AN ASSESSMENT OF THE MAJOR POLLUTANTS IN ONDO STATE, NIGERIA

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I certify that OJO OLUWASESAN OLUWASINA passed all the prescribed course work and fulfilled all requirements for the award of Master of Science in Project Management from the City University, Cambodia. This dissertation is the outcome of long essay carried out by him during the course of his Postgraduate studies at City University Cambodia.

Engr. Prof. Bamidele Francis. **MNSE., MNICE., COREN REG.**

Supervisor

DEDICATION

This research is dedicated to the most high God (Jesus Christ), who made it possible for me to reach another milestone in my academic pursuit.

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I give glory to God, the creator of all knowledge who made it possible for me to reach this level and my Supervisor who guided me through the thick and thin of this Dissertation..

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ABSTRACT

This study assesses major pollutants in Ilaje and Ese-Odo Local Government Areas of Ondo State, Nigeria, to establish baseline data for future environmental monitoring. Prompted by inadequate government policies and weak pollution-health management systems, the research aims to reduce disease burdens in riverine communities through robust laboratory analysis. The methodology employs scientific environmental and medical laboratory testing to determine pollution damage and identify pollutant-induced health risks. Key findings reveal significant concentrations of various metals and minerals across ten mapped communities, directly linking pollution to public health concerns. The study concludes that strategic alliances between environmental and medical laboratories are essential for targeted interventions. It recommends public sensitization, stakeholder training, adoption of international best practices, and private investment in laboratory infrastructure to enhance revenue and sustainability. These actions are critical for effective pollution management and improved health outcomes in the region.

Keywords: Pollution, pollutants, health management systems, government, laboratories, public sensitization, metals, minerals.

CHAPTER ONE

1.0 Introduction

Environmental Analytical Laboratory is one of the most effective tools to manage pollutions starting from their sources. Investigation of pollution through scientific measures is very important when addressing pollution, whether on land, water, air, organic materials and more. This is where technologies play important role along the line to aid the course of determining pollution extent in the environment via laboratory techniques.

In Ondo State, Pollutions of different type are on the increase, as in every other State of the Federation due to the increase in human activities many of which are unwholesome, and are liable to add to the pollution margin, if a reasonable proportion of sceintific investigation, management and evaluation are not enshrined into the system.

It is on this above concept that this dissertation would be looking at ways in which Environmental Laboratory (comprising Scientists, Technologies, Policy Makers) can improve human well-being, as well as safety of other ecological factors.

Ondo State is one of the States in the Federal Repobite of Nigeria, It has the landmass of 14,500 square kilometers representing 4.39 percent. The State is blessed with mineral resources as it is one of the crude oil producing States in the country. It lies between longitude 4^0,3^0 and 6^0 East of the Greenwich Meridian, $5^0$4 and $8^0$15 North of the equator, It boasts of the population of about 3,440,877 as at year 2010 which constitutes 1,745,057 male and 1,715,820 female respectively. (National Population Commission)

The State was established in 1976 and the population projection as at 2016 stood at 4,671,700. It has 18 Local Government Council Areas with other mineral deposits ranging from

Bitumen (still the second largest deposit in the world after Canada), Limestone, Clay. Tar sand, Glass sand, Quartz, Kaolin. It also possesses Agro raw materials such as Cocoa. Bamboo, Cocoyam, Maize, Raffia palm, Oil palm, Plantain, Banana, Cassava, Livestock, Vegetables, Yam, Piggery. Poultry, Rubber, Timber and the likes. It has the longest coast line in Nigeria. The State practices a democratic system of Government in the Federal Republic of Nigeria. Below is the map of Ondo State showcasing Local Government areas with their Headquarters in the state.

THE MAP OF ONDO STATE

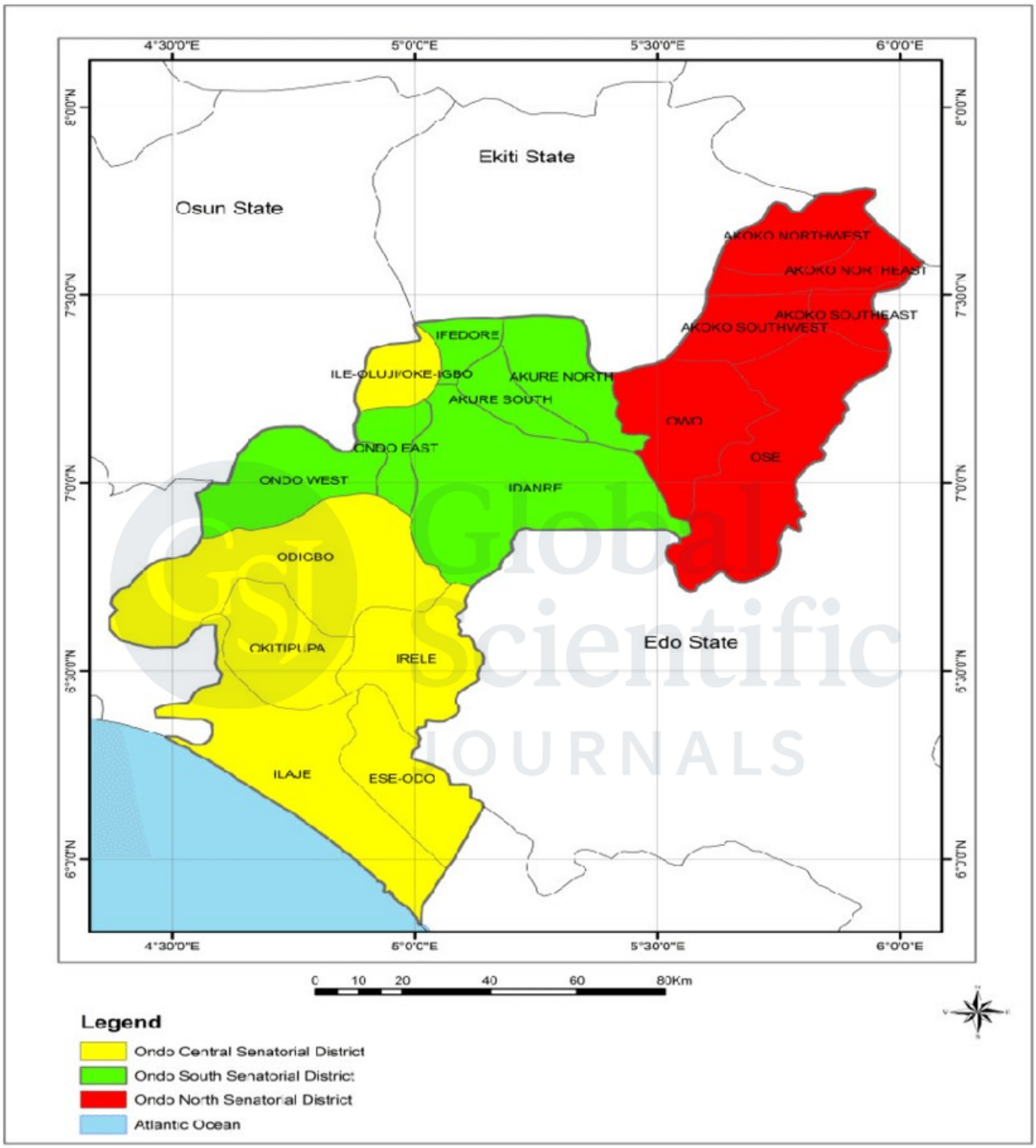

Fig. 1.1: Map of Ondo State

Table 1: Local Government and their Headquarters in the State

AKURE SOUTH	AKURE
AKURE NORTH	IJU/ITA-OGBOLU
AKOKO NORTH EAST	IKARE
AKOKO NORTH WEST	OKE-AGBE
AKOKO SOUTH EAST	ISUA
AKOKO SOUTH WEST	OKA
ESE-ODO	IGBEKEBO
IDANRE	OWENA
IFEDORE	IGBARA-OKE
ILAJE	IGBOKODA
ILE-OLUJI/OKE-IGBO	ILE OLUJI
IRELE	IRELE
ODIGBO	ORE
OKITIPUPA	OKITIPUPA
ONDO EAST	BOLORUNDURO
ONDO WEST	ONDO CITY
OSE	IFON
OWO	OWO

Pollution Index in Ondo State

Industrial: - 11% (Air, water, soil)

Transport - 48% (Air, land, water)

Domestic - 25% (Watar, air, land)

Agricultural - 12% (Water, air, alnd)

Energy - 2.5% (Air, noise)

Organic matter - 1.5% (Land, water)

1.1 Background of study

Pollution management is effective when complemented with laboratory analysis Worldwide, Environmental Surveillance has been complemented by a standard analytical laboratory as it is the only means of proving pollution scientifically, Emphasis has been shifted from the "fire-brigade approach" in solving environmental problems to that of employing detailed investigations and environmental studies to offer lasting solutions. It is in the light of the above recognition that the majority of countries of the world established environmental institutions, notably is the United States Environmental Protection Agency (USEPA), which directly involves in the management of all matters that affect the environment, taking into consideration the importance of analytical laboratory to determine all environmental parameters so as to ensure public health and safety.

In Nigeria, the Federal Government via World Bank programme aimed at improving Africa's developmental system in the areas of obtaining sustainability of various investment drives in 1997 was able to acquire many laboratory equipment/facilities which were domesticated across some selected States of the country. The intention was to address numerous environmental challenges arising from human activities that can be traced to domestic, commercial and industrial pollutions of all sorts via scientific investigation which centers on analysis of parameters on-site and in the laboratory with the aid of modern articulated technologies deployed. This study focuses on the situation analysis of all pollution challenges within the Ondo State context. Many factors are contributing to increase in pollution level ranging from poor or shrinking budget provisions, lack of experts in pollution management, inability of the Government to enact necessary environmental bye-laws, lack of political will to support relevant environmental managers, diversion of pollution monitoring funds among many others.

Fig: 1.2 Pollution Index Chart

POLLUTION INDEX CHART

Source: UNDP Project in the State (2008-2013)

Management of pollution has become insurmountable task of late due to the various obvious and impending unforeseen disasters attached to it. The natural ecosystem has been largely depleted through human activities in various occasions as a result of the traditional belief of every individual that natural endowments are given to explore to our own benefits, without any recourse to environmental sustainability. Given this scenario however, it is obvious even right from the beginning of creation of the universe, that humans the head of all creatures has been mismanaging all these God-given resources. These natural resources have witnessed tremendous and unpleasant exploration ranging from improper felling of trees, uncontrolled blasting of rocks, and unwholesome spilling of oil contents into the coastal water, to inappropriate encroachment of forest reserves, unlawful flaring of gas thereby influencing changing of climate, unprotected effluent discharges into the immediate environment, habitual dumping of solid wastes among many others. The environment (Land, water, atmosphere, human animal, and plants has continued to suffer from the above activities

and more which is the important reason this research is carried ond. The research will look for ways to administer appropriate seientific laboratory methods in mitigating the effects of pollutants arising from such activities so as to safeguard human, animal and plant lives.

Research has shown us over the years of various sources of pollutiom, with which individual sources have their fair share of the challenges as a result. Though, the long list of sources has been pruned down to suit the essence of this study. In Ondo State for instance, the major source of pollution that affect human, air, water and soil resources including fauna and flora is the release of gases from the transportation system. It has been proven that there is an increase of vehicular movements on daily basis due to some factors such as unemployment of graduate youths, which gives rise to motorcycles operation, not leaving aside the influs of used cars into the country, for the use of middle level income Nigerians (has the largest percentage of the country's population). At a recent statistics, the pollutions gotten from Transportation alone stand at 48%. However, Domestic activities contributes 25%, Agriculture 12%, Energy source 2.5%, organic matter from various living organism poses the lowest of the sources, 1.5%.

Though industrial operations also have a significant percentage of 11%, but may increase as continued industrialization of the State occurs (Panel's reflection during UNDP Country Programme in the State). Accordingly, all the above identified sources could be effectively and efficiently managed via a well-articulated scientific environmental laboratory procedures which in a way will minimize their impacts on humans, plants and animals along with their respective surroundings/habitats.

Types of pollution

- Water polhtion
- Air pollution
- Soil pollution
- Thermal pollution
- Radioactive pollution
- Noise pollution
- Light pollution

Environmental Laboratory operations are of different ways and reasons. The Environmental laboratory services serves as a mediator between pollutants and the recipients. Havoc carried out by pollutants could be addressed at a functional Environmental Laboratory. In fact, laboratory proffers scientific solutions at all times to numerous pollution upheavals. To buttress the above further, samples collected from any source of pollution would be analyzed, determined and confirmed with the aim of putting stoppage to widespread of diseases. However, the Environmental Laboratory does not have the capacity to show the extent of any contamination in the recipients (hosts) and also does not have the intent of creating a way out (remedy) of the problems which is the main function of the medical/clinical laboratory.

The problems to be solved in this thesis are how to:

i. create more Environmental Laboratories by Government and Private Organizations to address pollution upsurge at coastal communities of the State;

ii. identify other hidden sources of pollutions from human activities which hitherto have effects on the natural habitat;

iii. strengthen pollution monitoring and evaluation activities of the State Ministry of Environment with a view to having outstanding succes

iv. appropriately keep all pollution records and create reliable data base for referencing,

v. involve more qualified environmental professionals to man pollution management activities and ameliorate shortage of personnel.

Types of Laboratory

- Environmental Laboratory
- Modical/Clinical Laboratory
- Drugs Chemical Laboratory
- Physics Laboratory.
- Microbiology Laboratory
- Electrical Laboratory
- Water Laboratory
- Soil Laboratory
- Biosafety Laboratory
- Analytical and Quality control Laboratory
- Cleanrooms Laboratory
- Incubator Laboratory
- Production Laboratory
- Research & Development Laboratory

- Chemistry Laboratory
- Biology Laboratory

Though the areas of coverage at repands this schyect under review is the toles of Enviromental Laboratory. Furthermore, many of the other types of laboratory have links also to poltumor managemem which activities are closely inter-related.

1.2 Statement of the Research Problems

This research study will examine the role of Environmental Laboratory in identifying environmental hazards at the coastal areas which can be terned pollutions, understanding human exposures and health effects, measuring environmental progress and shaping the environmental health policies agenda for the future. It is a fact that the advances in laboratory techniques operations in the 1970s and 1980s provided the scientific foundation for a revolution in environmental policy. Despite the progress of the past two decades many questions about the health effects of environmental exposures still remain. The challenges then to the laboratories is to provide a scientific framework for answering these questions. Some case studies of pollution and hazardous wastes sites are presented to illustrate the need for improved measurement against total human exposures to environmental pollutants at the remote reverine areas. Recommendations are also enunciated to expand the roles of laboratory in measuring public health risks, evaluating the effectiveness of risk management strategies, and shaping the development of future environmental health policies in the State. This thesis is also focusing on how to allay fears from intending investors who might be nursing the ambition of investing in Environmental laboratory operations in one time or the other but are seeing it as a project with high level of economic risk due to its abstractness and public's failure to understand its importance to their well-being.

1.3 Research Questions

This study will provide answers to the following research questions.

- What are the various sources of pollution available?
- What harm does pollution create to the immediate environment?
- How do people at the reverine areas increase the level of pollution through their activities?
- What are the roles of Government, corporate organizations and the public at ensuring health and safety of the immediate environment?
- Can environmental laboratory serve as the best viable tool to manage health-related challenges effectively?

1.4 Aim and Objectives

The study is aimed at the assessment of major pollutants at the reverine areas in Ondo State with a view to enhance pollution-free environment for all and sundry.

However, the specific objectives are to:

i. assess the various sources of pollution available within the Ondo State as a whole;

ii. determine significant number of harms/diseases/ailments which could be derived from pollution within the coastal environment;

iii. discuss ways at which humans attitude and activities keep increasing pollution margin in Ondo State.

iv. evaluate stakeholders' responsibilities Government, Private sector and individuals towards ensuring health and safety of their environment;

v. ascertain if environmental laboratory could bridge the gap and remain the best option among others when managing pollution-induced health concerns in the State.

1.5 Definition of Terms

This thesis was able to introduce some specific scientific and technical terms, and xpression with a view to further enrich the contents and make it understandable to future searchers alike. Some are however listed and defined hereunder,

- Anthropogenie: This is the evolution or genesis of the human race.
- Atmospheric precipitation: The quantity of water falling to earth at a specific place with a specified period of time.
- Biochemical Oxygen Demand: Organism through diatomic gas,
- Carbon monoxide: Odorless & very poisonous gas that is a product of incomplete combustion of carbon
- Chloride: Any salt or compound containing chlorine atom.
- Constituents: The total amount of microorganism that are in a particular component.
- Copper: A reddish-brown metallic element occurs in various minerals.
- Data-intensive science: A branch of science that has been modified via data applications.
- Degradation: Changing to a lower or bad state.
- Dissolved Oxygen (DO): A reduction in the diatomic gas via technical processes.
- Domestic sewage: Waste matter carried away in sewers or drains.
- Effluent Discharge: Release of a water mixed with waste matter into a nearby neighboring environment.

- Encroachment. An entry into an area not previously occupied or invasion of foreign sdentities.
- Environmental pollution: Wastes matters released into the external surroundings causing major health risks to humans, plants & animals,
- Fe: A heavy metal element that transport Oxygen via blood in mammals
- Flora and Fauna: Plants and animals alike.
- Habitat: An environment in which organisms or group of organisms normally lives or occur
- Hazardous Waste: Materials, disposal of which poses a threat to the environment, which is explosive, flammable, oxidizing, poisonous, radioactive, corrosive and or toxic.
- Host: A carrier of a specific types of ailment.
- Influx: The process of flowing in a various products or properties
- In-situ analysis: Samples analyzed on field with the aid of movable, pocket type apparatus.
- Invasive exotic species: Also called introduced species are any non-active species that significantly modifies or disrupts the ecosystems it colonizes.
- Lead: Soft heavy toxic malleable metallic element when freshly cut but tarnishes readily to dall grey from bluish white.
- Manganese: A hard metallic element that resembles iron but is not magnetic.
- Organic matter: A living tissue or fertilizer that is derived from plants/animals.
- Particulate matter: A small discrete mass of solid or liquid matter that remains individually dispersed in gas or liquid emissions.
- Pollutants: Wastes matter that contaminates water, soil or air.
- Radioactive pollution: waste emission stream of particles or electromagnetic rays in nuclear decay/materials left after laboratory process is completed.

- Recipients: The semantic role of animate entity that is involved in the happening, denoted by an action.
- Seawater intrusion: movement of the seawater from its place to another due to the presence of foreign matters in the water.
- Sulphate: A salt of sulphuric acid.
- Sustainable Development: Developmental project/goods and services that are liable to stand the test of time without having environmental damages.
- Tidal activities: Involvement of periodic rise and fail of sea level under gravitational pull of the moon.
- Total dissolved solids: A scientific reduction of solid matter to a liquid form.
- Vehicular movement; operation of motor vehicle as means of transportation in a given society.
- Volatile organic compounds: wide range of both natural and synthetic substance.
- Zine: atomic number 30.

1.6 Significance of the research study

The significance of the research study among many others is to identify, evaluate, minimize and control pollutions at the coastal level and Ondo State in general through the intervention of effective and efficient Environmental Laboratory Operations. This study will also have specific significance in order to fashion out ways of inproving professionalism from all categories of laboratory and environmental managers. The study ashers in the below benefits;

- Leals to creation of more environmental laboratories as it leads to provision of new employment opportunities for relevant professionals;
- Achieves significant reduction in the pollution margin in the State,

- Ensures pollution-free environment for improvement of human health and safety of Fama and Flora;
- Provides economic improvement in the State as income realized from its numerous activities automatically boosts internally generated revenue;
- Gives insight to various information that may be useful for researchers alike in no distant future:
- Creates medium for proper management of scientific data.

1.7 Scope of the research study

Considering the various sources, types and constituents of pollutions we have in the State, coupled with diverse industrial and domestic operations, the scope of this study however would not be extended beyond water pollution matters in some sections of Ondo State.

Meanwhile, the above areas of concentrations may not be undertaken as expected but will have their fair share written throughout the contents of this dissertation and represent the topic for discussion. Some other areas sources of pollution may also be briefly identified as well.

In addition to the above, Government, Private Organizations and individuals can derive benefits from this research work. Investors and scholars also stand to gain from the information provided in the project.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

The United States Environmental Protection Agency (USEPA) was created by congress 1970. The purpose of its creation was to consolidate a variety of federal research, monitoring, standard-setting and enforcement activities in one agency with an ultimate goal of ensuring environmental protection (www.epa.gov). The Food Recovery Hierarchy of EPA starts with source reduction, which is the most preferred option, and ends with the least preferred –and fill incineration. In June 2013, EPA and the United States Department of Agriculture (USDA) announced a collaborative effort to raise awareness of the environmental, health and nutrition issues created by food wastes. Extraction of the entire benefits from waste products and minimizing waste generation are the main goals of this hierarchy. The Reduction/Recover/Recycle) application helps to minimize the amount of wastes to disposal, to achieve more effective waste management, and finally to minimize associated health and environmental risks (Murugan and Ramasamy, 2013).

USEPA also set National Ambient Air Quality standards for six principal pollutants in 1990s to provide protection of public health and the environment. These principal pollutants are called 'criteria" pollutants, which include carbon monoxide (Co), lead, nitrogen dioxide (NO_2). zone (01), sulfur dioxide (SO_2), and particles (or aerosols). The adverse environmental effect of O were first reported in Los Angeles during 1940s. Now it is realized that Os pollution is no longer confined to Los Angeles but also affects major urban locations in the world.

2.1 Committee's statement of task

The US Environmental Protection Agency (EPA) is undertaking an integrated evaluation of laboratories for the purposes of strengthening the management effectiveness, and efficiency Fits laboratory network and enhancing its capabilities for research and other laboratory-based Sentific and technical activities; addressing US Government Accountability Office (GAO) commendations of EPA improved cohesion in managing and operating agency laboratories BAO 2011); and helping the EPA laboratory enterprise respond to change and be equipped to handle emerging scientific challenges (Perciasepe 2013). EPA'S initiative will conclude with the administrator's guidance on changes to strengthen the laboratory enterprise and its portfolio of facilities.

As part of the effort, EPA sought independent expert advice from the National Research Council, which established the Committee on Strengthening the US Environmental Protection Agency Laboratory Enterprise: Phase 1 - Priority Needs, Guiding Principles and Overall Goals. The statement of task developed in consultation with EPA, served as a guide for the committee's work. The Committee was asked to assess EPAs highest-priority needs for mission-relevant aboratory science and technical support, develop principles for the efficient and effective management of EPAs laboratory enterprise to meet the agency's mission needs and strategic goals, and develop guidance for enhancing efficiency and effectiveness now and during the next 10 years.

The committee was asked not to assess the organization, the facility-level and portfolio-level master plans, or the consolidation initiatives of EPAs laboratory enterprise; that analysis is being undertaken in a separate effort. Smith Group JJR (an architectural and engineering firm) is assisting EPA with the analysis of data collected by EPA on the current portfolio of laboratory facilities. Topics being considered during the analysis include how efficient, facility space is used and the current operating costs of the facilities. An EPA work group will consider the committees input and the

results of the separate portfolio-level analysis in developing options for improving the efficiency and effectiveness of EPAs laboratories, including options for colocation and consolidation of the EPA administrator and deputy administrator (Paulson 2014). Therefore, the committee was asked not to recommend a reorganization of the laboratory enterprise.

COMMITTEES APPROACH TO ITS TASK

At the committee's first meeting, EPA officials indicated that the committee was not expected to develop a new list of the agency's highest-priority needs for mission-relevant laboratory science and technology as innovation was already on ground.

The EPA laboratory enterprise is the aggregate capability and capacity required by its laboratories and laboratory-based centers to meet the agency's high-priority mission needs of its programs and strategic goals" (Paulson 2013).

The results of the portfolio-level analysis were not available to the committee as it was carrying out its study on technicality, previously by EPA on the basis of mission relevance, legislative mandates, and guidance from EPA's strategic plan, which is revised every 4 years. Therefore the committee considered EPAs current highest-priority needs to be those associated with major pollution laws administered by the agency and the goals and objectives identified in EPA's strategic plan. They are described later in this charter. EPA officials also indicated that National Research Council report Science for Environmental Protection: The Road Ahead (NRC

2012)provides a good basis to sentifying priorities for the agency for the next 10 years (The pervemes identified in that report are provided in this chapter).

Consistent with its statement of task, the committee identified various opportunities where EPA laboratories could become more effective and efficient through a rethinking of its verall system

of laboratories. One of the committees prime activities was to understand the makeup and function of UPA's "laboratory enterprise, which is the subject of the subject of the sly Although GAO (2011) used the term extensively, there is no readily available guide to how the various types of facilities within the enterprise fit together. In preparing its report, the committee attempted to define the characteristics and dynamics of the enterprise and provide principles and recommendations for its management. It did not attempt to develop principles and recommendations for specific laboratories. Likewise, the committee considered the breadth and complexity of EP'A's highest-priority science needs collectively in developing principles and recommendations for the agencys laboratory enterprise. The committee did not attempt to develop guidance for meeting specific priority needs individually.

An NRC committee will assess EPA's highest priority needs for mission-relevant Laboratory science and technical support, now and during the next ten years. Recognizing the need to operate within budget constraints and growing demands, and recognizing the potential contributions of external sources of scientific information from other government agencies, industry, and academia in the U.S. and other nations, the committee will develop principles for the efficient and effective management of EPA's laboratory enterprise to meet the agency's mission needs and strategic goals. Drawing upon these principles, the committee will develop guidance for enhancing efficiency and effectiveness, now and during the next ten years, which:

- Improves EPAs ability to plan, prioritize, coordinate, and deliver scientific research, technical support, and analytical services from EPA's laboratory enterprise for achieving the highest-priority scientific needs and strategic goals, and for achieving the strategic goals and objectives in the GPRA Modernization Act of 2010 for laboratory and research organizations,

- uses an analytical framework(s) to ensure that laboratory facilities, functions, scientific solutions, and capabilities are aligned with the highest-priority scientific needs for the agency's strategic goals; and
- sustains the leadership capability of the laboratory enterprise for environmental science and research.

The committees work is part of a multi-phase effort by EPA and collaborating organizations to make the agencys laboratory enterprise more effective and efficient while reducing costs. The committee will not assess the organization, or the facility-level and portfolio-level master-plans, or the consolidation initiatives for EPA's laboratory enterprise, because that analysis will be undertaken through a separate effort. EPA will consider the findings and recommendations provided by the committee, as well as the input from other efforts, in developing an implementation plan for the laboratory enterprise. At EPA's discretion, another ad hoc NRC committee may be asked subsequently funded separately to assess the draft plan. The committee has developed principles and recommendations relevant to aligning laboratory functions with the highest-priority needs, workforce, laboratory equipment, management and Icadership, and planning. It considered and built on the relevant findings and recommendations of previous reports from the National Research Council, GAO, and other organizations. The present report does not address the physical space and configuration options of laboratory facilities, which are being addressed under a contract with Smith Group DR. Although there was no opportunity to receive any results of reports on the work of Smith Group JJR, it is the committee's understanding that the firm is not addressing laboratory equipment issues.

Although it is possible that the agency's laboratory system functions optimally by having ench type of laboratory work well on its own, it is the committees view that greater efficiency and

effectiveness could be gained through systematic collaboration and communication. Based on information provided by EPA, the committee considered the extent to which examples of greater coordination between laboratories appeared to be systematic or ad hoc, and what additional benefits could be achieved by extending the coordination and communication throughout the agency's laboratory enterprise.

Regarding EPA's laboratory workforce, the committee recognized that budgetary constraints over the past few years have made it difficult for the agency to hire people with the necessary skills for addressing current and emerging complex problems. The committee examined how tools and programs EPA currently uses, or had used in the recent past, for workforce development could be enhanced. For laboratory equipment, the committee considered where connecting EPA's processes for managing and acquiring laboratory equipment across the enterprise might present potential opportunities for enhanced efficiency, such as increased sharing of equipment.

Although, following the committee's recommendations may result in efficiency gains that, in turn, may result in lower resource requirements for EPA, the committee realizes that implementing its recommendations is not without cost. However, the committee was not asked to and did not attempt to estimate the implementation costs associated with its recommendations.

2.2 Pollution Management and Laboratory Operation

The roles of a well-established Environmental analytical laboratory in respect of managing pollutions effectively will be enumerated in this section. A scientific laboratory isa room or building equipped for scientific experiments, research, teaching, or for the manufacture of drugs or chemicals, In other words, we can also define laboratory as a facility that provides controlled conditions in which scientific or technological research, experiments and meqsurements are made for the use of

the public. Parts of the activities of the scientific laboratory is the detention of various pollutants from water, air, soil or land, Thermal. Radioactive, Noise and light. Furthermore, sources of pollution are of different degrees and nahire, hence this project work will make use of some common ones in order to focus on the line of concentration of this study.

Sources of pollution

Environmental pollutants may be in form of gas, liquid, solid or energy. The two major sources of pollution are point source and non-point source.

- Transportation (Fumes and Exhaust)
- Solid wastes (Nylon, plastic, iron, wood)
- Industrial Effluents (Chemicals)
- Domestic sewage (Excreta, urine)
- Organic matter (tissues from living organisms)
- Liquid wastes (Waste Water from Domestic and Industrial)
- Energy Wastes (Noise)
- Agricultural (pesticides applications)

Pathways of pollution into the recipient

Pollution has pathiways in which it transports into the recipient. The recipient in this context may be human, plants or animals depending on the way the pollution emerges and the situation that surrounds its emergence. Moreover there are pathways that need to be taken into gonsideration when analyzing the concept of pollutants. Below are some of the pathways:

Dispersion:- smoke disperses into the air

Dillution:- soluble pollutants diluted in the water

Deposition:- suspended solids carried into the river seethe

Degradation: substances break down by natural processes

Direct ingestion: - consumes via foods, water, beverages or inhaling

2.3 The United States Environmental Protection Agency's Mission

EPA was created in 1970 in response to public alarm and mounting political pressure over degradation of the environment from air, water, and pesticide pollution. Its creation was accomplished by Executive Order 1110.2, which transferred duties related to 15 environmental programs from five departments and one commission to the new agency, whose stated mission was "to protect human health and the environment", Specifically, EPA's purpose is to ensure that;

- all Americans are protected from significant risks to human health and the environment where they live, learn and work;
- national efforts to reduce environmental risks are based on the best available scientific information:
- federal laws protecting human health and the environment are enforced fairly and effectively;
- environmental protection consideration in U.S policies concerning natural resources, homen health rooms greeth energy traimportation, agriculture industry. and international trade, and these factors are similarly considered in establishing ens ironmental policy,
- all parts of society communities, individuals, businesses, state, local and tribe governments have access to accurate information sufficient to effectively participate managing human health and environmental risk,

- environmental protection contributes to making our communities and ecosystems diverse, sustainable and economically productive, and
- the United States plays a leadership role in working with other nations to protect the global environment, (EPA 2014).

When it was established, EPA was given statutory authority to provide the regulatory framework for and enforce environmental-pollution laws and to conduct research to support policy development that underpins such efforts. The agency now has responsibility for implementing some 33 laws, congressional mandates, executive orders, and presidential directives. Of those, 10 major federal pollution-control laws drive the bulk of the agencys activity and budget (Bearden et al. 2007). The 10 laws are complex to implement, and they create a continuing demand for specifie kinds of scientific research and other knowledge that motivate much of the agencys scientific endeavors (Bearden et al. 2007).

Science underpins the achievement of EPA's goals by providing information to support a variety of activities from enforcement of current laws and regulations to development of new regulations and identification of threats to public health and the environment. At the time of its creation, EPA was mandated to establish six program offices (some of which were focused on specific enetromental mishia), an assistant administrator to direct the Office of Research and Monitoring fnow the Office of Research and Development, ORD), and 10 regional offices whose asles were to directly support and interact with the 50 states and territorial and tribal jurisdictions that were responsible for implementing environmental-polutioning, control, anforvement, and cleanup inherited 42 Laboratories from programs in various federal departments, including the Department of the Interior, the former Department of Health. Education, and Welfare, and the US Department of Agriculture" (GAO 2011). Although some Laboratories have been closed or

consolidated since the establishment of EPA, most of the current EPA laboratories remain in the original locations for political, logistic, and other pragmatic reasons. EPA has three general types of laboratories, as discussed below.

EPA's laboratory enterprise consists of a distributed network of three general types of Laboratories, which are:

National Program Office Laboratories

Six laboratories and two centers support five national regulatory program offices the office of Air and Radiation (OAR), the office of Chemical Safety and Pollution Prevention, the Office of Enforcement and Compliance Assurance (OECA), the Office of Water (OW), and the Office of Solid Waste and Emergency Response (OSWER).

National program laboratories have primary responsibility for implementing legislative mandates to develop and provide specific information that supports decisions regarding regulations, compliance, and enforcement at a national level. For example, EPA has been tasked with enforcement of such regulations as vehicle tailpipe-emission regulations and with providing information to the public, such as vehicle mileage performance; the OAR National Vehicle and Fuel Bastasions Laboratory performs the non-fode vandands and performance testing to provide the nooded information Another OAR laboratory is devoted to assing faliation fras Two laboratories in the Office of Chemical Safety and Poll diss Prevention support the agency's pesticides registration and enforcement program. National enforcement efforts are supported by the OFCA National Enforcement livestigations Center, which investigates violations of environmental laws and provides technical and forensic services to support for civil and criminal investigations. The center also provides counsel on legal and policy matters.

To augment its intramural analytic capabilities, OSWER contracts with private-sector organizations through the Contract Laboratory Program to carry out laboratory-related activities, primarily to support waste-site remediation projects.

Law Purpose Science Requirements

Clean Air Act - Requires EPA to set mobile-source Imits, ambient-air quality standards, harardous air-pollutant emission standards, standards for new and existing pollution sources, and deterioration requirements and to focus on areas that do not attain standards. Set national standards for air quality, monitor and model air quality for implementation plans, identify best available control for new point sources, set mobile source and emission standards, implement acid-rain control program of EPA.

Clean Water Act - Establishes a sewage-treatment construction grants program and a regulatory and enforcement program for discharges of wastes into US waters.

Establishment of national standards on fluent limitations

Comprehensive Environmental Response, Compensation, and Liability Act Superfund provides authority for the federal government to respond to releases of hazardous substances and establishes a goe-maintained fund to clean up abandoned hazardous-waste sites. Develop and apply Hazard Ranking System to identify the most hazardous sites in the United States and to prioritize and develop response actions.

Emergency Planning and Community Right-to-Know Act: Requires industrial reporting of toxie releases and encourages planning to respond to chemical emergencies. Establish categories of health and physical hazards for reporting purposes, establish data and information summaries via the Toxics Release Inventory.

Federal Insecticide, Fungicide, and Rodenticide Act Governs pesticide products and their uses Assess human and wildlife risk posed by pesticides and ensure that such assessments maintain scientific currency.

Ocean Dumping Act: Regulates intentional disposal of materials into ocean waters and authorizes related research. Conduct general research on ocean resources and long-term research on ecosystem effects of ocean dumping, pollution, overfishing, and other human activities.

Pollution Prevention Act: Seeks to prevent pollution through reduction in generation of pollutants at their point of origin. Identify source-reduction approaches, develop, test, and disseminate model source-reduction auditing procedures to highlight opportunities; promote research and development of source-reduction techniques and processes.

Safe Drinking Water Act: Establishes primary drinking-water standards, regulates underground injection disposal practices and establishes a groundwater and surface-water quality control program. Identify causes of diagnosis methods for treatment and control and prevention of diseases and other impairments resulting from contaminants in drinking water; set national standards for drinking-water contaminants; identify and set priorities for contaminants that warrant regulation on the basis of human health risk analysis identify cost-effective treatment technologies; assess water-supply vulnerability denologies, assess water supply vulrweshility to terrorist attacks, and provide padance on илитронсу покрытие approaches.

Solid Waste Disposal Act/Resource Conservation and Recovery Act: Regulates solid and hazardous waste. Establish minimal national standards for hazardous waste doposal and criteria for states to establish and enforce hazardous waste programs, and advance research on hazardous-waste management.

Tosic Substances Control Act: Regulates the testing of chemicals and their uses. Conduct and coordinate research, development, and monitoring related to toxic substance screening, control and risk management.

Regional Office Laboratories

Eleven laboratories are distributed among the 10 EPA regional offices two in Region 3 and one in each of the others. The primary responsibilities of these laboratories include providing scientific data to support decisions by the regions environmental programs and to inform instpediate and near-term decisions on environmental conditions, compliance, and enforcement. To enforce federal laws and regulations, data on potential violations have to be gathered with legally defensible methods and in accordance with associated quality-assurance procedures. These enforcement actions are typically local and are supported by the network regional office Laboratories. Regional office laboratories also provide technical oversight of work carried out by

State agency laboratories, such as assesmend of the quality of data that result from drinking water testing by state laboratories.

Office of Restarch and Development Laboratories

To improve the basis of the regulations needed to protect public health and environmental quality, it is necessary to improve the scientific understanding of environmental functions and its interactions with people. ORD Laboratories are responsible for performing research and assessing findings developed with support of other agencies and research institutions to provide the basis of standards and regulations and to anticipate emerging threats to health and the environment. ORD consists of seven divisions of the National Health and Environmental Effects Research Laboratory,

five divisions of the National Risk Management Research Laboratory, six divisions of the National Exposure Research Laboratory, and six research centers in four national center facilities.

Since 2001, Homeland Security has also been an important consideration in environmental protection, ORD's National Homeland Security Research Center, created by a presidential directive after the bioterrorism incidents after 9/11, established the Emergency Response Laboratory Network (ERLN) to respond to monitor, and remediate incidents of chemical, biologic and radiologic (CBR) hazards. ERLN is structured as a distributed and virtual Laboratory disasters in diverse urban and environmental settings. All ORD program and regional Laboratones participate in ERLN. The network also encompasses state-based facilities, commercial laboratories and networks of other federal agencies such as those of the Centers for Disease Control and Prevention, DOE, and the US Department of Agriculture to achieve critical technical capability, manpower, and concentrated resources to respond to an emergency.

Definition of Laboratory

Given the complex and broad duties of the egerzy in responding to all its statutory quirements and mandates to meet its mission, it is remarkable that EPA can complish its ussion within current budget constraints. One indication of its size relative to its mission is flu the full-time equivalent allocation to ORD and its budget (not including laboratorics in regions or program offices) are roughly equivalent to those of a single, smaller Department of Energy (DOE) national laboratory,

Comununications about the size of the laboratory enterprise are often complicated by the fact that different groups in and outside EPA apply different definitions to laboratory. In its communications, EPA does not consistently categorize a laboratory entity among its national program laboratories, its regional office laboratories, and the laboratories, divisions, and centers in

the ORD laboratories. Therefore, the discrete components of the laboratory enterprise are not well defined. For the present report, we consider the aboratory enterprise to include the Laboratories, divisions, and centers listed above.

EPA uses the term laboratory in two contexts. One is that of a discrete physical space of a traditional utilitarian research, development, or testing activity that may be devoted to a single technical product or medium-specific activity. The other is that of a large multipurpose structure or collection of structures, perhaps not even in the same location, that focus on a large programmatic theme or a multifaceted research or technology effort. Confounding the designation is that similar entities may be described as centers instead of laboratories, and there appears to be no formal or at least stated hierarchic definition of the different entities. That may be due in part to a historical medium-specific function of laboratories inherited at EPA's formation. It may also be due to an attempt to ascribe functional activities to some facilities that link them to programmatic goals and theuses of the agency. All this lends a degree of confusions side evaluation of the stility, efficiency, and productivity of a sunit referred to as laboratory.

As described above, a degree of semantic confusion leads to different estimates of the nber of laboratories that the agency operates. Further sonfounding the situation is the jumble of acronyms used to refer to the laboratories and their program offices. For instance, the National Air and Radiation Environmental Laboratory in Montgomery, AL. is also referred to as the National Analytical Radiation Environmental Laboratory, using the same abbreviation (NAREL) To say the least, the morphing of names and abbreviations for laboratories, program offices, and research programs makes for a daunting challenge in following lines of responsibility and goals.

Overall, the committee found that the term laboratory is applied in many circumstances with regard to EPA's science and technical assistance functions. Moreover, EPA does not clearly define

how its laboratories interact, Clear definitions of laboratory and enterprise are essential. Because of the complexity of EPAs laboratory enterprise, a single principle might not apply to all aspects of it.

EPA's laboratory enterprise is part of the larger scientific endeavor within the agency. The larger endeavor is summarized below to provide context for the discussion of the laboratory enterprise in this report.

2.4 Science in the Environmental Protection Agency

EPA science entails a wide array of activities, from scientific assessments and reviews to observational and experimental research, modeling, cross-disciplinary synthesis, benefit cost analysis, and risk analysis. As summarized by the National Research Council Committee on Science for EPA futute (NRC 2012), those activities should meet a number of objectives, notably to:

- support the needs of the agency's regulatory randates and timetables, informing decisions about regulatory heath standards, policies, risk managemere, emergency response, compliance, and enforcement,
- identify, build, and maintain the intellectual foundations that will allow the agency to meet current and emerging environmental challenges over the next several decades,
- set priorities for information and research needs,
- sustain and continually rejuvenate in-house research, staff and associated laboratories and field capabilities to meet the mission needs of the agency in active collaboration with its partners
- appropriately balance in-house and extramural research investment.

More than 6,000 full-time EPA employees involved in research and other science-related activities are distributed throughout the agency (EPASAE 2012). About 1,450 of them are in ORD,

and about 4,700 in program and regional offices. On the basis of information provided by EPA for 2013, the laboratory workforce which includes scientific researchers, technicians, engineers, support staff, and administrative staff in laboratories as opposed to headquarters or program and regional offices totals roughly 3,630 persons, or about 60% of the agency's total science workforce. About two-thirds of those are federal personnel.

Since 1970, EPA has played an important and ofter a leadership role in advancing many fields of environmental science and engineering, notably ecological and health sciences, environmental chemistry, environmental monitoring, pollution rate and transport, environmental remediation, ecotoxicology, vehicle efficiency, and emission control. That role has been especially important ingenerating scenic information has provided a hasoratory Avirinas (summarized in NRC 20121 For example, thency has long history of leadership air-pollutant modeling (NRC 2012), is Community Multiscale Air Qulity musket is widely wned by researchers and agencies in the United States and abroad to model chemical mansfontations and transport processes of environmental pollutants, such as pround-level orone wactive nitrogen, and particulate matter. Since 2006, EPA has maintained a substantial computational-toxicology program whose objective is to develop approaches to the assessment and prediction of toxicology program whose objective is to develop approaches to the zesessment and prediction of toxicity in vitro by using high-through put testing. EPA scientists have produced new low-cost methods for monitoring landfi't gas emissions with laser technology The agency has advanced the use of molecular tools to track sources of microbial pathogens in surface waters and to set total maximum daily load standards. Similar advances have been made by EPA scientists and engineers in other fields of special relevance to the agency.

The agency's responsibility for regulation and enforcement creates a unique combination of drivers for its laboratory functions in providing fundamental knowledge and information to form

policy and rules in establishing robust and defensible analytic methods to support monitoring, certification, and compliance, and innovation to respond to environmental agents of new concern, forensic needs, terrorism, and natural disasters. Often, the agency's timetables and manpower staffing are driven by requirements imposed by Congress or the Executive Office of the President. Science activities in support of the agency's regulatory mission are often conducted in the context of important policy-making and decision-making and under public scrutiny. Those factors contribute to a particular challenging setting in which to build new, long-Jerm science-based initiatives to meet emerging environmental challenges. In addition, tightening budget constraits can exacerbate an inherent tension between the warnsy's need to respond mediate demands for expedited assessments and investigations for regulatory purposes and Longer-term program development to address current and future needs.

2.5 Environmental Protection Agency: SCIENCE DIRECTIONS AND CHALLENGES

A recent National Research Council report provided a detailed analysis of persistent and αποτρίng nvironmental challenges for EPA and of the need for new scientific theories and anethods that can help to address the challenges (NRC 2012) Key drivers of environmental such as population growth, land conversion, energy and water consumption, change consumption of nonfuel materials, and transport of invasive exotic species - have increased considerably over the last 30 years and continue to increase. For example, annual vehicle miles traveled on US highways doubled from around 1.5 trillion miles in 1980 to 3.89 billionmetric tons in 2006 before decreasing to 2.57 billion metric tons in 2010 likely as a result of the global financial crisis (Matos 2012). Aggregate emissions of common air pollutants - such as carbon monoxide, lead, nitrogen oxides, volatile organic compounds, particulate matter, and sulfur Goxide have declined by 63% since 1980. Thanks to

effective environmental policies, in particular the Clean Air Act (NRC 2012) but other environmental problems and threats have proved less tractable, and some have increased dramatically.

Current and Emerging Environmental and Human Health Challenges for EPA

- Human and environmental exposure to increasing rumbers, concentrations, and types of chemicals. Factors contributing to human and environmental exposures include energy choices, technological change, and changing energy consumption.
- Threat of deteriorating are quality through changes in weder och and Womer 20 and through the formation of more particles in the atmosphere from allerguin, mod spores, pollen, and reactions of primary air pollutante (Condalonter er af 2007) contributing to deteriorating air quality include population growth, coergy demes changing consumption, and climate change
- Water quality and coastal-system degradation, including challenges to rebuild old infrastructure and address such issues as urban stormwater and bypass of taw sewage (NOΛA 2012). Factors contributing to water quality and coastal-system degradation include land use, urban sprawi, climate change, and energy systems.
- Non-point-source pollution and nutrient effects associated with agricultural runoff of nutrients and soils. Factors contributing to non-out-source pollution and nutrient effects include climate change, land use, and technological change (NRC 2011).
- Expending quantities of waste with a wider array of component materials (Schmitz and Graedel 2010). Factors contributing to expanding quantities of waste include population growth, energy usage, technological change, and changing consumption.
- Expanding ecologic disruptions (USDA 2012). Factors contributing to ecological disruptions include population growth, land use, climate change, and transport of organisms.

Source: NRC 2012

Advances in science and engineering and in associated tools and technologies are increasingly important in addressing environmental challenges. For example, improvements in analytic chemistry, advances in chemical fate and transport modeling, and new approaches and technologies for monitoring human exposure to chemicals in the environment are helping to meet the challenges of assessing the effect of human and environmental exposare to chemicals At the same time, understanding and management of rols avociated with those chemicals is changing Thanks to new tools in molecular biology (for example, genomics, proteomics and metabolomics), such information technologies as bioinformatics, and systems-based approaches for predicting in vivo outcomes on the basis of multiple lines of evidence (NRC 2012). In the air-pellution arena, coupling of air-quality models with regional atmispheric models is improving short-term forecasting, Models for understanding the interactions between climate change and regional air quality are being developed. Advances in oircraft and satellite remote sensing offer unprecedented opportunities for regional to global air-quality monitoring and prediction similar adiances are occurring in the water-quality arena, notably in the ability to detect and attribute sources of pathogens and microbial populations in wastewater and surface waters (NRC 2012). And ever more sophisticated tools in computer science and informatics are revolutionizing data collection (including public engagement), analysis, and reuse and thereby new kinds of data-Intensive science and synthesis research emerged (Michener and Jones 2012).

EPA's ability to address emerging environmental challenges with cutting-edge tools and technologies is strongly conditioned by and intertwined with its role as a regulatory agency. For example, improved detection capabilities would enhance the agency's capabilities of evaluating the effectiveness of chemical-pollutant regulations (NRC 2004).

2.6 Strategic Science Goals and Resource Allocation

To achieve its mission, EPA develops a 4-year strategic plan that defines its goals. In the current strategic plan, EPA outlines the following goals and objectives (EPA, 2014).

Goals & Objectives

1. Addressing Climate change and Improving Air Quality

- Minimize the threats posed by climate change by reducing greenhouse gas emisions and taking actions that help to protect human health and help communities and ecosystem become more sustainable and resilient to the effects of climate change
- Achieve and maintain health- and welfare-based air pollution standards and reduce risk from toxic air pollutants and indoor air contaminants.
- Restore and protect the earth's stratospheric ozone layer and protect the public from the harmful effects of ultraviolet (UV) radiation.
- Minimize releases of radioactive material and be prepared to minimize exposure through response and recovery actions, should unavoidable releases occur.

2. Protecting America's Waters

- Achieve and maintain standards and guidelines protective of human health in drinking water supplies, fish, shellfish, and recreational waters, protect and sustainably manage drinking water resources,
- Protect and Restore Watersheds and Aquatic Ecosystems. Protect, restore, and sustain the quality of rivers, lakes, streams, and wetlands on a watershed basis, and sustainably manage and protect coastal and ocean resources and ecosystems.

3. Cleaning Up Communities and Advancing Sustainable Development

- Support sustainable, resilient, and livable communities by working with local, state, tribal. and federal partners to promote smart growth, and reuse of contaminated and formerly contaminated sites, and the equitable distribution of environmental benefits.
- Conserve resources and prevent land contaminania by reducing wante portion Loxicity, promoting proper management of waste and petroleum products, ing stainable materials management.
- Prepare for and respond to accidental or intentional eleases of contaminants and clean up and restore polluted sites for reuse.
- Directly implement federal environmental programs in Indian country and support federal prograro delegation to tribes. Provide tibes with technical assistance and support capacity development for the establishment and implementation of sustainable environmental programs in Indian country.

4. Ensuring the Safety of Chemicals and Preventing Pollution

- Reduce the risk and increase the safety of chemicals that enter our products, our environment, and our bodies.
- Conserve and protect natural resources by pror oting pollution prevention and the adoption of other sustainability practices by companies, communities, governmental organizations, and individuals.

5. Protecting Human Health and the Environment by Enforcing Laws and Assuring Compliance.

- Pursue vigorous civil and criminal enforcement that targets the most serious -air, and chemical hazards in communities to achieve compliance.
- Assure strong, consistent, and effective enforcerient of federal environmental laws nationwide. Use Next Generation Compliance strategies and tools to improve compliance and reduce pollution.

Source: EPA, 2014.

Science underpins the achievement of those goals by peuvisting the mformation needed to ATE/Avariety of activities, from the enforcement of current laws and reputations the Arvekyment of new regulations and identification of threats to probe health and the inment. In preparing a budget request, EPA does not provide requests for individual Jhoratories, types of laboratories, or the entire enterprise. Therefore, it is not apparent from an vubiders view of the budget how resources given to the agency for its scientific functions respond with laboratory activities. However, it is apparent that EPA faces a substantial challenge in using available resources to meet all its priority needs for laboratory science and technical support, which may change with factors, such as congressional deadlines, new pandates, changing administrations, and the unknown, such as massive oil spills.

Table 2: Science Contributions from EPA Laboratories

LAB	GOAL 1	GOAL 2	GOAL 3	GOAL 4	GOAL 5
Regional labs	Yes	Yes	Yes	Yes	Yes
Program labs					
NEIC-CO				Yes	
OW-OH	Yes				
OAR-MI	Yes				
OAR-AL	Yes	Yes	Yes	Yes	
OCSPP-MD		Yes		Yes	

OCSPP-MS			Yes	Yes	
ORD	Yes	Yes	Yes	Yes	Yes

Source: Paulson 2013.

Through management, strategic priority-setting, leveraging of resources with stakeholders and other agencies, and the work of committed professionals, the agency has built a laboratory-science capability in support of its mission. Whether it can maintain that she reipend to future environmental threats, and continue to protect the public health remains an por question in light of the current budget climate. For example, the agency operates in a climate of shrinking resources, which results in great reduction in the ability to make up for dic Die of seasoned personnel.

2.7 Summary

The EPA responsibilities required considerations at the intersection of diverse fields, chaling environmental program design and management; toxicology; environmental medicine. vironmental health engineering, environmental law: environmental policy, regulation, risk jgement; and ecologic and health risk assessment. This provides some brief, fundamental Background on those topics as a basis for discussions and recommendations. The intention was to develop principles for the efficient and effective management of EPA's laboratory enterprise to meet the agency's mission needs and strategic goals in the present and during the next 10 years. also provides an analytical framework in which EPA can efficiently and effectively deliver the tific outputs that will contribute to health and environmental protection outcomes. Moreover, sdentifies summary principles of a high-quality laboratory enterprise and focuses specifically the workforce and equipment. Although physical facilities constitute a critical element of a uboratory system, that aspect is being addressed in a separate effort, as discussed above. This Sercatore review has been able to address the management processes that would help to tie the enterprise together, focusing on planning, implementation,

assessment, and communication within EPA. It further discusses approaches for identifying emerging challenges, and also presents all the principles identified in this review and links them to the EPA committee's recommendations.

The challenge is however is in the efforts the developing countries are putting in place to wish this level of pollution management through scientific laboratory set by EPA's style of ation which has given us an insight and a clue to the modern and the most effective ways of Afressing pollutions without creating more challenges. Moreover, Ondo State Government ends to tap from this laudable gestures from the United State Environmental entity in ctablishing a structured, all-encompassing public environinental laboratories at strategic places show emerging parameters would be analyzed and many environmental uprising challenges would be adequately determined, and bring out the expected results, for the betterment of Ondo Ste at the long run.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

Managing pollution has been proven to be one of the most difficult tasks in mental management over the years. The sources of pollution, classes and types with its elementary areas of concerns makes it more difficult to manage. As mentioned in chapter of this study, identification of pollution in any given environment and its causes is a major fence In the developing world however, many of these pollutions are not totally or sentifically addressed, while many are wrongly analyzed leaving the immediate environment. mane with both flora and fauna to suffer as a result Contaminants are also of different levels. ccording to Kimberly Mullen, CPG Information on Earth's water (YASKAWA Journal), about 1 of our earth surface is made up of water and all living things are dependent on water as a ve of survival. The oceans hold about 96.6% of all Earth's water, Water also exists in the air water vapour, in rivers and lakes, in iceacaps and glaciers, in the ground as soil moisture and aquifers. It also exists in humans, plants & animals. Water is an essential part of human lives ich has sometimes been taken for granted. To explain the above further, water pollution is the metamination of water bodies such as lakes, rivers, oceans, aquatics and groundwater. Such an environmental degradation occurs when pollutants are directly or indirectly discharged into ater bodies without proper and adequate treatment to remove harmful chemicals and mpounds. Water pollution is a global problem to varying degrees. As an introduction, there are two main types of pollution (Hill, 2010): point source and nonpoint source pollution. The former Mentifies any single identifiable source from which the pollutant is discharged (e.g ship, pipe) ich makes it fairly easy to trace. In the case of nonpoirt source pollution, there is no specific source that can be identified such as surface water or run off in a watershed and therefore is dr to control to that of point source

pollution Water pollution has brought about many lications to our daily lives yet, many are still unaware of just how lethal or harmful water can be to natural lives.

Consequent upon the above, this chapter of the project focuses on the impacts of natural anthropogenic multiple sources of pollution on the environmental conditions of Ondo State stal water, There are various contaminations of water bodies going on in this area as research love it, hence the need to switch focus to the happenings at the rivering suburb of the State research work showcases the extent of laboratory activities and the dynamism it has due to stemic approach to identification of microbial characteristics, chemical and fossil fuel posits, ion content volume, anthropogenic and natural sources, atmospheric precipitation, al activities among others. The above areas of concentration are summed up under the Austrial, domestic and agricultural sources of pollution identified in these riverine communities.

3.1 Research Design

The design of this research is tailored towards obtaining specific data that may be useful future references for scholars and researchers. The design is based majorly on sampling tvibes to achieve data that represents through picture of level of pollutions going on at the elected riverine areas of the State. In this research section, laboratory activities extension (in-comes to the fore and re-addressed with a view to showcase and emphasize its portance in the administration, monitoring and management of pollutions. Other areas of esign work is the identification of various parameters, constituents and concentrations and the aphical representations of the end results. The design standard deployed is modern and of great value to scientific researchers years to come. Tabular Dunrations are also course along with specifie technical terms in use in today thesis writing.

3.2 Study Area and Population

This study was conducted on the coastal region of Ondo State (Lat. 5^0 50'N - 6^0 09'N and Long. 4^0 45'E - 5^0 05'E). The total area covered by the study was about 500lm with communities dispersed within the coast and increasing population size of 2.2% al: The population of the entire state is well over Braillion. There are over 50 settlements red around the river tributaries that empty into the cast. The area also falls within the oil wing states in Nigeria called Niger Delta region. It consists of rivers and streams which mes different settlements and discharge into the coastal ocean (Bright of Benin, Atlantic ent Ten (10) sampling points were selected (Table 2) along the estuarine part of the coast for evaluation. Furthermore, interview was conducted from each community, with five evadents from each settlement. The study ensures adequate understanding of the concept of research by all the respondents. Along the line, interpreters were introduced to explain in el dialects the contents of the questionnaire so as to obtain true representation of happenings these settlements, though majority of those interviewed were learned and of age.

In total, ten communities were selected across Ilaje and Ese-Odo Local Government areas a boast of 445,593 population (laje = 290,615. Ese-Odo = 154,978 dwellers respectively) ording to 2006 National Census. In all, 50 scripts of questionnaires were distributed and nistered showcasing 75% of indigenous rural dwellers. The above ten communities sent ten sampling points selected for this study. The choice of sampling points was based on observed anthropogenic activities in the area that have the potential of impacting negatively on the zone. The occupations of majority of the populace are trading, fishing, and farming. All el and domestic wastes are directly discharged into the coast, untreated. There is none e of any waste treatment plant in the area. Heavy transportation of goods and people in and fishing activities are by motorboats and canoe. The oil exploration and fueling in the area are notable sources of pollution.

3.3 Field Sampling and Preservation Method

Samples were collected into vessels pre-treated with HNO3 for 24hours before finally demineralized distilled water. Samplings were done by discrete grab method in a vur with engine switched off. Water samples for the determination of dissolved oxygen Dot were collected into narrow-mouthed glass bottles and fixed on the field with Winkler's ent Analyses of these were done immediately on returning to the laboratory. High density frethylene (HDPE) bottles were used to collect samples for the determination of parameters Be electrical conductivity (EC), chloride, sulphate, nitrate-nitrogen, phosphate, hardness and Bers. Samplings for oil and grease analysis were done in amber glass bottles washed in acetone samples were preserved in Iml cone. HCL These samples (except the ones for DO remination) were all preserved at 4°c in an ice chest for transportation to the laboratory. Also, ples of a litre each per sampling point were collected for determination of some metals using EDPE bottles. Samples for metal determination were preserved with 2ml of conc. HNO, per litre keep at 4°c till analysed. Temperatures (both ambient and water) and pH were measured in field and all samples were refrigerated at 4°C in the laboratory till analyses were completed them. The period between sampling and analysis were however kept between the mended times by Standard Method (APHA, 1995).

Table 3: Names and Locations of Sampling Points

Sampling Code	Name	Location	Activities
SW01	Ukua	Lat.5^{0}50'N Long 5^{0}04'E	Oil Exploration
SW02	Awoye	Lat.5^{0}54'N Long 4^{0}59'E	Settlement & discharge point into the Atlantic Ocean
SW03	OdoNla	Lat.5^{0}55'N Long 4^{0}58'E	Settlement
SW04	Ikorigho	Lat.5^{0}57'N Long 4^{0}56'E	Settle,ment
SW05	Ojumole	Lat.5^{0}59'N Long 4^{0}55'E	Settlement
SW06	ObeNla	Lat.6^{0}01'N Long 4^{0}52'E	Settlement
SW07	Ilepete	Lat.6^{0}02'N Long 4^{0}51'E	Settlement
SW08	Ilowo	Lat.6^{0}03'N Long 4^{0}50'E	Settlement
SW09	Ibijinmi	Lat.6^{0}04'N Long 4^{0}49'E	Settlement & close to a fishing camp
SW10	Idi Ogba	Lat.6^{0}06'N Long 4^{0}48'E	Close lake with scattered oil palm farm & hospital/dispensaries

3.4 Scientific Data Collection and Analysis

Samples collected were analysed for some physical and aggregate properties, inorganic -metallic constituents, metallic constituents, and aggregate organic constituents based on APHA (1995) classification. The methods adopted for the analysis were as specified by Standard for Examination of Water and Wastewater (APHA, 1995). The metal analyses were by the digestion of the samples with concentrated nitric acid (Ultrex) to release the organic nd metals and those in

particulates. The digestion was done in glassware previously soaked ame seid and washed with demineralized water. The digested samples were analysed for in duplicate using a Buck Scientific Flame Atomic Absorption Spectrophotometer Model Sample blanks were also analysed and results which were less than 5% of each metal mined in samples were used to correct for any contamination in the course of analysis. The control of the methods was determined by the analysis of some samples spiked with sndard and subjected to same process 50 as to determine accuracy and precision of the wed. The spiked samples analysed show recovery values ranging from 92-103% All Pranalyses were done in triplicate and the mean value presented.

The pollution status of the coastal areas of Ondo State was investigated and found to be ed by pollutants from both anthropogenic and natural sources. Solids, total dissolved solids Hischemical and chemical oxygen demand were evaluated as measures of environmental ons of the area. Also, some ionic and metal components were analyzed. Principal ponent analysis and linear correlation model of the data revealed that the coastal water was ely impacted by pollutants from related anthropogenic sources and natural sources and mospheric precipitation; tidal activities ensure the perfect mix of the pollutants across the Seawater intrusion and erosion of the soil into the coastal water are natural activities ng the water which is gradually rendering it useless thereby creating unfavorable condition quatic lives. The observed DO of water system was high (mean value -7.85mgO/L) due to aptation while the BOD also were lower than 3r1g0/L in most sites. However the concentrations of chloride and sulphate in the water system were on the high side ranging from 10417,366mg/L and 2,119-3.143mg/L respectively. The metal components investigated ere through laboratory/in-situ analysis beneficial to human health but exist in concentration too ch for human consumption, Fe, Mn, Cu, and Zn were found to be anthropogenic metals from elated sources in this coastal area having correlated positively and significantly with measures of organic matter and each

other coastal soil too contributed some level of Fe. Mn and Cu cording to scientific investigations. Therefore, there is a growing need to monitor and control he release of pollutant into the coastal water system of Ondo State so as to save the residents aquatic lives and the entire coastal environment from further degradation.

Estuarine and coastal environment globally are contaminated by human wastes containing elevated concentrations of nutrients, organic poilutions, trace metals and radionuclide Fang et. Al., 2006). Some of these contaminants are highly toxic and persist, therefore able to bio-accumulate (Donalson, 1980; Manahan, 1992). The environmental status of coastal areas globally is reportedly being stressed due to increasing industrial, commercial and population gowth associated with such area and is of high interest because of trans-boundary movement of such pollutants (Brothner, 1998; Fang, 2005). Most often than none, in the developing countries, the infrastructural facilities at these coastal areas are not adequate to meet the needs of the large population of people thus causing environmental deterioration due to direct waste discharge Matthai, Birth & Bickford, 2002; Dhage et. al., 2005 & Sadiq, 2002) which are not controlled nor seen as global treat.

Outfalls of human wastes occur in the coastal area globally because of the perception that oceans have a large capacity to assimilate waste (Koop & Hutchings, 1996), Unfortunately, neither the estuaries nor the coastal ocean are capable of assimilating pollutant indefinitely. Thus, enviromental monitoring and control are seriously ensured in the advanced economy but neglected in the emerging and developing ones. Hence, the global environmental now requires that any pollutant released in the coastal zone, especially in the developing should be heavily regulated, and properly managed (Bilgil et. al., 2005).

The coastal area of Ondo State, Nigeria, is one of sich coast that requires regalation and wing. It is among the oil belt region of Nigeria where Crude Oil exploration is going on. It ally located

between the Lagos coast with very high population density and industrial ties and the Delta coast where there is high volume of ongoing crude oil exploration. The At increasing domestic and commercial activities while the major means of transportation the area is motorboat with lightly heavy traffic of goods and persons. These make ionic nents, metals, and organic matter contamination most likely, Metals have been reported to present in used engine oils, fuels (lead) as well as in brake linings (copper), safety fences el ete used in vehicles and motorboats (Legret and Pagotto, 1999). These metals are released the environment and are sources of pollution in the water system. The sewage and other pestic wastes from settlements around the coast are major sources of pollution in coasts Ks et al. 2004). Agricultural practices which have been reported to be major sources of non in the environment (Keller, et al., 2002; Murray, et al. 2004; Quilbe, et al., 2004, beau, et al. 2002) can be a marked source of pollution in this coast. Moreover, there is an oil estion platform along the coast and there is always the intrusion of saline water from the into the coastal region making further the water none portable.

We are not aware of any work reported on the investigation of the quality of the water in coastal area nor is there any monitoring/control measure put in place to check pollution. Hence, this study presents preliminary data on impact of multiple sources of pollutants on water of an emerging populated coastal area: Ondo coast The study will serve as baseline data valuting pollutants contents and indicate the potential of such pollution on the global ment through trans-boundary movement of pollutants across coasts.

3.5 Administration

To access and obtain the data from the ten identified communities at the coastal areas of State namely Ukua, Awoye, Odo-nla, Ikorigho, Ojumole, Obe-nla, lepete, Howo, Ibiyunmi Idi-Ogba respectively, questionnaires were issued and given to some residents of the unibes The

questionnaires which were administered concurrently with the interviews dacted for respondent characteristics includes some critical variables that could help in ing at a decent result. It was revealed during the exercise that majority of the coastal ts have adequate information about the various pollutions on ground, though they eved that the activities of the so-called oil companies only led to the coastal water antaminations without considering other factors that also have their fair share among the tential impacts

3.6 Analytical Tools and Strategies

Descriptive statistics; mean standard were used to describe results of analysis. These car values were compared with the water quality standards of World Health Organization WHO) and Nigerian Federal Environmental Protection Agency (FEPA). Principal Component alysis (PCA) was used to obtain information on the cluster of the pollution parameters, their gee of association and the variation of pollutants with respect to sites. PCA of the parameters done with correlation matrix using the pollution parameter concentrations as the variable sites as cases while the sites' PCA was done with correlation matrix using the sites as the able and pollution parameter concentration cases. Linear correlation model was also used to establish relationship trend between parameters, possibility of relationship in pollutant sources and differentiation between pollutant natural to the environment and those contributed by human activities.

Some scientific Apparatus/Equipment and chemicals/gas for Environmental Analysis:

- Incubator
- Fume cupboard
- Heating mantle
- Hot box oven

- Medical freezer
- Autoclave
- Microscopes
- Weighing Balance (for nano items)
- Scientific Evaporator
- Chematography
- Spectrophotometer (Atomic, flame etc)
- Distiller
- Deionizer
- Soil Auger
- Ice pack
- Centrifuge
- Magnetic stirrer
- Drying cabinet
- Dessicator
- Muffle furnace
- pH meter
- Burette
- Pipette
- Plates
- Funnel
- Measuring cylinder (of different types)
- Sample bottles

- Syringe and needle
- Tripod stand
- Crucible
- Ammonia
- Chlorine
- Alcohol
- Sulphuric acid
- Methane
- Butane
- E-coli Agar
- Gram staining iodine
- Buffer

3.7 Summary

The method adopted has helped in arriving at a significant level of pollution in those selected communities. The questionnaires outcome, which will be discussed in the subsequent hapter has great impact as regards respondents' reflections towards achievement of all expected goals of the study.

CHAPTER FOUR

4.0 Introduction

This study has been able to assess characteristics of some pollutants in coo Ondo State as the subject of focus. As discussed earlier, contaminants can also he fet in the Kod and soil samples collected from the riverine region of the State However, the songer hav sight to bow water contaminations could affect the surrounding environment one limitad ashomans, plants and animals and has serious residual consequence if not spgeprately managed.

Fishing activities hampered due to sudden emergence of water Hyacinth decades which may be linked to spillages of oil contents in the ocean, killing and disorganizing sepatic Sves in the process. Business of fishing at a point in time becomes a hand task leaving my sobless. The laboratory work starts from the scientific investigation of pollution emergencies coupled with field sampling of an intended mapped area for research which continued and everslel to the bench-top analysis carried out in a registered well-equipped lavatory. Water pollutions and contaminations are of various degrees and diverse in nature, hence, the scientific and technical approaches to manage these. In the subsequent section, consideration will be given to respondent analysis to obtain information from residents mostly at the coastal areas av as to tify the study further.

4.1 Characteristics of Respondents

Figure 4.1 shows the demographic characteristics of the staly participants, most of them are aged 31-45 (48%) and the lowest percentage are those in the age group 56-65 (2) and 66 and above (2%). A little above half of the populations are male (54%) and a little below half of the population are females (46%). As regard the marital status, 33 out of 50 participes (66%) are married, 30% are single while the rest are either divorced or separated.

Most of the respondents are from the Yoruba ethnic group, this study reported 98% of Varula while the other two ethnic group "Hausa" and "Igbo" share the remaining 4% equally. All of the participants that took part in this research are all Christian (100%). The study also reported a higher number of Masters and Bachelor graduates students for the highest level of education achieved, It shows that 34.69% and 30,61% of the respondents have Masters and Bachelor degree respectively while HND and PGD have 4% and 3% respectively.

Table 4.1: Demographic characteristics of respondents

		Frequency	Percent
Age brackets	18 – 30	21	42%
	31-45	24	48%
	46-55	3	6%
	56-65	1	2%
	66 and above	1	2%
	Total	**50**	**100%**
Gender Respondent	Male	27	54%
	Female	23	46%
	Total	**50**	**100%**
Marital Status	Married	33	66%
	Single	15	30%
	Divorced	1	2%
	Separated	1	2%
	Total	**50**	**100%**
Ethnicity	Yoruba	48	96%
	Hausa	1	2%
	Igbo	1	2%
	Total	**50**	**100%**

Highest Level of Education	PHD	1	2.04%
	Masters	17	34.69%
	PGD	3	6.12%
	Bachelor	15	30.61%
	HND	4	8.16%
	NCE	1	2.04%
	Diploma	2	4.08%
	Others	6	12.24%
	Total	**49**	**100%**
Work Type	Civil Servant	19	38%
	Farming	6	12%
	Fishsing	6	12%
	Trading	3	6%
	Artisan	2	4%
	Others	14	28%
	Total	**50**	**100%**
Position	Top Management	12	24%
	Senior Management	9	18%
	Middle Management	1	2%
	Junior Management		
	Staff	8	16%
	Others	20	40%
	Total	**50**	**100%**
Categories of Environmental Management Project being undertaken	Physical Science	8	16%
	biological Science	6	12%
	Chemical Science	6	12%
	Plant Science	9	18%

Zoology	3	6%
Mineralogy	2	4%
Oceanography	1	2%
Limnology	0	0%
Soil Science	5	10%
Atmospheric Scienc	8	16%
Others	2	4%
Total	**50**	**100%**

For the work type category, majority of the respondents 19 out of 50 are civil servants with a total percentage of 38% which is closely followed by others (28%) which are students and politicians (14 of 50 respondents). The study also shows that 12 out of 50 (24%) are top management, 18%, 16% and 40% are senior, junior and other managers respectively. Majority of the respondents undertake plant science (18%), followed by physical and atmospheric science (8%). No respondent are undertaking a project in Limnology.

Table 4.2: Response rate of respondents to various sources of pollution

	Technical Data 1	Strongly Disagree	Disagree	Agree	Strongly Agree
Considerating the various Sources of pollution derived From air, water, land etc	Pollution of air have the largest share	46% (23)	24% (12)	22% (11)	8% (4)
	Light rays contribute to global warming	40% (20)	20% (10)	14% (7)	26% (13)

Table 4.2 above shows that by considering the various sources of pollution derived from air. water, land etc. 46% of the total population strongly disagree that pollution of air as a result of combustion of fuel have the largest share while 24%, 22% and 4% disagree, agree and strongly agree resepctively. A higher number (40%) also strongly disagrees that lightrays contribute to warm while 26% strongly agrees.

Table 4.3: Response rate of respondents on the various harmful substance in pollution

	Technical Data 1	Strongly Disagree	Disagree	Agree	Strongly Agree
The various related harmful substances in pollutions	Escherichia Coil, can only be traced to water contamination	10% (5)	16% (8)	46% (23)	28% (14)
	Health challenges are as a result	16% (8)	20% (10)	16% (8)	48% (24)

Majority of the population (28% strongly agree and 46% agree) believed that Escherichia can only be traced to water contamination. Also in determining the various related harmful stance in pollution, 48% and 16% of the respondents strongly agree and agree respectively health challenges are as a result of environmental pollution.

Table 4.4: Response rate of respondents on the various harmful substance in pollution

	Technical Data 1	Strongly Disagree	Disagree	Agree	Strongly Agree
Analyzing human Activities as they affect Pollution management	Technological advancement scientific discoveries increase pollution level	25% (11)	61.36% (27)	13.64% (6)	0% (0)
	Unwholesome fishing Contributes 70% of pollution of coastal water in Ondo State	0% (0)	12.82% (5)	10.26% (4)	76.92% (30)

Majority of the respondents, 25% and 61.36% strongly disagree that technological vancement, seientific discoveries increase pollution while they strongly agree to the fact that bolesome fishing contribute 70% of pollution of coastal waters in Ondo state.

Table 4.5: Response rate of respondents on stakeholders' assessment towards the reduction of pollution

	Technical Data 1	Strongly Disagree	Disagree	Agree	Strongly Agree
Stakeholders' assessment Towards reduction of Pollution indications	Government has performed its role to ensure reduction of pollution	8% (4)	18% (9)	36% (18)	38% (19)
	Government policies create Enabling atmosphere for private Sector in the management of pollution	4% (2)	20% (10)	36% (18)	40% (20)

In order to order to access the stakeholders' assessment towards reduction of pollution indicators. of the respondents strongly agree that the government has performed its role to ensure ation of pollution, 36% also agree to this claim. Almost all of the respondents (76%) agreed Be government policies create enabling atmosphere for private sector participation in the gement of pollution.

Table 4.6: Response rate of respondents on how environmental laboratory can stand in the gap it comes to proper management of pollution induced health concerns.

	Technical Data 1	Strongly Disagree	Disagree	Agree	Strongly Agree
How environmental Laboratory can stand In the gap when it	Incorporating medical and environmental laboratories may improve the course of pollution management.	0% (0)	22.73% (10)	38.64% (17)	38.64% (17)
Comes to proper Management of pollution Induced health concerns	Health-related challenges could be effectively managed when statutory funds are diverted into upgrading of Environmental laboratory status.	0% (0)	12.5% (5)	50% (20)	37.55% (15)

By answering the question on how environmental laboratory can stand in the gap when it comes to proper management of pollution-induced health concerns, 34 of 44 respondents who swered this question agreed to the fact that incorporating medical and environmental oratories as a single entity may improve the course of pollution management while the rest disagree. Also 35 of 40 respondents agree that healthineated challenges could be effectively when statutory funds meant for medical-oriented projects are diverted into upgrading of mental laboratory status.

Table 4.7: Response rate of respondents towards enhancing professional expertise on pollution monitoring

	Technical Data 2	Very High	High	Average	Low	Very Low
	Organize Workshop	0% (0)	16%(8)	50% (25)	20% (10)	14% (7)
	Management buying into it	8%(4)	20% (10)	50%(25)	14%(7)	8%(4)
	On job training	6%(3)	74%(37)	6%(3)	8%(4)	6%(3)
	Out of job training	14%(7)	20%(10)	30%(15)	16%(8)	20%(10)
	Public Sensitization	20%(10)	50%(25)	14%(7)	6%(3)	10%(5)
	Proper level of implementation					
	Agreement process	12%(6)	36%(18)	20%(1)	16%(8)	18%(9)

Based on the respondents rating on the criteria to improve the management of ironmental laboratory towards enhancing professional expertise on pollution managernent, Salf of the respondents believed that by organizing workshop, there would be improvement in management of environmental laboratory, 20% rated it low while 16% and 14% rated it high d very low respectively, Half of the respondents also agreed on the average to management buying into it, 20% rated it high while 8% rated it very high. Almost all of the respondents agree on job training in order to improve the management of environmental laboratory. For the out of job training, almost the same number cut across all levels, 14% and 20% agree to this, 30% svetagely agree, 16% and 20% reply low. A higher percentage of the respondents agree to public nutization while the same number of respondents cut across the agreement to proper mplementation method.

4.2 Discussion of Results

In all they canvassed for an improved supery sion, enforcement, comtoring and drive which will see to the effective management of pollutions via constitutol mental Laboratory Systems. According to the results of the interview, Molical arel Lavatories must be restructured in such a way that it will have the capacity to take care only aihuents which are genetic but most especially pollution induced health challenges are common, and re-occurring lately in the society. There are also support for establishments ve Pavimental Laboratories both Government/Private that are up to standards and med by relevant regulatory bodies with a view to minimize the overall pollution effects in the environment.

On the public awareness creation and sensitization, majority of the respondents believed ment, both past and present have done averagely well to bring in Private Organizations el to implement this appropriately. To affirm this, many members of the public are still not love of challenges posed by pollution due to the way they go about their daily activities, bout a recourse to best practices and standards.

On the final note, respondents threw weight on the need for adequate training of fessionals involved as this is a stepping stone to achieving a better environment for everyone.

4.3 Summary

The coastal water of Ondo State is negatively stressed by pollutants generated from Amestic, agricultural, and majorly industrial activities. Natural contributions from geological cture, intrusion of saline water from the Atlantic Ocean and possible trans-boundary vements of pollution from and into the coast were indicated to be significant also. Atmospheric precipitation and tidal activities aid the perfect mixing of the pollutants across the anth minimal variation. The environment is stressed and negatively impacted such that the cannot likely support uses. The anthropogenic sources of contamination in coastal areas of nveloping nations must be carefully identified and controlled, being overlooked as sources of al environmental contamination. There is hence on urgent and serious need for the doring and control of pollution in coastal areas of developing nations, Nigeria inclusive.

The above activities have shown that Environmental Laboratory plays a major role in ing environmental pollutions in a given society, It reveals the extent of damage and proffer sontific solutions to the problems at hand. Government at all levels meanwhile have ponsibilities of establishing Environmental research Laboratories at their domain so as to ckle the increasing pollutants in the environment most especially at the riverine areas with a www to stopping all forms

of degradation and mostly, the impending health deterioration and ventual death which may occur to the recipients as a result of contaminations.

CHAPTER FIVE

5.0 Summary of Findings

Environment pollution has become a subind of crecern in recent times. There have been various reports of pollution cases free diversos Environment has been at the antine end lately with challenges of exhausts released into the atmosphere from combustion damping of solids leading to degradation of the scosystem, channelization of leachate Almanding water bodies thereby creating turbulence for aquatic habitat, effluent discharge strial premises among many others.

Based on this promise, the Environmental Laboratory plays important and active roles in de anew and management of environmental pollutions. According to reports by Ezrati et al namental pollution and global burden of diseases by David Briggs) majority of the most health issues emerge as a result of environmental pollutions Environmental Laboratory sandeek to measure amount of pollution in our air, water and land resources, including flora nt with a view to reducing pollution level in the State and having a reliable data for the wall and sundry. It is interesting to note that the huge amount of elements such as Fe, Mn, Cu and Zn mostly found in the coastal waters have great impacts leading to environmental stress ne soil and water which in the process depicted their nutrients.

The sampling project at the ten (10) sites namely Ukua (SW01), Awoye (SWO2), Odo- (SW03), Ikorigho (SW04), Ojumole (SW05), Obe-Nla (SW06), llepete (SW07), lowo chinjinmi (SW09) and Idi-Ogba (SW10) revealed huge disparity among them. Most of parameters analyzed revealed results tailored towards the extent of constituent deposits in community. Ukua, the point for oil exploration in this regard has the highest concentration metals 11888.64±13.76 (Na mg/l), 354.16±6.68 (C3 mg/l), 1026.44-8.48 (Mg mg/1), 456.47±4.62 (Kmg/1), 4.72±0.63 (Mn mg/1) respectively. Ibijinmi has a settlement which is very a fishing camp. The results of pollution impacts

from this settlement that revealed high content has greatly impaired the natural sea water, though has its richness in the amount Cakum discovered in this area. As a result, fish farmers face a lot of challenges on their s due to sea water intrusion and introduction of foreign properties into the natural water going on.

Idi Ogba, another coastal community with abundance of oil palm resources also has the con of medical facilities and dispensaries. This area has the lowest amount of sodium ely but very rich in Potassium and Calcium. Relatively, due to the fact that oil palm field is rally located in this place, the sea water pollution and contamination is fair compared to the her nise sampled sites. Settlements like lowo, llepete, ObeNla, Ojumole, Ikorigbo, OdoNla Awoye produced high Total alkalinity (TA) MgCO3/L and total hardness of water MC003/L most especially ObeNla (102.60±3.1:990±153) and Ojumole (TA: 59.40±0.9; TH: 10.0) communities respectively. In all, this research study with its findings showcase evely significant differences in final results among the ten (10) coastal communities.

5.1 Conclusion

Assessment of pollution cut across every facet of human endeavor. Activities of human daily basis is bringing to the fore essence of instituting a well-defined and articulated lytical environmental laboratory, which is the major tool to address and manage pollution due the relative impacts accommodating these activities. Exemple is the pollution of air resources anved from automobiles and industrial turbines through their exhaust released into the mosphere that brings about issue of earth warming. Through the unwholesome medium, ous respiratory diseases have cropped up. Noise pollution mostly from religious quarters also has a very negative impact as this has led to hearing impairment, sleeplessness and continued e headache to the victims.

Furthermore, pollution of water resources through the unwholesome attitude of the ye is a major concern. Open defecations, bush burning, dumping of refuse, channelization of ite and many more of these contribute in large extent to environmental degradation. This er has also led to various communicable diseases that are preventable in the first instance sativities of virulent micro-organisms abound where there is an uphill of debris packed up. A maor water mixed with foreign matters possesses huge microbial load which may be ferred into humans when such water is ingested Diseases like diarrhea, cholera, vulosis, and many others are possibilities. It will be interesting to point out here that there categories of micro-organisms that are so virulent in nature. Fungi yeast, molds, smuts, rooms, toadstools and others are micro-organisms that have the capacity to instill diseases in living tissues.

Moreover, nature also produces ultra-microscopic infections agents (viruses) that cate themselves only within cells of living hosts. Viruses are a bunch of pathogenic sms that can only be active when living and feeding inside a living tissue. This virus, as her category of microbes also produces ailments such as Small Pox, Human Immune Deficiency Virus (HIV), Monkey Pox, Measles and so many other diseases. These are microbes tare so pathogenic and virulent to the hosts. They act fast to bring out result in their hosts. heputcome ranges from skin diseases, Catarrh, inflammation of the internal organs viz-a-viz kidney, bladder, lungs, heart, blood carrying vessels and so many important internal parts.

To say furthermore, Environmental analytical laboratory is a stop gap for all the above It has the potentialyze and discuss the existence and extent of pollution in any Namams exempted). It shout and provides scientific clue to any effects, Laboratory mouthedscovers the edent at which a purticular pollution has been brining out tive analysis of the initial and end result of the process. As discussed in the earlier of this research work. Environmental Laboratory has links with other

numerous science O mostly medical laboratory, but the mode and system of operation and activities differ. Environmental Laboratory has witnessed the synergy among major players alike. iski, Biochemists, Technologists, Geologists, and Nursing Scientists. Though, most dese Wolessionals are available and suitable in medical laboratory. Other experts with links mental Laboratory are Soil and Water Scientists, Geographers, Instrument Engineers, cail Labsccatory Scientists among others. The major difference between Environmental y and Medical Laboratory at the local level is that the former addresses prevention of while the laner addresses occurrence of diseases in the hosts. Meanwhile, mental Laboratory also addresses pollution concerns as regards plants and animals. rific investigation via environmental laboratory aid could be carried out on vegetation determine its natural contents before consumption.

Scientific examination can also be carried out from living strains of animals for ural analysis prior to consumption. Many foods and beverages manufacturing companies ents to Environmental Laboratory. It is on this note that the research work with all mation provided would improve human cause for living a very healthy life with many benefits enumerated.

On the solation level, Government of Osho State nay quickly make a move to address a punge at the nettoe areas as to salegued the people along with the daily mes The coastal water should be damned and montrest closely with frequent scientific mation of the surrounding habitol, as this will minimize pollution Requency in this area.

4.2 Recommendation

This research work has surveyed numerous reles ant scientific information as regards povest attached to the management of pollution thuyugh the medium of Environmental (aboratory. The information gathered have been from the present state of pollution management Oslo State and the

country in general. The thesis was also able to briefly consider pollution ente at global stage, with the current references to exmuple set by notable international entity, the United States Environmental Protection Agency (USEPA).

It has been discovered that most of the under-developed nations, especially in Africa and see parts of the Middle East are the major victims of the effects of environmental pollution as a result of poor resource allocations to tackle pollution menace and also, Government indifference the plight and health concerns of the citizens, It is on this hypothesis that this study recommends as follow:

- Ondo State Government should fast-track the implementation of Sectional Envirorumental Laboratories in each Local Government Areas of the State to address pollution emergency in each area.
- Ondo State Government should encourage active private sector participation in pollution matters and invite investors into the management of pollution via establishments of private Environmental Laboratories.
- Adequate funding of Public Environmental Laboratories are required towards effective reduction of pollution effects in the State.
- Recruitment of more scientific personnel to man public Environmental Laboratories so to address shortages of experts,
- Training and capacity building programmes are to be enshrined into the system to achieve optimum use of professionals
- Establishment of synergy between Environmental and Clinical Laboratories with other relevant laboratories for collective and proactive pollution management
- Sensitization of public on the need to putting in place pollution check mechanism into their operations/activities,

- Enforcement and compliance drive of the State Ministry of Environment should be strengthened.
- State Government to constitute a committee that will see to the proper management of State water resources, mostly at the riverine areas with a view to boost internally generated revenue (IGR) and lift the economic standard of the people.
- Generation of up-to-date scientific data and information for future references.

5.3 Contribution to Knowledge

In recent times, most studies have been centered always on the organization of different ars and workshops to discuss and address pollution matters, not minding its practical lications towards improvement of health of the public and the environment at large. In on to this, attentions are always focused on the urban events, not putting into consideration deprecarious living conditions at the very remote villages

From the foregoing and as it has been discussed by this research work, the previous chers have not done enough to sensitize and educate the populace on many dangers ted to their activities which are liable to unleash pollutants. Therefore, there is need to turn bion from the existing strategies as explained above towards aggressive people's oriented ach of which is public sensitization and awareness creation. This system is bound to bring people's attitudinal change from unwholesome activities which is the ground for many th hazards in the State.

5.4 Areas for further studies:

i. Policy making on the introduction of eco-friendly products and services introduced into the Nigerian markets for the improvement and sustenance of the immediate environment.
ii. Re-addressing climate change issues as it affects the national security.
iii. Analyzing categories and roles of major players in environmental planning and processes.

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REQUEST TO FILL QUESTIONNAIRE

Master of Science Dissertation: An Assessment of major pollutants in Ondo State, Nigeria.

I, OJO OLUWASESAN OLUWASINA, a Master of Science student in Project Management, from the Department of Project Management, City University, Cambodia under the supervisor, Engr. Prof Bamidele Francis hereby seek for your assistance to fill this questionnaire, The reason for this questionnaire is to identify other areas at which Laboratory Science can effectively and efficiently address uprising pollution issues in Ondo State via sampling of opinions with attention on pollution effects at the coastal areas of the State The resultant data collected from this medium would give me opportunities to improve my dissertation and would be mainly for scientific research purpose. All information provided would be treated strictly with highest level of confidentiality, and in line with today's best practices.

Yours truly,

Ojo Oluwasesan Oluwasina
M.Sc. Student, Project Management
Department of Project Management,
City University, Cambodia.

Section A: Demographic Data and background information about respondents

1. Name (Optional):
2. Age: 18-30 [ ] 31-45 [ ] 146-55 [ ] 56-65 [ ] 66 & above [ ]
3. Gender Respondent: Male [ ] Female [ ]
4. Marital Status: Married Single [ ] Divorced [ ] Others (Please specify)_____
5. Ethnicity: Yoruba [ ] Hausa [ ] Igbo [ ] Others (Please specify)_____
6. Religion: Christianity [ ] Islam [ ] Traditional [ ] Others (Please specify)_____
7. Highest Level of Education: PHD [ ] Masters [ ] PGD [ ]Bachelor [ ] HND [ ]

   NCE [ ] Diploma [ ] Others (Please specify)_____
8. Specific area of specialization (Optional):

   Work type: Civil Servant [ ]Farming[ ] Fishing Trading [ ] Artisan [ ] Others

   (Please specify)
9. Department at work:_____(Optional)
10. Position (Optional): Top management staff [ ] Senior management staff [ ]| middle managernent staff [ ] Junior management staff [ ]Others (Please specify)_____
11. Category of Environmental Management Project being undertaken: Physical Science [ ]

    Biological Science[ ] Chemical Science [ ] Plant Science [ ] Zoology [ ] Mineralogy [ ] Oceanography [ ] Limnology [ ] Soil Science[ ] Atmospheric Science [ ] Others Please specify_____ (You may tick more than one)

Section B: Technical data 1

(A) Considering the various sources of pollution derived from air, water, land etc: Pollution of air as result of combustion of fuel from automobiles and industrial machines have the largest share. Kindly express your level of agreement.

Strongly disagree, Disagree [ ] Agree [ ]Strongly agree [ ]

(B) Scientific research shows that light rays are another source of pollution which contributes to global warming. Kindly express your agreement level.

Strongly disagree [ ] Disagree[ ] Agree [ ] Strongly agree [ ]

The various related harmful substances in pollutions:

Escherichia Coli, which is the most common causative agent of acute urinary tract, can only be cored to water contamination. Please discuss briefly option taken_____

_____

Strongly disagree ( ) Disagree ( ) Agree ( ) Strongly agree ( )

All health challenges are as a result of environmental pollution.

Strongly disagree[ ] Disagree ( ) Agree ( ) Strongly agree [ ]

_____

_____

Analyzing human activities as they affect pollution management.

Technological advancement, scientific discoveries/inventions and innovations of the society has in one way or the other increased pollution significantly.

Strongly disagree [ ] Disagree[ ] Agree[ ] Strongly agree[ ]

Justify your option with brief discussion_____

_____

Unwholesome fishing activities at the riverine communties contribute 70% of pollution of postal water in Ondo State. Kindly give any relevant statistical data to support your option taken

_____

_____

Strongly disagree[ ] Disagree[ ] Agree[ ] Strongly agree[ ] kindly rate Government performance with your option on percentage_____

_____

Government policies create enabling atmosphere for private sector participations in the management of pollution and its implications.

Strongly disagree [ ] Disagree [ ] Agree [ ] Strongly agree[ ] Please justify your options

_____

How environmental laboratory can stand in the gap when it comes to proper management of pollution-induced health concerns.

Incorporating medical and environmental laboratories (dual scientific approach) as a single entity may improve the course of pollution management. If you agree, please briefly discuss

_____

_____

Strongly disagree[ ] Disagree[ ] Agree[ ] Strongly agree [ ]

Health-related challenges could be effectively managed wł en statutory funds meant for modical-oriented projects are diverted into upgrading of environmental laboratory status.

Strongly disagree [ ] Disagree [ ] Agree[ ] Strongly agree[ ] Kindly discuss and define briefly the option taken_____

Section C: Technical data 2

How can the management of environment laboratory be improved towards enhancing relevant professional expertise on pollution monitoring?

Based o the rating below, kindly express your agreement with the criteria to improve the management of environmental laboratory towards enhancing professional expertise on pollution management.

Very high, b. High, c. Average, d. Low, e. Very low

How would you rate the level of involvement of your organization in the under-listed criteria?

Very often, b. Often, c.Rarely often, d. Very rarely, e. Never

S/N	Criteria to improve management of environmental laboratory	Level of Agreement						Level of involvement				
1.	Organize workshop											
2.	Management buying into it											
3.	On job training											
4	Out of job training											
5.	Public sensitization											
6.	Proper implementation process											

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