functioning, this is made manifest in the eye being incapable of seeing well at that direction. This may also result in facial defect especially when the muscle defect is a major one.

1.1.7 The Orbit

This is a bony cavity that holds the appendages or accessories of the eye such as extraocular muscles. The inner portion of the eyelid, lacrimal apparatus etc are all held in a quadrilateral pyramid shaped orbit. Each eye is placed in the anterior orbit towards the roof and lateral wall.

1.1.8 Chambers of the Eye

The eye is divided into two chambers which are the anterior and posterior chambers. These are spaces filled by fluid of the eye.

Anterior Chamber – This chamber is bounded by the back (posterior) of the cornea and posteriorly by the anterior part of the iris and anterior part of the ciliary body. For a normal adult, the anterior chamber is about 2.5mm deep.

Posterior Chamber – It is bounded anteriorly by the posterior surface of the iris and posterior part of the ciliary body. It is also bounded posteriorly by the anterior part of the crystalline lens.

1.1.9 Blood Supply to the Eye

The blood supply to the eye are the arterial supply and venous drainage systems.

ARTERIAL SUPPLY – This includes between 20 and 22 short ciliary and 2 long ciliary artery supply spreading as a meshwork over most of the fundus. These arterial supply are the branches of the ophthalmic artery and the branches of the internal cavital artery.

VENOUS DRAINAGE – Venous drainage is by the short ciliary veins, anterior ciliary veins, 4 vortex veins and the central retinal vein. All these veins empty into the cavernous sinus.

Nerve Supply to the Eye

Three types of nerves supply the eye:

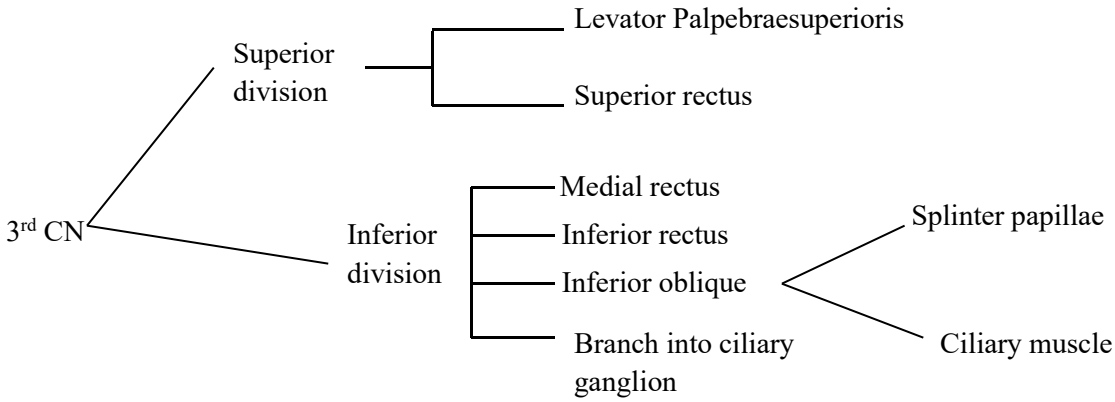
The motor nerves,

The sensory nerves and

The autonomic nerves.

THE MOTOR NERVES – Includes the 3rd, 4th, 6th and 7th cranial nerves

(i) 3rd Cranial Nerve. This is also called the oculomotor nerve



(ii) 4th CN is also called the Trochlear nerve. It supplies the superior oblique muscles.

(iii) 6th CN also called the Abducens nerve, supplies the lateral rectus muscle.

(iv) 7th CN also called the facial nerve, which supplies the orbicularis oculi muscle.

These nerve systems are interconnected with the muscle systems. Defect or deficiency of any of them also manifests as a problem to the normal functioning of the eye.

1.1.10 AUTONOMIC NERVES

These nerves include the sympathetic and parasympathetic nerves. The sympathetic nerve supply is through the cervical sympathetic fibre to

- The iris-dilator pupillae muscle
- Ciliary body
- Muller's muscle in the lids
- Lacrimal gland

The parasympathetic nerve supply originates from the nuclei in the brain and branches into

- The iris – sphincter pupillae muscle
- The ciliary body
- The lacrimal gland

The autonomic nerves are very important because of the exigencies involved in survival. They are like an automatic system which immediately there is a stimulus, there would be an instant reaction. Light stimulus results to an immediate response of the pupil which is triggered by the iris. Sandy sensation of the cornea results to an instantaneous secretion of tears to ameliorate the stimulating process or to wash away the impacting factor such as minute particles of sand.

1.1.11 Anatomical Basis of Vision

The anatomical structure, necessary for the perception of vision include the following: The eyes, optic nerves, optic tracts, optic thalamus, and visual cortex. Interestingly, the eyes possess both sensory and motor systems, implying that each eye can turn to a particular direction so as to capture the images of the objects. They are also coordinated so as to utilize binocularity especially for the eyes to converge to perceive near objects and diverge to perceive distant objects. Another motor function is the regulation of the shape and size of the iris and ciliary body so as to form sharp distinct images on the retina. Also the iris regulates the amount of light reaching the retina by contracting or expanding the pupils. Motor activities of the eye are involuntary or reflex actions instigated by several reflex pathways inside the brain, implying the connectivity of the eyes with the brain is superbly superlative. Infact, the connection is much more significant than other tissues.

The optic nerve from the two eyes of an individual extends up to the optic chiasma. Fibres from the inner (nasal) half do cross over to the temporal side of the brain as the nerve move from the optic chiasma up to the optic tract while the outer (temporal) half do not cross over but remain on the same side. The consequence of this outstanding anatomical arrangement on the visual field, is that the right visual field stimulates the left half of each retina, activates the left half of the thalamus and visual cortex. Conversely, the left visual field affects the right half of the thalamus and the visual cortex. This arrangement is in accordance with other

sensory and motor projection systems in which the left side of the body is represented in the right side of the brain and vice versa.

The visual cortex possesses a projection area in the occipital lobe of each hemisphere. In this location, there is a point-for-point correspondence between the retina of each eye and the cortex implying that the cortex sensorily manifests as a "map", or projection area, each point on this map representing a point in the retina and thus the visual space as perceived by each eye.

Additionally, there are visual association areas and other regions of the brain, which are also implicated in the perception of sight. These include complex visual functions such as form recognition, movement perception and reading as you are doing now.

1.1.12 Mechanism of Vision

The sensation of vision involves perception of form, size, colour, movement and distance of an object. It is important to note that of all the special sensory activities of the body, vision provides the most detailed and extensive information regarding the environment. Indeed, about 90% of all activities of higher animals are visually based, birds and primates being the most prominent. The eyes of these animals have developed in size, efficiency, effectiveness and complexity far above the other sensory systems.

To compensate and make other sensory organs more efficient and effective, the brain is revolutionalizing by the process of Encephalization, which is the procedure and process by which most of the special sensory organs are developing through the mechanism of evolution by being located closer to each other for efficiency, effectiveness and synergy among these sensory systems. That is, the senses of smell, taste, hearing, vision among others are gradually coming closer and interconnected, in synergy, due to encephalization.

The visual stimuli results in rays of light falling on or impinging on the cornea, go through the aqueous humour, crystalline lens, vitreous humour and fall on the retina. The intensity and characteristics of the light are dependent on the source of light. Our eyes are sensitive to light waves ranging from between 390 and 720 nanometers of wavelength. This is called the Visible Spectrum. The sunlight and other common sources of artificial light fall within the visible spectrum and there are other wavelengths each with its unique spectral energy distribution. Light stimuli are commonly measured using physical procedures regarding their energy, dominant wavelength and spectral purity. These attributes of light are closely related to perceived brightness, hue and saturation of the light

Visual stimuli not aroused by light are called Atypical or Inadequate Stimuli or Phosphene. These include momentary pressure on the eyeball, electric current through the eye or head, sudden blow on the back of the head, disturbances of the CNS caused by drugs, fatigue or disease. Any of these atypical stimuli may yield visual experience not aroused by light. They are significant because they essentially indicate that the real visual character of the sensory experience is determined by the region stimulated e.g. eye, visual tracts rather than by the nature of the stimulus (Argawal et al, 2012)

The eye is a very complex, fragile and versatile organ that responds to light and uses some photosensitive materials to bring about the process of vision. About 85 – 90% of all human activities are visually implicated. Even our dreams are visualized so as for them to come to reality. Also, the dreams we experience during sleep are based on conscious visualization of our neural processes during sleep! The eyes are indeed a bundle of complex wonders. The attribute of sight is mankind's greatest sense organ because the eye acts unquestionably as a link between the world and its abundance of imagery which also gives humans the impetus to visualize and conceptualize our perception of the imagery of life. In our environmental

setting, vision is initiated by light. This is revealing but like everything created there is no perfection.

According to Wertenbaker (1984) “Vision begins with light, the abundant rain of the sun’s energy falling through space to touch and warm the earth: Light projects value, tone and shadow into nature. The eye, keen to this kaleidospic effect, then relates what it senses to the brain, perceptions seat”.

He further stated that “The eye is an extension of the brain. It grows from that fertile organ like a plant reaching toward the light. In the back of the eyeball lies a patch of tissue no thicker than a postage stamp, not much larger than a quarter (of the art in win). This is the retina, the light catching net of the eye. It is woven of brain cells. The retina can form, dissolve and create new image every tenth of a second, an ability which matches mans power to life. The eye from the printed page, fixate on a bird skimming across the horizon and then return to rejoice in the pattern of the wind through a nearby grove of trees”. Little wonder Leonardo da Vinci described the eye as a ‘piece of so great a wonder’.

Leonardo da Vinci stated the following about the eye “who would believe that so small a space could contain the images of all the universe?” he further stated “O mighty process (the eye) what talent can avail to penetrate a nature such as this? What tongue will it be that can unfold so great a wonder? Truly none” (Wertenbaker, 1984).

Both Newton and Huygens were later found to have made superlative discoveries about the nature of light and others findings were further exposed later by scientists who used scientific methodologies to substantiate these theories. Newton used the apple experiment to propound his universal theory of gravitation, one of the natural laws of the universe. In his book Opticks, Newton postulated that light is made of minute particles moving as straight rays of light from an illuminated object. At the same period Huygens formulated the wave theory of light. Currently, scientists all over the world believe that light exhibits characteristics of both

theories of waves and particles. These were the manifestations of the works done during the beginning of the scientific revolution by utilization of Scientific Methodology, which were reproducible anywhere, worldwide. These periods were also referred to as Experimentalists era, which initiated the new era of experimental research. That era was also the period that ushered in the advent in science in which truth is revealed by experimental research. The experimental period introduced advances in every aspect of mankind's existence in a dizzying and dazzling manner into what is now termed development. The experimentalists ushered in an era which is indicative of global development strides in every facet of human existence.

1.1.13 Inflammation

Generally, inflammation is an aspect of the body's defense mechanism to forestall xenobiotics from harming the body. The xenobiotic maybe generated internally and externally. Inflammation is therefore the mechanism by which the immune system of the body recognizes and takes away deleterious stimuli from the body which might be internal or foreign stimuli. This process of inflammation is the irritation of healing. The following are the major significant signs of inflammation. They include pain, feeling of heat or hotness, redress, swelling and loss of function.

There are two major pathophysiologies of inflammation, which could be acute or chronic. The causes of inflammation are several and include infections, injuries, diseases, autoimmune response in the body, aging and inflammation of unknown etiology. the pathophysiology of of inflammation is quite complex, a mechanism that utilizes assorted cellulars processes and signaling proteins that protect a tissue or tissues by production of white flood cells which are the warriors against inflammatory causes which is instigated by the autoimmune system of the body. However, the autoimmune system can be stimulated without appropriate

inflammatory instigators and the body responds by attacking its own healthy tissue resulting to autoimmune inflammation.

Classifications of Inflammation

As stated earlier, inflammation is classified into Acute and Chronic inflammation.

Acute Inflammation may occur when there is a sudden attack on a healthy tissue and this response assists in fighting bacteria and other xenobiotics. In such situations immediately the tissue is healed, the inflammation temporarily disappears. Acute inflammatory processes include infections of different tissues such as cough, sore throat, sinusitis, dermatitis etc.

Chronic Inflammation is a persistent inflammatory reaction that may or may not possess an instigator factor. It may be transient or continuous without going away for a long time. It is usually made manifest persistently as aging process increases. Examples include asthma, inflammatory arthritis, ulcerative diseases, eczema etc.

Xenobiotics are chemical compounds that are falling to an organisms are the major causes of inflammation and are grouped into:

- Biological – which include infections, diseases such as diabetes, drug hypersensitivity, and autoimmune diseases such as allergic conditions,
- Chemical – which are part of the xenobiotic such as poisons, drugs, alcohol toxins and toxic substances.
- Physical – exposure to radiation, burns, injuries etc

Ocular Inflammation

The entire eye and its adnexia are susceptible to inflammatory processes and like the tissues of the body, this can be caused by different factors as stated earlier. Because of the location of the anterior segment of the eye which includes the external adnexia, the eye is continuously bombarded by xenobiotics. This is indicated by the massive vascular network. This network of vasculature is natural immunologic defense system (Terry, 2003).

According to Terry (2003) the conjunctiva is the most immunologically active tissue of the external eye and can respond rapidly to a stimulant. In the entire anterior segment, there are 3 layers that generally respond to inflammatory perturbations – the cornea and conjunctiva; the collagenous sclerea and the extremely vascularized area.

Sign of Ocular Vascularization

Ocular redness is the sign of ocular vascularization which is a manifestation of the response of the eye to xenobiotics. This is made manifest by

- Increase in local temperature which triggers increase in blood flow of the locality of the area affected in size of the blood vessels and capillaries
- Oedama results from the inflammation of the local area by production of plasma proteins and body fluids due to the permeability of the vasculature
- Deposition of cellular warriors in form of white blood cells such as macrophages, immunogloblins, neutrophils, polymorphonuclear leukocytes etc
- Destruction of the affected locality of the tissue
- Production of scar tissues

Differential diagnosis of ocular inflammation (redness)

Catania (1985), disclosed that the major parameters to consider in differentially diagnosing ocular redness include the following

- Consideration of the aetiology of the ocular redness
- Is the redness infected or non infected
- Is th ere an associated infiltrate or ulcer?
- Has any causative antigen been removed?

It is important to note that ocular redness might be due to the following

- Mechanical / traumatic manifestations
- Chemical toxic agents

- Environmental factors
- Physical/radiational mechanisms
- Infection-bacterial, fungal or viral
- Autoimmune manifestations
- Allergic reactions which might be systemic, organic or local

It is common knowledge among the health care researchers and practitioners that inflammation is one of the complex sequences of biological responses of tissues of the external adnexia of the eye which is triggered by perturbating agents that include assorted xenobiotics such as irritants, that may originate as pollutants. This response is the known attempt by the body to self-protect by releasing chemicals and tears so as to mitigate the damaging causes which may be irritants, pathogens, damaged cells etc. This brings about pain, increased temperature of local area, swelling, redness and other reactions. The eye is the window of the body and so must respond in such manner so as to forestall imminent damage. When such reactions are suddenly experienced, it is acute and if it occurs frequent and in persistent episodes, it is chronic. Inflammation therefore is one of the bodies defenses against foreign agents that affect the eye. The pollutants that are being produced in our environments are among the irritants and pathogens that affect our eyes and vision.

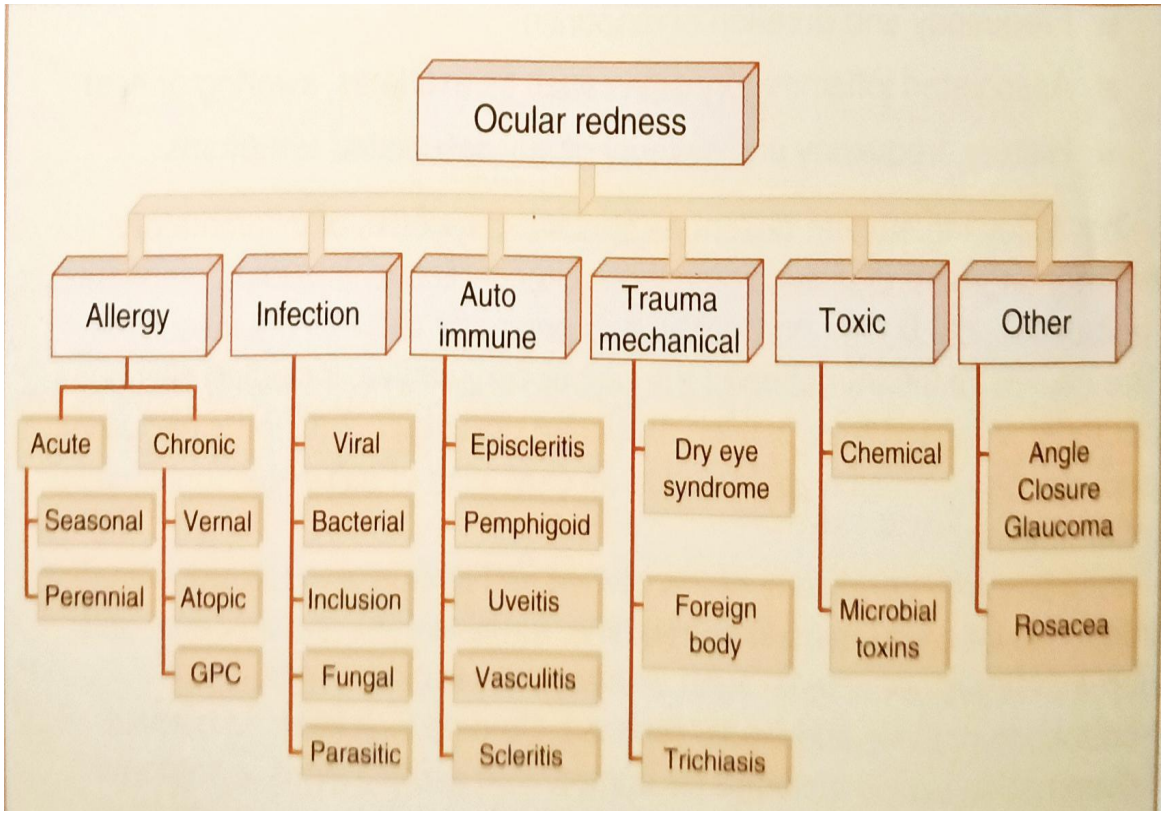


Figure 1.2: Differential Diagnostic Tool for Red eyes/ Redness (Source: Terry, 2003)

1.2 AIMS OF STUDY: To investigate the impact of petroleum pollution on the ocular visual system of the people of Ogbite community in Ogba/Egbema Nelen LGA Rivers state Niger Delta (Rivers States) of Nigeria, by clinical eye examination, and Environmental Impact Assessment (EIA), of the soil and water of environments impacted by pollution.

1.3 SIGNIFICANCE OF THE STUDY

About 12 million tons of petroleum (oil and gas) from 4200 spillages have been released into the ecosystem of the Niger Delta region since 1958. This quantity is more than 50 times the amount spilt in the Exxon Valdex oil spill saga in Alaska in 1989, which was regarded as the largest in other parts of the world.

From 1975, the Niger Delta region has consistently accounted for far greater than 75% of Nigeria exportable revenues. Painfully, most of the natural gas derived from oil wells are immediately flared directly into the air in the oil well's location at a rate of about 70

million M^3/per day which is more than 50% of the entire African continents natural gas consumption. Apparently, this is the single largest source of greenhouse gas emissions worldwide which has resulted in massive pollution of the region and contributing to climate change.

This devastation has resulted to conflict, violence, disease, deprivation and death among the inhabitants most of which are living in utter quagmire. Petroleum products pollution has affected the soil and groundwater (O'Reilly et al, 2001), plant (Zeigler, 2006) wildlife and Habitat (MS Fish and Wildlife service, 2010) and human health (Aguilera et al, 2010)

These massive and continuous spills has resulted in grave atmospheric degradations, surface and ground water contamination, generalized soil pollution and specific temperature increases in flare sites. The consequences are serious health hazards which include respiratory diseases, high incidences of kidney diseases, neurological diseases, eye diseases and eventually death. The environment impact of petroleum exploration and exploitation are diminishing in dignity and deleterious to health. The diminishing dignity manifested for the quest for justice and end to marginalization especially regarding the case with Ken Saro Wiwa and the war against the state by several shades of militancy.

1.4 STATEMENT OF THE PROBLEM

According to the World Bank, "Nigeria's economy depends heavily on the oil and gas sector, which contributes to 99% of export revenues, 85% of Gross Domestic Product (GDP) (World Bank, 2005).

This implies that the Federal, States and Local governments in Nigeria depend solely on this oil and gas industry. The Niger Delta region would continue to face spillages and gas flaring because of the anticipated revenues accruable to government, without output from the

governmental regulatory bodies that oversee the environment where crude oil is explored and exploited .

Also, the environmental impacts of petroleum pollution though very devastating at onset, these impacts are extremely chronic as they take very long time to ameliorate. According to the World Health Organization (2018), at least 2 billion people have vision impairment or blindness of whom at least 1 billion have vision impairment that could have been prevented or are yet to be addressed. The visual problems of the people of Niger Delta falls within the WHO description. This is because the pollutants in the Niger Delta would continue to be persistently increased as far as crude oil and gas are continuously being explored and exploited.

This is a vicious cycle of sadness, sorrow and shame regarding the health and wellbeing of the people of the region. Moreover, the persistent conflicts, violence, disease, deprivation and death has worsened the pathethic scenario in the Niger Delta region (Ikelegbe, 2005)

1.5 RESEARCH HYPOTHESIS

NULL HYPOTHESIS-Ho1- There is no consequence of environmental pollution due to petroleum exploration and exploitation on the oculovisual systems of people of the Niger Delta region of Nigeria.

ALTERNATE HYPOTHESIS- There are consequences of environmental pollution due to petroleum exploration and exploitation on the oculovisual systems of people of the Niger Delta region of Nigeria.

Keywords:

Abatement: reduction or lessening of pollution through reuse or waste treatment.

Acid rain: rain made artificially acidic by pollutants, particularly oxides of sulphur and nitrogen.

Acidity: the quantitative capacity of aqueous media to react with OH ions or to donate electrons.

Adsorption: attachment of gas molecules or molecules in a solution to the surface of solid material of which the come in contact.

Alkalinity: the quantitative capacity of an aqueous media to react with H+ ions or donate electrons.

Anaerobic: characterized by the absence of free oxygen.

Anthropogenic: arising from or generated by human activity.

Autotroph: an organism that produces its own food from inorganic compounds and a source of energy. They are photoautotrophs (photosynthetic plants) and chemical autotrophs.

Bioassay: determination of the concentration or dose of a given material necessary to induce an acute or chronic response from a test organism.

Bio magnification: also known as biological concentration. The tendency for some substances to concentrate with each tropic level. Organisms preferentially store and contain chemicals and excrete others. When this occurs constantly among organisms, the body weight as the material is transferred along a food chain or tropic level.

Biomass: the amount of living material or the amount of organic material contained by a living organism, both alive or dead material.

BOD (biological oxygen demand): a measure of the amount of oxygen necessary to decompose organic matter in a unit volume of water. As the amount of organic waste in water increases, more oxygen is used resulting in a higher BOD

COD (chemical oxygen demand): a quantitative measure of the amount of dissolved oxygen required for the chemical oxidation of organic material in waste water using inorganic dichromate or pamanganate salts as oxidants during a two hour test.

Corrosion: a slow chemical weathering or chemical decomposition that proceeds from the surface of objects.

De nitrification: the conversion of nitrate to molecular nitrogen by the action of bacteria an important step in the nitrogen cycle.

Dissolved oxygen (D.O.): the oxygen dissolved in water, sewage etc. expressed in ppm or percent saturation.

Ecology: the science of the study of the relationship between living things and their environment.

Environment: all the factors (living and nonliving) that actually affect an individual organism or population at that point in the life cycle.

Environmental impact: the effects on some action on the environment, particularly by human beings.

Eutrophic: referring to bodies of water having an abundance of chemical elements required for life.

Food chain: a sequence of organisms through green plants to eating toe being eaten.

Fossil fuel: fuels such as coal, oil and gas that have formed by the alteration of the decomposition of plants, animals etc. from a previous gcologic time.

Habitat: the natural abode for a plant or animal species, the place where the organism is found

Hardness: any multivariate cations, usually calcium and magnesium, that that cause undesirable precipitates and deposits in water.

Hydrocarbon: an organic compound consisting of carbon and hydrogen.

Index, pollution: the measurement of the degree of pollution as indicated by plant bacteria count, BOD etc.

Insecticide: any chemical agent or otherwise used for destruction of insects mainly in the agricultural operations.

L D –50: the lethal dose for 50% of the population. The dose of a toxin which causes death in 50% of the population or which can be expected on the average to cause death in 50% of the population.

Leaching: the process of dissolving, washing or draining earth materials by percolation of ground water or other liquids.

pH: measure of the degree of acidity and alkalinity of a solution in terms of the the negative logarithm of hydrogen in concentration.

Pollutant: any factor that has harmful effect on living things or there environment.

Potable water: water of quality acceptable for human consumption and initially free from tastes and odor, dissolved solids, suspended solids and pathogens.

Salinity: a measure of the total amount of dissolved salts in water.

Sediment: settlement of any solid phase from out of a liquid phase.

Synergism: interaction between two entities producing an effect greater than a simple additive effect.

Thermal pollution: pollution resulting from the discharge of heated waste water at temperatures that can be detrimental to aquatic life.

Turbidity: reduction of transparency of a sample due to presence of particulate matter.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 IMPACT OF MAN ON THE ENVIRONMENT

The seventeenth century European concept of creation emanated from the interpretation of the Holy Bible, postulating God's creation began in 4004 B.C. This Postulation was explained by the proponents of creation as a major goal of nature "divinely formulated for the total wellbeing of all of its living organisms". The initiators of these concepts proposed that Men and Women were regarded as caretakers, stewards of God, created with the major goal of improving the ancient Earth in a sustainable manner. This proposal was substantiated by great philosophers such as John Ray who proposed that "people are living in a world which they can improve the order and beauty of nature which is the manifestation of God's skill and wisdom" (Goudie, 1990).

However, opponents of the progressive philosophers such as Descartes, Francis Bacon and Galileo were the propounders of the Genesis Theory (Genesis 1: 26 – 30) in which they indicated that God had set mankind above and against nature, "entitled to dominate as absolute despots to rule with the aid of science. The proposition by Darwin of the famed Darwin's theory further encouraged the proponents of the Genesis Theory. They transformed Darwin's theory of Natural Selection into the major theme of "Survival of the Fittest" which manifested in the callous and brutal manner man made numerous animal and plant species to go extinct. Mary Somerville was one of those to initially oppose and highlight such brutality against other animal species. In 1858, Somerville stated that "mankind, dexterously avails himself of the powers of nature to subdue nature".

In 1884, Perkins March published the book entitled "Man and Nature" in which he used sound scientific data to discuss human influence on the wood, the waters and the sands. These powerful investigators on human impact on the environment and organism living in the

environments exposed the devastating effect of human activities on the environment. But instead of advocating for equilibrium of existence of all life forms, mankind purposefully decimated most species into complete extinction by application of negative activities. Majority of these activities are still indicating negative effects on humans and all other organism. Such situations are still being made manifest in different environments worldwide. Different organs and tissues are currently being devastated by negative human impacts on the environment. The eye is a fragile, vulnerable and very susceptible organ. It needs much attention because any event of compromise of the environment, the eye being very vulnerable, fragile and susceptible, would be the first organ to be affected and being the premier organ for survival, the consequences would be very deleterious.

2.2 IMPACT OF HUMAN POPULATION GROWTH ON THE ENVIRONMENT

It is proposed and postulated that during the early era of the ice age, about 3 million years ago, humans were in existence on Earth. Most of these humans were residing in Africa. Evidence from these human remains such as their skulls were gotten from the Rift Valley of East Africa, including today's countries of Tanzania, Kenya and Ethiopia. These humans who were hunters and gatherers, were always on the move from one place to the other in habitable parts of the world. They were undeterred by the very harsh environmental conditions. They were indeed wanderers for they were just moving from place to place. During this period, the population of the world was less than 5 million and by then, large swaths of the world were uninhabited. Such areas included the Americas, Australia, New Zealand, Asia and must parts of Africa.

Agricultural revolution began about 15,000 years ago and this singular change in the culture of mankind led to increase in human population to about 200 million people worldwide up to the time of Jesus Christ. By A.D. 1650 the population of humans had

increased to about 500 million people. From 1650 AD upwards ushered in the Industrial and Medical revolutions which progressively increased development of agriculture and colonization of new lands, whose consequences were the explosion of human population from 500 million in 1650 AD to 1 billion (1000 million) in 1850 AD, two billion (2000 million) in 1930 AD and four billion in 1975 AD. By 1987 AD it came to 5150 million and by January 2021 we have between seven and eight billion (7000 million) people. Between 2010 and 2022 the population of the world increased by 500 million people. From above data, clearly, the growth of human population on Earth is a major cause of human transformation of nature which was made by the growth and development of culture and technology.

Sears (1957) put the power of humankind in context with other species and stated "Man's unique power to manipulate things and accumulate experience presently enabled him to break through the barriers of temperature, aridity, space and mountains that have always restricted other species to specific habitats within a limited range. With the cultural devices of fire, clothing, shelter, and tools (mankind) was able to do what no other organisms could do without changing its original character. Cultural change was for the first time, substituted for biological evolution as a means of adapting an organism to new habitats in widening range that eventually came to include the whole earth". (Sears, 1957)

This singular capability of mankind, of being able to move from one place to another was instrumental in the developmental strides which has been entrenched as part of the culture of mankind. Exploration and exploitation of natural resources resulted to rural areas being bastardized by such activities. The scenario in Africa is very devastating. People from Europe, Asia, America etc. are in Africa to pillage the natural resources and consequently destroy the environment. Unfortunately, Nigeria, being blessed with unprecedented natural resources, is one of the biggest victims.

2.3 THE IMPACT ON RESOURCES OF AN ENVIRONMENT RESOURCES

There are basically two types of resources available to sustain human endeavour and survival. It is important to note that all the resources on Earth are finite. Some, when used, cannot be replaced while some are replaceable. Therefore, there are:

(1) **Nonrenewable Natural Resources:** These are of finite quantity on Earth and supply is exhausted by mining activities and utilization, though some of them such as the metals can be recycled. A vivid and sad example is petroleum resources. They provide different forms of exhaustible energy which when used cannot be replaced.

(2) **Renewable Resources:** These can be sustained to give a continuous flow of raw materials on a long term basis. But if not properly harnessed can degrade the environment irretrievably. The most important renewable resource of energy is the sun.

2.4THE IMPACT OF PETURBATION OF THE ENVIRONMENT ON THE ECOSYSTEM

This deals with the manner in which anthropogenic or natural influences impact on the quality of the inorganic and biotic components of the biosphere and of purely the human environment. Every environment has its own ecosystem that is specific to it. Perturbation of an environment could result to ecological stress which Freedman (1989) defined as “any environmental influence that causes measurable ecological change”. There are two categories of stress agents.

(1) **XENO STRESSING SYSTEM:** In this category the stressing agent is a foreign agent introduced to the ecological system. Examples include pesticides, toxic metals, petroleum pollutants, etc.

(2) **PREEXISTING STRESSING SYSTEM:** Involves accentuation of already existing environmental factor above the level where by ecological change manifests. Examples

include nutrient loading, thermal, wind etc, systems. The following are examples of the different classes of environmental stresses

(1) **PHYSICAL STRESS:** Freedman (1989) also described physical stress as "an episodic effect or disturbance caused by an intensive loading of kinetic energy which affects an ecosystem within a short period of time". Examples include volcanic eruption (the most recent being in the year 2020 in the Philippines). Also there could be anthropogenic explosion, windstorms including hurricanes, tornadoes, oceanic tidal waves or tsunamis, earthquakes glacial radiance and glacial avalanche.

(2) **WILDFIRE** is another episodic stress as a consequence of rapid combustion or by an anthropogenic source. Examples are the fires that have devastated Australia since October 2019 till January 2020. The heat and the smoke affect the visual system in a very devastating manner. Wildfires spread very fast as they burn huge swaths of land within a short period of time causing the manifestation of huge smoke, sooth and the air filled with chemical substances that are deleterious to health.

(3) **POLLUTION:** This is a situation in which some chemical agents may be present in an environment in a concentration that is toxic enough to result to physiological impact on the organisms. In this process there is ecological change which usually is negative. The impact of pollution on the environment was put into perspective by Gerasimor (1976) who stated that, "By taking energy and matter from the environment and returning them in converted industrial, domestic and other – forms, society interferes with the dynamically balanced cycles of the natural process". He further stated that "since the industrial revolution, the general intensity of human impact on the environment has exceeded its potential for

restoration in many large areas of the earth's surface, leading to irreversible changes not only on local but also on regional scale."

The word pollution has its origin from the Latin word "Pulleire" which means to defile or spoil. Pollution involves the undesirable change in physical, chemical or biological characteristics of air, water and land that has or would affect the existence of living organisms. This implies that pollution is the contamination of an environment with substances that are harmful for the existence of life forms. Pollution is also described as the introduction of contaminants into the natural environment causing adverse change. Currently, pollution can be classified into the following:

i. Air Pollution

ii. Water Pollution

iii. Land Pollution

iv. Noise Pollution

v. Radiation Pollution

2.5 AIR POLLUTION

According to WHO (2022), "Air pollution is contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere". Data from the WHO indicates that 99% of humans breathe air that exceeds WHO guidelines' limits and contains high levels of pollutants and poverty stricken low income countries and middle income countries are affected most. According to WHO (2022) air quality is closely linked to the earth climate and ecosystems. Globally, majority of the causes of air pollution has risen from 60% to 80% from just within 2008 – 2013.

2.6 WATER POLLUTION

According to WHO (2022) Two thirds of the planet is made of water (about 1.0 trillions liters) and the human body is made of 70% water. Water is also called a universal solvent and is the only substance that easily converts from solid, liquid and gaseous forms. Water pollution is the presence of extreme levels of pollutants into a water body, such that it is no longer suitable for regular human usage such as bathing, cooking or drinking (WHO, 2022) Human activities such as industrial activities, agriculture, domestic sewage, transport, mining all affect water quality. Water pollution results from 'point sources such as discharge from pipes, or from 'Scattered sources' or 'Diffuse Sources'. Diffuse sources come from nutrients such as nitrogen and phosphorus from fertilizers, waste water etc. Diffuse sources are few but their impacts are very damaging. There are six (6) categories of water pollution (1) Biodegradable wastes (2) Excess Nutrients (3) Sediments (4) Toxic Chemicals (5) Thermal Pollution (6) Radiative Wastes. Water pollution is caused by several physical, chemical and bacteriological impurities.

Physical impurities include turbidity, taste, colour and odour of the water

Chemical impurities include carbonates and bicarbonates of sodium etc.

Bacteriological impurities. There are several bacteriological impurities. E-coli is used as a gold standard. Presence of E-coli indicates presence of other micro-organisms.

There are different standards of qualities of water for different purposes.

2.7 LAND POLLUTION

This is the place of habitation for mankind and several other animals. Land is static, even where certain areas are sand filled, they are negligible. And so when men and other animals exhaust a particular location, they move on to "greener" pastures and so it goes. In addition to this scenario is the increasing population of mankind. Areas devastated by

bastardization by mankind may experience soil erosion. The following are the major contaminants of the soil of the land:

1. Smelting and mining areas where calcium, zinc, lead, copper, arsenic and nickel are mined. These minerals are phytotoxic even in very small quantities.
2. Industries such as pulp and paper mills, oil refineries, power & heating plants, chemicals and fertilizers manufacturing etc.
3. Modern agriculture – non judicious use of agro chemicals such as fertilizers, herbicides, insecticides etc. Agricultural pollution is the heaviest as it involves huge expanses of land.
4. Solid rubbish especially from households – domestic wastes such as groceries, food scraps, vegetable remains. etc.

2.8 THE ENVIRONMENT, VISION, COGNITION AND ACTION

In any environment habited by for example humans, the most important factor that must be considered and recognized is the aspect of vision because, for one to experience cognition, the individual must recognize the environment. This implies that vision precedes cognition, which is the process of knowing something by the attribute of perceiving the physical presence, such as feeling the heat from increased temperature or the cold of decreased temperature, touching an object and probably knowing what it is. Vision, is defined as the process of seeing objects both at distance and near. Aristotle stated that higher animals appreciate what an object means by seeing and defined seeing as “knowing what is located where by looking”. David Marr in 1996 defined vision “as the process of discovering from image what is present in the real world (our environment) and where it is”.

Marr (1996) further enthused that vision is first and foremost, “an information – processing task because if we are capable of knowing what is where in the world (our environment), our brains must somehow be capable of Representing this information – in all

its profusion of colour and form, beauty, motion and detail". The study of vision must therefore include not only the study of how we extract from images the various aspects of the world that are useful to us, but also an inquiry into the nature of the internal representations by which we capture this information and thus make it available as a basis for decision about our thoughts and actions. (Marr, 1980) Earlier, Marr in 1976 had defined vision "as a process that produces from images of the external world (our environment) a description that is useful to the viewer and not cluttered with irrelevant information" (Marr, 1976)

This, thus implies that vision is the prelude to cognition of our environment because, what we see about our environment gives us the privilege to know about that same environment. According to Evans and Garling (1991), "What we know and understand about our surroundings influences our evaluations and behaviors in the physical environment". Evans and Garling (1991) believe that the distinct areas of scholarly inquiry should include environmental cognition, environmental assessment and decision making and action in real world situations. Vision is very vital in the way and manner humans interrelate with their physical environment. Presence of a physical environment could mostly be noticed by the attributes of vision which are sensation, perception and recognition.

The prelude to visual perception, in any environment is imagination which is described as a conscious mental process of evoking ideas or images of objects, events, relations, attributes or processes. Imagination is a prelude to perception. The impute of imagination to vision can be alluded to the fact that how an event is described inevitably reveal the assumptions of the individual giving the narrative. There is a great distinction between the process of imagination and sensation.

SENSATION: It is the feeling of something that consciously has come into contact with an organism. Sensation is that aspect of consciousness resulting from the stimulation of a nerve process commencing from any point in the body and passing to the brain. Sensation is

especially characteristic with those stimuli affecting the special sense organs such as hearing, smell, sight, taste and touch. Sensations can also be described as the capacity to respond to stimulations especially the ones described above.

For the fact that sensations are accessible to our introspection implies that when humans first acquired the ability to think and speculate about their own nature, they were very much aware of the importance of sensory experience.

2.9 PERCEPTION OF THE ENVIRONMENT

In consideration of the question of perception, there must be an innate assumption of the nature of the world relative to the perceiver of the real world. Perception implies the perceiver has a 'common-sense knowledge' that there is a concretized external world that is real and has both constant and variable properties. However, it is common knowledge that from the same visual impute, a variety of percepts' originate. It is important therefore, to note that there is a difference between pure sensation and the manifestation of a final percept.

Thus, perception is defined as a mechanism in whose sensory stimulation is sequentially processed into organized usable experience. For perception to occur, there must be a sequence of Perception Processes. These processes must involve operations including selection, understanding the details, simplification of the details, analysis and synthesis, completion, correct, comparison, problem solving, combining, separating and putting into context the perceptual process into reality.

The instigating stimuli for perception is the Environmental Stimuli which include all things, both living and non-living, in the environment, that are perceptible. The stimuli that we focus on as our center of concentration is the Attended Stimuli. An example is the forest vegetation all over the place in Southern Nigeria.

Therefore, perception is a conscious sensory experience that visually elicits the seeing of objects that in reality are true.

2.9.1 Environmental Cognition

Cognition simply means perceiving or knowing of the presence of something, like having an idea or perception of something. The cognitive process is perceptual and is very indicative in any environment. Like perception, a stimuli must proceed in an environment in which an individual is located. It is important to note that all organizational frameworks of information-processing task in an actual environment must be made by vision giving mankind and other higher animals the capability of knowing what is where in the world which is exuded in profusion of colour, form, beauty, motion and detail.

The effects of aging, experience, are extremely important in the development and sustenance of cognitive representations of real-world environments. Cognition of an environment is fairly different from Environmental Recognition which is identification or awareness of an environment that is known or have been observed before which ultimately is accepted as of value or true. Recognition involves the processing of visual information which might have been earlier perceived and stored which when evoked result to recognition. To evoke means causation of the manifestation of something which is usually from the mind (brain)

2.92 Environmental Assessment

Majority of the investigations on environmental assessment are targeted at the descriptions and assessment of the quantity and quality of the ambient environment. According to Evans and Garling (1991) the physical characteristics of the settings in any particular environment could determine the environmental evaluation. They (Evans and Garling, 1991) further stated that there are important physical variables, such as complexity, coherence, naturalness, mystery and enclosure. Complexity considers the number and variety of different elements in a location while coherence considers the extent of underlying structure or organization of the components of the environment. Naturalness determines the

quantity and quality of natural components present in a particular scene. Most importantly, good vision reveals the mystery because it demystifies the partially visible locations and spaces indicating to the individual, whether the environment is enclosed or small, well-defined, and bound spaces. These are all positive visually assisted evaluation of real-world settings.

2.9.3 The Environmental Action

The action to be taken in a given environment are influenced by environmental cognition and assessment. This prompt the observer to process information visually, directly from the external environment and the reaction which is the environmental action. The action which comes from the brain may be a psychological response. As an example it is what is observed in the oil producing areas of the Niger Delta that makes the international communities and local (Nigerian) communities to show anger and vehemence. The outcry regarding pollution of the air, soil (land) and water bodies is thought evoking because it is only in Nigeria that such scenarios exists.

The question of action is the major issue in any environmental setting. This is because, action is influenced by motions, goals and attitudes. This can also be exemplified by the lackadaisical attitude of oil exploration companies and the Federal government since independence of Nigeria, on the perennial problems of gas flaring in Nigeria. One emotional (psychological) question is, why are the International Oil Companies (IOCs) not using technologies used for oil prospection in advanced countries such as USA and Saudi Arabia, in Nigeria? To this regard, action must be conceptualized as a prelude to the visual processes in which an observer perceives and forms preferences for various action alternatives. Visualization of the Ogoni land scenario made the inhabitants of the land to petition the United Nations and the case instituted in international courts for justice. The outcome is the Federal government being forced to initiate clean up mechanisms which till this moment is at

snails pace. Therefore, implementation of an action could be overt or covert depending on the individuals mind set. The question being asked is, why is the attitude of most IOCS towards Nigeria's exploration and exploitation crude oil very negative. Though Evans and Garling (1991) stated that cognitive factors such as previous experience, perceptual and representational abilities, hierarchically organized goals, and decision rules are assumed to affect the representation of the environment as well as individual choices and their implementation. Why is that of the Nigerian scenario different? Evans and Garling insisted that because actions in the making process, rather than action itself, is the bone of contention. What are the decision making processes of so many government that have come and gone in the Federal Republic of Nigeria, regarding the entire environmental space called Nigeria?

2.10 PETROLEUM

According to Freedman (1989) "Petroleum is a complex, naturally occurring mixture of organic compounds that are produced by incomplete decomposition of biomass over a geologically long period of time". Petroleum compounds can occur in the following states.

- GASEOUS STATE = Usually referred to a Natural Gas
- LIQUID STATE – Usually referred to as Crude Oil
- SEMI-SOLID AND OR SOLID STATE – for semisolid, it is Asphalt and in solid state it is referred to as Tar found in oil sands and shales.

All of these petroleum compounds consist of hundreds of molecular species ranging from methane which is a gaseous hydrocarbon with molecular weight of 16g/mole to complex hydrocarbons of molecular weight of 20,000 g/mole (Freedman, 1989).

Hydrocarbons are the major component of petroleum and are of 3 major types namely:

AROMATICS: These groups of hydrocarbons contain at least one six-carbon ring in their molecular structure. The backbone is C_6H_6 which is also known as Benzene backbone.

ALIPHATICS: These are open chain compounds with just a single bond between all adjacent carbon atoms and this characteristic made it a saturated compound. Unsaturated hydrocarbon compounds possess at least one double or triple bond. For example, Saturated – $H_3C – CH_3$, Unsaturated – $H_2C = CH_2$, HC ≡ CH. Saturated aliphatics are called Paraffins or Alkanes and are chemically more stable than those usually produced during refining and are by products of spilled crude oil that undergoes photochemical processes.

ALICYCLIC HYDROCARBONS: These types have some or all of their carbon atoms arranged in a ring structure. Alicylics are both saturated and unsaturated. The alicylic hydrocarbons have so many categories and are of significant industrial purposes.

It is important to note that crude oil or even petroleum from different areas have different chemical composition especially the hydrocarbon content.

2.10.1 History of Crude Oil Marketing in Nigeria

According to NNPC (1990) "Oil exploration began in Nigeria in 1908 although the documentation of the occurrence of minerals was reported some five years earlier in 1903. The exploration efforts were punctuated by the two world wars but eventually yielded results with the discovery of oil in commercial quantities in Oloibiri in 1956 by Shell-BP. Production increased from a mere 5,000 barrels per day (b/d) in 1957 to 17,000 b/d by Independence in 1960 and leap frogged to 450000 b/d by 1966. Although this upward trend was slowed by the civil war, by 1970 daily production had reached 1 million barrels. A peak production level of 2.4 million barrels per day was achieved during the second quarter of 1976.

Production has fallen since then to the current 1.611 million b/d both on technical grounds and adherence to OPEC quota brought about by the need to control production to support prices in a globally over-supplied market.

The first exportation of oil from Nigeria occurred in 1958. As most of the multinational oil companies operating in the country had 100% equity in their operations up till 1973, there was no active government participation in the marketing of crude oil until then. Prior to 1973, all Nigerian crude oil was marketed by the oil producing companies through their integrated system using transfer prices.

Government's interest in the oil industry was handled by a number of government departments including the Hydrocarbon section in 1963 and the Department of Petroleum in the Ministry of Mines and Power in 1970. Although the Nigerian National Oil Corporation (NNOC), the fore funner to the Nigerian National Petroleum Corporation (NNPC), was formed in 1971 primarily to market Nigerian crude oil, governments direct involvement in the marketing of oil did not begin until 1973. That was when the government started having its own equity crude which it would market directly following its acquisition of participation interest in the operations of the oil companies.

The government initially sold back the bulk of its participation oil to the foreign oil operating companies through a buy-back arrangement. Under this arrangement the government sold back 50 per cent of its equity crude oil to other companies at a concessionary price to help cushion the effects of its participation and to enable the companies meet previous long term commitments. It sold another 25% of its oil to the companies as option oil. The remaining 25% was sold to third-party customers, that is, those buyers with no concession or stake in the country.

The buy-back arrangement with the producing companies terminated in December 1975 giving way to a formal sales agreement between the NNOC and the various producing companies operating in the country." NNPC further stated that "The cyclical market downtum of 1976 - 1978 showed the independent oil buyers as mere fair weather

friends who besiege you when the trading margins are good but are the first to vanish at the slightest hint of a downturn.

Between 1976 and 1978, during the world economic recession that followed the 1973/74 four-fold oil price increase, about 65% of our direct sales went to the oil producing companies who had a stake in Nigeria. There was a swing back to third-party customers and government-to-government sales during 1979 and 1980 when the oil market had improved substantially. Direct sales to the oil producing companies dropped from 65% in 1977 to 39% in 1980. Sales to third party customers and on government-to-government basis increased from 30% and 5% in 1977 to 43% and 18% respectively.

The collapse of the market in 1986 again witnessed a shift back to the oil producing companies averaging about 61 per cent of all sales while third party and government to-government sales dropped to 28% and 12% respectively. The culmination of the swings back and forth from independent third-party buyers, most of whom usually are traders to oil producing companies was the termination in early 1988 of all third party contracts when almost all such third parties had stopped lifting during unfavourable market conditions.

It was then decided by government to adopt a new sales strategy that would guarantee regular and secure outlets for the crude oil and a steady flow of revenue.

2.10.2 Crude Oil Pollution in the Environment

Crude oil pollution could impact the Air, Water and Land i.e. Soil of any environment and are considered as follows:

AIR POLLUTION BY CRUDE OIL: Air pollutants produced by crude oil could be by gaseous or particulate forms. The gaseous pollutants may be separated into Primary and Secondary aspects. The primary pollutants include Sulphur Dioxide, Oxides of Nitrogen and Carbon Monoxide. These primary gaseous pollutants are exuded directly from industrial activities such as emissions from engines of cars, ships, aero planes etc and other machineries

and indirectly from oil spillage, seepage, etc. One of the major pollutants of our environments are generating sets (generators) used all over the country for generating electricity. These generators produce both sound (noise) and chemical pollutants.

Secondary air pollutants: These are as a result of chemical reactions in the atmosphere involving primary pollutants, sunlight, and other reactive agents.

The particulate forms of pollutants are made of very tiny solids that are barely visible. Some are liquid suspended droplets. Examples are particulate carbon (Asonye and Bello, 2004), dust, smoke, aerosol salts. Most of these particulate pollutants contain insoluble substances such as quartz, carbon, etc. Some contain soluble substances such as chloride, sulphate and nitrate. These are very important as they are consequences of human industrial activities. These air pollutants are also detrimental to plants and other organisms that are airborne. They not only affect humans as airborne pollutants, they form acid rain that are very detrimental to the wellbeing of the organ of sight and all its related tissues.

According to Goudie "Local concentrations of industrial fumes kill vegetation. An example is the fumes of 2 million tones of noxious gases emitted annually that was found to impact on 1900 km^2 area in the land of Salbury mining district of Canada". Also in California, USA, the Ponderosa pines of San Bernadinomountains were affected by photochemical smog up to about 130km to the east of Los Angeles (Goudie, 1990). Massive suspended particulate matter in the atmosphere adversely affect any type of vegetation.

Also excessive quantities of heavy metals affect all living tissues including plants and animals. These have been shown in contaminated waste from copper, nickel, zinc and lead mines. Heavy metals in soil may be toxic to different species of microbes and fungi which would ultimately reduce the rates of leaf-litter decomposition mechanism (Smith, 1974).

2.11 PESTICIDE POLLUTION OF THE ENVIRONMENT-THE EYE OPENER

The impact of air pollution stretches from local, regional to global sequences. The atmosphere acts as a major channel for the transfer of pollutants from one area to another making it possible for toxic substances to be taken to places very far from the source of emission. A vivid example is Dichlorodiphenyltrichloroethane (DDT) disaster of the Post World II era and the 1950s. DDT is a pesticide which Rachel Carson (1962) exhaustively described in her book the "Silent Spring" Rachel's book became an eye opener regarding the deleterious effects of pesticides and other air pollutants on the environment and how they could be spread thousands of miles/kilometers from the point of origin. Freedman (1989) defined pesticides as "Substances that are used to protect humans against the insect vectors of disease causing pathogens, to protect crop plants from competition from weeds, and to protect crops, plants and livestock from disease and depredation by fungi, insects, mites, and rodents." He further stated that "Our reliance on pesticides has increased greatly in recent decades, and the practice of chemical pest control is now a firmly entrenched component of the technological culture of modern humanity."

The use of pesticides have been beneficial to humans in the following ways.

(1) There have been increased production of food and fibre due to protection given by pesticides in crop plants from pathogens, competition from weeds, defoliation by insects and parasites among nematodes.

(2) Protection from destruction of harvested, stored food i.e. weevil in beans.

(3) Protection of billions of people from certain diseases.

2.12 CLASSIFICATION OF PESTICIDES ACCORDING TO BIOLOGICAL TARGETS

HERBICIDES: To avoid competition, herbicides are used to eliminate weeds so as to allow the crop plant to thrive without competition. The following are the types of pesticides.

(i) **INORGANIC HERBICIDES:** include the arsenicals, cyanates, and chlorates.

(ii) **RODENTICIDES:** used in the control of rats, mice, gophers and other rodent pests of human habitations and agriculture. Examples include cardiac glycosides, alkaline strychnine and warfarin.

(iii) **NEMATICIDES:** These variety of pesticide are used to eliminate nematodes which are parasites of roots of crop plants. Examples include halogenated organics such as ethylene dibromide, dichloropropene and other organophosphorous chemicals.

(iv) **MOLLUSCICIDES:** Destroy snails, slugs which are parts of citrus trees, vegetables and flower gardens.

(v) **FUNGICIDES:** Used to protect both plants and animals from fungal pathogens. Fungicides include the following:

(i) Inorganic chemicals such as sulphur, copper used as components in the fungicide compound.

(ii) Organimetallic compounds of mercury and tin

(iii) Chlorophenoles such as tri-tetra- and pentachlorophenol

(iv) Antibiotics such as penicillin and streptomycin

(v) Synthetic organics such as dithiocarbammales and captans

(vi) **ACARICIDES**: These are used to kill mites, ticks and other arachnid arthropods which are organisms involved in destruction of animals used for agricultural purposes especially in animal husbandry.

(vii) **INSECTIDES**: Used to eliminate insect pests in agriculture and vectors of deadly human diseases such as malaria, yellow fever, trypanasomiasis, plaque and typhus. Examples include:

(i) Inorganic arsenicals and fluorides

(ii) Natural plant derived chemicals and their synthetic analogs which include nicotine,pyrechromics, and rotenoids.

(iii) The chlorinated hydrocarbons including DDT, DDD.

(iv) Lindane insecticidal isomer of benzene hexachloride.

(v) Strongly chlorinated clyclodienes – chloridane heptachlor, mirex, aldrin, dielchin.

(vi) Chlorinated terpenes. Example include toxaphene.

(vii) Organophosphorus Esters. Examples include Parathion, diazinore.

(viii) Carbonates such as carboaryl and amnicarb.

(ix) Microbal agents. Example – *Bacillusthuringiensis* (Bt).

During the 2nd World War, there was an outbreak of the plaque of typhus. The allied troops used DDT which is a colourless, tasteless, and almost odourless crystalline chemical compound among the organochlorines to control the outbreak of the plaque. Winston Churchill after the successful use of DDT, referred to it as a "miraculous DDT powder." However, Racheal Carson (1962) referred to the same chemical as an "elixir of death" because of the ecological damages that was caused in its use. In her book "Silent Spring" she documented the first high profile chronicle of the environmental consequences of massive use of pesticides.

DDT was the first pesticide pollutant to travel very long distance from where it was found deposited but not used. DDT was massively used in Europe and found in harmful quantity in Ice land. This investigation on the motility of DDT gave great insights into the overwhelming effects of chemical pollutants on the ecosystem. Again, this indicates that effects or impacts of pollutants are worldwide no matter the focus area.

Lead is another glaring example of pollution by air. It has been showed that the lead content of Greenland ice cap since the industrial revolution of Europe has been increasing.

Lead in Greenland whose source is the atmosphere have been found to be increased fivefold in plant and fifty fold in animals beyond natural levels. This is indeed a disturbing trend because as the exploitation increased so also would the concentration levels being increased. There would be a consequent threshold level at which acute and chronic diseases of the various organs of the body are initiated. The eye is not an exception. Effect of lead pollution to the eye is of great importance because in the north of Nigeria lead poisoning has been on the increase. More attention need to be placed on organ specific toxicity of lead especially when it is in the atmosphere.

Another described impact of air pollution in the environment is “acid rain” defined as rain which while falling, has a pH of less than 5.05 which is the pH produced by carbonic acid in equilibrium with atmospheric CO_2. In north-east USA, acid rain and snow could have pH of as low as 2.1. This pH can be very devastating to the external tissues of the body. Altruistically the eye is the most vulnerable. Another cause of acidification is the increased deposition of Sulphur Oxides and Nitrogen Oxides emitted by fossil fuel combustion. These oxides could be chemically turned to sulphuric and nitric acids. Their effects on the organs and tissues of the body may be extremely detrimental to health. Moreover, such chemicals can be very dangerous to ocular health.

The first serious research on acidification was a report released by the Swedish government in 1970 during the Stockholm United Nations Conference on the Human Environment. The report was titled: Air Pollution across National Boundaries. The impact on the Environment of Sulfur in Air and Precipitation by [Royal Ministry of Foreign Affairs / Royal Ministry of Agriculture (RMFA/ RMA) 1971]. This study showed that acid rain is one of the most identifiable environmental problems to the person on the street, especially in today’s contemporary industrialized environment. Acid rain is becoming very common even in rural areas without industrialization. Acid rain is becoming almost ubiquitous in the planet

Earth. Most pristine and well preserved environments are now experiencing acid rainfall. This means that the atmosphere is saturated with chemicals capable of producing acid rain and consequently, climate change.

Acid rain can be deposited from the atmosphere to aquatic and terrestrial ecosystems by the following processes:

(a) Wet deposition in form of rain, snow, and fog known as acidic precipitation.

(b) Uptake of some particular gases by vegetation, soil and water surfaces.

(c) Dry deposition of extremely tiny particulate substances such as carbon particles.

2.13 PETROLEUM POLLUTION IN THE NIGER DELTA REGION OF NIGERIA

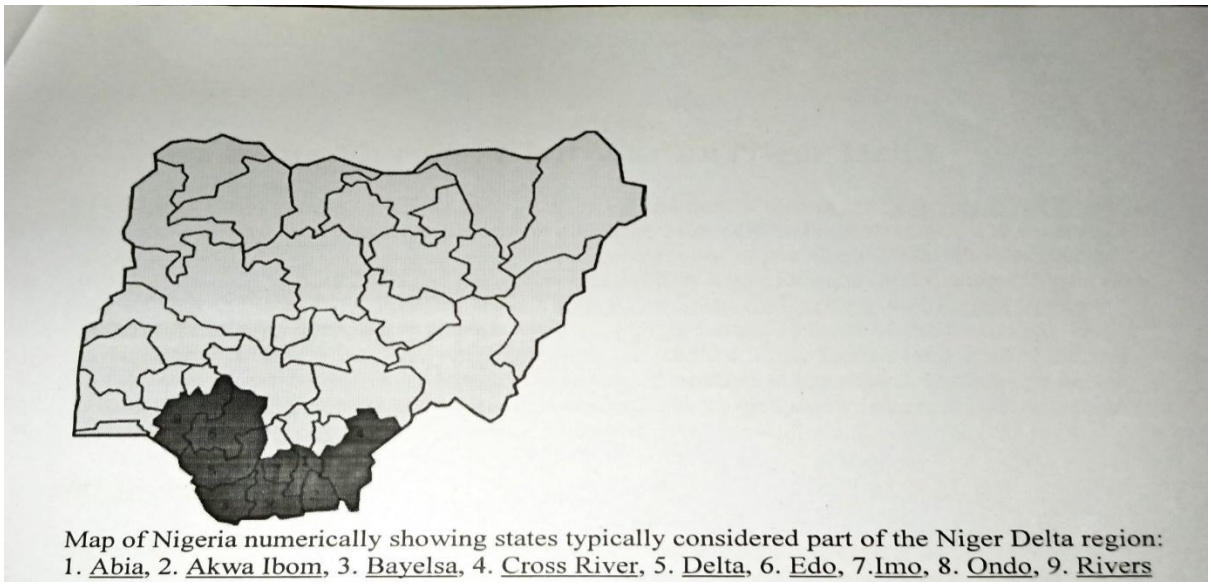


Figure 2.1 Map of the Delta Niger Region
Source: Ukpere et al (2018)

Ukpere et al (2018) defined environmental pollution as the introduction, release or addition of any biological, chemical, physical or radiological substance into any of the component parts of the environment and to naturally accommodate it through the process of absorption, dispersion or decomposition (breaking down); and which threatens the life or survival of man, plants and animals or any biotic system of the environment". Ukpere et al (2018) further stated that "air pollution affect the eyes among the people of the Niger Delta.

The other deleterious health effects are on the respiratory system, immune system and the vascular system".

The Niger Delta (ND) region is located in the Atlantic coast of Southern Nigeria, in the bight of Biafra. With a landmass of more than 70,000 square kilometers, the ND is the largest delta area in Africa and the world's second largest with a coast line stretching up to 450km, ending at the entrance of the Imo River. This area has experienced massive exploration and exploitation of crude oil and natural gas now referred to Liquified Natural Gas (LNG) when processed.

This region is made of profoundly diverse ecosystems which include Mangrove Swamps, Fresh water swamps and Rain forests. The following states are located in the Niger Delta region; Abia, AkwaIbom, Bayelsa, Cross River, Delta, Edo, Imo, Ondo and Rivers States. These states are endowed with huge deposits of crude oil and natural gas. Nigeria today, is the 10th largest producer of crude oil and 4th largest exporter of LNG worldwide.

Paradoxically, these huge deposits of hydrocarbons in the area, has now turned out to be a curse to the people of this region. This is because the inhabitants, both human and other life forms are experiencing truly massive oil and gas pollution whose consequences are different stages of environmental degradation, which include destruction and deforestation of all aspects of the vegetation, soil pollution / degradation, destruction/ total annihilation of aquatic lives, and gross air pollution. The human inhabitants thus face unprecedented hardship from this particular devastation of their environments.

The impacts of these pollutions are massive as the farmers, fishermen, hunters, artisans are now jobless and living in abject poverty where disease and squalor are predominantly manifested (Oviassuyi and Uwadiae, 2010).

According to Oviasuyi and Uwadiae (2010), the Niger Delta is made of the following oil producing states: Abia, AkwaIbom, Bayelsa, Cross River, Delta, Edo, Imo, Ondo and

Rivers. They stated that in normal circumstances, petroleum as a natural endowment in a particular community, area or region, with its exploration and exploitation should have been an abundant blessing to such people in whose place the resource is located. Rather, sadly, the opposite is the case as the presence of oil has turned to a curse to the people of the Niger Delta, since the discovery of oil in the region.

According to Nisimovu (2000), "It is claimed that the advent of oil business in Nigeria has not really brought with it any tangible benefits; instead it ushered in high degradation of the Niger delta environment, with concomitant poverty and much strife to the Niger Delta Region".

Onduku (2001) reiterates that "Today the Niger Delta is best known as a region that sustains much oil exploration and exploitation by the agents of Western economic powers. The Niger Delta basin is considered the mainstay of the Nigerian economy for its significantly high level of oil reserves. The region is also naturally endowed with viable hydrocarbon and gas reserves. Petroleum and its derivatives dominate the Nigerian economy making about 98% (in 2010) of exports, over 80% of governments annual revenue and 70% of budgetary expenditure. Crude oil resources give the Nigerian government about US$20 million a day. At the moment, Nigeria boasts of over 21 billion barrels of petroleum reserves. Nigeria is currently Africa's 3rdlargest crude oil producer and the world's tenth most important exporter of crude oil.

Oviasuyi and Uwadiae believe that "To a considerable extent, the geographical location of the Niger Delta and its resources determine the traditional occupation of the people: fishing and farming". However the region is currently politically polarized as both occupations of fishing and farming have been destroyed by oil exploration and exploitation with both the Federal Government and transnational oil companies being nonchalant about the peoples of Niger Delta and their environment. The Niger Delta is now known to be

synonymous with poverty and death. Ikejiaku in 2009 described poverty as a "multidimensional problem that goes beyond economics to include among other things, social, political and cultural issues" (Ikejiaku, 2009). The real issue is the relationship between poverty and conflict. This is being made manifest in the Niger Delta where conflict has brought about serious lack of care. This is mind boggling because poverty in extraordinary plenty and due to inadequacies of leadership are unforgivable and may lead to activities that result to conflicts. Ikejiaku (2009) revealed that it is difficult for any government to keep stability, peace and justice when it is hoisted on injustice; corruption, inadequacies and inequity.

Asonye et al (2000) investigated specifically on the effect of pollution on the eye in an industrialized environment. This study on NNPC refinery in Warri, Delta State showed that the activities in the refinery could have degenerative effects on the eyes of the people living in a radius of 20 kilometers from the epicenter where the refinery is located and may spread further especially when there is the dusty weather in the dry season.

Asonye and Bello (2005) highlighted on the blight of pollution keratoconjunctivities among children in oil producing industrial areas of Delta State, Nigeria. The study specifically investigated the effect of particulate carbon which are very common in the Warri refinery environment. The carbon particles were embedded in the keratoconjunctival areas of the eye resulting in what the investigators aptly described as pollution keratoconjunctivitis which is a consequence of the very tiny carbon particles in the air, water and soil of the Niger Delta region embedded in the corneo-conjunctival region of the eye causing irritations continually until when removed.

In yet another classic study, Asonye et al (2007) investigated the physicochemical characteristics and heavy metals profiles of Nigerian rivers, streams and waterways. Majority of the surface waters investigated were in Southern Nigeria, most of which are in the Niger

Delta region. They found out that due to the problems of pollution, most of these rivers, streams and waterways were very dangerous to use for any purpose especially on the very fragile ocular tissues. The water from these water bodies are mostly toxic and not recommended for drinking or even to bath with them. It is not surprising therefore, that the elites in these environments resort to sinking boreholes for their personal uses, but forgot that underground water systems have been polluted by seepage of crude oil and other chemicals used for exploration and exploitation of the crude oil.

One of the major petroleum pollutants very hazardous to the eye is cyanide which is produced and released into the atmosphere, soil and water Asonye and Okolie (2004) posited that antioxidant vitamins mitigate cyanide pollutants during cataractogenesis. This implies that antioxidant could remediate toxicity of cyanide in the other tissues of the eyes including the external adnexia. Accumulation of cyanide and other toxic pollutants is on the increase due to increased explorative and exploitative activities of International Oil Companies (IOCS)

Based on the few related literature on the impact of pollution on the ocular tissue of people in the Niger Delta, it is very important for more studies to be performed in this region which is the gold mine of the people of the Federal Republic of Nigeria. This is because the people whose land is being exploited for crude oil are currently facing difficult times as described in the review of related literature.

Hydrocarbons are the main components of petroleum and vary from place to place depending on period of decomposition and other factors especially the chemical composition of the land mass.

Petroleum and gas pollution may occur as oil spillages, gas flaring, and gas leakages. Approximately 12 million tons of crude oil and other petroleum products have been spilled into the Niger Delta environment since the commencement of oil exploration, exploitation and exportation from Nigeria in 1958. There had since 1958 been more than 4200 crude oil

and its products spillages in the Niger Delta region. No other part of the world have experienced such huge oil spillage as that of the Niger Delta region. This trend of oil spillage is so common that one wonders if the Niger Delta is not hell on earth. The people living in the Niger Delta live worse than our ancient forebearers.

Gas flaring is another way of dangerously polluting an environment. It is known that Nigeria, with more than 125 gas flaring sites in the Niger Delta, is the biggest gas flaring nation worldwide. This generates more than 46.0 billion kilo watts of thermal energy from 1.8 billion cubic feet of gas daily. These are released into the atmosphere and are contributing immensely to the greenhouse effect in the world. The adverse effect is also in the ecosystem surrounding the flaring. This is being seen and experienced even in flow stations which are also part of the necessary flaring processes. Gas flaring in any immediate vicinity destroys the ecosystem due to extreme heat on plants and animals all of which cannot survive in such environments. Communities that are located in such gas flaring areas have the contents of the environment such as streams, ponds, farms etc being of temperatures higher than the normal ambient temperature as applicable in similar environments without flaring activities. The problem of flaring of gases in Nigeria has turned to a huge environmental disaster in the world.

Leakage of both the natural gas and the LNG has been very devastating in the Niger Delta region. Leakage of gas can burn the area involved for days or even weeks while the unburnt gas when ignited just seeps into the ecosystem and atmosphere. Destruction of the ecosystem is visible especially in impacted areas. Fishing and farming are no more lucrative because the ecosystem has been devastatingly destroyed. Currently, there are very few fishermen in the Niger Delta region. Some of them have resorted to establishing fish farms that breed limited species of fish.

All these phenomena are experienced in different part of the Niger Delta whose inhabitants make up about 25% of the entire population of Nigeria.

Petroleum pollution can be caused by spillage of crude oil or its products from a tanker or drill platform at sea. It could also be due to a blow out of an oil well whether at sea or land.

Pipeline spillage could be due to faulty pumping equipment and pipe seam welds, earthquakes, aging pipes, or by sabotage.

Petroleum (Crude oil) is a strategically important source of energy which is nonrenewable. It is a natural product which when refined is used as an energy source for most of the machines produced on earth. It is also used for the production of synthetic materials such as plastics while the waste which is referred to asphaltic residue is used for heating and construction especially road construction. Petroleum is mostly used as source of energy in powering machines. These machines were primarily designed to use this abundant but depleting and environmentally destructive source of energy. These machines are still the most used for the industrial revolutions of the entire world. They would continue to be relevant till new innovative technologies are introduced and applied that would be environmentally friendly. Unfortunately, the pace of invention and innovation of new technologies is very slow and mankind is not yet in a serious mode and mood to change due to the abundance of fossil energy.

Petroleum is mostly used by developed countries in Europe and North America while most of the natural products are produced in underdeveloped Africa and the Middle East. This also explains lack of seriousness on the part of the consumers because the pollution of the areas of exploitation has little or no immediate effect on Europe and North America.

The global production of petroleum and its by-product is valued at more than three trillion dollars in 2019. The major problem of this natural resource is transportation from

areas of extraction to areas of consumption. Transportation alone is the major contributor to the cost of production. Also, this commodity must be transported in very large quantities and the major consequence of this are spillages of all types of petroleum whether refined or crude.

The most important means of transportation is by oceanic tankers usually called super tankers and through pipeline over a long stretch of land. Transportation processes are known to cause pollution of an environment through the following:

(1) Accidental oil spills.

(2) Operational discharges i.e. cleaning of storage and ballast tank.

(3) Leakage from offshore/onshore platforms

(4) Leakage from disabled supertankers.

(5) Leakage from burst pipelines.

(6) Leakage from stationary facilities especially refineries.

(7) Leakage from storage facilities such as depots.

Table 2.1: Petroleum Exploration and Exploitation activities and the resultant Pollutants Produced

S/N	Activity	Pollutants Produced
1.	Crude oil exploration and production (exploitation)	Drilling muds, cuttings, oil and greases, salinity, sulphides, turbidity suspended solids e.g. carbon particles, temperature changes, pH changes, heavy metals production, Biological Oxygen Demand (BOD).
2.	Petroleum Refining	Oil and Greases, BOD, Phenol, Cyanide, Sulphide, suspended solids, Toxic Additives, Hydrocarbons.
3.	Petroleum Utilization	CO, CO_2, carbon particles, soots, lead.
4.	Gas Flaring	CO, CO_2 Carbon particles, suspended particles.
5.	Gas leakages (a) Burnt (b) Unburnt	Same as Gas flaring Hydrocarbons

2.14MODERN CONCEPTS ON MECHANISM OF TISSUE DAMAGE BY POLLUTANTS

Most of the known environmental pollutants are oxidative in nature (Oxidants) and thus free radicals. Free radicals are chemical species which posses one or more unpaired electrons and are characterized as being highly unstable and strongly reactive. These oxidants and free radicals constantly produce reactive oxygen species in living tissues including humans. The consequences are massive, as the chemical reactivity of these disruptors damage all categories of micro and macromolecules such as nucleic acid, lipids, carbohydrates and proteins which are the building blocks of cells. Petroleum products, pesticides, some specific drugs, anaesthetics, industrial solvents produce huge amounts of free radicals.

The perturbations of some tissues and organs especially ocular tissues may result to degenerative diseases such as cataracts, senile macula degenerations, retinopathies, etc. Examples of free radicals generated during pollutants re-activities with cellular tissues include Hydroxyl radical-OH, Superoxide-O2, Nitric oxide-NO; Lipid Peroxy-Lool. Some non radicals with reactive oxygen species tendency include Ozone O_3, Singlet Oxygen-O_2, Hydrogen Peroxide-H_2O_2

Biochemical pathways that affect ocular functions are involved in the production of free radicals . The entire ocular tissue, especially the retina is metabolically high and active. To this regard, the retina requires huge amounts of ATP which is the universal energy storage molecule for cellular metabolism. All cells in the ocular tissues cash in on this energy bank by hydrolyzing ATP and coupling this event to cell specific enzyme reactions that are otherwise energetically unfavourable.

ATP is generated by oxidative metabolism, particularly of glucose and of other molecules such as lipids and proteins. Hydrolsis of ATP is not without risk to the cell because free radicals are produced, the major one being the hydroxyl (OH) radical. These are

normally mopped up by NADH. To be precise, NADH is the main electron carrier in the oxidation of glucose and other molecules. NADPH is used to reduce certain molecules such as free fatty acids so as to permit them to enter into the metabolic pathways for maximum production of ATP. Oxidative consumption of glucose would require the presence of oxygen. This is made manifest in Glycolysis, a process in which glucose is converted to pyruvate. If in the absence of oxygen, it is accompanied by a net gain of 2 ATP molecules. However, in the presence of oxygen, Pyruvate enter into the citric acid cycle and there is the production of 24 molecules of ATP. This example is to show the implication of oxygen and the consequences of having such high yield of ATP which is massive production of free radicals

There are basically 2 major mechanisms for free radical production

1. HEMOLYTIC BOND-CLEAVAGE-this is the most common mechanism for generation of free radicals. It involves the following pathway

   A------B A+B ⟶

2. ELECTRON TRANSFER SYSTEM-this is the process of transfer of an electron from one molecule to another thus:

   A+B A+B ⟶

The mechanismsn of action of oxidative mechanisms is that the extra free electron in a free radical is not spin paired with a second electron in a chemical bond. Free radicals are usually to be extremely reactive unless the extra electron is delocalized over several atoms. Therefore, the major characteristic of free radicals is that they react readily with other molecules by several different mechanisms.

AUTOXIDATION- this is the process of continuous and automatic free radical manifestations and reactions which occur repeatedly, creating new reactive radicals. This process is also referred to as Free Radical Chain Reaction in which different radical species may be involved. This process follows the following sequences:

Initiation-----Propagation-------Termination

This process could continue as long as possible as long as the initiating factor is continuously being manifested.

2.15 ACUTE TOXICITY AND EYE IRRITATION (DRAIZE) TESTS

There are two major procedures and principles utilized in assessment of effects of deleterious xenobiotics in the body. These involve eye irritation and toxicity, systemic toxicity as generalized hazards to the body. These parameters evaluate long term and short term exposure levels. Toxicity to this regard is defined as the deleterious impacts of a xenobiotic to any living organism while DiPasquale and Hayes (2001) defined toxicity " as the harmful effect of a chemical or a drug on a living organism".Paul Efirlich in 1911 introduced the concept of quantitative measure of selectivity which he referred to as "Chemotherapeutic Index" defined as the ratio of

$$\frac{\text{Minimum curative dose}}{\text{Tolerated dose}}$$

However, Trevan an English Mathematician in 1927, introduced the concept of LD_{50} which is a process of Median Lethal Dose of Standardization of drug effect. He showed that members of a set of cells, organs or intact animals respond to a fixed dose of a drug according to a log of normal distribution curve. He recognized that the precision of the value was dependent on many factors such as seasonal variation, number of animals used for the test etc. Currently, Trevans LD_{50} has been improved by adding sex, species, strain, age, diet, nutritional status, general health conditions, animal husbandry, experimental procedure, route of administration, stress, dosage formulation (vehicle) etc. Therefore, the refined equation is:

$$\text{Therapeutic Index} = \frac{\text{average tolerated dose}}{\text{Minimal effective dose}}$$

Quite a lot of toxicity studies utilize LD_{50} as a means of determining Acute Toxicity. However, a properly designed acute toxicity test should involve dose response relationship of both lethal and nonlethal parameters

According to DiPasquale and Hayes (2001) Ocular signs and observations in acute toxicity test include the following:

Clinical Observation, Observed Signs, Organs, Tissues, Systems involved

1. Reflexes Corneal eyelid closure: touching Sensory, neuromuscular of the cornea causes eyelid to close
2. Ocular signs

a. Lacrimation: excessive tearing, clear or coloured Autonomic
b. Miosis: constriction of pupil regardless of presence Autonomic
c. Mydriasis: Dilation of pupils regardless of presence or absence of light Autonomic
d. Exophthalms: abnormal protusion of eye in orbit Autonomic
e. Ptosis: dropping of upper eyelid, not reversed by prodding animal
f. Chromodacryorrhea: red Lacrimation autonomic Hemorrhage, infection
g. Relaxation of nictitating membrane Automic
h. Corneal Opacity iritis, conjuctivits Irritation of the eye

2.16 ASSESSMENT OF IRRITATION INDUCED BY CHEMICALS

Any perturbation whether chemical, physical, radiationaletc may disrupt ocular function, hampering vision. Exposure of chemicals to the eye may result to local injury. Systemic ingestion of chemicals or drugs can also result to injuries to the eyes. According to DiPasquale and Hayes,(2001) " Because many chemicals can produce ocular damage either locally or systemically, it is important to test products for ocular effects before exposing workers during manufacturing and ultimately, before subjecting consumers to products on the market.

DiPasquale and Hayes (2001) “Irritation (of the eye) can be defined as reversible inflammatory changes in the eye and its surrounding mucous membrane following direct exposure to a material on the surface of the anterior portion of the eye. Corrosion is irreversible ocular tissue damage following exposure to a material. Therefore, the term “eye corrosion” should be reserved for gross tissue destruction of eye, which generally occurs rapidly following exposure”

2.16.1 The Draize Test

This test was initiated in 1944 by Draize and his colleagues solely for investigation of eye irritation. However, the work on Draize test was began by Freidenwald and his colleagues also in 1944. Draize test is easy, simple, fast, efficient and effective. It uses animals for identification of human eye irritants. This simple test is also generalized, which make it very popular because it could identify majority of the moderate to severe human irritants. The only hindrance being that it cannot detect mild or subtle ocular irritation even with proper modification.

2.16.2 MethodologyOfDraize

i. **Test**. A standard 0.1ml or 1.0g of test substance is instilled into the conjunctival sac of an albino rabbits’ eye
ii. (ii) close the eyelids together for a few seconds and then release
iii. (iii) Examine the extent or rate of corneal opacity, iris inflammation, conjunctival chemosis and discharge
iv. score subjectively at preselected intervals
v. Opacification of the cornea scores maximum 80 points, conjunctival perturbation score maximum of 20 ponts and iritis gives maximum of 20 scores.

Note, after observing the Draize test and scoring, irrigate the eye of the animal profusely.

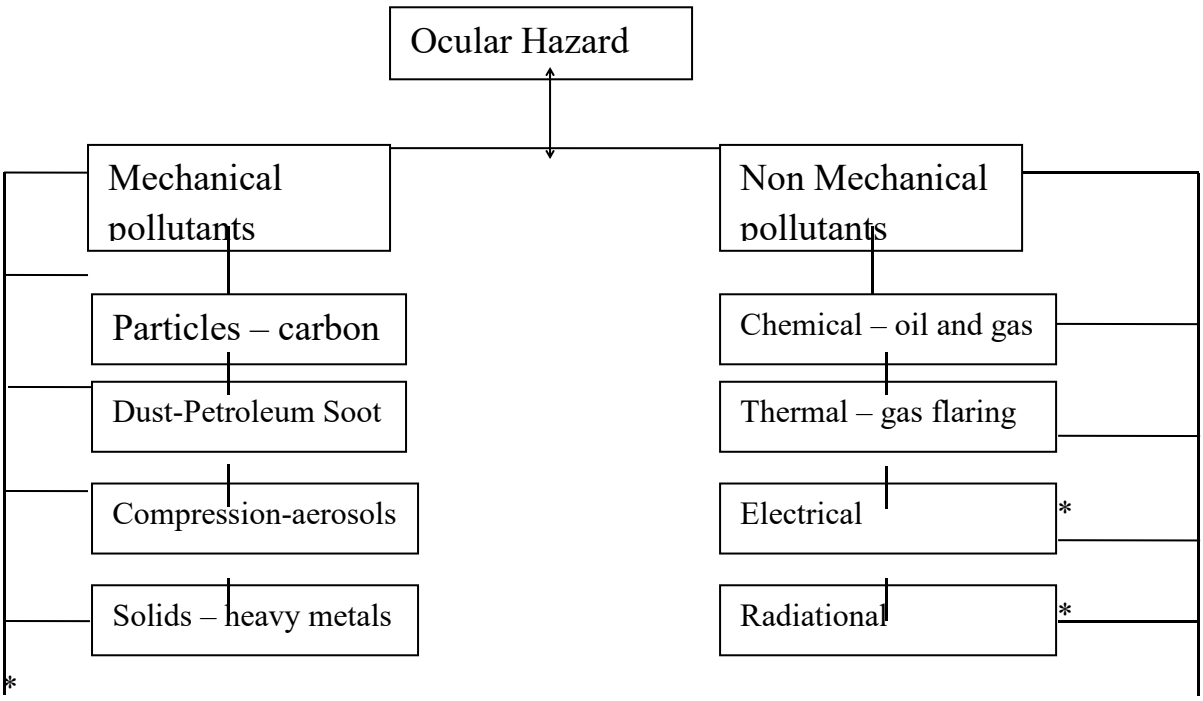
CHAPTER THREE

METHODOLOGY

Pitts and Kleinstein (1993) stated that environmental vision "emphasizes on the concepts and methods for solving problems that occur through the interaction of the eyes and vision of the people in their environment". Therefore, the effect of petroleum pollution on the oculovisual systems of the people of the Niger Delta have to be given proper attention.

The impacts of petroleum pollution on the eyes of the people of Niger Delta have to be investigated by the unraveling of the pollutants. These pollutants are referenced here as Ocular Hazards which as shown in Table 2 are either Mechanical or Non Mechanical (see below)

TABLE 3.1: Ocular hazards due to the consequences of Petroleum Pollution



- Not within the scope of this study.

This study as stated in our objectives, involved clinical examination of members of the Ogbite community in Ogba/EgbemaNdoni local government area Concurrently Environmental Impact Assessments (EIA) were performed in the locations selected.

3.1 STUDY LOCATION

The study location was Ogbite Community in Ogba / Egbema, Ndoni Local Government Area of Rivers State. The surrounding villages include the following: Ogbogu, Obiyebe, Agitha and Akabuta.

Ogbite has a gas plant that was constructed in 1989. It also has a huge flow station that was built in 1962. The flow station is called OB 1 and owned by SERAP, ELF and TOTAL. This Ogbite area is also crises crossed by several crude oil and gas (LNG) pipelines. Ogbite is a hub for crude oil and gas exploration and exploitation. It houses a huge compound where crude oil and natural gas are purified before sending for export or internally, for refining.

3.2 MATERIALS

The following were the materials used for this project work:

A. Special case notes – These case notes were designed according to Modified Clinical Techniques (MCT) parameters for the case note to be specific, especially regarding the literacy level of the sample population and the need to see as much patients as possible. Thirdly, this clinical model quickly indicates the sample populations with problems that arose from the consequences of pollution in the environment.

B. Equipment – The following instruments were used for the clinical eye examination of the patients.

(1) Visual Acuity Charts

(a) Distant Visual Acuity

(i) Literate Visual Acuity Chart for distance – Snellen chart for distance

(ii) Illiterate Visual Acuity Chart Distance – Snellens Chart for Distance

(b) Near Visual Acuity

(i) Literate Starry Reading Chart (Near)

(ii) Illiterate Starry Reading Chart (Near)

} Approved by the Faculty of Ophthalmologists

(2) Special Ophthalmic Penlight – for external examination. Generic white light Pentorch by Pal Surgical Works, Mumbai, India.

(3) Ophthalmoscope – Diagnostic set manufactured by Keeler co. uk

(4) Retinoscope – Category of Keeler professional Ophthalmic diagnostic set also by Keeler, co. uk.

(5) Trial lens set and trial frame manufactured by Topcon. co. jp.

(6) Digital camera – Samsung Android S8 camera, by Samsung Electronics coy Ltd, South Korea.

(7) Cotton wool – manufactured by C.C. Obi Nig. Ltd, Lagos, Nigeria.

(8) Generic Methylated Spirit from Monic Pharmacy and Stores, Benin City.

(9) Sterile Latex gloves (Neogloves) manufactured by Normadic Pharmaceuticals Ltd, Lagos.

(10) Hand held magnifier from Topcon. co. jp.

(11) Notes – Pamphlets

3.3 RESEARCH DESIGN

This is a cross sectional research design as suggested by Asonye et al, (2000) and Asonye and Bello (2004).

3.4SAMPLE POPULATION

This study included participants between the ages of 1 to 100 years.

3.5 SAMPLING TECHNIQUE

Convenience sampling technique was used for this study.

3.6 SAMPLE SIZE

Fisher formula was applied because the sample size is less than 10,000 which is

$$nf = \frac{n}{(1+n)}N$$

Where nf = the desired sample size when study population is less than 10,000 and n is the desired sample size when the study population is greater than 10,000, where N is the estimate of the population which can be up to 1000.

This study was to determine the proportion of people in Ogbite who have been imperilled by the consequences of pollution of their air space, water network and land. Because proportion is a qualitative variable, the Fishers formula for sample size calculation had to be performed, which is

$$\text{Sample size} = \frac{Z^2 p(1-p)}{d^2}$$

Where Z is the standard normal variate at 5% type 1 error ($p< 0.05$) giving 1.96

P = Expected proportion in population based on previous studies . P was in this situation is 3.7% (Abah et al, 2011)

D= degree of precision which is usually set at 0.05 after substituting for above;

$$\text{Sample size} = \frac{1.92^2 \times 0.074(1- 0.74)}{0.05^2}$$

After adjusting 10% attrition rate which is 10/100 x 55/1 = 5.5

Total minimal sample size = 55+5.5 = 60.5 approximately 61 respondents

INCLUSION CRITERIA

Patients / respondents between the ages of 1 and 100 years.

Patients / respondents from Ogbite in Ogba/Egbama, Ndoni LGA in Rivers State.

EXCLUSION CRITERIA

Persons outside the community as described above.

3.7 PROCEDURE

The community chairman was informed of our intention to visit the Ogbite community for eye examination of willing participants who we refer to here as patients or respondents. A date was fixed by the community leadership of Ogbite. The community hall was allocated to our team and patients /respondents of different age groups all from Ogbite community came for eye examinations. The patients were strictly the people of Ogbite, which is the location of several petroleum exploratory and exploitatory activities within the Local Government Area (LGA).

The patients told the outreach research team they were aware of the relationship between constant exposure to pollutants in their environment and the consequences on their eyes. The water and soil samples taken were analyzed according to suggestions by Asonye et al, (2007).

3.8 ETHICAL CONSIDERATIONS

Ethical clearance for this study was obtained from the ethical committee of the Department of Optometry, University of Benin.

3.9 DATA ANALYSIS

Data collected were subjected to statistical analysis using the Statistical Package for Social Sciences (SPSS) version 22.0. Descriptive statistics are presented in charts and graphs.

The relationship between petroleum pollution and impacts on the eye were explore utilizing the Pearson's Chi-square test. Statistical significance are defined in this study at $P < 0.05$.

METHOD OF CLINICAL EXAMINATION: The clinical examinations outreaches were in the form of Vision Screening utilizing Modified Clinical Techniques as indicated below. The general purpose was to detect those people who had defective vision and for this study, defects which were caused by pollutants. These patients had ocular signs and symptoms that would necessitate their coming for clinical assessment. This is because from earlier studies by Asonye and Bello (2004), Asonye et al (2000), Asonye et al (2007) and Okolie and Asonye (2004), there were indications of the relationship between pollution and the ocular tissue.

This is also because the problem of pollution is very hazardous to the oculovisual system. The hazardous materials were identified as being connected to signs and symptoms manifestations on the patients/respondents in the environment. The clinical examination procedure were valid and reliable.

This was based on data collected from parameters as shown in Table 3.1.

CLINICAL EXAMINATION METHOD

The Modified Clinical Technique (MCT) was applied for this project work. The following clinical procedures were performed on all patients / respondents.

1. History, signs and symptoms.
2. Visual acuity at distance, and near
3. External eye examination
4. Ophthalmoscopy (internal examination)
5. Retinoscopy (objective refraction)
6. Subjective refraction

Specially designed case notes were used to record the results of the clinical eye examination. Patients were examined according to time of arrival. As stated in our inclusion criteria, the patients were indigenes of Ogbite community.

B. ENVIRONMENTAL IMPACT ASSESSMENT

An initial field inspection visit was made to the locations to be studied to negotiate with the community on when to visit. This gave us the opportunity to go round and check on the various petroleum exploitative installations. Before commencement of our clinical examination, soil and water samples were collected and sent for analysis. See below for specific description of the samples.

Careful analysis were performed to determine the physical and chemical perturbations of the environment.

SOIL, WATER AND AIR ANALYSIS

(i) **WATER ANALYSIS:** Water samples were collected within 1 kilometer from the entire community. The water samples were collected from different sites. These samples were put in special plastic containers, labeled and stored as recommended by Asonye et al, 2007. These were then taken to the laboratory for analysis. The parameters analyzed were according to the stipulated recommendations of the Federal Ministry for Environment. Please find for your perusal the report by Martlet Environmental Research Laboratory Limited, Benin City on the water sample collected from Ogbite. The result for the clinical analysis of water samples were Egbem 1 which was the water consumed by the Ogbite people. Egbem 2 was another water sample collected close to the gas plant. RV was the water collected

from the river close by Ogbite where effluents were deposited and PW 1 was locally made “pure water”.

(ii) **SOIL ANALYSIS:** Soil samples were collected from a profile pit, at depths of 0 – 15cm, 15 – 30cm using the Dutch Auger. The bulk density of the core sample were determined. The separate soil samples were stored in aluminium foil, put in containers and refrigerated before analysis. This is because we were performing hydrocarbon analysis. The particle size, pH, organic content, alkalinity, acidity and presence of heavy metals such as Al, Cd, C, Pb, Fe and Zn were analysed. This was also undertaken according to the stipulated regulation of the Federal Ministry of Environment. SSS was collected in the centre of the Ogbite community land. SSC was close to the gas plant air flow station. SSC 2 was on the eastern side of the Ogbite community.

(iii) **AIR ANALYSIS:** This was aimed at determining the existing air quality at the location of investigation. The gas meter called Gaslertquathro by BW Technology was to be used. This gas meter would have analyzed the Hydrogen Sulphide (H_2S) Carbon Monoxide (CO) Oxygen (O_2), Methane (CH_4) Sulphur dioxide, oxides of nitrogen, aldehydes, ammonia and hydrocarbons. This would have been immediately transmitted by the result slip as the outcome of the analysis.

However, due to the high exchange rate this equipment was very difficult to be bought. We have to keep the air quality analysis in view as other EIA analysis were very expensive. Borrowing very difficult due to the fact that it was the International Oil Companies that have the modern precision types.

TABLE 3.2- classification of air pollutants according to chemical composition

Major classes	*Sub-classes*	*Typical member of sub-classes*
Particulates	Solid Liquid	Dust smoke,fumes, fly ash Mist, spray
Gases-Organic	Hydrocarbons Aldehydes and ketones Other organics	Hexane, benzene, ethelene, methane, butane, butadiene dehyde,acetone Chlorinated hydrocarbons alcohols
Gases - Inorganic	Oxide of carbon Oxides of sulphur Oxides of nitrogen Other inorganics	Carbon monoxide, carbon dioxide Sulphur dioxide sulphur trioxide Nitrogen dioxide, nitrogen trioxide Hydrogen sulphide, Hydrogen fluoride, ammonia

CHAPTER FOUR

RESULTS AND ANALYSIS OF DATA

In this chapter, we analyze the data and provide interpretation to the results obtained during the study. The results are presented below.

4.1 RESULT PRESENTATION

A total of one hundred and fifteen (115) patients of all age categories were seen in the Ogbite town hall. These people came from different parts of the community presenting with a variety of ocular problems.

They were examined utilizing a modified but simplified clinical technique. Appropriate treatments were given in form of over the counter drugs and prescription glasses. Cases which were identified that required referrals were referred for thorough clinical examination, further evaluation and management after counseling.

The following are the results that are presented below:

Table 1 showed the age and gender of the respondents. Patient response indicated different age intervals were fairly duely recorded. There were no significant difference between the males and female age groupings

TABLE 4.1: Age and Gender of Patients

Age	Gender	No. of patients	Percentage
1-10	M	2	1.74
	F	1	0.87
11-20	M	1	0.87
	F	3	2.61
21-30	M	4	3.48
	F	4	3.48
31-40	M	7	6.10
	F	8	6.96
41-50	M	6	5.22
	F	13	11.30
51-60	M	10	8.70
	F	10	8.70
61-70	M	5	4.35
	F	9	7.80
71-80	M	11	9.57
	F	7	6.10
81-90	M	5	4.35
	F	6	5.22
91-100	F	1	0.87
	TOTAL		115

TABLE 4.2: The Mean Number of Patients with Different Age Ranges

Age range	Mean	Standard Deviation	Standard Error of Mean
1-10	1.5	± 0.70711	0.5
11-20	2	± 1.41421	1
21-30	4	± 0.00000	0
31-40	7.5	± 0.70711	0.5
41-50	9.5	± 4.94975	3.5
51-60	10	± 0.00000	0
61-70	7	± 2.82843	2
71-80	9	± 2.82843	2
81-90	5.5	± 0.70711	0.5
91-100	0.5	± 0.70711	0.5

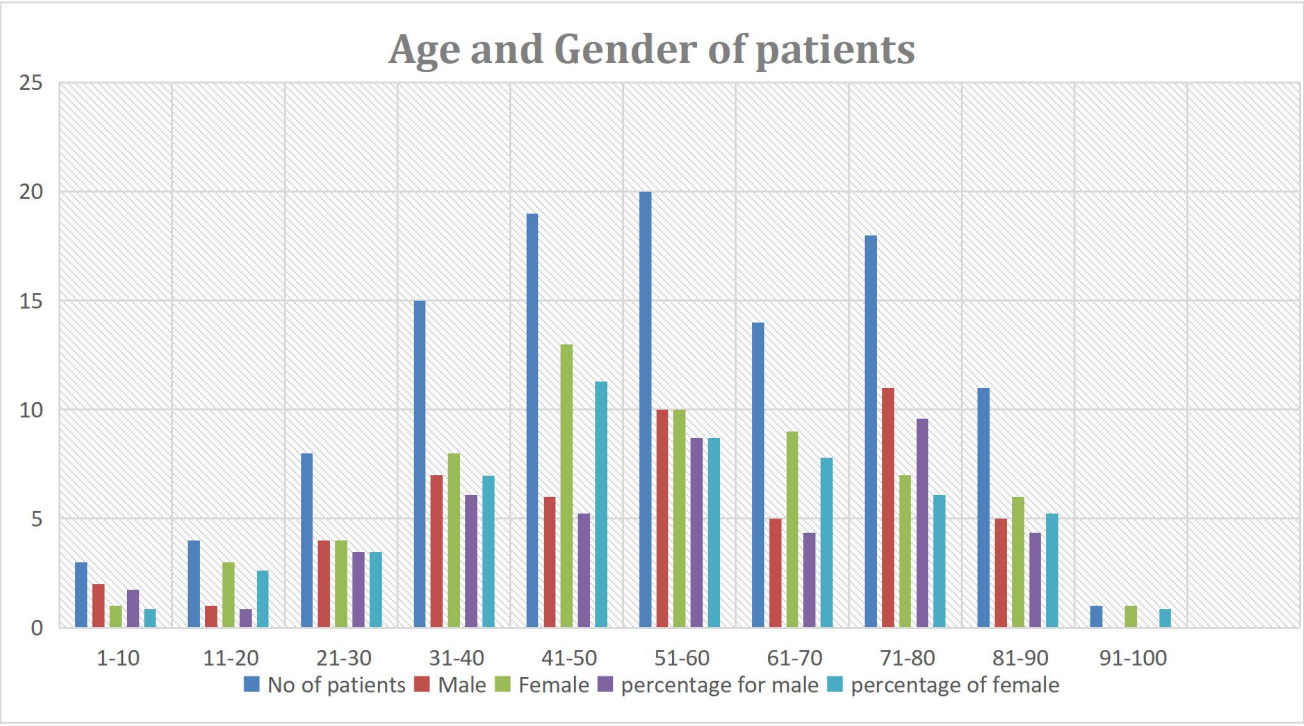


Figure 4.1 Bar chart showing Age and Gender of patients

Table 4.3: Occupation of the respondents showed that farmers (49,) teachers (10,), business / trading (21,), retirees (15,) students ( ), masons (2), fashion designers (2,), drivers (2,) mechanics (1,), civil servants (4,) and electrician (1,).

The major occupations of the people of Ogbite is farming and business / trading.

TABLE 4.3: OCCUPATION OF PATIENTS

OCCUPATION	NUMBER OF PATIENTS	PERCENTAGE	PERCENTAGE
1. Farmers	49	42.60	42.60
2. Teachers	10	8.70	8.70
3. Business and trading	21	18.26	18.26
4. Retiree	15	13.04	13.04
5. Students	8	6.96	6.96
6. Mason(builder)	2	1.74	1.74
7. Fashion designers	2	1.74	1.74
8. Drivers	2	1.74	1.74
9. Mechanics	1	0.87	0.87
10. Civil servants	4	3.48	3.48
11. Electricians	1	0.87	0.87
Total	115	100	115

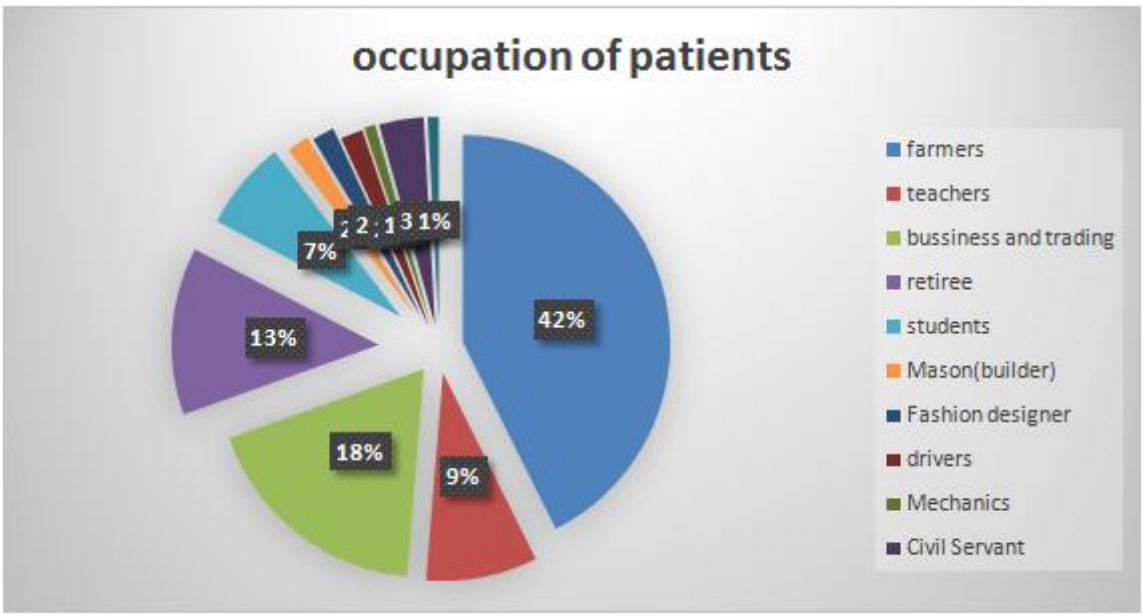


Figure 4.2 Pie chart representation of occupation of patients.

The visual acuity (v.a) of the patients which are the sample population were meticulously measured using the visual acuity (v.a) chart for measurement of distant vision.

Table 4.3 shows that the patients who had v. a of 6/60 and below were 43 which makes up approximately 37.3% of the study population. From the data in table 4.3, 59 patients approximately 51.3% had visual acuity ranging from 6/5 to 6/12 which could be regarded as normal. The range of 6/18 to 6/36 had 13 were approximately 11.3%.

TABLE 4.4: Visual Acuity at Distance for Both Eyes

VA.			Number of patient whose two eye were examine	Percentage
6/5	OD	21	23	6.09
	OS	22		
6/6	OD	7	7	20.0
	OS	7		
6/9	OD	15	16	13.91
	OS	15		
6/12	OD	11	13	11.30
	OS	12		
6/18	OD	1	2	1.74
	OS	2		
6/24	OD	2	3	2.61
	OS	3		
6/36	OD	7	8	6.95
	OS	5		
6/60	OD	2	3	2.61
	OS	2		
Hand movement at 6 meters.	OD	7	10	8.70
	OS	7		
Hand movement at 3 meters.	OD	8	12	10.43
	OS	8		
Counting finger at 3 meters.	OD	6	6	5.22
	OS	5		
Light perception	OD	4	6	5.22
	OS	2		
No light perception	OD	3	6	5.22
	OS	4		
		Total	**115**	**100**

TABLE 4.5: Mean of number of eyes with different distance visual acuities

VA	Mean	Standard Deviation	Standard Error of Mean
6/5	7	± 0.00	0
6/6	23	± 0.00	0
6/9	16	± 0.00	0
6/12	13	± 0.00	0
6/18	2	± 0.00	0
6/24	3	± 0.00	0
6/36	8	± 0.00	0
6/60	3	± 0.00	0
HM@6m	10	± 0.00	0
HM@3m	12	± 0.00	0
CF@3m	6	± 0.00	0
LP	6	± 0.00	0
NLP	6	± 0.00	0

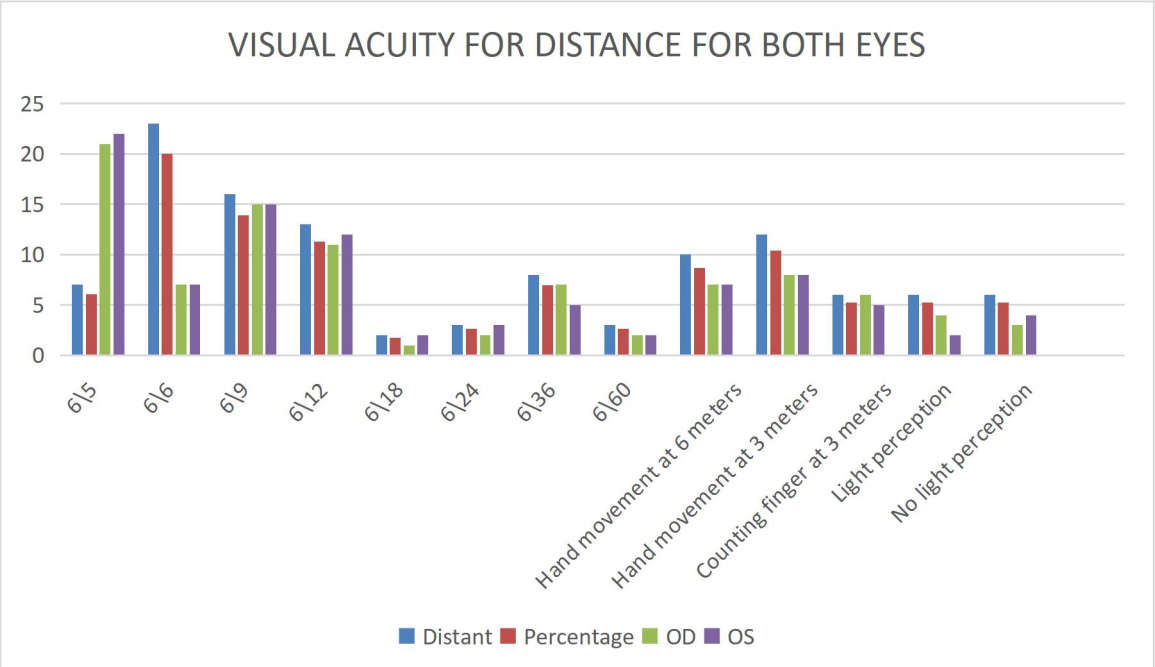


Figure 4.3 Visual Acuity for Distance for both eyes
Bar chart showing visual acuity for distance

VISUAL ACUITY AT NEAR

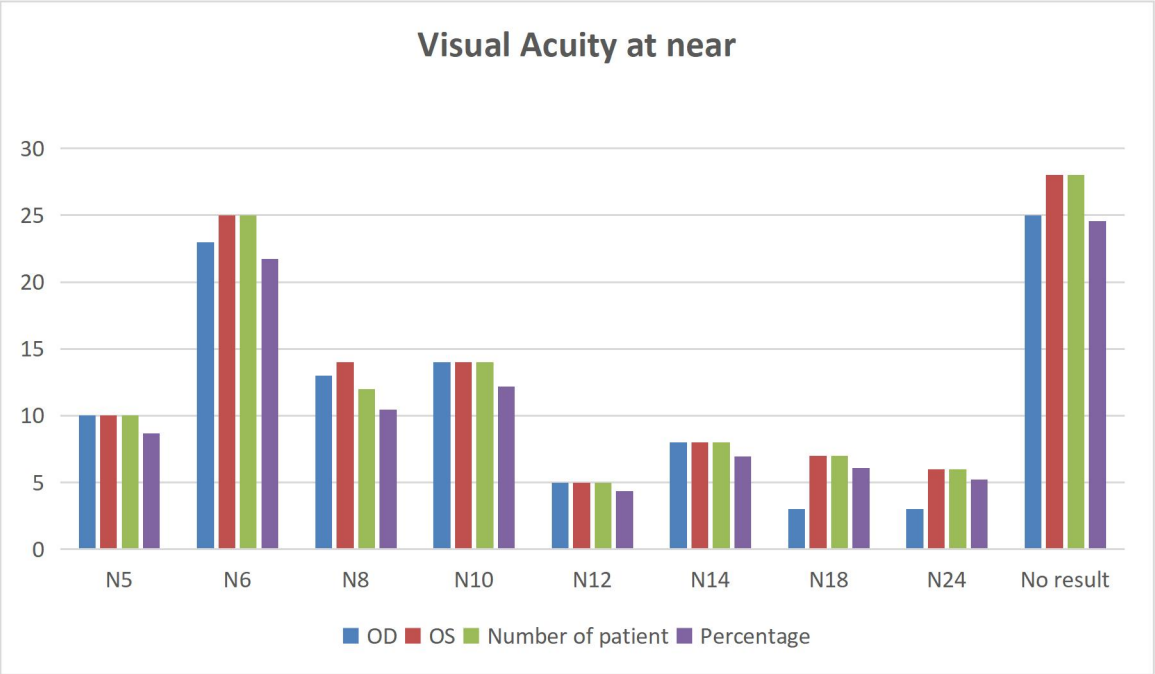
Table 4.6 – Near Visual Acuity: This also followed the same trend for the data in table 4.3. Near v.a ranging from N5 to N10 is 61 (53.04%), N12 – N12 has 20 (17.40%) and N24 to No result gave 34 (29.56%).

TABLE 4.6: Visual Acuity At Near

			Number of Patient	**Percentage**
N5	OD	10	10	8.70%
	OS	10		
N6	OD	23	25	21.74%
	OS	25		
N8	OD	11	12	10.43%
	OS	12		
N10	OD	14	14	12.17%
	OS	14		
N12	OD	5	5	4.35%
	OS	5		
N14	OD	8	8	6.96%
	OS	8		
N18	OD	3	7	6.10%
	OS	7		
N24	OD	3	6	5.22%
	OS	6		
No Result	OD	25	28	24.55%
	OS	28		
		Total	115	100

TABLE 4.7: Mean of number of eyes with different near visual acuities

VA	Mean	Standard Deviation	Standard Error of Mean
N5	10	± 0.00000	0
N6	24	± 1.41421	1
N8	13.5	± 0.70711	0.5
N10	14	± 0.00000	0
N12	5	± 0.00000	0
N14	8	± 0.00000	0
N18	5	± 2.82843	2
N24	4.5	± 2.12132	1.5
No_ result	26.5	± 2.12132	1.5



Bar chart showing visual Acuity at Near

Figure 4.4 Visual Acuity at Near

Table 4.8 indicates the visual perceptual description in which the patients stated that they were experiencing blur vision, double vision, cloudy and hazy vision as their visual complains. 48 (41.74%) complained of blur vision, cloudy/hazy vision 12.18% and double vision 2.61%, normal 43.47%

TABLE 4.8: Visual Perceptual Description

Blur vision		Double vision		Cloudy vision / hazy vision		Normal	
OD	OS	OD	OS	OD	OS	OD	OS
45	48	3	3	14	14	50	50
Total Number of patients=48		Total Number of Patients=3		Total Number of Patients=14		Total number of patients=50	
Percentages: 41.74%		2.61%		12.18		43.47%	

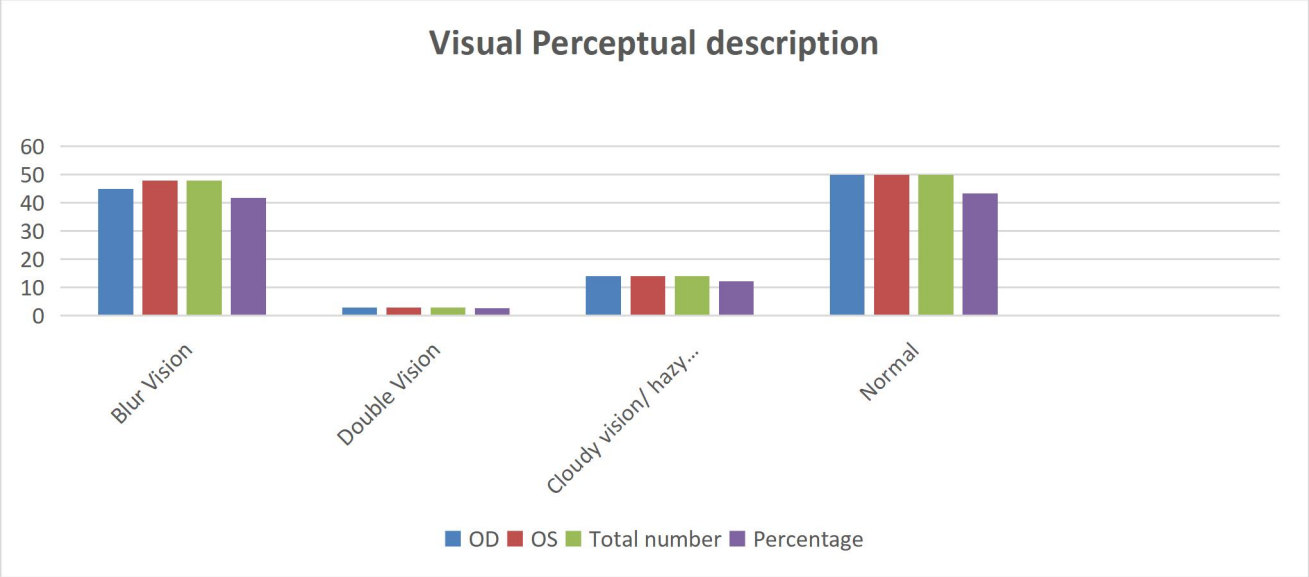
Note

*Patients presenting with abnormal visual perceptual description= 65

*Patients with normal visual perceptual description = 115- 65 = 50

TABLE 4.9: Mean of number of respondents/patients with different visual perceptual descriptions

Symptom	**BlurVision**	**Doublevision**	**Cloudyvision**	**Normal**
Mean	46.5000	3.0000	14.0000	50.0000
Standard Deviation	±2.12132	±0.00000	±0.00000	±0.00000
Standard Error of Mean	1.50000	0.00000	0.00000	0.00000



Bar chart showing Visual Perceptual description.

Figure 4.5 Visual Perceptual description.

Table 4.10 indicated findings during internal examination using the Keeler Ophthalmoscope. The patients showed glaucomatons copping of different stages, macular degenerations, cloudy / opaque media, disc palor and retinopathy. The numbers were 12 (10.43%), 19 (16.52%), 19 (16.52%), 2 (1.74%), 1 (0.87%) and 2 (1.74%) respectively 60 (52.18%) presented with clear normal media in which the internal examination was normal. It is important to note the respondents with glaucomatons cupping age related macular degeneration and cataract were mostly from ages between 70 years and 100 years. Many had indications of no improvement with treatments.

TABLE 4.10: Internal Examination

Glaucomatous Cupping		**Age Related Macular Degeneration**		**Cloudy/Opaque Media cataract**		**Disc Palor**		**Floaters**		**Retinopathy**		**Clear Media**	
OD	OS	OD	OS	OD	OS	OD	OS	OD	OS	OD	OS	OD	OS
10	12	18	19	17	19	2	2	1	1	2	2	60	60
Total Number of patients=12 (10.43%)		Total Number of Patients=19 (16.52%)		Total Number of Patients=19 (16.52%)		Total Number of Patients=2 (1.74%)		Total Number of Patients=1 (0.87%)		Total Number of Patients 2 =(1.74%)		Total Number of Patients 60 (52.18%)	

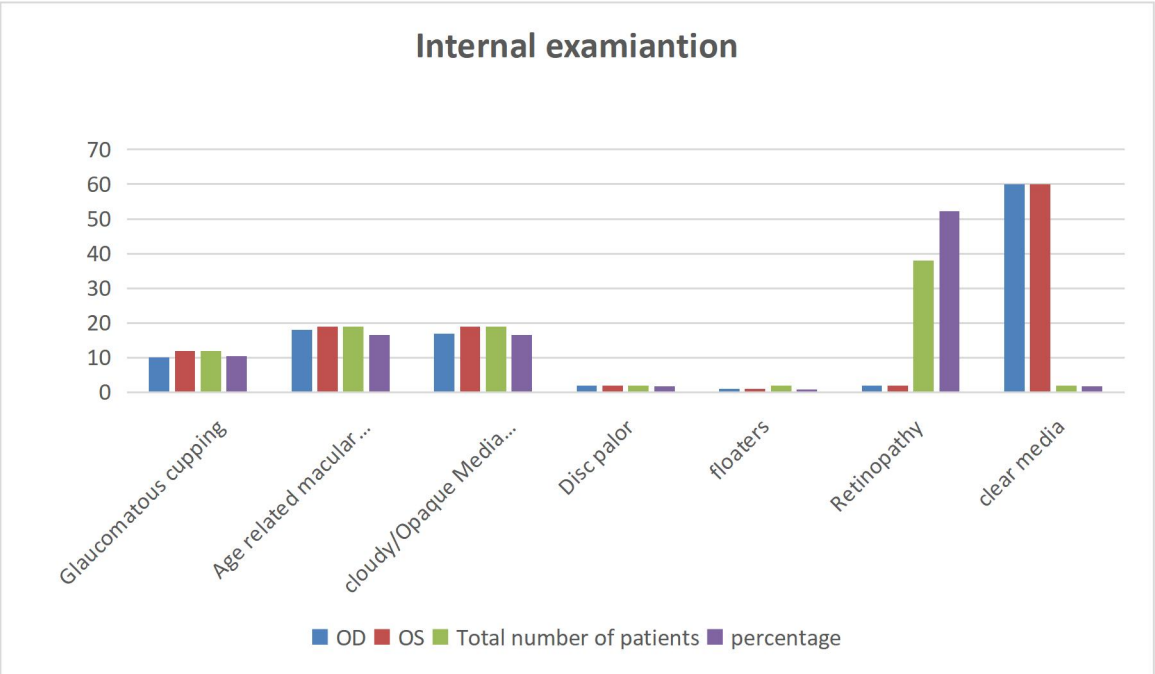
NOTE

***Patients with internal problems =55**

***Patients without internal problems=115 -55=60**

TABLE 4.11: Mean of number of eyes with different signs on internal examination

Signs	Mean	Standard deviation	Standard error of the mean
Glaucomatous Cupping	11	± 1.41421	1
ARMD	18.5	± 0.70711	0.5
Cloudymedia	18	± 1.41421	1
Discpallor	2	± 0.00000	0
Floaters	1	± 0.00000	0
Retinopathy	2	± 0.00000	0
Clearmedia	60	± 0.00000	0



Bar chart showing internal examination

Figure 4.6 Internal Examination

Table 4.11 showed the signs and symptoms presented by the patients. These patients presented with tearing in which 35 complained of tearing which was followed by itching of the eye which had 25 of them, photophobia was indicated among 11 and discharges were 6. Pain in both eyes were among 30 patients. Foreign body/sandy sensation 30, trauma recorded 3 and headache 19.

Table 4.12 indicated multiple signs and symptoms. Some patients complained of headache, tearing and itching all at once. This data is very important as shall be explained in the discussion.

TABLE 4.12: Signs and Symptoms Presented

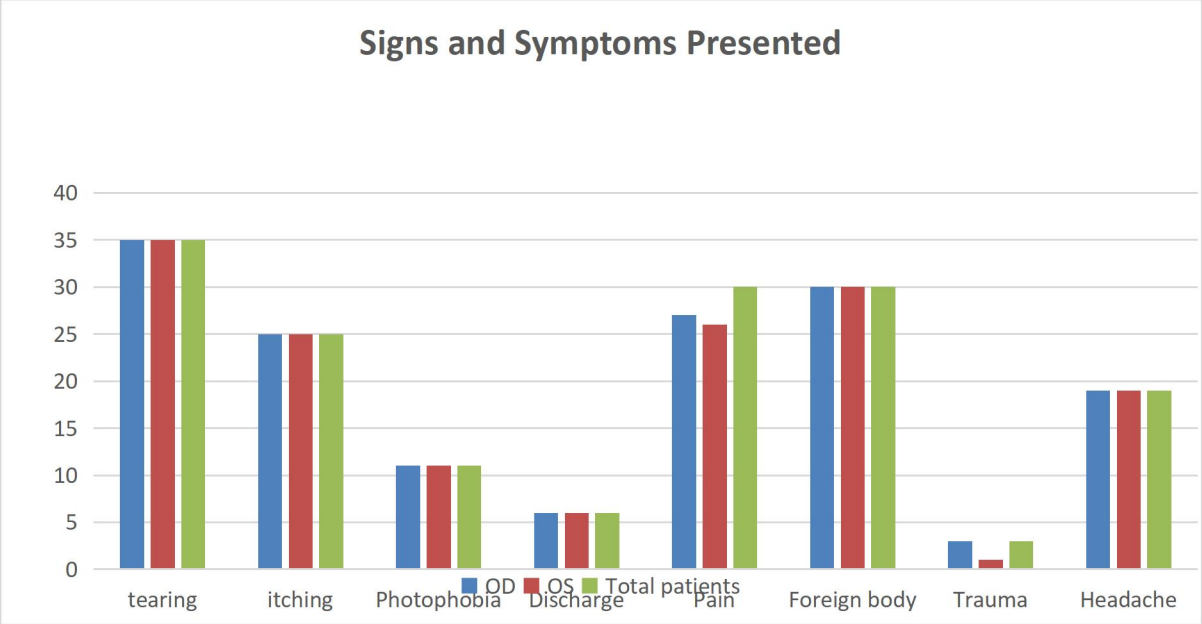
Tearing		**Itching**		**Photophobia**		**Discharge**		**Pain**		**Foreign body/ sandy sensations**		**Trauma**		**Headache**	
OD	OS	OD	OS	OD	OS	OD	OS	OD	OS	OD	OS	OD	OS	OD	OS
35	35	25	25	11	11	6	6	27	26	30	30	3	1	19	19
Total Number of patients=35		Total Number of Patients=25		Total number of patients=11		Total Number of Patients=6		Total Number of Patients=30		Total Number of Patients=30		Total Number of patients =3		Total Number of Patients=19	

Please Note: The abnormal signs and symptoms were recorded as multiple signs and symptoms. That is, a patient or respondent could present two or more signs and symptoms.

*To express in percentage would not give accurate representation of data.

TABLE 4.13: Mean number of eyes with different symptoms

Symptoms	Mean	Standard deviation	Standard error of mean
Tearing	35	± 0.00000	0
Itching	25	± 0.00000	0
Photophobia	11	± 0.00000	0
Discharge	6	± 0.00000	0
Pain	26.5	± 0.70711	0.5
FB sensation	30	± 0.00000	0
Trauma	2	± 1.41421	1
Headache	19	± 0.00000	0



Bar Chart showing signs and symptoms presented

Figure 4.7 Signs and Symptoms Present

Table 14 were findings from external examination using Pentorch and hand held magnifier. We were able to identify pterygium, (20, 17.39%), Penguecula (9, 7.82%), chalazion (3, 2.61%), red eyes / redness (16, 13.91%), conjunctivitis (4, 3.48%), corneal ulceration / laceration (3, 2.61%), allergic conjunctivitis / brownish eyes (5, 4.3%) and cases with no abnormality detected (55, 47.82%).

Table 4.14: EXTERNAL EXAMINATIONS

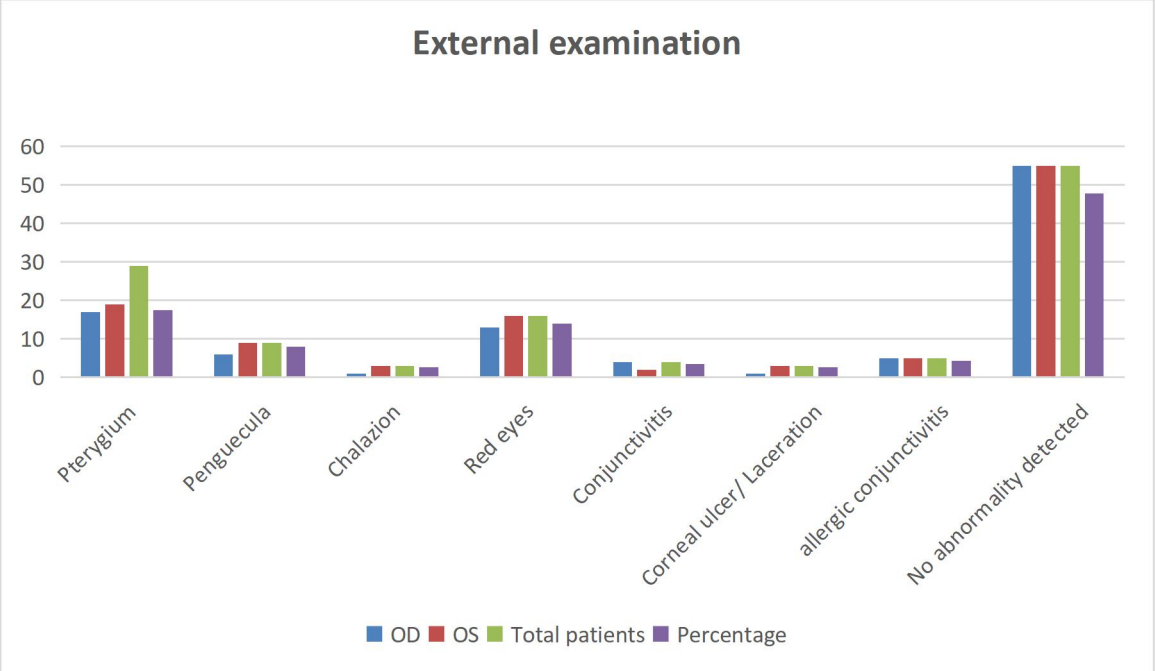
Pterygium		**Penguecula**		**Chalazion**		**Red eyes/Redness**		**Conjunctivitis (Bacterial/ viral infection)**		**Corneal Ulcer/ laceration**		**Allergic conjunctivitis/ Brownish eyes**		**No abnormality detected**	
OD	OS	OD	OS	OD	OS	OD	OS	OD	OS	OD	OS	OD	OS	OD	OS
17	19	6	9	1	3	13	16	4	2	1	3	5	5	55	55
Total Number of patients=20 (17.38%)		Total Number of Patients=9 (7.88%)		Total Number of Patients=3 (2.60%)		Total Number of Patients=16 (13.90%)		Total Number of Patients=4 (3.48%)		Total Number of Patients =3 (2.60%)		Total Number of Patients=5 (4.34%)		55 (47.82%)	

NOTE

- **Patients with external eye problems= 60**
- **Patients without external problems = 115- 60= 55**

TABLE 4.15: Mean number of eyes with different signs on external examination

Symptoms	Mean	Standard deviation	Standard error of the mean
Pterygium	18	± 1.41421	1
Pinguecula	7.5	± 2.12132	1.5
Chalazion	2	± 1.41421	1
Redness	14.5	± 2.12132	1.5
Conjunctivitis	3	± 1.41421	1
Corneal ulcer	2	± 1.41421	1
Brownish eyes	5	± 0.00000	0
NAD	55	± 0.00000	0



Bar chart showing external examination

Figure 4.8 External Examination

Table 4.16 showed the Chemical Analysis of Water Samples. Majority of the parameters for the assessment of water samples were performed by Martlet Environmental Research Laboratory Limited. The Aas Model-Solar 969 Unicam Series with Air Acetyelene Frame was used for the analysis

RESULT OF THE CHEMICAL ANALYSIS

Table 4.16: Result of water samples

Sample Code	Ph	EC	Sal.	Col.	Turb	TSS	TDS	COD	HCO_3	Na	K	Ca	Mg	Cl	P	NO2	NO3	NH4N	SO4
		µS/cm	g/l	Pt.Co	NTU	mg/l													
Egbem 1	6.2	84.1	0.038	0.3	0.6	0.2	41.2	19.2	24.4	0.53	0.14	1.17	0.97	70.9	0.121	0.028	0.582	0.610	0.013
Egbem 2	5.8	115.	0.052	0.3	0.5	0.1	57.3	23.3	36.6	0.88	0.20	2.84	1.62	88.6	0.128	0.044	1.254	0.642	0.014
RV 1	6.1	8.3	0.004	0.5	0.8	0.2	4.4	16.0	12.2	0.11	0.05	0.56	0.28	35.5	0.031	0.017	0.473	0.583	0.011
PWA	6.7	120.4	0.054	ND	ND	ND	60.4	34.4	109.8	1.04	0.27	3.11	1.83	106.4	0.157	0.071	1.710	0.651	0.020

Sample Code	FeP	Mn	Zn	Cu	Cr	Cd	Ni	Pb	V	THC
Egbem 1	0.233	0.065	0.174	0.041	0.015	0.008	0.005	0.010	0.002	ND
Egbem 2	0.184	0.050	0.151	0.033	0.011	0.005	0.005	0.007	0.001	ND
RV 1	0.353	0.073	0.180	0.048	0.020	0.011	0.007	0.017	0.004	ND
PWA	0.104	0.044	0.076	0.030	0.008	0.003	ND	0.005	ND	ND

ND- Not Detected

AAS MODEL- SOLAAR 969 UNICAM SERIES

FLAME USED- AIR ACETYLENE FLAME

Table 4.17: Result of Soil Samples

Sample Code	pH	EC	Org.C	Org.M	T.N	EA	Na	K	Ca	Mg	Cl	Av.P	NH_4N	NO_2	NO_3	SO_4
	μS/cm			%			Meq/100g of soil				Mg/kg					
SSS	4.2	103.1	1.16	2.01	0.105	1.8	0.027	0.014	0.081	0.053	177.3	0.420	1.35	0.501	4.68	0.204
SSC1	4.9	613.4	2.58	4.44	0.235	1.1	0.180	0.051	0.972	0.555	871.0	14.60	8.78	0.970	10.9	0.360
SSC2	5.9	1118.0	4.56	7.84	0.415	0.6	0.214	0.084	1.041	0.875	1,773	39.81	14.40	1.856	17.7	0.861

Sample Code	Fe	Mn	Zn	Cu	Cr	Cd	Ni	Pb	V	THC
					Mg/kg					
SSS	156.02	85.11	104.30	56.30	22.73	10.41	17.80	7.34	2.61	ND
SSSC1	62.81	43.10	58.21	32.41	18.61	3.44	8.35	1.82	0.93	0.141
SSC2	29.04	17.40	21.12	11.33	8.53	3.17	5.15	0.85	0.60	ND

ND- Not Detected

AAS MODEL- SOLAAR 969 UNICAM SERIES

FLAME USED- AIR ACETYLENE FLAME

FLAME USED- AIR ACETYLENE FLA

TABLE 4.18: Mean Concentration of Chemical Components in the Water

Component	Mean	Standard deviation	Standard error of mean
pH	6.2	± 0.37417	0.18708
EC	81.95	± 51.63865	25.81932
Sal	0.037	± 0.023123	0.011561
Col	0.275	± 0.20616	0.10308
Turb	0.475	± 0.34034	0.17017
TSS	0.125	± 0.09574	0.04787
TDS	40.825	± 25.70037	12.85019
COD	23.225	± 8.02678	4.01339
HCO3	45.75	± 43.847	21.92326
Na	0.64	± 0.413	0.20628
K	0.165	± 0.093	0.04664
Ca	1.92	± 1.248	0.62414
Mg	1.175	± 0.700	0.35001
Cl	75.35	± 30.263	15.13134
P	0.10925	± 0.054	0.027222
NO2	0.04	± 0.023	0.011726
NO3	1.00475	± 0.583	0.291687
NH4	0.6215	± 0.031	0.015559
SO4	0.0145	± 0.004	0.001936
FeP	0.2185	± 0.104	0.052122
Mn	0.058	± 0.013	0.006671
Zn	0.14525	± 0.048	0.023914
Cu	0.038	± 0.008	0.004062
Cr	0.0135	± 0.005	0.002598
Cd	0.00675	± 0.004	0.00175
Ni	0.00425	± 0.003	0.001493
Pb	0.00975	± 0.005	0.002626
V	0.00175	± 0.002	0.000854
THC	0	± 0.000	0

TABLE 4.19: Mean Concentration of Chemical Components in the Soil Samples

Component	Mean	Std. Deviation	Std. Error of Mean
pH	5	± 0.85440	0.49329
EC	611.5	± 507.45267	292.9779
Org.C	2.7667	± 1.70767	0.98592
Org.M	4.7633	± 2.92842	1.69072
T.N	0.25167	± 0.155671	0.089876
EA	1.1667	± 0.60277	0.34801
Na	0.14033	± 0.099611	0.05751
K	0.04967	± 0.035019	0.020218
Ca	0.698	± 0.535450	0.309142
Mg	0.49433	± 0.414344	0.239222
Cl	940.4333	± 800.11272	461.9453
Av.P	18.2767	± 19.95073	11.51856
NH4N	8.1767	± 6.54589	3.77927
NO2	1.109	± 0.688111	0.397281
NO3	11.0933	± 6.51215	3.75979
SO4	0.475	± 0.343265	0.198184
Fe	82.6233	± 65.76782	37.97107
Mn	48.5367	± 34.18083	19.73431
Zn	61.21	± 41.67107	24.0588
Cu	33.3467	± 22.49963	12.99017
Cr	16.6233	± 7.30549	4.21782
Cd	5.6733	± 4.10429	2.36962
Pb	10.4333	± 6.57730	3.7974
Ni	3.3367	± 3.50075	2.02116
V	1.38	± 1.07791	0.62233
THC	0.047	± 0.081406	0.047

Plot of means of components between different water bodies

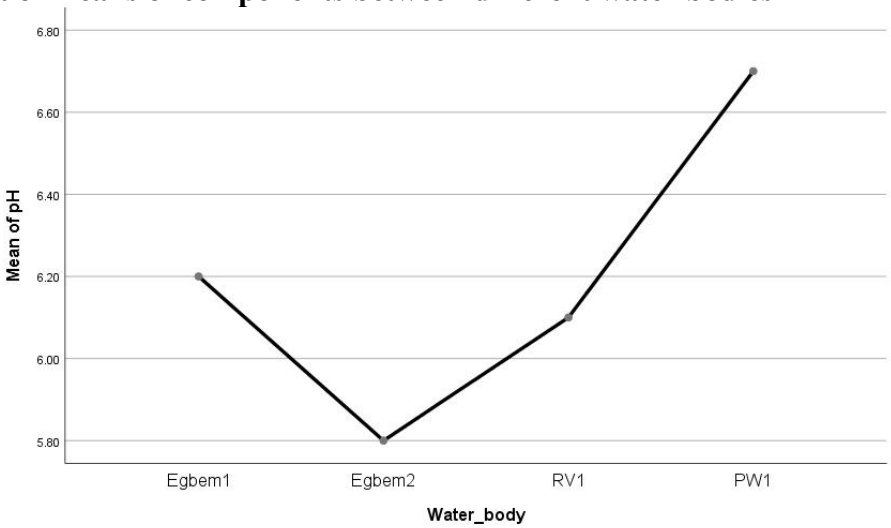


Figure 4.9: Graph of pH in water samples at Ogbite

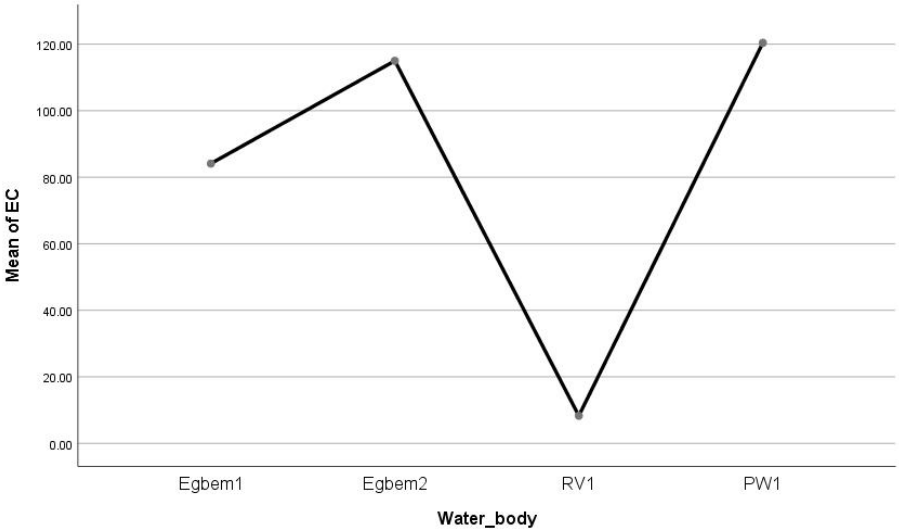


Figure 4.10: Graph of EC in water samples at Ogbite

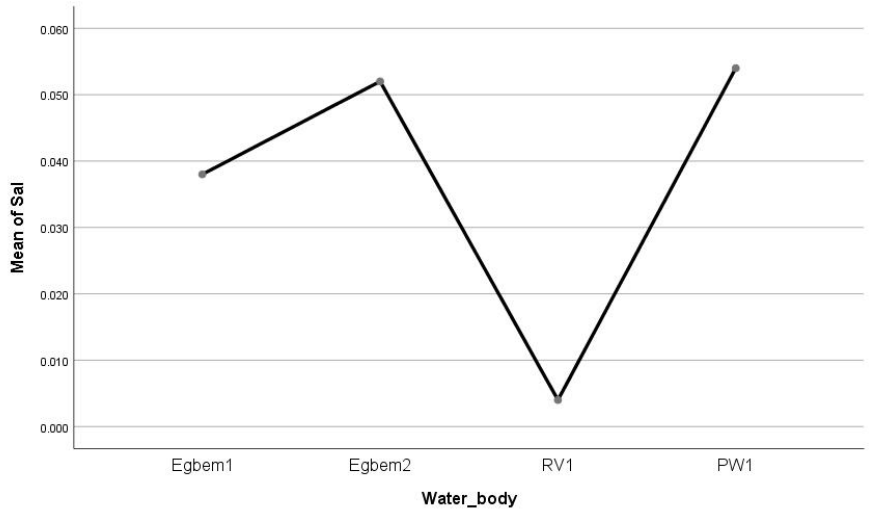


Figure 4.11: Mean of Sal in the water samples at Ogbite

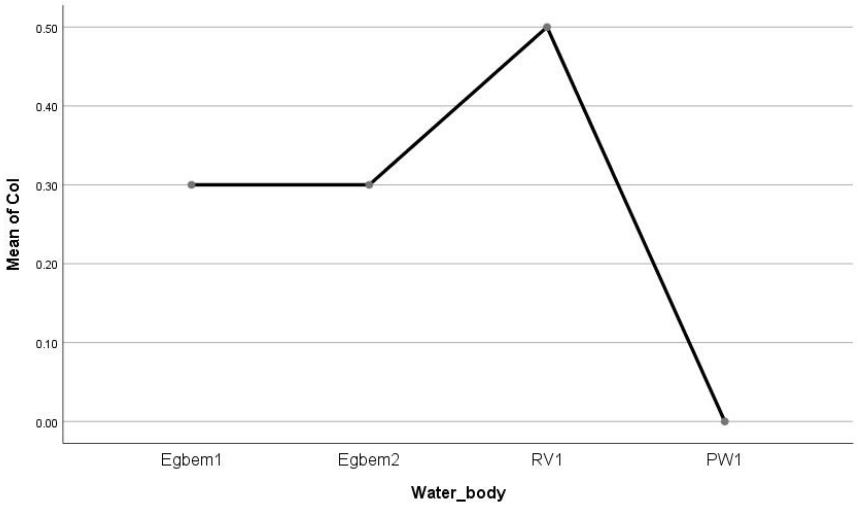


Figure 4.12: Graph of Col in the water samples at Ogbite

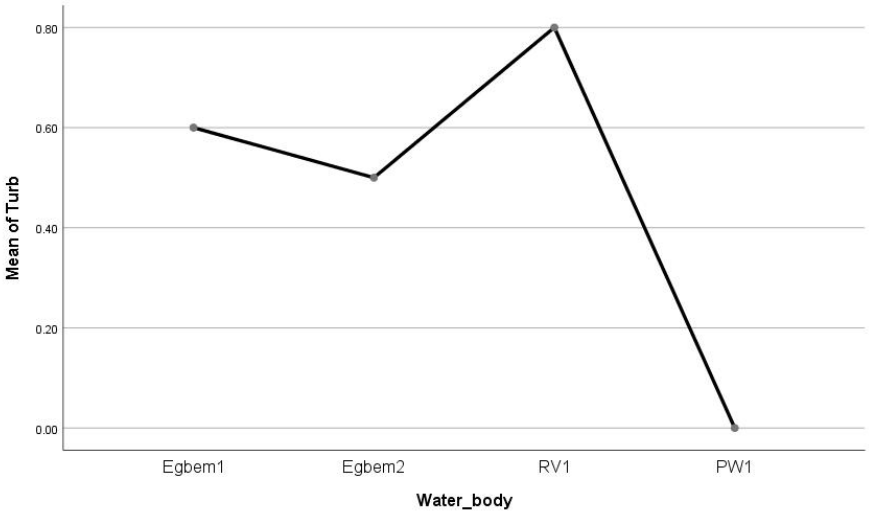


Figure 4.13: Graph of turbidity in water samples at Ogbite

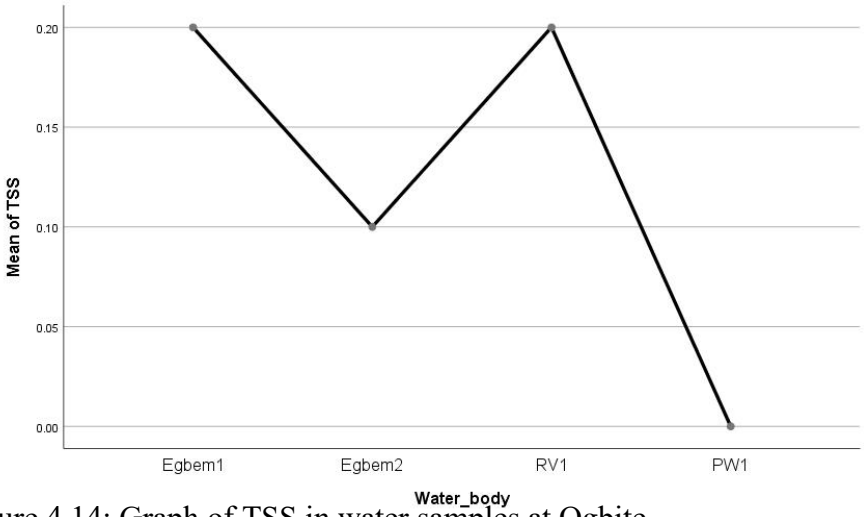


Figure 4.14: Graph of TSS in water samples at Ogbite

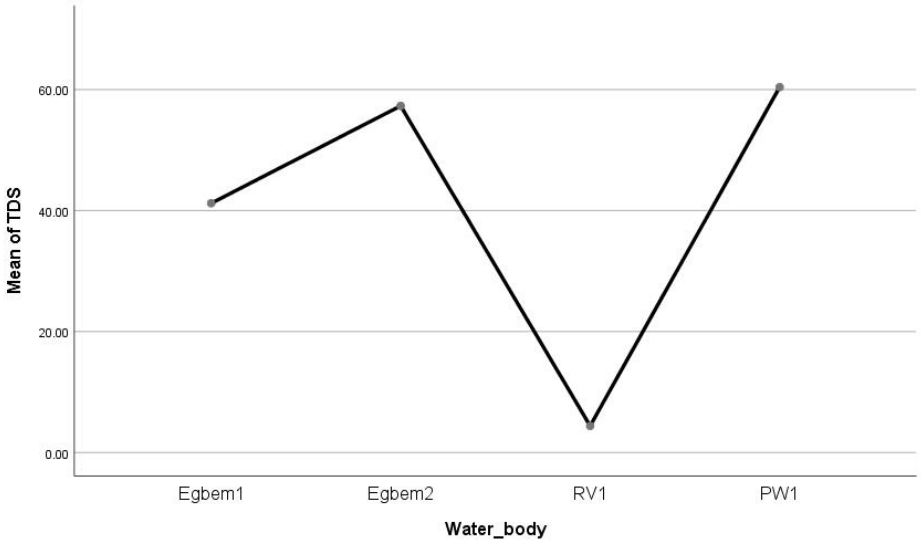


Figure 4.15: Graph of TDS in water samples at Ogbite

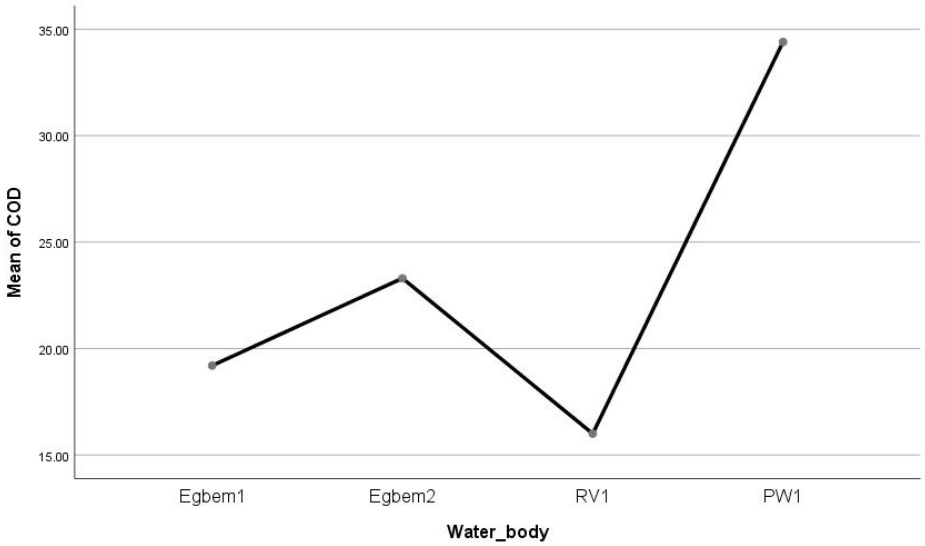


Figure 4.16: Graph of COD in water samples at Ogbite

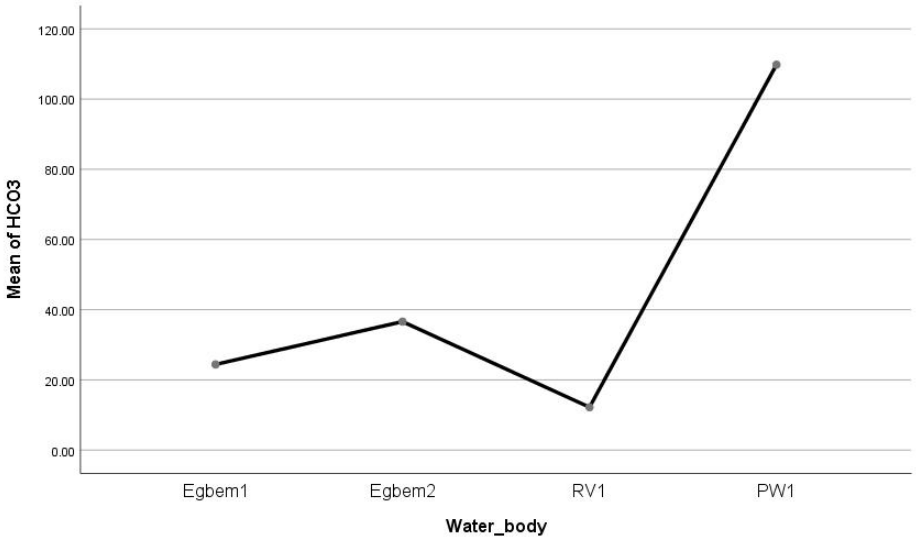


Figure 4.17: Graph of HCO_3 in water samples at Ogbite

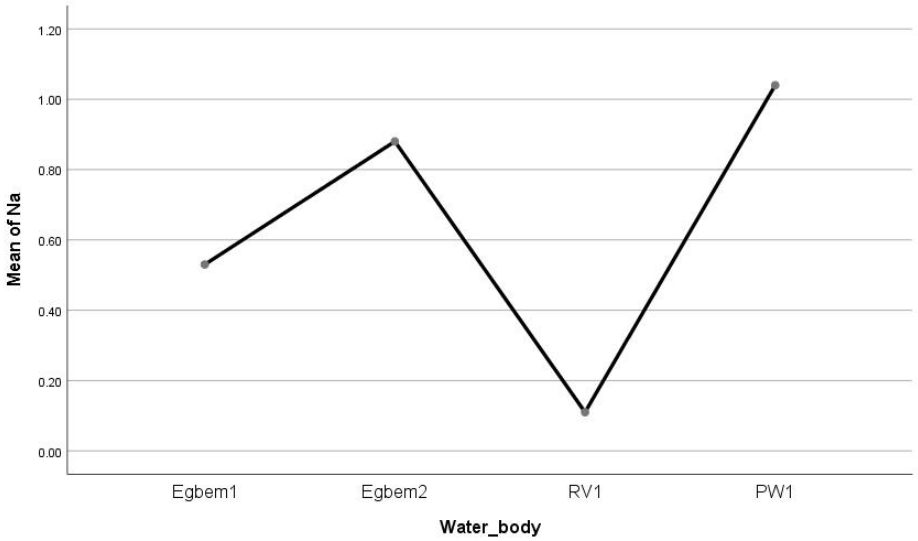


Figure 4.18: Graph of Na in water samples at Ogbite

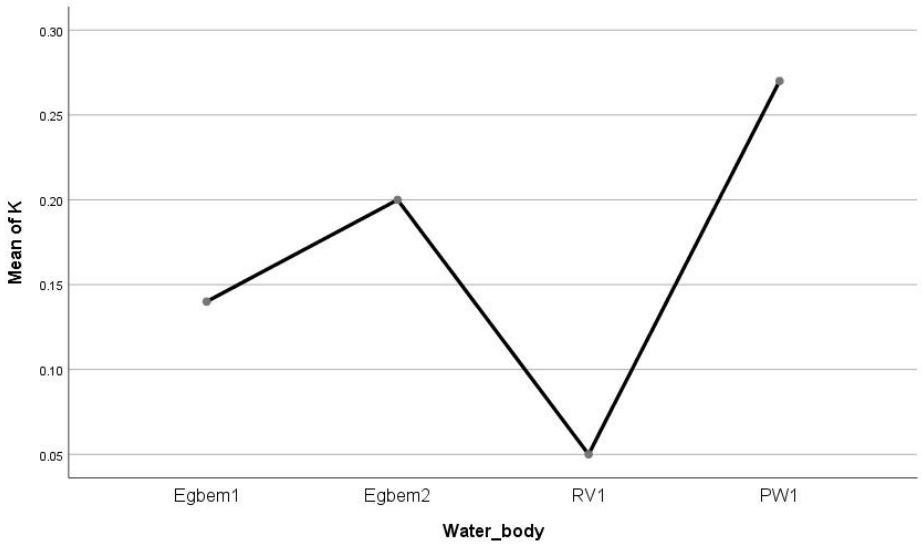


Figure 4.19: Graph of K in water samples at Ogbite

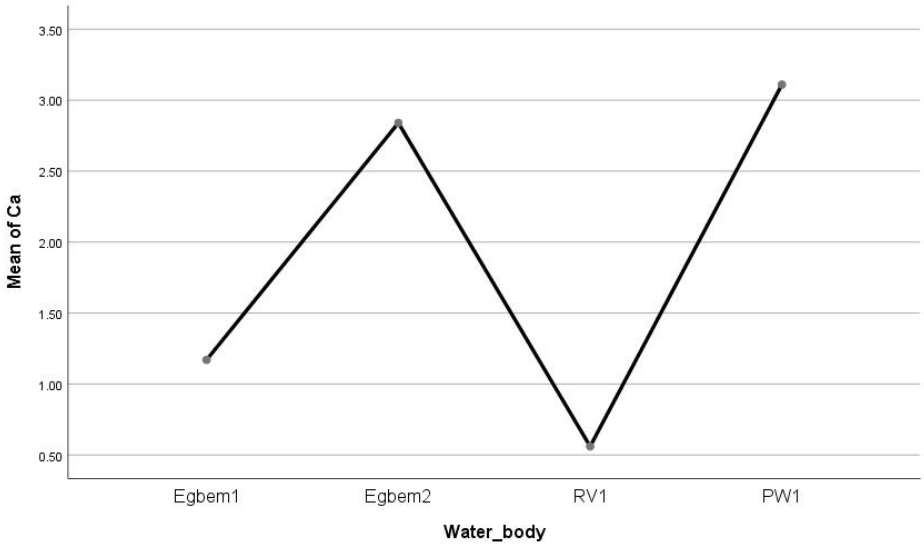


Figure 4.20: Graph of Ca^{++} in water samples at Ogbite

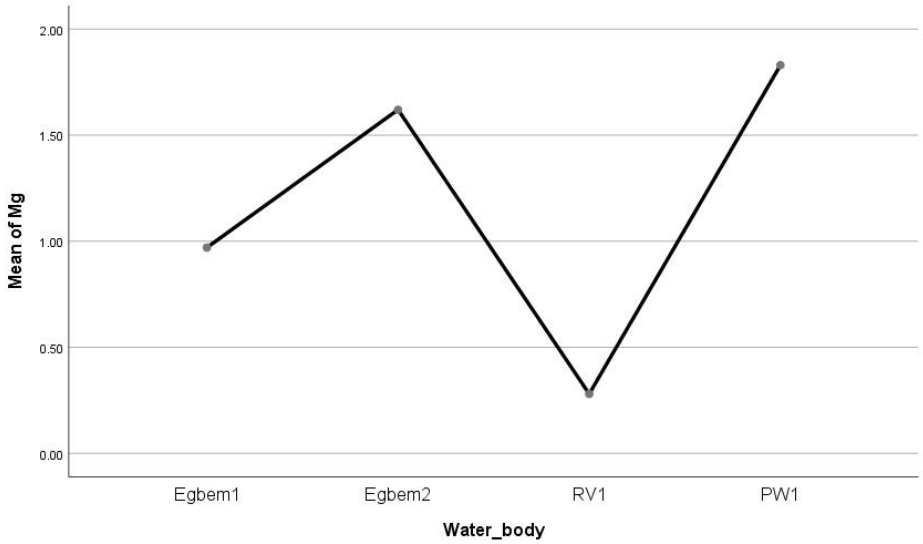


Figure 4.21: Graph of Mg in water samples at Ogbite

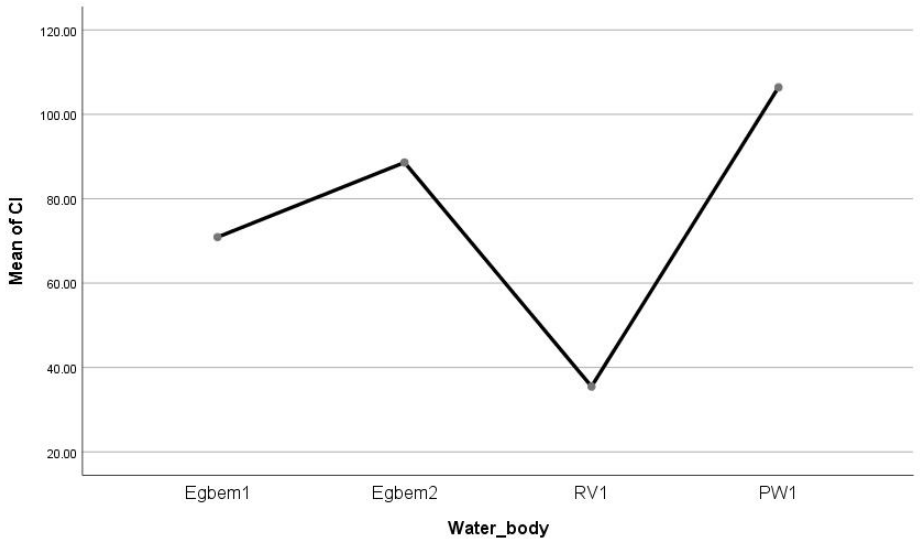


Figure 4.22: Graph of Cl in water samples at Ogbite

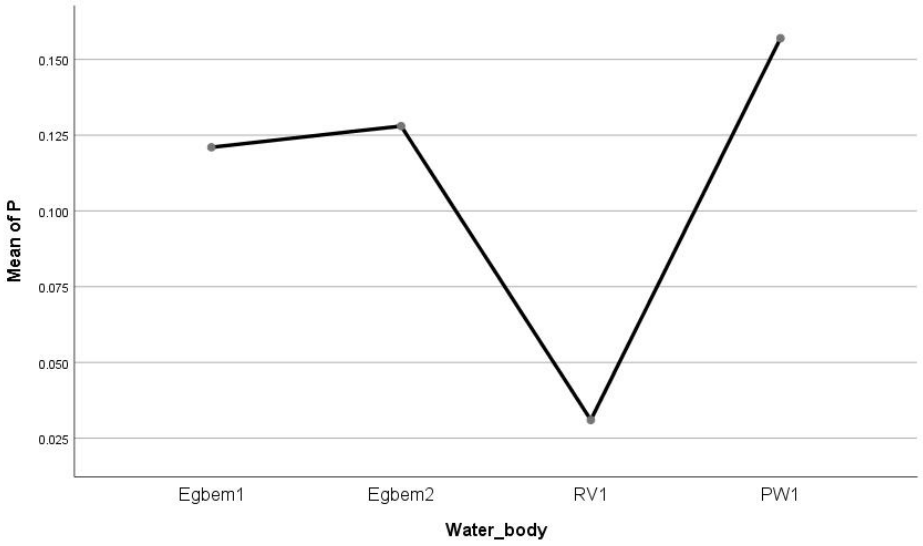


Figure 4.23: Graph of P in water sample at Ogbite

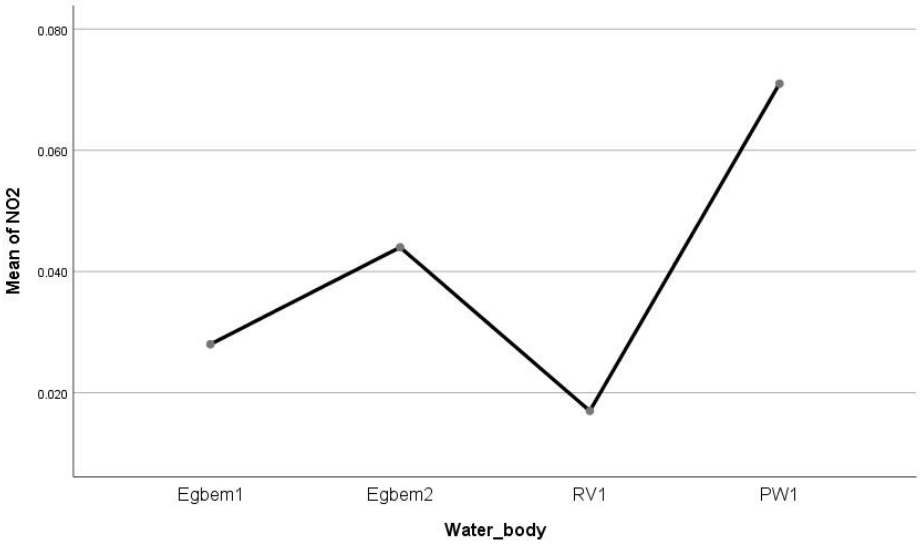


Figure 4.24: Graph of No_2 in water samples at Ogbite

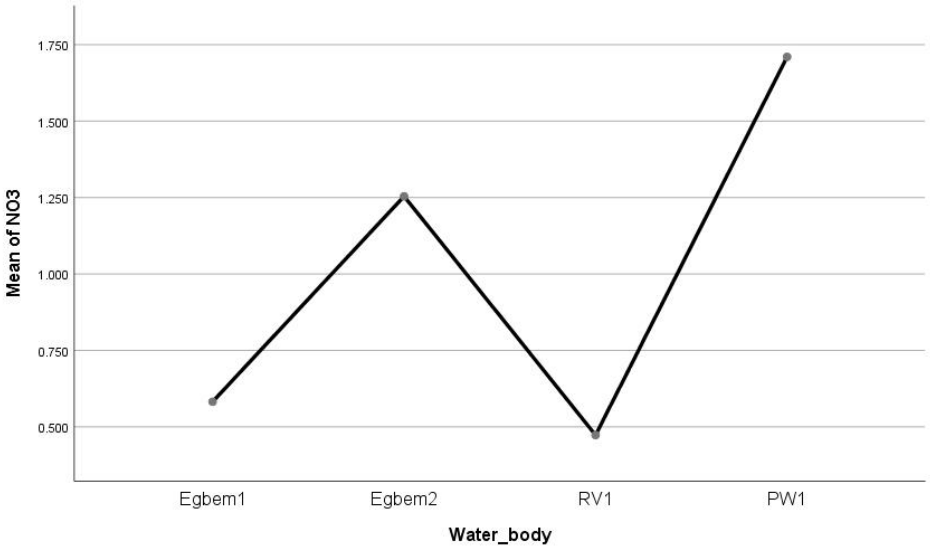


Figure 4.25: Graph of NO_3 in water samples at Ogbite

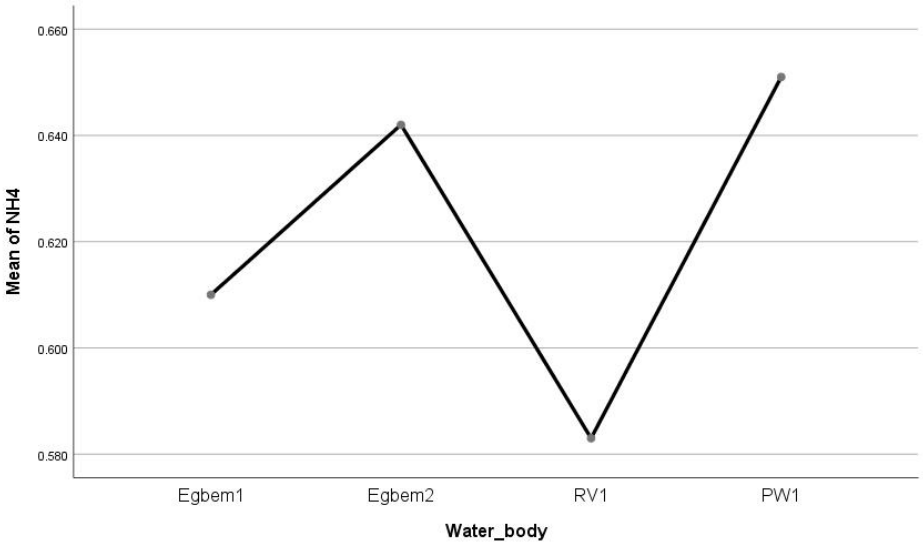


Figure 4.26: Graph of NH_4 in water samples at Ogbite

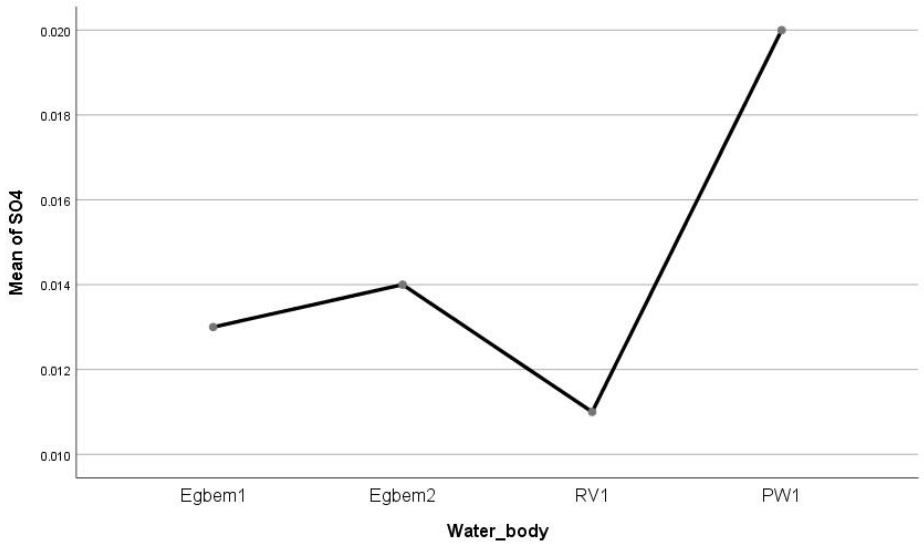


Figure 4.27: Graph of SO_4 in water samples at Ogbite

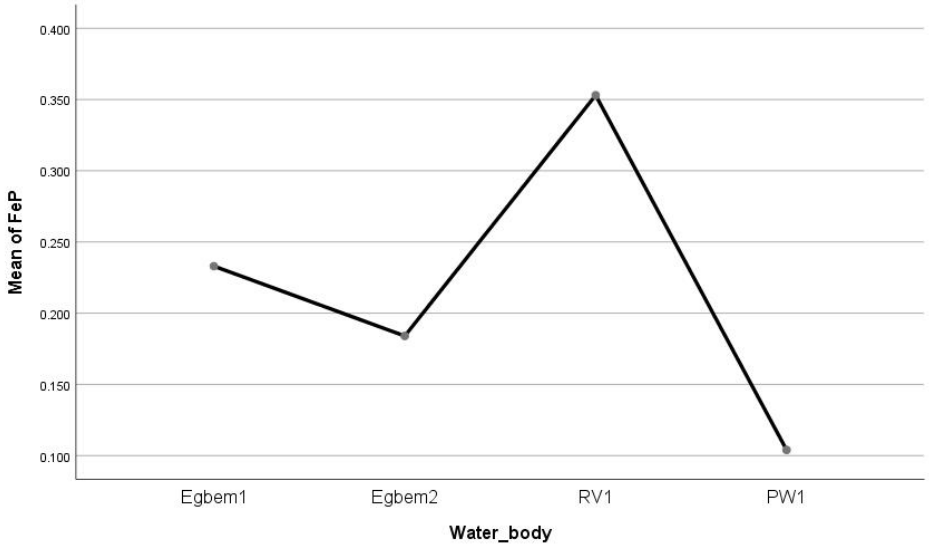


Figure 4.28: Graph of FeP in water samples at Ogbite

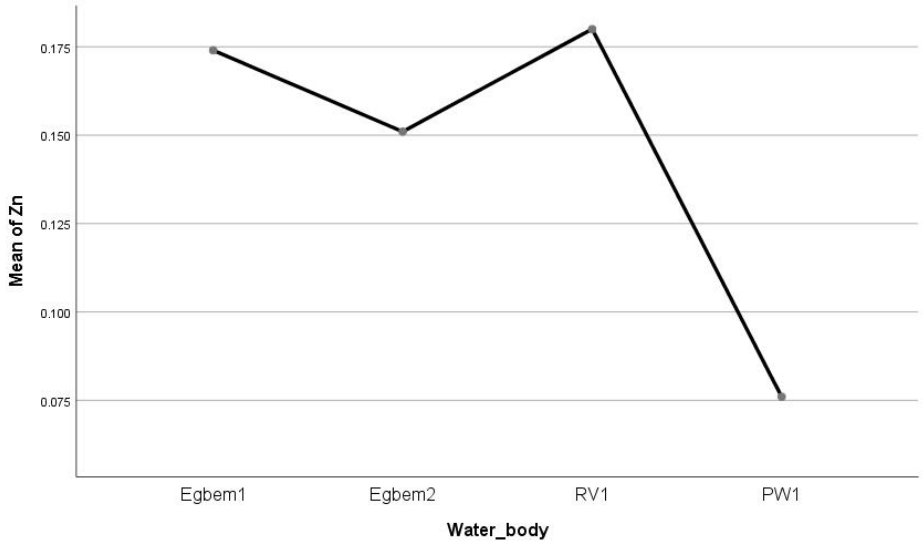


Figure 4.30: Graph of Zn in water samples at Ogbite

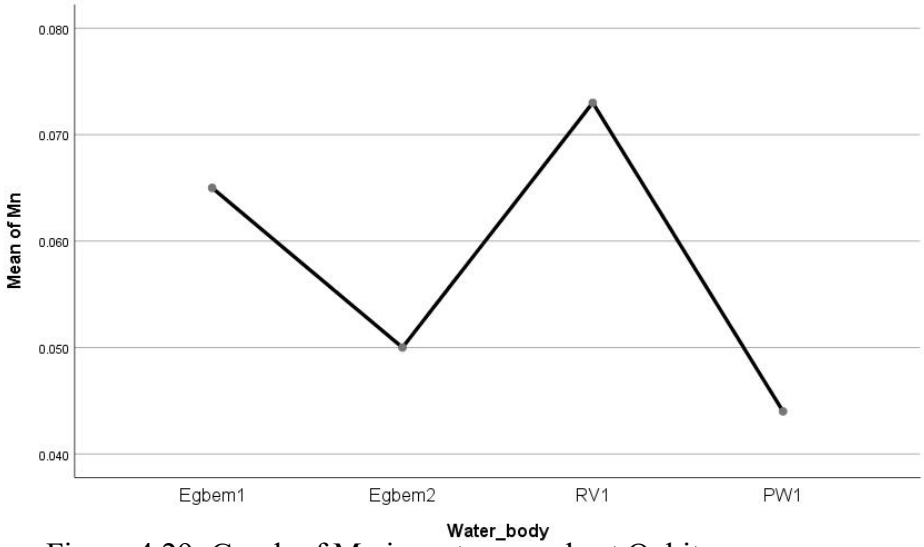


Figure 4.29: Graph of Mn in water sample at Ogbite

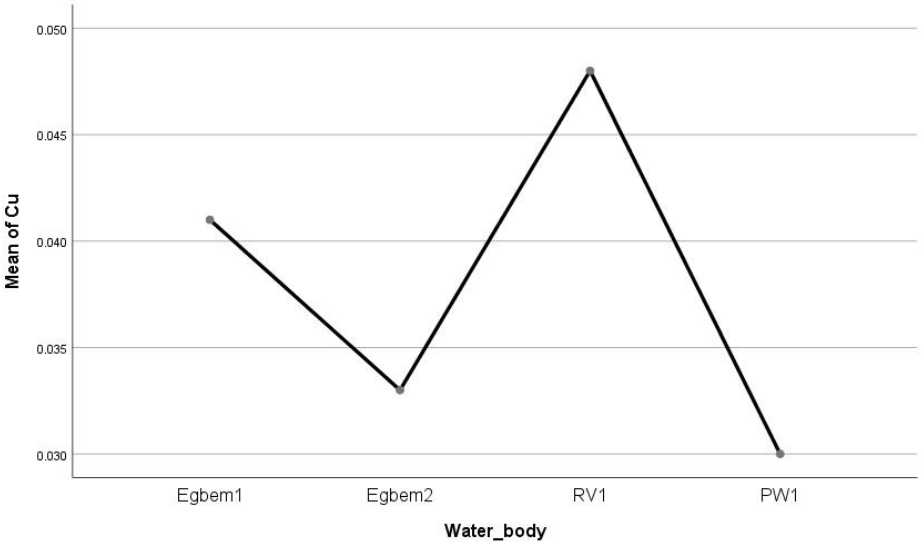


Figure 4.31: Graph of Cu in water samples at Ogbite

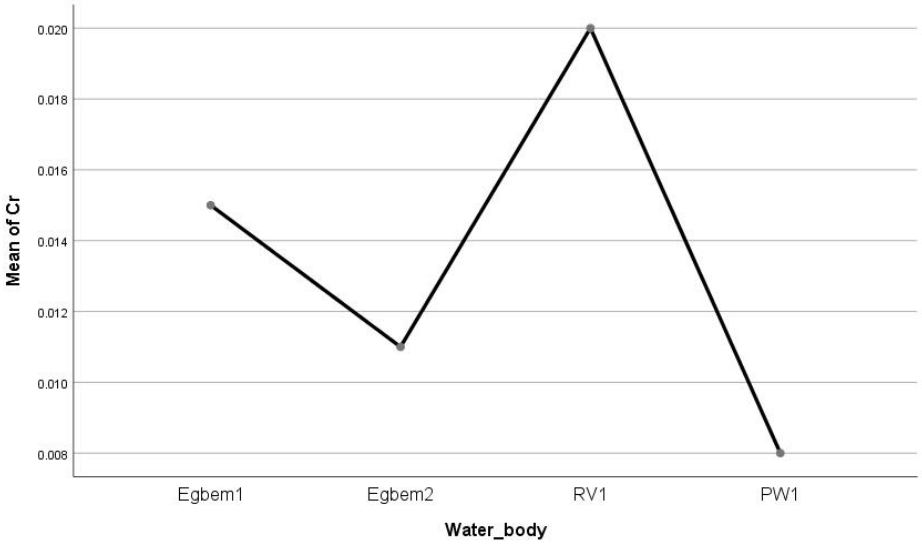


Figure 4.32: Graph of Cr in water samples at Ogbite

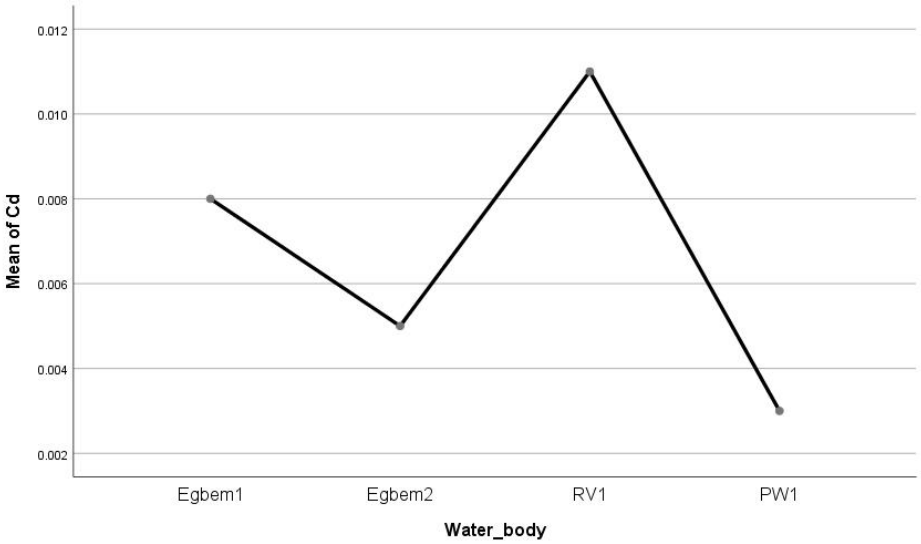


Figure 4.33: Graph of Cd in water samples at Ogbite

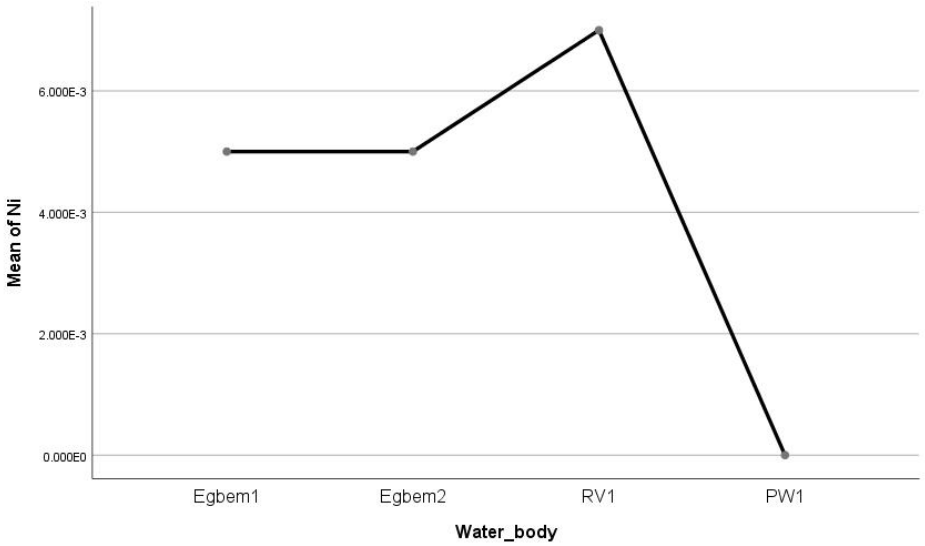


Figure 4.34: Graph of Ni in water samples at Ogbite

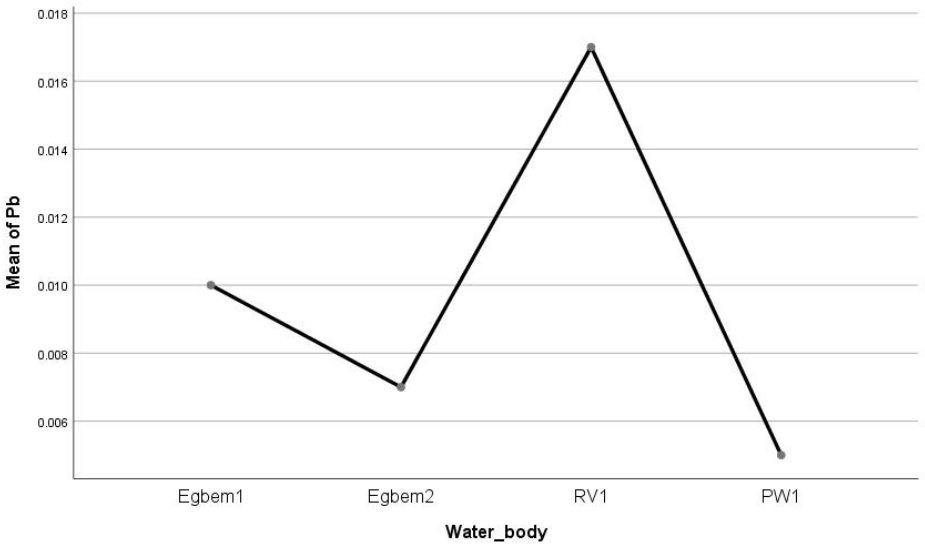


Figure 4.35: Graph of Pb in water samples at Ogbaite

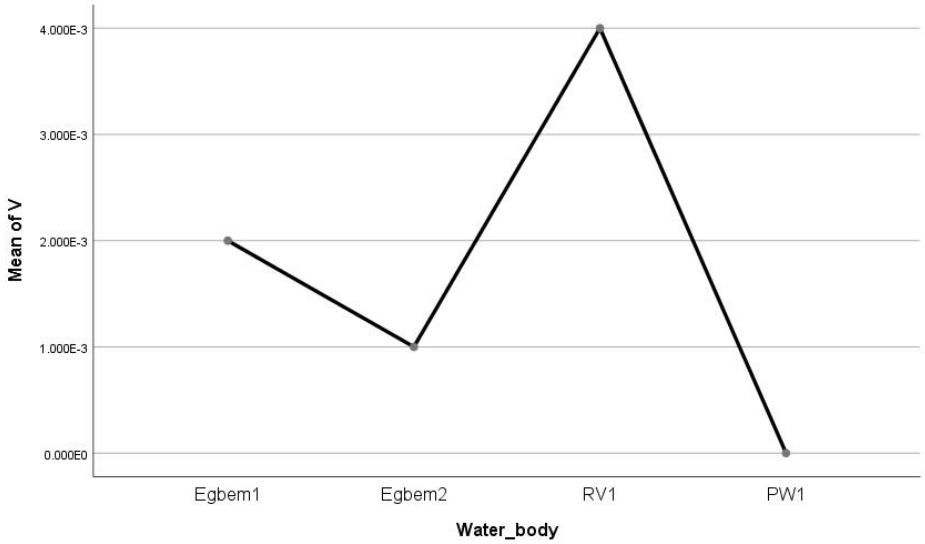


Figure 4.36: Graph of V in water samples at Ogbite

CHAPTER FIVE

DISCUSSION

According Oviasuyi and Uwadiae “Oil comes as a natural endowment in a particular community, area or region. Unfortunately, and regrettably too, oil has turned out to be a curse to the Niger Delta Region of Nigeria since 1956, when it was first in commercial quantity in the region. The inhabitants of the region have been subjected to untold hardship through oil pollution, environmental degradation, destruction of aquatic lives, and other negative activities that are inimical to the existence and survival of the people of the region as a result of oil exploration and exploitation”. (Oviasuyi and Uwadiae).

For Nigeria, pollution from exploration and exploitation of crude oil has been extremely devastating to the people of the Niger Delta region of the country. The introduction of Petroleum Hydrocarbon into an ecosystem, as a consequence of human activity, pollute the environment. As stated in chapter 3, Ogbite is where multinational companies located their gas plant, flow station and there are several oil wells located within and directly outside Ogbite.

Ogbite is just a tiny aspect of the big picture of environmental degradation. Nigeria is blessed with unfathomable biodiversity in a diversity of ecosystems. However, deforestation, desertification, pollution, fires, over hunting, exotic species poaching, apathy by government, communities and industry have destroyed more than 50% of her ecosystem. The entire ecosystem of the Niger Delta has been impacted negatively by massive exploration and exploitation of crude oil.

The respondents in this study are located at the focal area of the Niger Delta. The oil industry in Ogbite was established in 1962 and ever since then, the people have been exposed to emissions from flow stations, oil wells being affected. Leakages are very frequent within the entire environment including the air, soil and waters being affected.

Crude oil itself contains some volatile components which include Benzene, Ethylbenzene, Toluene, Xylene, Naphthalene, which seep out of the pipelines, flow stations and gas plants. The people residing in areas too close to locations of seepage are much more exposed to those substances which generally affect mucosal tissues especially the respiratory, neurologic, ocular etc tissues . A study by Asonye and Bello exposed what they called pollution keratoconjunctivitis (PKC) in the Niger Delta in 2004.

They indicated that PKC was frequent in oil producing industrial areas of Delta State in which they revealed high levels of black carbon and tetraethyl lead (TEL) which were found in the tear film. The black carbon deposits in the conjunectiva and consequently the initiation of itching, tearing, photophobia and other oculovisual reactions. They (Asonye and Bello, 2004) revealed that majority of the people in the Niger Delta region who are exposed to oil pollution generally manifest with redness of the yes, brownish discolouration of the eyes, watering and sore eyes. There were also frequent occurrence of dry eye diseases. These are all the signs and symptoms of the perturbation of the tear film layer of the eye by organic compounds. The carbon particles disrupt the normal flow of tears. The particles are usually embedded on the cornea .If not flushed out, they stick there and the irritation continues, with constant itching, pain and discomfort.

The eyes of humans are the most fragile, vulnerable among the entire organs of the body, to environmental insults especially atmospheric perturbations. Oil spillage results to increased levels of gaseous pollutants such as SO_2, CO_2, NO_2, etc, which become instant irritants to the eyes (Ukpere et al, 2000). The people of Ogbite have been exposed to such irritating agents to the eye for more than six decades now. When there is increased atmospheric SO_2 for example, the consequence would be reduction of the environments pH, resulting to increased production of H_2SO_4 and continuous irritation of the eyes. This is because, the conjunctiva, located in the external adrexia of the eye, possess numerous

antigens among which are the cells in the isle langerhans tissues and dendritic cells and produce the T lymphocytes on the surface of the eye as immune response to xenobiotics which are usually present on ocular tissue surfaces. With continuous exposure, the T cells remain chronically reactive on cells on the surface of the corneoconjunctival region including the local circulatory system. Thus subsequent and continuous exposure to the pollutants in the air would stimulate the manifestation of severe ocular allergic disease. Note that the Draize test uses the conjunctival sac. It is actually very sensitive and respond very fast to acute toxicity.

Also, the exposure to high level of NO_2 would induce goblet cell hyperplasia in the tarsal conjunctival region. The physiologic mechanism of the reaction of the eye to NO_2 is different from that of SO_2 and others. This assists in determining which of the components is initiating the immune response.

Perusal of table 4.6 shows that there are increased occurrences of glaucomatous cupping, increased age related macular degeneration and cataract. These may be connected to the chronic presence of pollutants in the Niger Delta region. The elderly had most of the problems of the internal aspects of the problems of the eyes. There may have been persistent accumulations of the pollutants in the ocular tissue of the people in the Niger Delta area. Further investigations needs to be done to affirm the cumulative effects of such chemicals.

According to Ayuba (2012) “When petroleum hydrocarbon is released into the environment, processes alter the chemical composition of the petroleum hydrocarbon which alters the toxicity. Physical weathering may transform the petroleum hydrocarbon to form a less or more toxic to the organism. The chemical and physical properties of the petroleum hydrocarbon determine the rate it passes into an organism. The bioavailability and persistence of specific hydrocarbon, the ability of an organism to accumulate and metabolize, fate of the metabolized products, metabolties of the hydrocarbon interphase with the normal metabolic

process may alter an organisms chances of survival and reproduction in the environment" Ayuba (2012).

Ukoli in 2005 gave a summary of some significant pollutants from the petroleum oil industry released into the environment.

(1) Exploration and Production Activities: Drilling mud, cuttings, Oils and Greases, Salinity, Sulphide, Turbidity, Suspended Solids, Temperature, pH, Heavy Metals, Biological Oxygen Demand (BOD) and COD.

(2) Petroleum Refining activities include: Oil and greases, BOD, COD, phenols cyanides, sulphide, suspended solids, toxic additives, hydrocarbons and total suspended solids.

(3) Petroleum Product Utilization: These consists of the fumes of all machinery released into the atmosphere. Gases such as sulphide, nitrides, carbon monoxide and others. Also, solids such as heavy metals are also released. When such pollutants are abundantly present in our immediate environment, susceptibility to ocular tissue perturbation may increase.

A careful study of table 4.7 indicates the various responses of the ocular tissue to an environment with increased pollutant levels. They include tearing, itching, redeyes, photophobia, foreign body sensation, pain, headaches. They are symptoms a patient would complain of when the environment is abnormal especially in a setting with a huge risk of exposure to pollutants. These signs would continue to occur or exacerbate until the triggering factor is ameliorated.

Table 4.8 is actually the sign of exposure to something foreign to the eye. They include pterygium, penguecula, chalazion, red eye/ redness of eye, conjunctivitis, corneal ulcer/ laceration, and allergic conjunctivitis. These could be caused by the chemicals listed by Ukoli (2005).

Heavy metals are also very important sources of pollutants and from the results of Chemical Analysis performed by Martlet Environmental Research Laboratory Ltd see Table 4.9 the water samples were not good enough for human consumption and the soil also had abnormal deposits of ordinary metals and heavy metals. Minute changes in concentration of heavy metals can be deleterious to living tissues. There is no exception in the impact of heavy metals poisoning. It is very dangerous to living organisms hence the very important control mechanism for heavy metals. This is not the case in the Niger Delta where there are little or no control mechanisms.

According to Ovid, who lived boticen 43 BC and A.DI7, "Act, before disease becomes persistent through long delays" The delays in acting about the environmental degradation of the Niger Delta is pulsating and has the likelihood of resulting into massive Catastrophe of the entire region. This is because, according to Garrett (2000) In her book 'The Betrayal of Trust'- The collapse of Public Health, She stated that "... hospitals have become primary vehicles for the spread of disease - not of their cure. These are not the results of mysterious Malicious microbes. These are public health failures. The system we trust to ensure safe water, food, hospitals and communities can no longer in this globalized world rise to the challenge" The problems of the Niger Delta needs to be given to a holistic approach In propounding any solution. Currently, the public health system in Nigeria is a gross failure. Apart from Ogoniland, most areas of the Niger Delta are experiencing unprecedented health challenges due mostly, to the explorative and exploitative activities of International Oil Companies (10) and a criminals involved in crude oil bunkering.

Administrations upon administrations have come and gone and nothing tangible has been done to alleviate the Devillos conditions of the in the region. there is no food as the farms have been abandoned are no fishermen as the water bodies in the areg has been abandon there are no health care facilities be cause, of the thirmail in the region Health care professionals

have abandon the area because the environment. The consequences of Petroleum pollution in the Niger Delta are direct and indirect. Direct effects have been indicated in our investigations as signs and symptoms, external examination, etc. complaints of eye irritation , tearing/watery eyes, redness, conjunctivitis, foreign body sensation, blur vision, double vision etc, are direct consequences. These signs, symptoms and subjectively confirmed external manifestations are suspected to be due to toxic xenobiotics present in the environment. Exploitative, explorative and wasteful destruction especially the issue of gas flaring are the major causes of these elaborated issues. It is indeed a shame that Nigeria has the highest gas flaring locations in the world. Farming in the vicinity where gas flaring take place is not possible. The focal area due to the excessive heat generated while natural gas burn continuously, day and night.

The cornea, conjunctiva and skin are tissue/organs that protect the outer barrier of the body. These issues have developed intrinsic mechanisms that protect organisms from a range of external threats. The tissues of the eye and the skin are embryological similar. They produce epithelial cells which are protective in nature and regenerate. Therefore they are affected the same manner by pollutants. The easy accessibility of these tissue makes them attractive platforms for perturbation by pollutants. Focal areas for gas flaring have the people reporting dry eye disease always.

Washing of the eyes with water contaminated by crude oil or its derivatives can also result to itching, tearing and feeling of irritation. It is therefore not surprising that occupants of devastated areas of Niger Delta region do not use natural sources of water in their vicinities. From our interviews, they complain of total body irritations when they use water from rivers, streams and rivulets in their areas.

Indirectly, gas flaring affect the food chain in such areas hence the problem of food insecurity. Also, gas flaring exacerbate the greenhouse effect because emission from

combustion of the associated gas produces toxic materials such as benzene, nitrogen oxides, toluence, xylene, hydrogen sulphide, dioxins etc. these chemicals are absolutely detrimental to the eyes. Oil spills seep into the ground water and the chemical components could be dangerous to people consuming borehole waters. Contamination of surface water bodies have been thoroughly discussed and investigated in this study.

5.1 CONCLUSION

Truly, IOCs Prospecting for crude oil and natural gas have almost destroyed the pristine environment in the Niger Delta region. Thousands of researchers have been published regarding the huge devastation caused by these IOCs who are unrepentant about their infarious activities. This research project has exhumed or revealed the deleterious manifestations of stress on the ocular tissues. The research project have indicated that the activities of these IOCs have caused serious ocular problems for the people of Ogbite in Rivers state of Nigeria. As stated earlier in our discussions, Ogbite is a microcosm of the Niger Delta region. This has become, therefore, a very serious issue of public health concern. According to Lucas and Gilles (2003) "public health has progressively become a central feature of the health sector through its involvement in policy-making, management and evaluation at every level of the health service" Beaglehole and Bonita (1977) identified the following essential elements of modern public health:

- Collective responsibility
- Prime role of the state in protecting and promoting the publics health
- Parternership with population served
- Emphasizing on prevention
- Recognizing underlying socio-economic determinants of health and disease
- Identifying and dealing with proximal risk factors
- Multi disciplinary basis of action

Among all of the essential elements of modern public health, both the government and IOCs have neglected the people

From the foregoing, the people residing in the Niger Delta region are exposed to the burden of environmental degradation, disease and neglect. Some common features of underdevelopment as emphasized by Lucas and Gilles apathy reflected in the Niger Delta region. These feature include:

- Limited central organization of services – infact there are no serious public health services in the Niger Delta region
- Scattered populations living in small self-contained units- due to the continuous problems of pollution in the region, many of the locals are migrating to cities abandoning their places of origin. Note that pollution has increased climate change and many have reacted to elevated water levels sacking villages by scattering to different environments
- Low level of economic development- altruistically, there are low levels of economic development in the region. Just a few cities are developing. Other areas are infiltrated by bunkering activities.
- Limited educational facilities- abandoned areas full of risk for diseases of different tissue of organs of the body will not be ideal for educational facilities to be built.
- Inadequate control of common agents of disease- we saw the way and manner diseases of the eyes are being treated. Some of our patients and respondents have never met eye care professionals before.

Truly, many of these communities are “holding tightly in the vicious cycle of ignorance, poverty and disease” (Lucas and Gilles, 2003).

We therefore conclude that there are existence of environmental pollution in the Ogbite community in Ogba/EgbemaNdoni Local Government Area of River state. This area is also like other places in the Niger Delta region, bedeviled with failure of the public health system showcasing a betrayal of trust by IOCs and all levels of government.

5.2 RECOMMENDATION

According to Garrett (2000) public health places primary of the public over individual health. She stated that "Public Health fought on behalf of the community, placing special attention on the poorest, least advantaged elements of the community, fort amid conditions of poverty that disease usually arose"

Garrett further stated that "a sound public health system, it seems, is vital to societal stability and conversely, may topple in the face of political or social instability or whom. Each affects the other: widespread political disorder or anti govern mentalism may weaken a public health system, and a crisis in the health of the citizenry can bring down a government"

From the above by Garrett, the following recommendations are made

- The government at all levels must make efforts to mitigate the deleterious effects of pollution in the Niger Delta region by making efforts at cleaning the region according to international standard.
- Environmental impact Assessment must be conducted on the different communities where there is or have been explorative and exploitative activities in the Niger Delta region
- Government at state and federal levels should make legislations and institute such, regarding the activities of IOCs in Nigeria as applicable to other oil producing areas worldwide.

- Government at levels must strategically plan the economic development of the region as soon as possible to avoid backlash of the people
- Indigenes should be mobilized and educated on the challenges of environmental pollution and the effects of pollutants so as to seek premeditative processes and procedures when the pollutants manifest in the area
- There should be a well-grounded essential elements of modern public health which would cover all and cover all tissues, organs, systems of the body
- The eye, being the most essential, important and necessary organ which is fragile, vulnerable and easily affected, eye care professionals must play a major role in whichever public health system constituted
- It is important to emphasize for equity, equality, justice, fair play and egalitarianism on all the peoples of the Niger Delta region. This is because big cities have be built, infrastructures developed while the Niger Delta people wallow in Powerly and neglect. It is a truly embarrassing scenario.

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APPENDIX I

SAMPLE OF CASE NOTE USED

DATE ……

CASE NO: _____

PATIENT'S NAME: _____

(SURNAME) (OTHERS)

ADDRESS: _____ PHONE NO: _____

OCCUPATION: _____ AGE: _____ SEX: _____

BUSINESS ADDRESS: _____

REFERRED BY: _____

PATIENT'S CHIEF OCCULAR COMPLAINTS: _____

OTHER COMPLAINTS: _____

OCULAR SYMPTOMS				OCULAR SIGNS		
BLUR	FAR	NEAR	PAIN	INJECTION	CHALAZON	
HEADACHES	F	T O PD	PHOTOPHOBIA	EDEMA	PTOSIS	
DIPLOPIA			HALOES	HYPEREMIA	CRUSTS	OR
FLAKES						
ITCHINESS			FLOATERS	CHEMOSIS	HEAD TILT	
BURNING			FLASHES OF LIGHT	HORDEOLUM	TROPIAS	
TEARING			SECRETION	OTHERS		

GENERAL HEALTH

CONDITION OF GENERAL HEALTH: _____

LAST MEDICAL EXAM: _____ RESULT: _____

LAST DENTAL EXAM: _____ RESULT: _____

MONTH YEAR

HISOTRY OF SYSTEMIC DISEASES		**FAMILY OCULAR AND HEALTH**	
HISTORY			
MEASLES	HYPERTENSION	REF. ERROR	BLINDNESS
POLIOMYELIYIS	HYPOTENSION	GLAUCOMA	DIABETES
MALARIA	ALLERGIES	HYPERTENSION	
DIABETES	SINUSITIS	CATARACT	SRABIMUS
GASTRIC COMPLAINTS	HERNIAS	OTHERS	
OTHERS			

COMMON VISUAL TASKS

AT NEAR DIST. FREQUENCY		AT FAR DIST. FREQUENCY	
OFTEN	**OCCASSIONAL**	**OFTEN**	**OCCASSIONAL**
READING		DRIVING	
WRITING		FOOTBALL	
TYPING		TENNIS	
COMPUTER		GOLF	
NEEDLE WORK		TARGET PRACT	
ART WORK		NAVIGATION	
STENO		AVIATION	
COMPUTING		MOVIES	
DRAFTING		TV WATCH	
OTHERS		OTHERS	

HABITUAL VA AND HISTORY OF PREVIOUS PRESCRIPTION

VISON OD_____ ACUITY WITH OD _____
PINHOLE ACUITY

VISION OS _____ OLD RX OS _____ OD _____

AT FAR OU _____ FAR OU _____ OS _____

AT NEAR OD _____ NEAR OD _____ PRESCRIBED BY

OS _____ OS _____ OD O OPHTH O

OU _____ OU _____ OTHERS

OLD RX: O WORN O NOT WORN

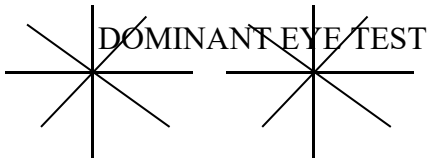
	SPH	CYL	AX	PRISM	BASE	ADD	SV	BF	MF	GLASS	PLS
OD											
OS											

WHEN PRESCRIBED _____ _____ PD: _____ TINT _____

MONTH YEAR

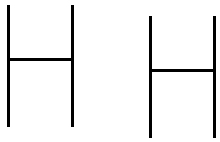
PRELIMINARY TESTS

VERSION TEST



OD OS

DOMINANT EYE TEST



OD OS

BROAD-H TEST

OD OS

◯ ◯

◯ RIGHT ◯ LEFT

UNILATERAL COVER TES: 6M _____ 0.4M _____ CONFRONTATION TEST _____

ALTERNATE COVER TEST:6M _____ 0.4M _____ MADDOX ROD TEST _____

IF STRABISMUS: CONTINOUS OR OCCASIONAL NPC _____

VERGENCE TEST ___

UNILATERAL OR ALTERNATING NPA _____ DIPLOPIA TEST _____

FUSION TEST _____ FIXATION TEST _____ BP _____

EXTERNAL EXAMINATION			OPHTHALMOSCOPIC EXAMINATION INTERNAL EXAMINATION		
SLIT LAMP O PEN LIGHT O OD		OS		OD	OS
GEN. APPEARANCE LIDS AND MARGINS CONJUCTIVA LIMBUS CORNEA LACRIMAL PUNCTA ANT. CHAMBER IRIS PUPIL SIZE PUPIL SIZE PUPIL SHAPE PUPIL REFLEXES DIRECT CONSENSUAL NEAR MACRUS GUNN			LENS VITREOUS DISC ELSC. TYPE C/D RATIO DEPTH OF CUP COLOUR LAMINA MARGIN RETINAL VESSELS CALIBRE RATIO COURSE A-V CROSSINGS SPON. VEN. PULSE MACULAR AREA FOVEA REFLEX PERIPHERY		

RETINOSCOPY **VISUAL ACTIVITY**

PRESCRIPTION

STATIC RETINOSCOPY - OD

- OS

DYNAMIC RETINOSCOPY - OD

- OS

SUBJECTIVE REFRACTION - OD

- OS

SUBJECTIVE BEST VISUAL ACTIVITY- OD

- OS

FINAL LENS PRESCRIPTION

	SPH	CYL	AXS	BASE	ADD	LENS TYPE
OD						
OS						

FOLLOW UP/PROGRESS NOTES

DATE	SYMPTOMS	OBJECTIVE	ASSESSMENT	PLAN

APPENDIX II

Martlet Environmental Research Laboratory Limited

(A DIVISION OF MACGILL ENGINEERING & TECHNICAL SERVICES LIMITED)
(Environmental Consultancy and Biophysicochemical Analyses)
237. 3rd East Circular Road. Benin City. NIGERIA.

RESULTS OF CHEMICAL ANALYSIS

Name of Client: Celestine Okoye
Type of Sample: Water Samples
Date Received: 21st April, 2021

Sample Code	pH	EC	Sal.	Col.	Turb.	TSS	TDS	COD	HCO_3	Na	K	Ca	Mg	Cl	F	NO_3	NO_2	NH_4N	SO_4
		µS/cm	g/l	Pt.Co	NTU	mg/l													
Egbem 1	6.2	84.1	0.038	0.3	0.6	0.2	41.2	19.2	24.4	0.53	0.14	1.17	0.97	70.9	0.121	0.028	0.582	0.610	0.013
Egbem 2	5.8	115.0	0.052	0.3	0.5	0.1	57.3	23.3	36.6	0.88	0.20	2.84	1.62	88.6	0.128	0.044	1.254	0.642	0.014
RV 1	6.1	8.3	0.004	0.5	0.8	0.2	4.4	16.0	12.2	0.11	0.05	0.56	0.28	35.5	0.031	0.017	0.473	0.583	0.011
PWA	6.7	120.4	0.054	ND	ND	ND	60.4	34.4	109.8	1.04	0.27	3.11	1.83	106.4	0.157	0.071	1.710	0.651	0.020

Sample Code	Fe	Mn	Zn	Cu	Cr	Cd	Ni	Pb	V	THC
	mg/l									
Egbem 1	0.233	0.065	0.174	0.041	0.015	0.008	0.005	0.010	0.002	ND
Egbem 2	0.184	0.050	0.151	0.033	0.011	0.005	0.005	0.007	0.001	ND
RV 1	0.353	0.073	0.180	0.048	0.020	0.011	0.007	0.017	0.004	ND
PWA	0.104	0.044	0.076	0.030	0.008	0.003	ND	0.005	ND	ND

ND - Not Detected
AAS MODEL-SOLAAR 969 UNICAM SERIES
FLAME USED – AIR ACETYLENE FLAME

Approved by.....
(Prof. R. O. Onyeonwu)
Date: 24th April 2021

Martlet Environmental Research Laboratory Limited

(A DIVISION OF MACGILL ENGINEERING & TECHNICAL SERVICES LIMITED)
(Environmental Consultancy and Biophysicochemical Analyses)
237. 3rd East Circular Road. Benin City. NIGERIA.

RESULTS OF CHEMICAL ANALYSIS

Name of Client: Celestine Okoye
Type of Sample: Soil Samples
Date Received: 21st April, 2021

CODE	pH	EC	Org.C	Org. M	T. N	EA	Na	K	Ca	Mg	Cl	Av. P	NH_4N	NO_2	NO_3	SO_4
		µS/cm	%			meq/100g of soil					mg/kg					
SSS	4.2	103.1	1.16	2.01	0.105	1.8	0.027	0.014	0.081	0.083	177.3	0.420	1.35	0.501	4.68	0.204
SSC1	4.9	613.4	2.58	4.44	0.235	1.1	0.180	0.051	0.972	0.555	871.0	14.60	8.78	0.970	10.9	0.360
SSC2	5.9	1118.0	4.56	7.84	0.415	0.6	0.214	0.084	1.041	0.875	1,773	39.81	14.40	1.856	17.7	0.861

Code	Fe	Mn	Zn	Cu	Cr	Cd	Pb	Ni	V	THC
	mg/kg									
SSS	156.02	85.11	104.30	56.30	22.73	10.41	17.80	7.34	2.61	ND
SSC1	62.81	43.10	58.21	32.41	18.61	3.44	8.35	1.82	0.93	0.141
SSC2	29.04	17.40	21.12	11.33	8.53	3.17	5.15	0.85	0.60	ND

AAS MODEL-SOLAAR 969 UNICAM SERIES
FLAME USED – AIR ACETYLENE FLAME

Approved by.....
(Prof. R. O. Onyeonwu)
Date: 24th April, 2021