# ASSESSMENT OF THE ENVIRONMENTAL COMPLIANCE OF RETAIL PETROL OUTLETS IN LOKOJA METROPOLIS, NIGERIA

**BY**

**Awwal DAUDA**

**DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL MANAGEMENT,**
**FACULTY OF PHYSICAL SCIENCES,**
**AHMADU BELLO UNIVERSITY,**
**ZARIA**

**DECEMBER, 2017**

# ASSESSMENT OF THE ENVIRONMENTAL COMPLIANCE OF RETAIL PETROL OUTLETS IN LOKOJA METROPOLIS, NIGERIA

**BY**

**Awwal DAUDA, B.Sc. (KSU) 2012**
**P14SCGS8216**

**A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY, ZARIA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER DEGREE IN ENVIRONMENTAL MANAGEMENT**

**DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL MANAGEMENT,**
**FACULTY OF PHYSICAL SCIENCES,**
**AHMADU BELLO UNIVERSITY,**
**ZARIA, NIGERIA**

**DECEMBER, 2017**

## DECLARATION

I declare that the work in this project dissertation entitled "**Assessment of the Environmental Compliance of Retail Petrol Outlets in Lokoja Metropolis, Nigeria**" has been carried out by me in the Department of Geography and Environmental Management. The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this project dissertation was previously presented for another degree or diploma at this or any other institution

**Dauda Awwal** ____________________ ____________

**Signature** **Date**

## CERTIFICATION

This dissertation entitled **"ASSESSMENT OF THE ENVIRONMENTAL COMPLIANCE OF RETAIL PETROL OUTLETS IN LOKOJA METROPOLIS, NIGERIA"** by Awwal DAUDA meets the regulations governing the award of the degree of M.Sc. in Environmental Management of the Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

**Prof. A.B. Nabegu** ____________________ ___________
Chairman, Supervisory Committee (Signature) Date

**Dr. Y.Y. Obadaki** ____________________ ___________
Member, Supervisory Committee (Signature) Date

**Dr. A.K. Usman** ____________________ ___________
Head of Department (Signature) Date

**Prof. S. Z. Abubakar** ____________________ ___________
Dean, School of Postgraduate Studies (Signature) Date

## DEDICATION

This work is dedicated to Allah (S.W.T) who has blessed me beyond my imagination with the willpower and zeal to start and complete this dissertation.

## ACKNOWLEDGEMENTS

I sincerely thank Allah (S.W.T) for his grace upon my life, for the wisdom and understanding he has given me as well as the strength to go through the rigors of this work.

Words cannot express my appreciation to my Supervisors; Prof. A.B. Nabegu and Dr. Y.O. Yusuf for every contribution made towards the success of this work, and the time used to go through this work in detail at every given time, putting me through every mistake and making all the necessary corrections to improve this work. I pray Almighty Allah bless you abundantly and grant you your heart desires.

I wish to appreciate other staff of the Department of Geography and Environmental Management, Ahmadu Bello University especially Dr. B. Akpu, Mallam Mukhtar and My Cousin Mallam Hamza Mohammed for their assistance at various times in the course of this research. I will also like to show my appreciation to Mr. Zayyanu Goronyo and Mr. Hanifa of the Department of Petroleum Resources (DPR) for their assistance towards the success of this research..

My very big thanks also goes to my parents, Alhaji Dauda Onu and Hajia Zainab Dauda for all they have put into my life from childhood till date, the endless prayers, sacrifices, encouragement and financial support I have received from them is priceless, without which this research dissertation and related outputs would never have seen the light of the day.

I remain also very grateful to my siblings, Mrs. Haratu, Aisha, Bashir, Halima, and Aminu and also to my brother-in-law, Mallam Yakubu Usman for their understanding and prayers for this work to be a reality. I wish to also thank my uncle, Alhaji U.U Mohammed and his family for their love and support, may Allah reward you all abundantly.

I wish to thank Musa Aaron Mekidani, Anyanwu Nnamdi, Abdullahi Baba Ndajiya, Ibrahim Kabeer, Edith Amajuoyi, Mohammed AbdulAziz Dikko, Dangata Noel and my other course mates and all the set of 2014/2015, they were all unique people.

To all my friends Jangata George, Gideon Rimamfate, Bashir Dabo, Abdullahi Dabban, Aminu Yahaya, Ibrahim Bello and all my friends i could not mention, I appreciate the encouragement received at various times from you all.

There are so many people who have indeed contributed to this work in various ways that I might not have written their names, I am grateful to you all and also to everyone who has in one way or the other contributed to the success of this work may the Almighty God Bless you all Amen.

## ABSTRACT

Retail Petrol Outlets (RPOs), an integral part of the modern society has experienced a growth in numbers with the increase in consumption of petroleum products in Nigeria. Despite their importance, the location and operation of RPOs come with various implications on the local environment. Thus, their location and operation are often guided by a set of environmental laws and regulations. This study was aimed at assessing the environmental compliance of RPOs to the Department of Petroleum Resources (DPR) guidelines in Lokoja Metropolis. To obtain data for the study, a checklist based on the DPR guidelines was used to collect data on the operational characteristics and the environmental compliance of the RPOs in the study area. In addition, two sets of questionnaires were administered to managers and workers at the selected RPOs to collect data on the factors militating against the environmental compliance of RPOs in the study area. A reliability analysis of the questionnaires was performed and a Cronbach's Alpha Value of 0.833 was obtained. A cross tabulation analysis was also performed to test the relationship between the factors militating against environmental compliance of the RPOs in the study area. The results reveal that 71.7% of the RPOs were under the ownership of independent marketers, and were unevenly distributed across various routes in the study area. An assessment of the environmental compliance reveals that 98.3% of the surveyed RPOs have concreted forecourt. However compliance was low in other categories as only 18.3% of the RPOs had monitoring procedures to detect leakages from underground storage tanks (USTs). An analysis of the data collected on the factors militating against environmental compliance revealed that knowledge feasibility, capital adequacy and technical feasibility among the RPOs was generally low as 37.4% of the respondents agreed to a little extent that RPO employees are regularly educated on compliance to environmental regulations. Also, 33.6% of the respondents agreed to a little extent that the management of RPOs avails resources to implement required regulations. It was also revealed that the

monitoring and enforcement practices of the relevant regulatory body were generally weak as 30.9% of the respondents completely disagreed that the regulatory body monitors implementation of regulations. The Chi-Square test results obtained from the cross tabulation analysis revealed a relationship between capital adequacy and technical feasibility, monitoring and enforcement practices and knowledge feasibility, with the Cramer's V values indicating a strong relationship between the identified factors. Amongst other recommendation provided in this study, it is strongly recommended that education and sensitization of the employees at the RPOs to relevant environmental laws and regulations be made a priority by DPR.

## TABLE OF CONTENT

## LIST OF FIGURES

## LIST OF TABLES

## LIST OF APPENDICES

**Appendix** **Page**

# LIST OF ABBREVIATIONS

| | |
|---|---|
| BTEX | Benzene, Toluene, Ethylene and Xylene |
| DPR | Department of Petroleum Resources |
| EGASPIN | Environmental Guidelines and Standards for the Petroleum Industry in Nigeria |
| INECE | International Network for Environmental Compliance and Enforcement |
| PAH | Polycyclic Aromatic Hydrocarbon |
| RPO | Retail Petrol Outlet |
| UST | Underground Storage Tank |
| VOC | Volatile Organic Compound |
| VRS | Vapour Recovery System |

# CHAPTER ONE

# INTRODUCTION

## 1.1 Background to the Study

Retail Petrol Outlets (RPOs) can be defined as the major facilities for dispensing petroleum products to consumers for fuelling internal combustion engines. Most RPOs sell petrol and diesel, some carry specialty fuels such as liquefied petroleum gas (LPG), natural gas, hydrogen, biodiesel, kerosene, or butane while others add shops to their primary business. They may also have a mechanic workshop, lube bays, car wash, mini marts and restaurants. The petroleum products sold are usually dispensed from underground storage tanks (USTs) through pumps and dispensers (Department of Petroleum Resources [DPR], 2002; Ayodele, 2011). According to Ehinomen and Adeleke (2012), RPOs are an integral part of the petroleum industry that has occupied strategic importance in the Nigerian economy accounting for as high as 78% of Gross Domestic product and up to 90 per cent of the country's total annual revenue in the last two decades.

According to De Sousa (2015), because of the nature of the fuels that are stored and the activities that take place within them, these outlets generally have great potentials for degrading the environment where they are localised. The fuels stored and sold at RPOs are known to cause high levels of air pollution from offloading and dispensing activities as well as emissions from storage systems holding hydrocarbon. They are also important sources of contamination of the soil and groundwater through leakages of USTs and have been subject of numerous studies due to the complexity of the phenomenon and the interaction of these pollutants with the soil and groundwater (Shukla, Pekny and Venkatasubramanian, 2011).

According to Oluleye (2004) the deregulation of the downstream petroleum industry in Nigeria prompted massive investment in the sector, culminating in building of new RPOs with new pump deployment. There was also the expansion of trucking fleet, modernization of HSE equipment and considerable investment in the training of staff. This development brought an increased participation of the major and independent marketers in the downstream sector of Nigeria. As a measure of the growing involvement of the indigenous petroleum products marketers in the economic development process of Nigeria, it is interesting that in 1981, they accounted for less than 1% in terms of volume of petroleum products marketed in Nigeria. By 1998, they had captured about 25 % of the market. Today, they account for over 40 % of the volume of products marketed in country (NNPC, 2010).

Business competition, legislation and composition in the retail business have changed a lot over recent years. Businesses everywhere are now faced with new challenges like changes in patterns of customer demand and technological innovations, shortfall in capital and customer service level requirements. The petroleum industry is no exception to all these new developments in the retail business (Matsho, 2010). Consequently, the threats and challenges facing the oil industry in today's economic climate have an impact on the individual site performance of RPOs. As a result most of the RPOs are small, fragmented and unable to adhere to national environmental best practice standards as stipulated in the Environmental Guidelines and Standards for the Petroleum Industry in Nigeria (EGASPIN) (Ambituuni, Amezaga and Emeseh, 2014). This particularly is also the case with the identified RPOs in Lokoja Metropolis.

## 1.2 Statement of the Research Problem

In Nigeria, energy generation is largely dependent on petroleum products (Iwayemi, 2008). According to Agusto (2008), petroleum consumption has been on the increase in Nigeria since the early 1980s. This upward trend is evident in the energy consumption data of 2006, 2007 and 2011 where petroleum products represents 53%, 67.3%, and 68.5% respectively of the total energy consumed in the country (Energy Information Administration, 2012).

The increase in the consumption of petroleum products has obvious implication on the downstream sector particularly on petroleum retailing activities. According to Kanyi (2015), there are quite a number of environmental issues associated with the operation of RPOs like the risk of leaks from underground storage tanks, spills of fuels, liquid effluents (fuel delivery, dispensing and automobile repair areas, storm water runoff from fuel delivery, as well as from automobile cleaning activities). Similarly, RPOs are known sources of emission from storage systems holding hydrocarbons and as well as from dispensing and delivery activities from road tankers. Other relevant impacts caused by the activities of RPOs amongst others are the impacts caused by the respective waste generated from auxiliary services provided (Rocha, Soares and Medeiros, 2011; South Australia Environmental Protection Agency, 2015).

Rapid urbanization as experienced in many parts of the country leads to an increase in transportation demands and consequently an increase in number of vehicles to meet this demand. The increase in number of vehicles plying Nigerian roads are due to non-availability of other means of transportation apart from roads transport translates to higher consumption of petroleum products (Afolabi, Olajide and Omotayo, 2011). This resultant increase in demand has to be met by creating more RPOs and in most instances, these RPOs do not comply with local environmental laws, standards and regulations and international best practice standards. This leads to adverse environmental impacts.

Lokoja, the confluence town of Nigeria has experienced tremendous growth spatially and socio-economically since it was made the capital of Kogi state (Dukiya and Okhimamhe, 2013). This urban growth has brought with it increased use of automobiles, the need for fuelling services and consequently proliferation of RPOs in the area. The concentration of the

RPOs in the study area has obvious impact on the local environment as there has been observed evidences of ground contamination (e.g. visual stains, affected vegetation) around a number of RPOs in the study area. Also, a number of the RPOs in the study area lack the requisite environmental protection measures (layout and design, location and waste management, air, water and land pollution control mechanisms) required for operation as specified in the Environmental Guidelines and Standards for the Petroleum Industry in Nigeria (EGASPIN). This practice portends a dangerous trend, putting the staff and residents within the vicinity of RPOs at heightened environmental and public health risk. It is in line with the identified problem that this research is aimed at providing answers to the following questions:

1. What are the operational characteristics of the RPOs in the study area?
2. What is the level of compliance of the RPOs to the guidelines for their operations in the study area?
3. What are the factors militating against environmental compliance by the RPOs in the study area?

**1.3 Aim and Objectives**

The aim of this research is to assess the environmental compliance of RPOs to the guidelines for their operations in Lokoja Metropolis, Nigeria. However, the specific objectives are to;

i. identify and characterize the RPOs in the study area
ii. assess the environmental compliance of RPOs to the provisions for environmental management in the EGASPIN
iii. identify the factors militating against environmental compliance by RPOs in the study area.

## 1.4 Research Hypotheses

**$H_{01}$**: There is no relationship between capital adequacy and technical feasibility among the RPOs

**$H_{02}$**: There is no relationship between capital adequacy and monitoring and enforcement practices among the RPOs

**$H_{03}$**: There is no relationship between capital adequacy and technical feasibility among the RPOs

## 1.5 Scope of the Study

This study assessed the environmental compliance of all the functional RPOs within Lokoja metropolis, the Kogi State capital; this is the spatial scope of this research. The content scope covers issues on the operational characteristics of the RPOs in the study area, the compliance of the RPOs to guidelines for their operations, and the factors that militate against environmental compliance by the RPOs. This study assessed the compliance of the RPOs that were functional as at the time the field survey for this research was conducted in 2016.

## 1.6 Justification for the Study

The World Health Organization (WHO) in 2010 made the World Health Day theme Urbanization and Health with the slogan “1000 cities, 1000 lives” to draw attention to the development of cities and areas and its impact on the environment and consequently the health of man. As a result of urbanisation, an increase in the number of RPOs in the area is being experienced, and most times these RPOs do not adhere to the guidelines and standards for their operation. This leads to adverse environmental impact. It is thus imperative for this research to be conducted to provide insight to regulators and the general society at large on the level of compliance of RPOs to guidelines stipulated under regulation and majorly factors that influence compliance to guidelines specified in the EGASPIN. The information presented in this research work is aimed at providing guidance to policy formulation, intervention and relevant best practice adoption.

# CHAPTER TWO

# THEORETICAL FRAMEWORK AND LITERATURE REVIEW

## 2.1 Theoretical Framework

There are several theories underpinning environmental compliance and enforcement. These include standard theory of rational crime, theory of criminal enforcement, deterrence based enforcement theory and theory of compliance behaviour. The deterrence based enforcement theory and theory of compliance behaviour are further explored therein.

### 2.1.1 Theory of compliance behaviour

This theory reflects two different government approaches to achieving compliance, often referred to colloquially in English as the carrot and the stick. INECE (2009) asserts that these together both encourage and compel behavioural change. The carrot (compliance promotion activities) and the stick (the threat of an enforcement action against non-compliers) are based on the rationalist and normative models of behaviour. The rationalist's theory posits that regulated actors follow the logic of consequence. That everyone acts to maximise their own self-interest. If it is "cheaper" to violate an environmental requirement, then regulated actors will do so.

Normative theory posits that regulated actors follow the logic of appropriateness and often act in good faith. Compliance occurs (or does not occur) largely because of the regulated actor's "capacity" (e.g. knowledge of the rules, and financial and technological ability to comply) and "commitment" (e.g. perception that the rule is fair). Accordingly, this theory calls for more compliance promotion in the form of assistance, incentives and other activities. The rationalists and normative models represent opposite ends of the spectrum and each provides useful insight into the types of behaviour that lead to compliance. According to INECE (2009), regulated communities everywhere generally can be divided into three general categories: (1) those who will not comply at all unless they are forced to; (2) those who are "impressionable," and might comply if presented with incentives, knowledge, or capacity to do so; and (3) those who will cooperate in all circumstances. Which one of these categories predominates will vary from country-to-country and can help inform individual country decisions about what mix of compliance promotion and enforcement activities to stress in efforts to promote the rule of law and protection of public health and the environment.

### 2.1.2 The deterrence based enforcement theory

In any regulatory situation some people will comply voluntarily, some will not comply, and some will comply only if they see that others receive a sanction for non-compliance. This phenomenon that people will change their behaviour to avoid a sanction is called deterrence. Generally, for a policy to have a deterrent effect, the individual or the organisation must believe that there is a high probability of being caught. The responses of the violation will be swift, certain and fair. The punishment will be severe enough to outweigh the benefits of non-compliance. Deterrence may be enhanced either by expanding monitoring activities, improving enforcement capacity to investigate and prosecute violations, raising penalties or increasing awareness of enforcement. The basic theory of general deterrence rests on the notion that regulated business entities are profit-driven "amoral calculators" (Kagan & Scholz, 1984). Thus only fear of imminent legal penalties that exceed the cost of compliance can induce profit-seeking firms to invest in compliance with regulatory demands. Each tough legal penalty, it is assumed, sends a "threat message" that reverberates through the community of regulated businesses. As the perceived risk and cost of violations thereby increases, business executives increase their investments in compliance.

## 2.2 Retail Petrol Outlet (RPO)

A Retail Petrol Outlet (RPO) could be any petroleum facility, service station, public garage, highway filling station or fuel depot that sells fuel and lubricants for motor vehicles. Even though this facility may have different names depending on the part of the world, the purpose for which it is established remains the same. RPO is a structure or building where petroleum products are sold to motorists for local consumption purposes. In Australia, the facility is called a service station; in Canada, it is either garage, fuelling station or gas bar; in some English speaking Commonwealth Countries, it is also either petrol station or petrol pump; in India, petrol bunk; in Japanese English, gasoline stand; in Nigeria, filling or petrol station; in UK and South Africa, garage and in USA it is known as gas station It could also be called a distribution station, service station or traffic station (Nieminen, 2005; Hanekom, 2011).

A RPO is also an area including fuel equipment and piping, storage tanks, forecourts (fuel dispensing area) and possible building premises for the sale of fuels (flammable liquids) to customer's vehicle. According to DPR (2002), activities at RPOs include tank vehicles discharge of petroleum products, retailing of the products through pumps and dispensers, automobile services, carwash and supermarkets.

### 2.2.1 Categories of RPOs in Nigeria

According to Abdullahi, Alkali and Mustapha (2012), there are currently three categories of owners and managers of RPOs in Nigeria. These categories are discussed below.

#### *2.2.1.1 Major marketers*

Major Marketers are multinationals with local oil and gas retail outlets. They include TOTAL, MOBIL, MRS, OANDO and AP. These multinationals usually construct filling stations and appoint dealers to manage them under their supervision. These filling stations are licensed and supervised by DPR and are generally subjected to Regulations and Guidelines of the Oil and Gas Industry in Nigeria (Abdullahi et al., 2012).

#### *2.2.1.2 Independent marketers*

Independent marketers are private retailers of oil and gas products. Their existence became necessary due to limitations of major marketers in concentrating their business in the most locations. DPR is responsible for the approval of construction and monitoring of Independent petrol outlet and to ensure they comply with existing Regulations and Guidelines (Abdullahi et al., 2012). The names and location of Independent Marketers in Lokoja Metropolis are shown in APPENDIX V.

#### *2.2.1.3 NNPC owned stations*

There are two classes of NNPC owned stations; the NNPC mega stations and affiliate stations. The affiliate stations are outlets leased from independent marketers to Nigerian National Petroleum Corporation (NNPC) to ensure fair and wider distribution of oil products in Nigeria. Similarly, Mega stations are relatively large stations owned by NNPC and managed by NNPC Retail Limited, a subsidiary of the NNPC. DPR is also responsible for the monitoring of NNPC owned stations (Abdullahi et al., 2012).

## 2.3 Environmental Impacts of RPOs on the Local Environment

RPOs are an indispensable part of the modern technological society, and each outlet presents a wide range of potential challenges to the health and safety of people and their surroundings. The major environmental risks involve releases of petroleum based pollutants from RPOs which endanger the air, soil and water (Nieminen, 2005). According to DPR (2002), the sources of pollution identified with the operation of RPOs are spills arising from the sales of petroleum products as a result of overfilling of fuel tanks of automobiles, wrongful disposal of used engine oil (automobile drain oil and waste oil) generated from automobile services.

Other sources of pollution at RPOs include leaks from underground storage tanks due to corrosion, accident to tankers during product discharge, oil spills or use of inferior construction materials, sanitary wastes, drainages of carwash and stormwater and refuse generated onsite the RPOs. One of the major contamination sources of the soil, air, underground and surface water has been related to liquid fuel tank leaking, processed chemical products, toxic chemical products and diluted rejects.

According to Haveman (1992), careless handling of petroleum products, gaseous emissions from individual retail outlets, waste water discharge mainly oils, greases, solid waste from used oil rags, noise and smells have negative impacts on the environment. Petroleum products are considered hazardous because of their nature which ignites easily and hence causes hazards like fire while others are reactive and require special storage and handling because they tend to be unstable to shock, sparks or heat resulting in generation of toxic fumes and fire explosions. If improperly managed they release pollutants in sufficient quantities to cause direct health effects through inhalation, skin absorption and ingestion or potentially toxic accumulation in the environment.

### 2.3.1 Impacts of hydrocarbons from RPOs on air quality

Petrol vapour emissions constitute one of the main sources of air pollution from RPOs. Petrol is a complex mixture consisting mainly of hydrocarbons (Gonzalez-Flesca, Vardoulakis and Cicollella, 2002). There are a wide range of Volatile organic compounds (VOCs) present in the atmosphere around RPOs as a result of emissions of vapours during dispensing, loading, unloading and transportation of petrol (Periago, Zambadio and Prado, 1997). The major VOCs are benzene, toluene, ethylbenzene and the three isomers of xylene, often referred to as the BTEX compounds. BTEX and Polycyclic Aromatic Hydrocarbon (PAH) compounds have been found to be potentially hazardous to environmental and human health (Campos-Candel, Llobat-Estelle and Mauri-Acejo, 2007). According to Okonkwo, Orji and Onwuamaeze (2014), VOCs are the most prominent pollutants recorded at RPOs. This because of the continuous emission of the fuel vapours into the ambient air as a result of mishandling of the fuel which may lead to spillage, the displacement of air carrying fuel from the tanks during vehicle refueling and the evaporation of fuels from loosely closed underground tanks. More VOCs are prevalent at the dispensing areas and the reason is because evaporation of fuel occurs during the refueling of vehicles.

BTEX and PAHs belong to a very heterogeneous group of chemicals characterized by their relatively high vapor pressures. Exposure to these compounds can bring about a variety of adverse health effects, including asthma, headaches, mucosal symptoms and, in some cases (e.g. benzene), an increased risk of cancer (Steinemann, 2008). Benzene has long been known to be a human carcinogen, with the strongest evidence linking it with lymphohaematopoietic cancers, particularly acute non-lymphocytic leukemia. Prolonged exposure to benzene can also lead to neurological, immunological and haematological disorders (Davidson, Courage, Rushton and Levy, 2001). Petrol vapours released from RPOs also leads to the formation of damaging ozone in the lower atmosphere. A build-up of ozone in the lower atmosphere adversely affects human and animal health, interferes with plant growth and damages building materials. It can also cause photochemical smog which is detrimental to the human respiratory system (Institute of Petroleum, 2002). According to Al-Salem and Khan (2010), acidification of precipitation, visibility reduction, and other deleterious effects on human health and plants are all effects associated with VOCs released from RPOs.

### 2.3.2 Impacts of hydrocarbons from RPOs on soil and groundwater quality

The spilling and leakage of diesel fuels, gasoline and oil from RPO activities is a widespread problem that results in the contamination of surrounding land and groundwater resources

(Mbhele, 2007). Hydrocarbons which escape from containment at a petrol outlet may enter the soil directly beneath the site, or around its perimeter. Motor fuel entering the soil will, because of its known toxicity, have a detrimental or fatal effect on the flora and fauna within the contaminated area (Institute of Petroleum, 2002).

Gasoline is composed of more than 70 hydrocarbons, these hydrocarbon components have significant solubility in water and once dissolved can give rise to contamination plumes that can pollute significant volumes of water. As well as being toxic towards aquatic life, motor fuels may cause health problems to humans if ingested. According to the United States Environmental Protection Agency (USEPA), four litres of petrol can contaminate the water supply of 50,000 people. Because of this, any contamination will have to be removed from potable water by the relevant water supply companies (Institute of Petroleum, 2002; Enger and Smith, 2006; Moschini, Dos Santos and Pires, 2005). According to McHugh et al., (2015), most gasoline constituents are highly soluble in water and have the potential to threaten public water supply for tens to hundreds of years. According to Plaza, Wypych, Berry, and Brigmon (2006), BTEX compounds from RPOs are implicated as chief environmental pollutants majorly because of enormous leakages and accidental spills obtainable from various petroleum storage tanks and distribution stations. These hydrocarbons are toxic and can bio-accumulate via the food chain and hence, they constitute a major public health and ecological concern.

## 2.4 Hazard Mitigation Measures at RPOs

According to the European Fuel Oxygenates Association (1999), the safety of people and protection of the environment should be the major concerns at RPOs because they have potentials for environmental harm. The necessity therefore for well designed, well-constructed and operation of such facilities should be of paramount importance. Noting that, petrol and other fuels are potentially hazardous at ambient temperature and they give off vapours which when mixed with air in a proportion and ignited, can burn with explosive force. In addition, all petroleum products are potential pollutants which if released, can cause injury to aquatic life, harmful effects to human health and environmental damage if incorrectly handled.

### 2.4.1 Air quality protection measures at RPOs

According to Institute of Petroleum (2002), when a road tanker off-loads petrol into the underground storage tanks at RPOs, the vapour in the tanks is displaced by the incoming petrol and a vapour space is created in the tanker compartment. Petrol vapour is also released into the atmosphere when customers refuel their vehicles (Nieminen, 2005).

The release of petrol vapours into the air can be prevented by means of vapour recovery system i.e. stage 1 and stage 2 systems. The vapour recovery stage 1 system is the process in which vapour is collected and returned to a tanker when the fuel storage tanks are being filled. With vapour control equipment, the vapour vents from the underground tanks are connected back to the delivery tanker. In this way, as petrol flows out of the vehicle, the vapour present in the underground tanks is routed back to the vehicle compartment. This process ensures that petrol vapour is not released to the air (Institute of Petroleum, 2002; Nieminen, 2005).

The vapour recovery stage 2 system is the process in which vapour is collected and returned to a storage tank during refuelling of the customer's vehicle. As vehicles are being filled on the forecourt, vapours are displaced by the fuel entering the vehicle tank and at the same time a similar vapour space is created in the Underground Storage Tank (UST). The process prevents vapour from entering the air. Again not only does this system benefit the environment but it also protects the health of customers and the station workers by removing hazardous fumes (Institute of Petroleum, 2002; Nieminen, 2005).

### 2.4.2 Soil and groundwater Quality Protection Measures at RPOs

Petrol and diesel leakage from underground tanks and pipes can contaminate soil and ground water, with a high risk that it will flow off-site. Even very small leaks from underground tanks and supply lines can, over time, cause extensive contamination of soil and ground water. In many cases this contamination can cost hundreds of thousands of dollars to clean up (Department of Environment and Climate Change, 2008).

Several methods are used in the prevention of soil and groundwater pollution at retail petrol outlets. According to the Department of Environment and Climate Change (2008), a well-designed and maintained forecourt will minimize the risk of stormwater and other pollution. The forecourt area of a service station is generally considered to be the fuel dispensing area. It is the high-risk area of the service station in terms of environmental management. All forecourt surface areas where contamination is possible e.g. pump islands and tank off-loading points, and any drainage apparatus which could receive contaminated water, should be contained by peripheral surface drainage channels or kerbs to divert all spills and runoff to an oil/water separator or constructed wetland. It is advantageous to use absorbent material to contain all surface spills. The drainage containment should be designed to provide an adequate number of channels and gullies so as to limit the surface travel of spilt hazardous products and prevent the spilt products reaching areas where surfaces are unprotected. Adequate containment of any contamination is required during routing to the oil/water separator or constructed wetland (Institute of Petroleum, 2002).

Areas susceptible to contamination, e.g. near pump islands or tanker off-loading points, should be impermeable to hydrocarbons and other liquids and should not allow seepage through or below the surface. Typically, concrete or similar highly impermeable materials such as sealed block paving will fulfil this requirement provided any associated jointing material is also impermeable and resistant to attack by motor fuel. Other areas may be surfaced with materials such as hot rolled asphalt, macadam, unsealed block paving, gravel, etc. (Institute of Petroleum, 2002).

The Institute of Petroleum (2002) also prescribes wetstock monitoring/leak detection in a bid to check leakages of petroleum product into the soil and subsequently the underground water system. It is explained that the source of a leak or spill is not necessarily a good indicator of the potential spill size. The accuracy of stock monitoring and reconciliation and other leak detection techniques are critical to detecting leaks at an early stage. It follows that a larger quantity of product may leak to soil and groundwater from a long running undetected pipework leak than from a catastrophic failure of an underground tank.

## 2.5 Variables Influencing the Operations of RPOs

According to Lawal (2005), the location of RPOs is determined by a number of factors such as geographical location, rate of traffic flow and commercial viability of the area. Business profitability of a petrol station is influenced by a number of factors such as property maintenance and management, size of the site, neighbourhood business potential, grade of street and topography, visibility, compatibility of traffic flow, transient business potential, ease of approach, and special features of location (Friedman, 1978). The principal variables as discussed by Sartorius, Eitzen and Hart (2007) are presented in subsections that follow.

### 2.5.1 Geographical location of the RPOs

The location of any retail business is an important factor affecting the performance and success of that business (Chan, Padmanabhan & Setharaman, 2005). In the fuel retailing business, location is very important because it determines the turnover (Uba, 2013). Location may be important in relation to fuel retail stations if there is a correlation between the location of fuel stations and the demand for fuel. According to Chan et al. (2005), the demand for petrol can be expressly linked to local geographical and demographic factors such as; population, median income, number of cars, proximity to airport, downtown and highways. Therefore, the location of a fuel retail station in a rural area, for example, should influence a lower demand for petrol than an urban area due to a lower population, lower median income, fewer cars, and poorer proximity to an airport. A long distance between fuel service stations, however, increases the volume of petrol and diesel sold. The proximity of a fuel retail station to major routes may also be an important driver of fuel demand (Netz & Taylor, 2002). In this regard, customers attempt to reduce travel time and distance when commuting or traveling longer distances and, therefore, select fuel retail stations which are in close proximity to these routes (Chan et al., 2005).

### 2.5.2 Size of the RPOs

The size of the petrol station and the number of pumping bays available is an indication of the convenience of filling at a particular station (Smalley, 1999). Customer convenience is an important variable that has a significant influence on sales volume. Although there a many variables influencing customer convenience, one important factor is the number of pumps that can refuel cars. This provides an indication of the number of cars that can refuel without negatively affecting the traffic flow on the site or delay the refuelling time. Customers do not like to wait to refuel and tend to avoid stations where back up problems exist (Smalley, 1999). The number of pumping bays may provide a good indicator of the number of cars that can refuel without causing back up problems and provide an indicator of the volume of petrol that may be sold. Chan et al., (2005) also confirmed that station characteristics such as the number of pumping bays affects the market share of a particular fuel station and, therefore, the fuel demanded by customers.

### 2.5.3 Other factors influencing the operations of RPOs

Customers often buy more than just fuel when visiting a fuel retail station (Netz & Taylor, 2002) and customer convenience appears to be driving the industry (Bainbridge, 2000). In this regard, fuel retail stations are increasingly differentiating themselves through the additional services that are offered and the presence of convenience stores, car wash facilities and specialty stores increase the market share of a fuel station (Chan et al., 2005). General cleanliness and appearance, as well as the quality and speed of service, are other factors that improve the customers' experience and increase repeat customers. These variables are even more important within a South African context where price is regulated and fuel stations need to differentiate themselves by a means other than fuel price in order to maintain and increase market share. In America, visionary companies are turning fuel retail stations into more convenient transitory stops or even final destinations by providing a variety of services through a 'village hub' type service station (Weirauch, 2000).

The reliance of fuel stations on additional sources of income is commonplace in de-regulated markets. In the USA, fuel is considered the volume driver, whilst convenience store sales drive the bulk of the profits (Reid, 2004). A survey performed by National Petroleum News in 2005, indicated that 66.5% of sales relate to motor fuel, but these sales only contributed 31.7% to the gross profit in the industry. Therefore 68.3% of the gross profit in the US fuel retail industry is derived from convenience store sales. The United Kingdom is no different, and Shell has admitted that they make no profit from UK fuel sales (Harwood, 2006). Profits from European fuel sales are also being eroded, causing companies to search for new revenue streams (Weirauch, 2000).

## 2.6 Environmental Laws, Regulations and Compliance Imperatives

Although open to a variety of definitions, regulations generally involves a sustained and focused control exercised by a public agency over activities that are valued by a community (Selznick, 1985). In this context, environmental regulation involves the establishment of laws and regulations governing the interaction of man with the natural environment, in order to restrict or minimize the negative impacts on safety, human health and the quality of the natural environment. Environmental regulations establish the details of a law, e.g., criteria for issuing permits and licenses, how and when to test for harmful substances, how the government will conduct itself in an enforcement action, etc. Regulations are most often developed by an implementing agency that is charged with compliance and enforcement under the law (Olokesusi, 1992; International Network for Environmental Compliance and Enforcement [INECE], 2009).

Regulations also refer to all state actions designed to influence industrial or social behaviour. This may be in the form of promulgation of a binding set of rules (e.g. legislation or administrative regulation, executive directives) to be applied by a body devoted to this purpose or other modes of influence - for instance, those based on the use of economic incentives (e.g. taxes or subsidies), contractual powers, deployment of resources, franchise; the supply of information or other techniques in order to promote and protect both public and private interests. The rationale for State's intervention through regulations is aimed at promoting sustainable development (Aina, 1991).

Environmental laws provide the vision, scope, and authority for environmental protection and restoration. In some countries, laws also encompass the types of general requirements that other countries describe in regulations. Over the past forty years, environmental law has been central to government efforts to implement a wide range of environmental programs designed to protect air, water, natural resources, wildlife and public health. Countries throughout the world use environmental laws to help address problems such as the discharge of pollutants into the environment, the protection of flora and fauna, the handling, storage and disposal of solid and hazardous wastes, the application of pesticides, preventing air contamination, and protecting the quality and availability of clean water (INECE, 2009).

The aim of environmental laws and regulations is to regulate environmental risks within an appropriate overall risk management framework. Yet the mere existence of laws is rarely sufficient to ensure their success, and much environmental damage has been caused by illegal use, storage, and disposal of dangerous or waste materials. Obviously, compliance is a problem, and environmental laws and regulations typically include some kind of enforcement provisions that are intended to ensure that the desired level of environmental protection is achieved (Fang, Hipel and Kilgour, 2012).

Prevention underlies modern environmental law and regulation, and various mechanisms are adopted to achieve the aim of the regulation. Effective monitoring and enforcement by a regulator is crucial to the effectiveness of any regulatory regime, and this is facilitated by the laws being sufficiently robust, comprehensive and consistent; provision for a range of sanctions, including but not limited to criminal sanctions, to help compel compliance; appropriate institutional capacity and necessary resources to undertake enforcement action; and a conducive wider socio-political and governance environment for effective enforcement (Ogbodo, 2009).

Environmental Compliance according to the INECE (2009) means conforming to environmental laws, regulations, standards and other requirements such as site permits to operate. Since 1972, the number of environmental laws and regulations, international conventions and international organizations has grown, however, environmental quality continues to decline in many fields; weak compliance has been pinpointed as a reason for this disconnect (Jo and Durwood, 2005). Though the deterioration of environmental quality is a major concern worldwide, full compliance to environmental regulations is rarely observed. Evidence from developed countries indicates that compliance rates rarely reach 100%. For example, Russel (1990) reported the following rates of compliance with air pollution limits by industrial sources in USA: percentage of sources in violation was 65%; percentage of time the sources were in violation was 11% and excess emissions as a percentage of standards were 10%. According to Heyes (2000), the United Kingdom published compliance rates with many key water quality standards that were significantly below 100%, sometimes as low as 50%. The true compliance rates were likely to be even lower.

## 2.7 Provisions for Environmental Management at RPOs in the EGASPIN

In Nigeria, the guidelines for the location, construction and operation of RPOs are provided under the Petroleum Regulation Act of 1967 (Mshelia, John and Emmanuel, 2015). The Environmental Guidelines and Standards for the Petroleum Industry in Nigeria (EGASPIN) document published by the Department of Petroleum Resources (DPR) in pursuant to the Petroleum Regulation Act of 1967 stipulates that operators of RPOs shall institute planned and integrated environmental management practices, aimed at ensuring that unforeseen, identified and unidentified environmental issues are contained and brought to an acceptable minimum (DPR, 2002). The relevant provisions for environmental management at the RPOs are discussed in the subsections below.

### 2.7.1 Provisions guiding waste management at RPOs

In Nigeria, waste management at RPOs is controlled principally under the Petroleum regulation Act of 1967. Due to the harmful nature of wastes produced, waste management at RPOs is of great significance and it is provided for in the EGASPIN of 2002. PART VII, Section B, Subsection 4.3.1.5 of the EGASPIN stipulates that spent lubricants shall be differentially segregated from the other oily effluents and channelled into a source recovery system where feasible or into a receptacle approved by the Director of Petroleum Resources. The treatment and disposal of the spent lubricants shall be approved by the Director of Petroleum Resources. These treatment and disposal methods shall include but not be limited to recycling, incineration etc.

Also, PART VII, Section B, Subsection 4.3.1.6 of the EGASPIN (2002) states that refuse containers shall be provided for the recovery of oil rags, empty cans, etc. and disposed in accordance with public health and sanitation procedures satisfactory to the Director of Petroleum Resources. According to Mshelia et al. (2015), the wastes generated at RPOs in Maiduguri and Jere in Borno State comprised of engine oil drained from generators and vehicles during servicing, empty containers of various oil products, empty container of injectors, oil filter, leaking oil and gallons and other forms of waste. The management of the wastes generated onsite the RPOs in this study were disposed in public drainages, burnt, buried or thrown in the bush showing non-compliance to the stipulated provisions for waste management at RPOs.

### 2.7.2 Provisions against effluent discharge from RPOs

In Nigeria, the discharge of effluent into water courses by RPOs is also controlled principally by Petroleum regulation Act of 1967. Provisions are made to this effect in PART VII, Section B, Subsection 4.3.1 of the EGASPIN of 2002, which stipulates that it is illegal to discharge oily waste waters, solid waste and spent lubricants into public sewers, to this effect all existing discharge point sources of oily waste waters, solid waste and spent lubricants must be registered with the director of petroleum resources and a permit for discharge issued. Similarly, PART VII, Section B, and Subsection 4.3.1.2 of the EGASPIN (2002) stipulate that good drainage system shall be provided in the forecourt. The effluents should not be discharged to the highway of public sewers. These effluents shall pass through an efficiently operated oil/water separator. Abdullahi et al. (2012) in a study of the role of EIA in the environmental performance of RPOs discovered that all RPOs in Kaduna Metropolis were not in compliance to the provision against the discharge of effluents into public drains as all the RPOs utilised public drains for disposal of effluents generated on their premises.

2.7.3 Provisions guiding water and land pollution control at RPOs

Provisions are made to control land and groundwater pollution in PART VII, Section B, and Subsection 4.2.1 (vii) of the EGASPIN which stipulates that the whole forecourt of a retail outlet should be concreted. This is in a bid to prevent spilt oil from reaching the soil and subsequently getting to the groundwater. Similarly, PART VII, Section B, Subsection 4.2.1 (xii) of the EGASPIN (2002) also states that monitoring boreholes should be installed at suitable locations for early warning/detection of underground storage tank leakages. This is in line with PART VII, Section B, Subsection 4.6.1 of the EGASPIN (2002) which states that all retail outlets shall have petroleum products/chemical spill prevention and counter measures plan as approved by the director of petroleum resources. Similarly, PART VII, Section B, and Subsection 4.2.1.1 states that periodic checks for water/sludges in tanks are mandatory and records must be kept by tank owners.

Olukoya, Ana and Oloruntoba (2016) assessing soil contamination with monocyclic aromatic hydrocarbons and heavy metals in residential areas close to RPOs in Ibadan indicated that the concentrations of benzene, toluene, and ethylbenzene in the topsoil of the RPOs in Ibadan were about 600 times higher than the guideline limit. This is an indication that the soil is contaminated and that there is the possibility of a high impact level on human beings. This is particularly a pointer of non-compliance of the RPOs to Provisions Guiding Water and Land Pollution Control.

### 2.7.4 Provision for environmental compliance audits

The EGASPIN stipulates that operators of RPOs shall conduct environmental compliance audits to facilitate the management and control of environmental practices and assessing compliance with the management system and regulatory requirements. The frequency as a minimum of conducting these audits should be quarterly (DPR, 2002).

Environmental compliance audits are undertaken to determine the degree to which a facility is compliant to relevant

- Environmental legislation
- Environmental code of practice and other guideline document
- Environmental permit and other license condition
- Standards (e.g. ISO 14001)
- Policies and procedures

An audit typically involves interviews with site personnel, inspection of facilities and a review of documentation and monitoring data (FMG Engineering, 2016).

Abdullahi et al. (2012) observed that less than 10% of the RPOs in Kaduna Metropolis carried out environmental compliance audits. According to Yunusa, Nabegu and Yusuf (2016), companies forcing to be in compliance with environmental laws and regulations always think of the identification of violations during the implementation phase of self or third-party audits can lead to real liabilities to the industry.

## 2.8 Environmental Compliance of RPOs in Nigeria

According to Mintzberg (1991), the general challenges that face RPOs environmental compliance is with issues such as strenuous financial resources, lack of technological support (for case of independent investors), lack of effective industry regulatory authorities and poor infrastructure. According to Akinlo (2012), there has been increased private sector participation in some activities within the downstream sector in Nigeria with over 24,000 Independent Marketers controlling the retail fuel market, current data shows that independent marketers control about 83.3% of the retail petrol business in Lokoja, Kogi state (DPR, 2016). The reasons for such unprecedented increase are not farfetched: first, the growing number of people in the country and the attendant increase in the purchase of vehicles. Secondly, the attractive price of petrol both at control price and black market prices have made more people to go into the petrol retailing business (Uchegbu, 2002). However, generally, most of these local retail petrol companies are small, fragmented and unable to adhere to national environmental best practices standards (Ambituuni et al., 2014).

In line with various statutory provisions in Nigeria, DPR has the responsibility for enforcing safety and environmental regulations and ensuring that downstream operations conform to national and international best industry practices and standards (Agha, Irrechukwu and Ziga, 2004). Against this backdrop, DPR developed the EGASPIN covering all aspects of oil and gas operations since 1981, with the current one being in 2002.

According to Agha et al., (2004), the Guidelines were developed to enhance environmental control of the petroleum industry taking into consideration existing local conditions, international practice, available technology, and monitoring programmes. However, even with the inclusion of monitoring programmes, implementation and compliance has proven to be essentially ineffectual considering evidence of the magnitude of downstream safety and the state of environmental issues in the country (Fadeyibia et al., 2011).

Several studies on the compliance of retail petrol stations to regulations have been carried out in Nigeria. Most of the studies focused on compliance to town planning standards and relevant environmental, health and safety practices at RPOs in the country, in relation to the town planning standards, Afolabi et al., (2011) observed that only 11% of RPOs in Ile-Ife, Osun State have a setback of greater than 30m, and 52% were at a distance less than 30m from residential areas. This is also consistent with the findings of Blamah et al., (2012) where the authors stated that 100% of the RPOs along Abuja-Keffi road were found to be less than 30m from adjourning residential areas. Mshelia et al., (2015) also reported 49.26% compliance among retail petrol stations to the 30m setback between retail petrol stations and residential area in Maiduguri and Jere, Borno state.

Similarly, Mshelia et al., (2015) observed in Maiduguri and Jere that there was 26% compliance to the setback requirement among RPOs in the study area. In a similar study carried out by Mohammed, Musa and Jeb (2014), using GIS techniques to assess the location of stations against town planning standards, the authors discovered that 24% of RPOs in Kano Metropolis did not meet the setback requirement. Also Samuel, Ogoro and Amanoritsewo (2015) in their study in Obio Akpor Local Government Area in Rivers state observed that out of the 153 RPOs used in their study, only 23% met the same 400m standard between two retail petrol stations. Similarly, to the 15m setback from the road standard set by DPR, it was discovered that only a 33% of the RPOs in the area conformed to this standard while a total of 67 did not conform of the total number of 153 retail petrol stations studied.

It was observed that RPOs owned by major marketers had a higher percentage of trained staff when compared to independent marketers, the major marketers also complied more with regulations guiding the location of the RPOs (Afolabi et al., 2011). A larger percentage representing 62% of the defaulting RPOs to the requirement of the 15m minimum distance from the road were discovered among the independent marketers in Kano Metropolis. In the opinion of Afolabi et al., (2011) independent marketers are more concerned with making profits than complying with regulations.

Vivan, Leo and Ekpo (2013) in an impact assessment of the operation of RPOs on the socio-economic environment of Karu, Nassarawa State Nigeria observed that the operation of RPOs generally have both positive and negative impacts on the socio-economic environment where it is located. Identified positive impacts include the provision of job opportunities to residents of the area, scenic beauty as a result of the architectural design of some of the RPOs and provision of other services to the community such as shopping centres and restaurants. Identified negative impacts include environmental pollution through accidental spills and discharges, noise pollution from cars, tankers and generating sets and traffic congestions. Similarly the problems associated with the operation of RPOs as identified by Ogundahunsi (2014) include noise pollution, air pollution, and risk of fire outbreak, traffic accidents and traffic disturbances. Mshelia et al., (2015) indicated that residents living nearby RPOs have in one time or the other suffer various health effects as a result of living in close proximities to the RPOs. The identified health impacts of the RPOs particularly related majorly to respiratory problems and general ailments.

## 2.9 Factors Influencing Environmental Compliance

The main factors affecting compliance include economic, political, technological, personal, and social factors. However, the most common explanation for non-compliance is insufficient monitoring and enforcement of law (Mitchell, 1996; Sparrow, 2000; INECE, 2009). According to the Bank of Industry (BOI) (2017) indices, RPOs in Nigeria can be classified under Small and Medium Scale Enterprises (SMEs). Also, RPOs are classified as service sector SMEs according to the Organisation for Economic Co-operation and Development (OECD) (2007), and they have been identified to pose risk of significant routine pollution or accidental releases. The main factors militating against the compliance to environmental regualtions are further discussed below and are particularly linked with the operation of RPOs as SMEs.

2.9.1 Deterrence

In any regulatory situation some people will comply voluntarily, some will not comply, and some will comply only if they see that others receive a sanction for non-compliance. This phenomenon that people will change their behaviour to avoid a sanction is called deterrence. Enforcement deters detected violators from violating again, and it deters other potential violators by sending a message that they too may experience adverse consequences for non-compliance. This multiplier or leverage effect makes enforcement a powerful tool for achieving widespread compliance. Studies of and experience with enforcement show that four factors are critical to deterrence:

1. There is a good chance violations will be detected.
2. The response to violations will be swift and predictable.
3. The response will include an appropriate sanction.
4. Those subject to requirements perceive that the first three factors are present.

These factors are interrelated. For example, to create an appropriate level of deterrence, a more severe sanction may be needed for violations that are unlikely to be detected. Conversely, a less severe sanction may be sufficient if violations are likely to be detected and response can therefore be relatively swift (Sparrow, 2000). Cunningham, Thornton and Kagan (2005) are of the opinion that deterrence either specific or general is most often of greater concern to SMEs than it is to large enterprises.

2.9.2 Economics

Change may also be motivated by economic considerations. The regulated community may be more likely to comply in cases where enforcement officials can demonstrate that compliance will save money (e.g., achieving compliance by recycling valuable materials instead of discharging them to the environment may yield a net profit), or when the government provides some form of subsidy for compliance. Conversely, the higher the cost of compliance, the greater may be the resistance to compliance in the regulated community. Some facility managers that may want to comply might not do so if they feel that the cost of compliance would be an economic burden to their operations. For example, the Netherlands had experienced a relatively high degree of compliance for processing used oil from inland waterway vessels when the processing was offered free; however, compliance decreased as soon as the government levied a charge for this service. To remove economic incentives to violate the law, the monetary penalty for a violation would, ideally, at least equal the amount a facility would save by not complying. This deters deliberate economic decisions not to comply, and it helps treat compliers and non-compliers equally (INECE, 2009).

SMEs have fewer financial resources to invest in management and technological solutions that could make their operations more environmentally sustainable. The shortages of resources, together with the lack of technical expertise and skills, clearly contribute to the "sceptical" attitude that SMEs show towards the potential benefits, cost savings and customer rewards associated with environmental improvements. A negative company culture towards the environment may even persist despite positive attitudes among staff. For example, empirical investigations in Austria conducted by the Austrian Institute for Small Business Research showed that compliance with environmental requirements is perceived by a large percentage of SMEs primarily as a cost without any benefits. Indeed, costs of compliance might be high and “win-win” solutions are not always guaranteed. Sometimes this is further aggravated by the focus of SMEs on short-term economic gains (OECD, 2007).

### 2.9.3 Institutional credibility

Each country has its own social norms concerning compliance. These norms derive largely from the credibility of the laws and the institutions responsible for implementing those laws. For example, the social norm may be non-compliance in countries where laws have historically not been enforced, either because the law is unenforceable or because the institutions responsible for enforcement have lacked the political power or resources to enforce. There may also be a resistance to enforcement in countries where recent regimes have imposed laws against the will of the citizens. It may take longer for enforcement programs to build credibility in these countries (INECE, 2009).

Strategies to build credibility will vary. In some cultures, aggressive enforcement will provide credibility. In others, it may be important to have an initial period of promotion and encouragement to create a spirit of cooperation, followed by a well-publicized shift to more aggressive enforcement to signal that there will be consequences for non-compliance. In other cultures, a mixed approach at the outset may be most successful (INECE, 2009).

The government's will to enforce environmental laws - that is, to affirmatively promote voluntary compliance and identify and impose legal consequences on those who do not comply voluntarily - indicates and influences social values. Not enforcing a law tends to express a value that compliance is not important. A goal on the part of the government to bring a majority of the regulated community into compliance sends a message that compliance is important and helps build a social norm of compliance (INECE, 2009).

### 2.9.4 Social factors

Personal and social relationships also influence behaviour. Moral and social values may inspire or inhibit compliance. For example, in some situations, facilities may voluntarily comply with requirements out of a genuine desire to improve environmental quality. They may also comply out of a desire to be a “good citizen” and maintain the good will of their local communities or their clients. Facility managers may also fear a loss of prestige that can result if information about noncompliance is made public. Conversely, compliance will likely be low in countries where there has been little or no social disapproval associated with breaking laws and/or damaging the environment (INECE, 2009).

Successful personal relationships between enforcement program personnel and managers of regulated facilities may also provide an incentive to comply. On the other hand, a desire to avoid confrontation may prevent program personnel from pursuing the full range of enforcement actions they may need to take to ensure compliance. Also, an enforcement official's objectivity may be compromised if he or she becomes too familiar with the facility's personnel and operations. Oversight visits by an independent enforcement official can help monitor for and prevent this potential problem. The relationship factor can be incorporated into a compliance strategy through such means as providing technical support to regulated groups and enhancing the interpersonal skills of compliance personnel. Social respect for environmental requirements can be improved by finding industry leaders who agree to set a well-publicized example of compliance, and by firm and visible enforcement of environmental requirements (particularly if the initial focus is to correct noncompliance that is posing significant and clear risks to the environment and/or public health) (INECE, 2009). On the other hand as stressed by the OECD (2007) SMEs are however much less preoccupied about their image as a good environmental citizen than large enterprises. In the opinion of Gunningham, Thornton and Kagan (2005), in contrast to SMEs, larger corporations believe that social pressure, reputational concerns and avoiding bad publicity were the primary drivers of their environmental behaviour. Regulation was important in this regard because of the stigma associated with being sanctioned.

### 2.9.5 Psychological factors

Several psychological factors, common to human nature, may affect compliance rates. One of these is fear of change - the belief that familiar ways of operating are safe and new ways are risky. Closely related to this is inertia. Many people tend to naturally resist change because of the perceived effort it will require to enact the change. Both promotional efforts to publicize the benefits of compliance and the perception and reality of consequence for noncompliance play an important role in overcoming inertia (INECE, 2009).

Conformity is also a significant social driver in compliance among SMEs, when decisions are influenced by perceptions of what others are thinking and doing. Peer pressure and an individual's own psychology are at work here, and publicity is also influential. How and to whom information is distributed, the type of that information, and its accuracy, have degrees of influence on decisions to adopt new behaviours (Rogers, 2003).

### 2.9.6 Knowledge and technical feasibility

Besides being motivated to comply, regulated groups must have the ability to comply. This means they must know they are subject to requirements, they must understand what steps to take to create compliance, they must have access to the necessary technology to prevent, monitor, control, or clean up pollution, and they must know how to operate it correctly. A lack of knowledge or technology can be a significant barrier to compliance. This barrier can be removed by providing education, outreach, and technical assistance (INECE, 2009).

Lack of SME environmental management technical skills is well documented in the literature but may arise from the inability of SME operators to adequately identify environmental hazards and risks leading to a lowered perception of need for such technical skills (Vives, 2006). SMEs are unlikely to address environmental management issues that they are unaware they have. First of all, SMEs are often ignorant about the legislation that governs their activities or do not understand what is required. The proliferation of laws or multiple amendments to improve them can create confusion and make it difficult to understand what compliance involves. Inaccessible and incomprehensible regulation particularly affects small business compliance rates. Many studies show that small businesses cannot keep up with the volume of regulations that is produced by many government authorities (OECD, 2007).

A key factor affecting the compliance behaviour of SMEs is their limited competence level and capacity to adopt approaches of environmentally sustainable industrial development. Many SMEs do not have information about modern managerial and technical solutions that could help them improve environmental (and, sometimes, economic) performance. They suffer from an overall lack of managerial and technical skills and human resources to perform certain tasks, especially if these tasks are believed to be outside of the SMEs core business (OECD, 2007).

# CHAPTER THREE

# STUDY AREA AND METHODOLOGY

## 3.1 Description of the Study Area

### 3.1.1 Location and size

Lokoja is located between Latitudes 7° 45' N - 7° 51' N and Longitudes 6° 41'E - 6° 45'E of the Greenwich Meridian. It is the administrative headquarters (Capital) of Kogi State situated at the confluence of the Niger and Benue Rivers as shown in Figure 3.1. It is approximately 162 kilometres from Abuja, the Federal Capital Territory of Nigeria and covers an area of about 63.82 square kilometres (Olorunfemi, Eke, Chukwuemeka and Eno, 2014).

### 3.1.2 Population

The creation of Kogi state on 27th August, 1991 with Lokoja as the capital no doubt brought an influx of people to the capital city and according to 1991 census, Lokoja had a population of about 77,516 people (Olorunfemi et al., 2014), which increased to 196,643 in 2006 (National Population Commission, 2006). Based on a growth rate of 3.03% per annum, the population of the town was projected to reach 246, 101 in 2014 (Ukoje, Makanjuola and Oluleye, 2014). Also the location of the Obajana Cement Company close to the area has also led to the increase in population. The increase in human population has brought rapid development and a resultant increase in business activities including RPO business. Today, Lokoja is a trade centre for fishing and agricultural products following its location at the confluence of the Niger and Benue Rivers. In addition, transport services, banking, tourism, light manufacturing and leisure services thrive well within the city (Olorunfemi et al., 2014).

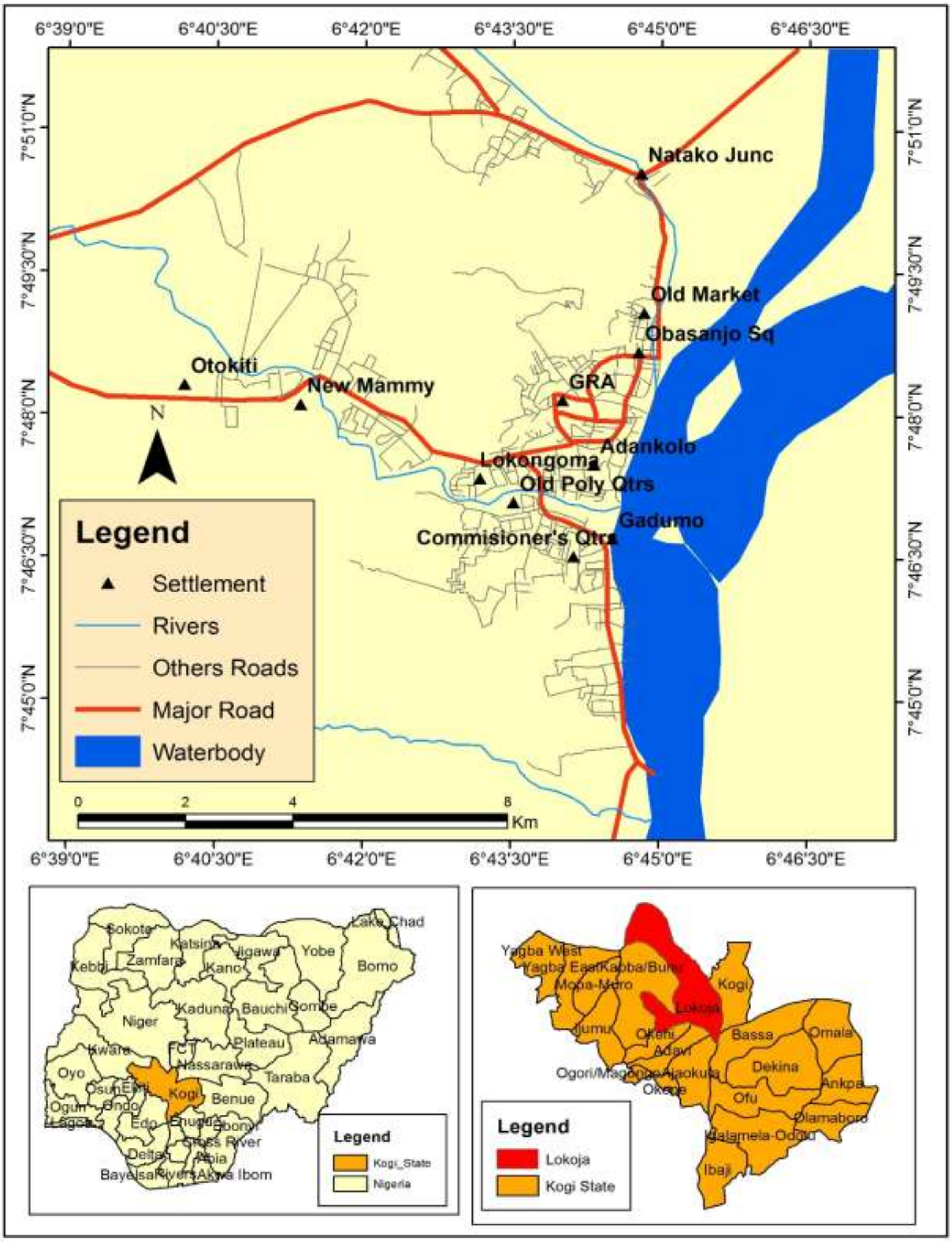


**Figure 3.1: Lokoja Metropolis**
Source: Google Earth Imagery, 2015

### 3.1.3 Settlement and urbanization

Modern Lokoja was founded in 1857, but its fame surged when it became the capital of the British Northern Protectorate. It was formerly the capital of Kabba Province, then, a Divisional and Local Government headquarter in Kwara State until 27th August, 1991 when it became the state capital of Kogi State. The administrative functions and strategic location have somehow encouraged immigration and accelerated the urbanisation process and the geographical expansion of the town (Ukoje, 2016).

The actual urban area of Lokoja is defined by "The land use (designation of Lokoja Metropolitan Area) order of 2nd October, 1991". This makes all parcels of land within 16 km radius of a circle around the Lokoja General Post Office within the geographical coordinates of approximately 07°48'05"N, 06°44'39"E to be part of the planning area of Lokoja Metropolitan Area. The planning area therefore encompasses portions of five Local Government Areas (LGA(s)) which include Lokoja LGA (Lokoja township, Kogi LGA (North East), Adavi LGA (South West), Ajaokuta LGA (South) and Bassa LGA (East). These areas include Lokoja as well as several small size localities within the 16 km radius. Despite this declaration, planning has been concentrated on the Lokoja Township alone to the neglect of other areas. However, there is rapid development going on at the peri-urban and other parts of the Metropolis where land is relatively cheaper than the Township. At the same time there is a movement of tenants to the periphery in search of cheaper accommodation. Thus, existing structures in the settlements are being expanded and transformed resulting in increasing urbanisation at the periphery (Ukoje, 2016).

Lokoja as presently made up of the wards that constitute the original Lokoja (Karaworo, Kpata, Cantonment, Kabawa and New Layout). It is also now made up of some settlements that were originally separate and independent from it. Some of these include Adankolo, Lokongoma, Felele, Otokiti, Ganaja (Alaci and Chup, 2015).

### 3.1.4 Climate

The climate of Lokoja is characterized by wet and dry Aw type of climate as classified by Koppen. It has annual rainfall of 1016 mm to 1524 mm, 90% of which falls between April and October with mean annual temperature of 27.7°C (Olorunfemi et al., 2014). The dry harmattan winds are felt mostly between December to February owing to the influence of Tropical Continental Air (cT) while the Tropical Maritime Air (mT) brings rainfall over the city during the rainy season. The dry season is between November and March but may be punctuated by sporadic showers during this season. Nevertheless, the area is subjected to cool dry North Easterly (NE) wind originating from the Sahara desert. From April the season changes bringing moist south-westerly wind which originates from the Atlantic Ocean and is characterized by high relative humidity. Wind speed ranges between 3.0 and 4.6 Knots in the months of June/July and 1.5 to 3.7 Knots for December/January. The prevailing direction of wind for the months of June/July and December/January are South to South Westerly and North Easterly respectively (Olorunfemi et al., 2014).

### 3.1.5 Geology

Lokoja is dominantly underlain by the Precambrian Basement Complex. However, part of the area is underlain by Cretaceous Sediments which overlie the Basement Complex. Migmatite covers about half of the area outcropping at the southwest, west, northwest and central parts of the area. The South and the southeast parts of the area are underlain by undifferentiated older granite, mainly porphyroblastic granite, granite gneiss with porphyroblastic gneiss and fine grained biotite granite. The northern part of the area is made of ridges (Mount Patti) of Cretaceous sediments of the Southern Bida Basin (Lokoja Sub- Basin) (Omali, 2014).

The ridges are dominantly composed of feldspathic sandstone and siltstone which are separated by the biotite hornblende gneiss. Thick alluvial deposit occurs around the Rivers Niger and Benue drainage system (Omali, 2014). Lokoja, falls within both the crystalline and sedimentary hydro geological provinces of Nigeria and occupies part of the middle Niger Basin whose genesis seems closely connected with the crustal movements of the santonian orogeny of southern Nigeria and which later became filled with past orogenic sediments only to be altered by tertiary uplifts.

### 3.1.6 Relief and drainage

The relief of Lokoja consists of unique physiographic regions mainly made up of a number of intermittent valleys sandwiched to the west and east by the Patti ridge and River Niger respectively. The city lies on the western bank of the River Niger at an altitude of 45 - 450m above sea level. The northern part of the town is dominated by a high plateau, the Patti Ridge, which reaches an altitude of 450m above mean sea level (Alabi and Enete 2012). The presence of the Patti ridge and River Niger had streamlined the settlement to a linear pattern and equally have modifying effect on the local climate as River Niger and Patti ridge absorb and release heat alternately during the day and night (Alabi, 2009). Lokoja is drained by River Niger and other two small rivers; River Meme and Ero and thus exhibit dendritic pattern of drainage. At their upper courses, the tributary valleys are incised and the streams in Lokoja dry up during the dry season. Even the perennial streams, have no continuous flow during the dry season but divide up into ponds of varying length.

## 3.2 Methodology

### 3.2.1 Reconnaissance survey

A preliminary survey was carried out by the researcher to gain acquaintance and requisite knowledge to effectively plan out the field exercise for this research. Visitations were also made to the Department of Petroleum Resources (DPR) field office to garner background information on the study area and ascertain the total number of RPOs in the study area. At the time of visit to the field office, though the total number of retail petrol stations was provided, the functional status of the retail petrol stations could not be ascertained so the researcher made it a point to visit all the stations to ascertain the number of functional and non-functional RPOs from the list provided. Also the number of workers was obtained from randomly selected stations on each route in the metropolis. It was observed that most of the stations had between 4 to 8 staff employed as fuel pump attendants and cleaners. This was carried out to enable the researcher effectively determine the number of questionnaire to be administered at each RPO during the course of the field exercise.

### 3.2.2 Types of data used

The types of data used in the course of this research include;

i. Data on the names and location of all the RPOs in the study area;

ii. Data on the operational characteristics of the RPOs in the study area;

iii. Data on environmental management practices/procedures of the RPOs;

iv. Data on the factors militating against the environmental compliance of RPOs in the study area

v. Guidelines for the operation of RPOs in Nigeria.

### 3.2.3 The sources of data

For the purpose of this research, data was obtained from two sources namely; primary and secondary.

*3.2.3.1 Primary sources of data*

Primary data was collected from the field using two sets of questionnaires and an observational checklist. The observational checklist was used by the researcher to collect data on the operational characteristics and the environmental compliance of RPOs in the study area. The first set of questionnaire was administered to the managers at individual RPOs to elicit information on the general factors that militate against environmental compliance and some of their environmental management practices that could not be captured in the observational checklist. The managers were chosen for this purpose because they are in charge of the general management of the RPOs and in a better position to provide adequate information on their general compliance. Also, the second set was administered to the workers at the RPOs also to identify the factors that militate against environmental compliance of RPOs in the study area. These categories of respondents were chosen due to the fact that they are engaged in the daily activity of running the RPOs and are in the best position to provide reliable information on the major factors that influence the environmental compliance of the RPOs in the study area. The validity of the Likert scale items on the questionnaire was tested using the Cronbach's alpha on SPSS and an alpha value of 0.833 was obtained from the analysis. Item total statistics of the Likert scale are shown and defined in Appendix IV.

*3.2.3.2 Secondary sources of data*

The secondary sources of data for this research include the names and location of RPOs in Lokoja obtained from DPR field office. Journals, internet articles, books, thesis and dissertations were used to review relevant literatures for this research. The Department of Petroleum Resources (2002) Environmental Guidelines and Standards for the Petroleum Industry in Nigeria was used for this research. Other relevant international guidelines like the Institute of Petroleum (2012) Guidelines for Soil, Groundwater and Surface Water Protection and Vapour Emission Control at Retail Petrol Stations, also served as reference points in the course of this research.

### 3.3 Sample Size and Sampling Technique

According to the DPR (2016), there are 72 RPOs within Lokoja Metropolis. From the reconnaissance survey, it was gathered that 60 out of the 72 were functional. This study focused primarily on all the functional RPOs within the study area. Thus a total of the 60 was used in this study for the purpose of drawing reliable inference.

The managers/supervisors and workers at each RPO made up the sampling frame of this study and thus were targeted for questionnaire administration. It was discovered from the preliminary survey that RPOs in the study area on the average employ between 4 to 8 workers. Making use of an estimated population of eight (8) workers at each of the sixty (60) functional retail stations in the study area, the total population of RPOs workers is put at four hundred and eighty (480) in the study area.

Using the Krejcie and Morgan (1970) table for determining sample size, a sample size of two hundred and fourteen (214) is prescribed for a population size of four hundred and eighty (480). The two hundred and Fourteen (214) questionnaires were administered randomly to workers at the RPOs in the study area. Sixty (60) copies of questionnaire were also administered to the managers/supervisors at each of the RPOs, putting the total number of questionnaires administered in the course of this research at two hundred and seventy four (274).

A total of 265 questionnaires were retrieved out of the total 274 administered to both RPO managers/supervisors. A breakdown of the total number retrieved from managers/supervisors and workers are shown in Table 3.1.

**Table 3.1: Questionnaires Administered and Retrieved**

| Sample group | Questionnaire administered | Questionnaire retrieved |
|---|---|---|
| RPO Managers | 60 | 60 |
| RPO workers | 214 | 205 |
| **Total** | 274 | 265 |

Source: Field Survey, 2016

### 3.4 Methods of Data Analysis

The data collected was summarized and presented in tables, charts, percentages etc. Specific methods to be used are indicated in the objectives below.

**Objective 1: Identify and Characterize RPOs in the Study Area**

This objective was achieved through the use of an observational checklist to capture the operational characteristics of the retail petrol stations in the study area. Data was analysed and presented with the use of descriptive statistics such as tables and charts.

**Objective 2: Assess the Environmental Compliance of the RPOs to the guidelines for their operations in the Study Area**

This objective was achieved through the use of an observational checklist and questionnaire administered to the managers at the RPOs. The key areas covered in the checklist include operational characteristics of the RPOs and the provisions for effective storm water, soil and groundwater, waste water, air quality and waste management at the individual outlets. Data was analysed and presented in the form of tables and charts.

**Objective 3: Identify the Factors Militating Against Environmental Compliance by RPOs in the Study Area**

In order to achieve the above stated objective, questionnaires were administered to managers and workers at the RPOs to identify the factors that influence the compliance of petrol stations to standards in the study area under the areas of awareness of regulations, knowledge feasibility, capital adequacy, technical feasibility and monitoring and enforcement practices as adapted from Kanyi (2015). A cross tabulation analysis was performed SPSS® to test the hypotheses formulated for this study and inferences were drawn from the Chi-Square and Cramer's V values obtained. As a general rule of the Chi-Square independence test, $H_0$ is rejected if $p$ is smaller than 5% (or 0.05 level of significance) using a degree of freedom, $df = k - 1$. The Cramer's V indicates the strength of the relationship and values closer to 1 are judged to reflect a strong relationship.

# CHAPTER FOUR

# RESULTS AND DISCUSSION

## 4.1 Introduction

This chapter presents the analysis of the data collected during the field survey. The results of the data analysed are discussed and presented in accordance to the objectives of this study. Interpretations are given and inferences drawn from the analyses.

## 4.2 Socio-Economic Characteristics of the Respondents

### 4.2.1 Educational level of the respondents

The educational level of the respondents principally made up of the managers and workers at the RPOs is presented in Table 4.1.

**Table 4.1: Educational Level of the Respondents**

| Educational Qualification | Frequency | Percentage (%) |
|---|---|---|
| **RPO Managers** | | |
| Primary education | 0 | 0 |
| Secondary education | 19 | 31.7 |
| Tertiary education | 41 | 68.3 |
| **RPO Workers** | | |
| Primary Education | 30 | 14.6 |
| Secondary education | 135 | 65.9 |
| Tertiary education | 40 | 19.5 |
| **Total** | **265** | |

Source: Author's fieldwork (2016)

A total of 205 questionnaires were retrieved from the RPO workers and 60 from the RPO managers. As presented in Table 4.1, it is shown that 41 out of the total managers of the RPOs surveyed had tertiary education represented by a percentage of 68.3% of the total population. Also, 19 of the RPO managers representing 31.7% had secondary education. The higher number of RPO managers maybe be as a result of the requirements for higher educational qualification for such managerial positions particularly as obtainable in other sectors in Nigeria.

With respect to the educational qualification attained by workers at RPOs as presented in Table 4.1, the number of RPO workers with secondary education ranks highest with 65.9% of the total surveyed population having secondary education. This is consistent with the findings of Monney, Dramani, Aruna, Tenkorang and Osei-Poku (2015) where 77% of workers at RPOs in Kumasi, Ghana had attained only senior high school education. This may be attributed to the relatively lower level of expertise required for fuel dispensing, housekeeping and other menial activities carried out at the RPOs.

### 4.2.2 Number of years the respondents have worked at the RPOs

This research sought to find out the number of years the respondents have worked at the RPOs. Table 4.2 presents the data on the number of years the respondents have worked at the RPOs and it is shown that 43.3% of the RPO managers have worked for a period between 6-10 years. Also, a total of 10 managers have worked for a period less than one year with 15 of the managers working at the RPOs for a period of between 1-5 years.

**Table 4.2: Number of Years the Respondents has worked at the RPOs**

| **Duration** | **Frequency** | **Percentage (%)** |
|---|---|---|
| **RPO managers** | | |
| Less than 1 year | 10 | 16.7 |
| 1-5 years | 15 | 25.0 |
| 6-10 years | 26 | 43.3 |
| Over 10 years | 9 | 15.0 |
| **RPO workers** | | |
| Less than 1 year | 25 | 12.2 |
| 1-5 years | 113 | 55.1 |
| 6-10 years | 61 | 29.8 |
| Over 10 years | 6 | 2.9 |
| **Total** | **265** | |

Source: Author’s fieldwork (2016)

According to Kanyi (2014), long work duration could be an indication that the RPO managers have worked for a period of time sufficient to acquire knowledge on issues and factors affecting environmental compliance as well as the potential risks and consequences of non-compliance. By this assumption, the managers at the RPOs based on their considerable work duration would be expected to have requisite experience required for achieving environmental compliance in the study area.

Also as presented in Table 4.2, a total of 113 workers at the RPOs representing 55.1% of the total 205 surveyed population have worked for a period between 1-5 years. This is also consistent with the findings of Kanyi (2014) where 53% of the respondents surveyed at RPOs in Thika-East Sub County have worked for the same duration. This may be an indication that a large percentage of workers at the RPOs do not stay long on the job, thus the management of the RPOs may not find it lucrative to invest in the education on this category of its employees. The resultant effect will be a low level of expertise required to achieve environmental compliance among this category of RPO employees.

### 4.2.3 Awareness to regulations guiding the operations of RPOs

Data on the awareness of the respondents to environmental regulations guiding the operations of RPOs was also collected. As presented in Table 4.3, out of the total number of managers surveyed, only 11 were aware of the environmental regulations guiding the operations of RPOs. 49 of the 60 surveyed representing 81.7% of the total surveyed population were not aware of the relevant environmental regulations guiding the operation of RPOs under their supervision. This could result in low compliance rates among RPOs in the study area. According to INECE (2009), requisite knowledge of environmental regulations and their implementation guidelines is vital in facilities drive to achieve environmental compliance.

**Table 4.3: Awareness to Regulations Guiding the Operation of the RPOs**

| Factor | Frequency | Percentage (%) |
|---|---|---|
| **RPO managers** | | |
| Aware | 11 | 18.3 |
| Not aware | 49 | 81.7 |
| **RPO workers** | | |
| Aware | 37 | 18.0 |
| Not aware | 168 | 82.0 |
| **Total** | **265** | |

Source: Author's fieldwork (2016)

Also as presented in Table 4.3, out of the total 205 station workers surveyed, 168 representing a total of 82.0% were not aware of the environmental regulations guiding the operation of RPOs while 37 representing a total of 18.0% claim to be aware of the regulations guiding their operations in the study area. This contradicts the findings of Salihu et al., (2006) where 72.5% of the respondents surveyed confirmed that they were aware of the various relevant environmental regulations applicable to the operation of their facilities in Minna metropolis, Nigeria.

### 4.3 Operational Characteristics of the RPOs

In line with objective one of this research, data on the operational characteristics of the RPOs in the study area was collected and the findings are presented in the subsections below.

4.3.1 Ownership categories of RPOs in the study area

Figure 4.1 presents the distribution of the RPOs by ownership categories in the study area. It is shown in Figure 4.1 that 43 RPOs representing 71.7% of the total number surveyed in the study area are under the ownership of independent marketers. The domination of the fuels retail market by the independent marketers can be attributed to the attractive price of petrol both at control price and black market prices which have made more people to go into the petrol retailing business (Uchegbu, 2002).

**Figure 4.1: Ownership Categories of RPOs in the study area**
Source: Author's fieldwork (2016)

This finding is supported by Akinlo (2012) who stated that there has been increased private sector participation in some activities within the downstream sector in Nigeria, with over 24,000 representing 51% of Independent Marketers controlling the retail fuel market on a nationwide scale. Similarly, in an environmental risk management at RPOs study carried out by the Australian Environmental Protection Agency (2003), it was discovered that 54.54% of the RPOs surveyed in Metropolitan Victoria, Australia were under the ownership of independent product marketers (both single site and multi-site marketers).

4.3.2 Distribution of RPOs by route across the study area

Data was collected on the distribution of the RPOs by route in the study area and the findings are presented in Table 4.4. The RPOs are unevenly distributed across the various routes in the study area and it is indicated that Okene Road has the highest concentration of RPOs in the study area with 13 of the total 60 RPOs located on this route. 10 of the RPOs are also located within the NATACO axis, 12 representing 20% along the army barrack road with 6 both on the Ajaokuta and Murtala Mohammed Way and 9 located along Ganaja Route.

**Table 4.4: Distribution of RPOs by Route in the Study Area**

| Location | Frequency | Percentage (%) |
|---|---|---|
| Ganaja Road | 9 | 15.0 |
| Ajaokuta Road | 6 | 10.0 |
| Murtala Mohammed Way | 6 | 10.0 |
| Old Market Road | 3 | 5.0 |
| NATACO | 10 | 16.7 |
| Okene Road | 13 | 21.7 |
| Old stadium Road | 1 | 1.7 |
| Barrack Road | 12 | 20.0 |
| **Total** | **60** | **100** |

Source: Author's fieldwork (2016)

The high numbers of RPOs along major routes in the study area is the resultant effect of the roles these routes play as passage ways to various parts of the country. As stated by Netz and Taylor (2002), the proximity of RPOs to major routes is an important driver of fuel demand. In this regard, customers attempt to reduce travel time and distance when commuting or traveling longer distances and, therefore, select stations which are in close proximity to major routes (Chan et al., 2005). This is applicable in the study area, where like other parts of the country petroleum products are sold at uniform prices, therefore customers need not travel any further to obtain petroleum products.

On the other hand, the Old Stadium road has just a single RPO and this can be attributed to the fact that this area is characterized by residential and office buildings. This finding is supported by Bainbridge (2000) who stated that RPOs are not built in town centres but rather on exit roads. It is further stated that RPOs exposed to passing traffic should have a higher demand for fuel than stations located in residential areas. Thus, investors in the fuels retail market tend to site their RPOs along major routes to drive larger fuel sales.

### 4.3.3 Period of operation of the RPOs

Data on the duration of operation of the RPOs in the study area was collected. The data collected is presented in Table 4.5. From the findings presented in Table 4.5, 43.3% representing the highest percentage of RPOs in the study area have been in operation for over 10 years. This can be a major factor influencing the compliance of the RPOs to environmental regulations as the age of some of the facilities at RPOs have been a basis for some provisions in the EGASPIN. According to DPR (2002), after pressure testing of the Underground Storage Tanks (USTs) for leakages upon installation, USTs should be pressure tested and leak detected after every 5 years until the tank is 15 years old, and thereafter the tank should be pressure tested/leak detected after every 2 years. This provision will cause an obvious increase in the cost of environmental compliance of RPOs and could possibly hinder compliance to this provision.

**Table 4.5: Duration of Operation of the RPOs**

| **Duration of operation** | **Frequency** | **Percentage** |
|---|---|---|
| Less than 1 year | 4 | 6.7 |
| 1-5 years | 10 | 16.7 |
| 6-10 years | 20 | 33.3 |
| Over 10 years | 26 | 43.3 |

Source: Author’s fieldwork (2016)

This is consistent with the findings of Kanyi (2014), who stated that most of the RPOs in Thika East Sub-County in Kenya are old, hence it is difficult and expensive for them to attain full environmental best practice compliance status, as the USTs age, corrode, pipes leak through corrosion holes and metal covers chips.

### 4.3.4 General appearance of the RPOs

This study sought to find out the state of appearance of the RPOs in the study area and data on the general appearance was collected via the questionnaire administered to station managers/supervisors. The data collected is presented in Table 4.6. As shown in Table 4.6, 75% of the total numbers of RPOs in the study area generally have a good appearance. This is in line with the findings of Abdullahi et al., (2013) where a large percentage of the RPOs in Kaduna Metropolis were adequately maintained and hence were generally of good appearance.

**Table 4.6: General Appearance of the RPOs**

| General appearance | Frequency | Percentage |
|---|---|---|
| Very poor | 0 | 0.0 |
| Poor | 5 | 8.3 |
| Good | 45 | 75.0 |
| Very Good | 10 | 16.7 |

Source: Author's fieldwork (2016)

This may be attributed to good housekeeping practices in a bid to look neat to attract more customers in a competitive market segment. According to Sartorius, Eitzen and Hart (2007), general cleanliness and appearance of RPOs is a major factor that improves the customers' experience and patronage.

### 4.3.5 Number of pumping bays at the RPOs

The number of pumping bays an outlet has may be an indication of its size and a retail petrol station can only refuel as many vehicles as the number of pumping bays it has (Smalley, 1999). According to Sartorius et al., (2007), the number of pumping bays may also be an indicator of the volume of petrol that may be sold. Data on the number of pumping bays at the RPOs was collected and the findings are presented in Table 4.7.

It is shown in Table 4.7 that the number of stations with 6 pumping bays ranks highest representing a total of 48.3% with the proportion of RPOs with 5 pumps ranking second with a percentage of 33.3% of the total RPOs in the study area. It can therefore be deduced that a large number of the RPOs are small sized

**Table 4.7: Number of pumping bays at the RPOs**

| Number of pumps | Frequency | Percentage (%) |
|---|---|---|
| 4 | 2 | 3.3 |
| 5 | 20 | 33.3 |
| 6 | 29 | 48.3 |
| 7 | 2 | 3.3 |
| 8 | 4 | 6.7 |
| 10 | 3 | 5.0 |
| **Total** | **60** | **100** |

Source: Author's fieldwork (2016)

Also, 4 of the RPOs representing 6.7% have 8 pumping bays in the study area, 3 of the RPOs have 10 pumps and 2 of the RPOs also have 4 pumps in the study area.

4.3.6 Products sold at the RPOs

Data on the range of products sold at the RPOs was collected and is presented in Table 4.8. It was inferred that all RPOs sold more than one product and the findings presented in combination in Table 4.8 shows that a large percentage represented by 86.7% of the total RPOs in the study area sold a combination of petrol, kerosene and diesel. Also 5 stations in the study area sold petrol and kerosene only with only 1 selling petrol and diesel only. 2 retail petrol stations in the study area sold petrol, kerosene and cooking gas only.

**Table 4.8: Products Sold at RPOs**

| Petroleum products sold | Frequency | Percentage |
|---|---|---|
| Petrol and Kerosene only | 5 | 8.3 |
| Petrol, Kerosene and Diesel only | 52 | 86.7 |
| Petrol and Diesel only | 1 | 1.7 |
| Petrol, Kerosene and cooking gas only | 2 | 3.3 |
| Petrol, Kerosene, Diesel and Cooking gas | 0 | 0.0 |

Source: Author's fieldwork (2016)

None of the RPOs sold a combination of petrol, kerosene, diesel and cooking gas in the study area. According to the Nigerian National Petroleum Corporation (2015), Petrol, kerosene and diesel occupy a major proportion of products distributed nationwide, thus the higher number of RPOs retailing a combination of petrol, kerosene and diesel may be an indication that these products are the major drivers of fuel sale among RPOs in the study area.

### 4.3.7 Non-forecourt service facilities at the RPOs

Table 4.9 shows the non-forecourt service facilities present at the RPOs in the study area. The findings presented in Table 4.9 show that 56 of the RPOs in the study area representing 93.3% have lubrication bays for the provision of lubrication services to motor vehicles owners in addition to the sale of petroleum products. Also 34 out of the total 60 stations in the study area have shops where consumables are sold while 2 of the total 60 offer car wash services in the study area. According to Reid (2004), the reliance of fuel stations on additional sources of income is now common place.

**Table 4.9: Non-forecourt Service Facilities Present at the RPOs**

| **Service facilities** | **Frequency** | **Percentage** |
|---|---|---|
| Lubrication bays | 56 | 93.3 |
| Carwash | 2 | 3.3 |
| Convenience shops | 34 | 56.6 |

Source: Author's fieldwork (2016)

In the USA for instance, fuel is considered the volume driver, whilst other non-forecourt service drive the bulk of the profits. This is consistent with Netz and Taylor (2002) who stated that customers often buy more than just fuel when visiting a fuel retail outlet and customer convenience appears to be driving the industry (Bainbridge, 2000). The presence of these service facilities may have environmental implications and may also increase the waste generated at the RPOs in the study area and such wastes include but may not be limited to packaging materials, plastic bottles, spent lubricants, coolants and wastewater from car wash services.

### 4.4 Environmental Compliance of RPOs in the Study Area

In line with objective two of this research, this section presents the data collected on the environmental compliance of RPOs in the study area. The compliance to environmental regulations is examined through an analysis of the provisions for stormwater management, soil and groundwater management, waste water management, general waste management and air quality management at individual RPOs in the study area. Findings are presented based on the general compliance of all the RPOs and also compliance by ownership and operational categories. This is in a bid to assess general compliance and compliance by the RPOs under the various ownership categories in the study area.

#### 4.4.1 Stormwater management practices

The stormwater management practices at the RPOs were examined and the findings are presented in Table 4.10. According to the Institute of Petroleum (2002), areas susceptible to contamination at RPOs should be impermeable to hydrocarbon and other liquids and should not allow seepages through or below the surface. PART VII, Section B, Subsection 4.2.1 (vii) of the EGASPIN states that the whole forecourt of a RPO should be concreted (DPR, 2002).

**Table 4.10 Storm water Management Practices**

| **Provisions for Environmental Management** | **Compliant** | | **Non-compliant** | |
|---|---|---|---|---|
| | **Frequency** | **Percentage (%)** | **Frequency** | **Percentage (%)** |
| Concrete forecourt (fuel dispensing area) | 59 | 98.3 | 1 | 1.7 |
| Stormwater drains around the premises | 6 | 10.0 | 54 | 90.0 |

Source: Author’s fieldwork (2016)

*4.4.1.1 Provision of concrete forecourt on the premises of the RPOs*

Table 4.10 shows the compliance of the RPOs to the provision of concrete forecourt in the study area. Compliance was generally very high as it is indicated that 59 of the stations representing 98.3% of the total number are compliant and thus have concrete forecourts with only 1 out of the total number operating without a concrete forecourt in the study area.

The compliance of the RPOs to the provision of concrete forecourts by ownership category is presented in Table 4.11. From the data presented, it can be deduced that all the major marketers, NNPC affiliate stations and NNPC mega stations are compliant to this provision. However, the only non-compliant RPO to the provision of concrete forecourts in the study area belonged to the independent marketers' category.

**Table 4.11: Compliance to Provision for Concrete Forecourts at RPOs**

| Compliance status | Independent Marketers | Major Marketers | NNPC affiliate stations | NNPC Mega station |
|---|---|---|---|---|
| Compliant | 42 | 12 | 4 | 1 |
| Non-compliant | 1 | 0 | 0 | 0 |

Source: Author's fieldwork (2016)

*4.4.1.2 Provision for the construction of stormwater drains at the premises of RPOs*

According to the Institute of Petroleum (2002), all forecourt areas where contamination is possible, e.g. pump islands and tanks offloading points, and any drainage apparatus which could receive contaminated water, should be contained by peripheral surface drainage channels or kerbs to divert all spills and run off to an oil/water separator or constructed wetland. PART VII, Section B, Subsection 4.3.1.2 (vii) of the EGASPIN states that good drainage system shall be provided on and around the forecourt area of RPOs (DPR, 2002). Table 4.10 shows the compliance of RPOs in the study area to the provision of stormwater drains on the premises of RPOs in the study area. Compliance to the provision of stormwater drains is particularly low as it is indicated that 6 of the total RPOs representing 10% of the total number in the study area were compliant and 54 of the total RPOs representing 90% in the study area were not in compliance. Non-compliance to the provision for stormwater drains around RPOs will result in area contaminated with spilt petroleum product being washed by stormwater into public drains which cumulatively could have a detrimental effect on the environment.

Figure 4.2 presents the compliance of the RPOs by ownership categories to the provision for stormwater drains in and around the premises of the RPOs in the study area. The independent marketers performed poorly under this provision as none of RPOs had drainage systems in and around their forecourts.

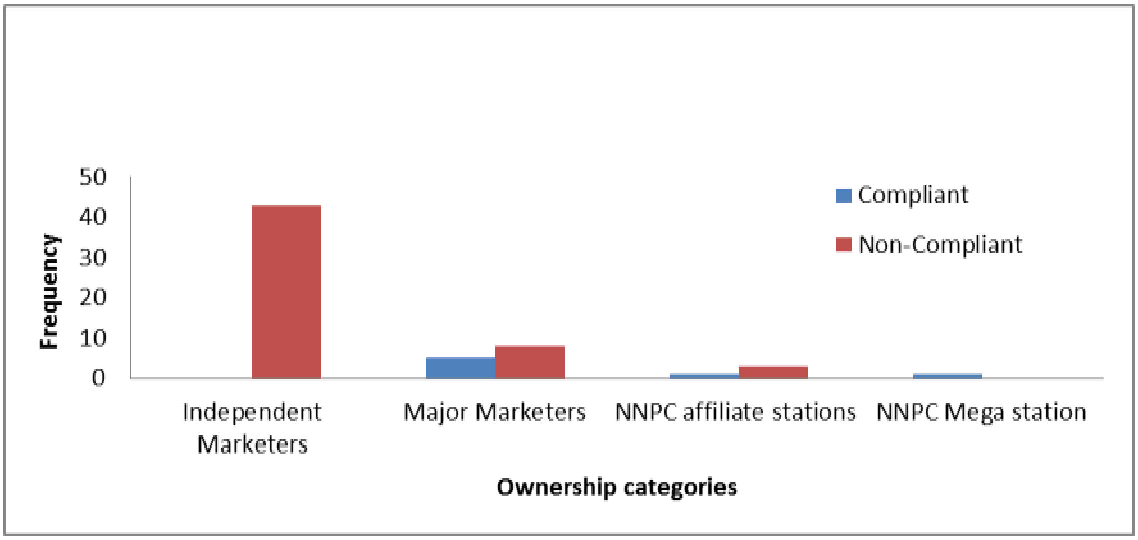


**Figure 4.2: Compliance to Provision for Stormwater Drains at RPOs**
Source: Author's fieldwork (2016)

RPOs owned by the major marketers performed fairly well as 5 out of the total 12 were in compliance to this provision, only 1 out of the 4 NNPC affiliate RPOs and the only NNPC mega station in the study area were in compliance to this provision.

### 4.4.2 Soil and groundwater management practices at the RPOs

Table 4.12 presents the findings on soil and groundwater management practices at the RPOs. PART VII, Section B, Subsection 4.2.1 (IV) of the EGASPIN states that it is mandatory for owners of Underground Storage Tanks (USTs) to monitor their receptacles for leaks by instituting proper inventory control or stock reconciliation (DPR, 2002).

**Table 4.12: Soil and Groundwater Management Practices**

| Provisions for environmental management | Compliant Frequency | Percentage (%) | Non-compliant Frequency | Percentage (%) |
|---|---|---|---|---|
| Monitoring procedures to detect leakages | 11 | 18.3 | 49 | 81.7 |
| Presence of spill management plan | 24 | 40.0 | 36 | 60.0 |
| Presence of groundwater monitoring well | 13 | 21.7 | 47 | 78.3 |
| Records of periodic check of water or sludges in underground storage tanks | 6 | 10.0 | 54 | 90.0 |

Source: Author's fieldwork (2016)

*4.4.2.1 Monitoring procedures to detect leakages*

From Table 4.12, it can be deduced that 11 of the RPOs in the study area have put in monitoring procedures in the form of inventory control to detect leakages from their underground storage tanks representing 18.3% of the RPOs in the study area. On the other hand, 49 of the RPOs representing 78.3% do not implement proper stock reconciliation to detect possible leakages from underground storage tanks in the study area. Studies relating to environmental compliance of RPOs in Nigeria shows the adoption of monitoring boreholes as the major leak detection mechanism often adopted with only a very few adopting inventory control mechanism (Abdullahi et. al., 2012). This contradicts the findings of Australia Environmental Protection Agency (2003) where 90.9% of the RPOs surveyed in Metropolitan Victoria, Australia instituted inventory control/stock reconciliation mechanism as a primary method of leak detection of their USTs.

Figure 4.3 shows the compliance of the RPOs by ownership categories to provisions requiring the institution of proper inventory control/stock reconciliation mechanisms to detect leakages from underground storage tanks in the study area. It is shown that all the RPOs under the ownership of independent marketers in the study area were not compliant to this provision. The major marketers performed well in this category with 10 out of the 12 instituting inventory control mechanism. None of the NNPC affiliate stations were compliant to this provision. The mega station in the study area was also complaint to this provision.

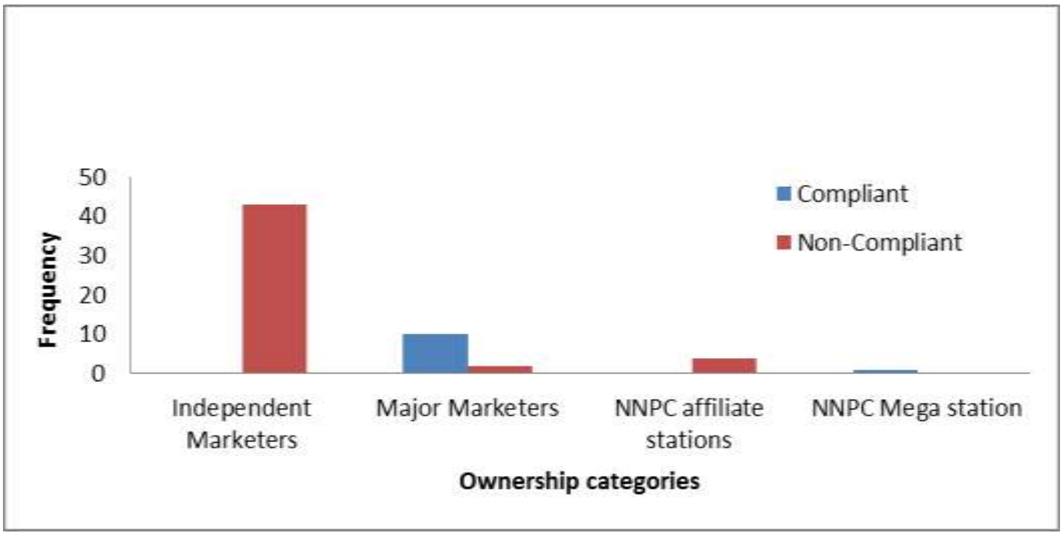


**Figure 4.3: Compliance to Provision for Inventory Control Mechanism at RPOs**
Source: Author's fieldwork (2017)

According to Afolabi et al., (2011), the reason for the good performance by the major marketers may be connected with adoption of good business practice to protect their names and integrity while independent marketers may be more motivated by profit than compliance to regulations. Non-compliance to the provision for the institution of inventory control mechanism particularly by the independent marketers may be as a result of the requisite technical knowledge required for the institution of this mechanism.

*4.4.2.2 Petroleum products/chemical spill prevention and counter measurers plan*

According to the Institute of Petroleum (2002), all site storing fuels of any type should have an incident response plan to manage spills during delivery of fuels, spills during dispensing and leaks from underground storage tanks. This is in line with PART VII, Section B, Subsection 4.6.1 of the EGASPIN (2002) which states that RPOs shall have petroleum products/chemical spill prevention and counter measures plan as approved by the Director of petroleum resources. The finding on the compliance of the retail petrol stations to this provision is presented in Table 4.12. From the findings it is deductible that 24 of the RPOs in the area are compliant to the provisions for spill management plans representing 40.0% of the total number while 36 out of the total number representing 60.0% are not in compliance to the provision for spill management plan.

In this category, the independent marketers performed well as shown in Figure 4.4, it is shown that 22 out of the 42 RPOs owned by independent marketers have spill management plans. Also 7 out of the 12 RPOs owned by major marketers have spill management plans with 3 of the NNPC affiliate stations having out of the total 4. Also the NNPC mega station in the study area was compliant to this provision.

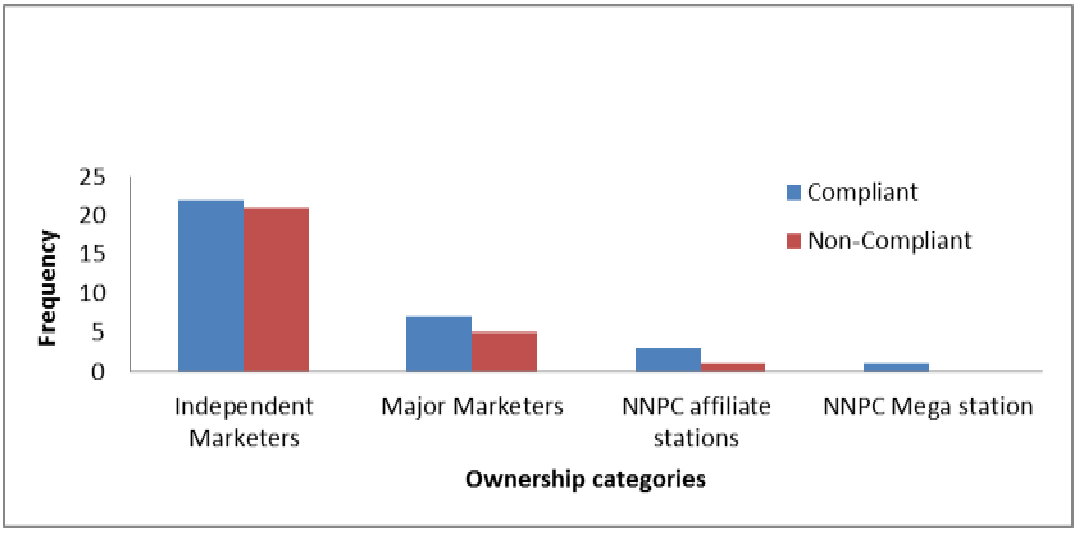


**Figure 4.4: Compliance to Provision for Spill Management Plan at RPOs**
Source: Author's fieldwork (2016)

*4.4.2.3 Groundwater monitoring well*

PART VII, Section B, Subsection 4.2.1 (xii) of the EGASPIN also states that monitoring boreholes shall be installed at suitable locations for early warning/detection of USTs leakages (DPR, 2002). However, the proximity of the monitoring boreholes to USTs is not specified in the EGASPIN. As shown in Table 4.12, 47 representing 78.3% of the RPOs in the area were not in compliance to this provision that stipulates that all RPOs must have groundwater monitoring wells for early detection of the leakages of USTs that may potentially pollute the underlying underground water system. This is consistent with the findings of Abdullahi et al.,

(2012) who stated that most of the RPOs in Kaduna Metropolis do not have groundwater monitoring wells for early warning and detection of UST leakages. The monitoring borehole is mandated upon RPOs regardless of the local environmental conditions such as the type of soil on which the station was built. The Institute of Petroleum (2002) guidelines recommend different classes of leak detection systems and points out that the monitoring borehole is not effective for leak detection in all soil types. It is stated that monitoring wells are ineffective in clay soils and ultimately it is for the operator of RPOs to determine and where necessary justify the most suitable system in the particular. In the event of the installation monitoring boreholes in unsuitable environments, the accuracy of leak detection will be greatly impaired, thus exposing the environment to a heightened risk of pollution from USTs.

Figure 4.5 presents the compliance of the RPOs to the provisions for groundwater monitoring wells by ownership categories.

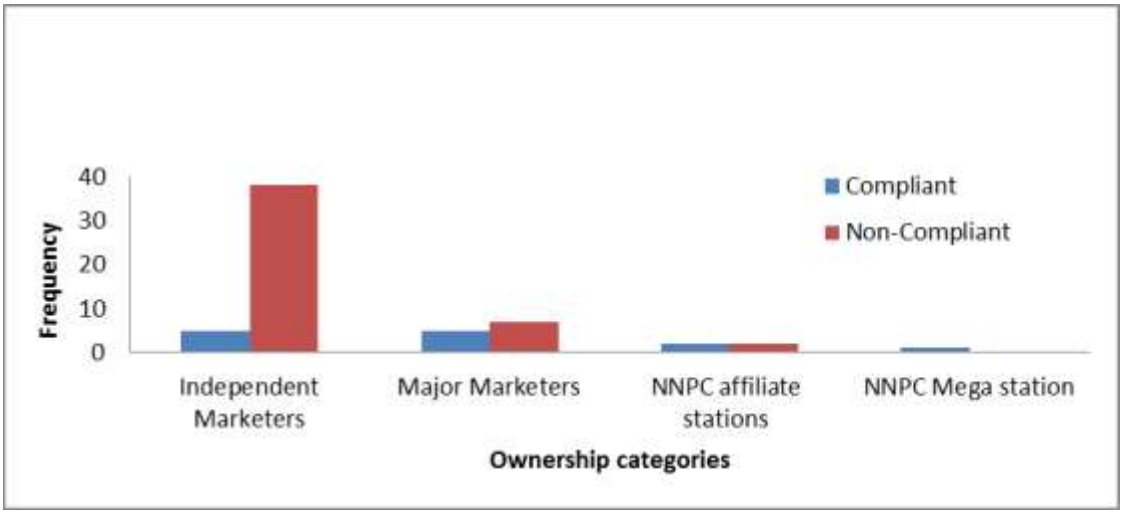


**Figure 4.5: Compliance to Provision for Groundwater Monitoring Wells at RPOs**
Source: Author's fieldwork (2016)

It is shown that only 5 out of the total 43 RPOs in the study area owned by independent marketers have groundwater monitoring wells. Similarly 5 out of the 12 stations owned by major marketers in the study area have groundwater monitoring wells with 2 out of the 4

RPOs owned by NNPC in affiliation having groundwater monitoring wells. The mega station was compliant to the provision for groundwater monitoring wells at the RPOs.

*4.4.2.4 Records of periodic checks for water/sludges in USTs*

The monitoring of water and sludges in USTs is provided for in part (vii), section (b), subsection 4.2.1 of the EGASPIN (2002) which states that periodic check for water/sludge in tanks are mandatory and records must be kept by the tank owners. Availability of records for periodic check of water/sludges at RPOs was used to assess compliance to this provision. As presented in Table 4.12, it is shown that only 6 of the RPOs representing just 10% of the total number were in compliance to the provision of records of periodic checks for water and sludges in USTs.

The compliance of the RPOs by ownership categories to the provision of records of periodic checks for water and sludges in USTs is represented in Figure 4.6.

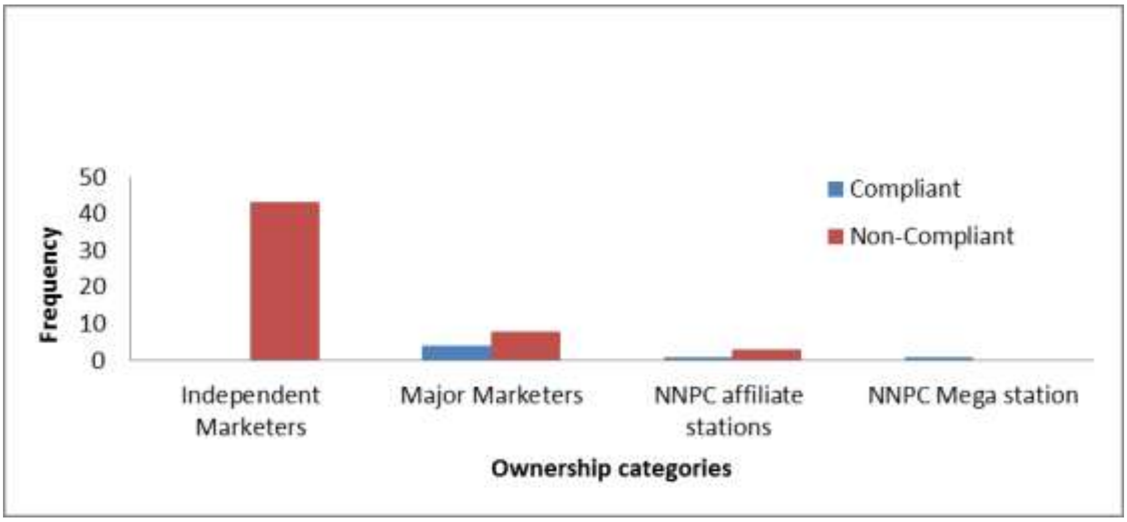


**Figure 4.6: Compliance to provisions for records of periodic checks for water in tanks at RPOs**
Source: Author's fieldwork (2016)

The presence of water and sludges in USTs may be an indication that its integrity has been compromised and particularly points to a leakage. It is shown that none of the 43 stations owned by independent marketers have available records of periodic check for water and sludges in their underground storage tanks. 4 of the 8 retail petrol stations owned by the major marketers have this record with only one of the NNPC affiliate station having record of this periodic check onsite. The NNPC mega station in the study area also had a record of periodic check of water/sludges in its USTs.

4.4.3 Wastewater management practices at the RPOs

The wastewater management practices at the RPOs were examined and the finding of this examination is presented in Table 4.13.

**Table 4.13: Wastewater Management Practices**

| **Provisions for environmental management** | **Compliant Frequency** | **Percentage (%)** | **Non-compliant Frequency** | **Percentage (%)** |
|---|---|---|---|---|
| Release of liquid waste into public gutters | 3 | 5.0 | 57 | 95.0 |
| Oil water separator for pre-treatment of forecourt wastewater | 6 | 10.0 | 54 | 90.0 |

Source: Author's fieldwork (2016)

*4.4.3.1 Release of liquid waste into public gutters*

Provisions are made to control the discharge of liquid waste into public gutters in PART VII, Section B, and Subsection 4.3.1 of the EGASPIN (2002) which states that it is illegal to discharge oily waste waters, solid waste and spent lubricants into public sewers. From Table 4.13, it is evident that 57 of the RPOs in the study area have waste water going into the public gutter in the study area representing 95% of the retail petrol stations in the study area. This finding is consistent with that of Abdullahi et al., (2012) who stated that all the surveyed RPOs in Kaduna Metropolis utilized public drains as a means of wastewater disposal in the study area. On the other hand, 3 of the RPOs representing just 5% of the total number do not have waste water going into the public gutters.

Figure 4.7 shows the compliance of the RPOs by ownership categories in the study area against the discharge of liquid wastes and effluents into public sewers. Only 2 of the 43 RPOs owned by independent marketers in the study area do not have waste water going into public drains. Similarly, 1 out of the 12 RPOs owned by the major marketers in the study area also do not have waste water going into public drains with all the NNPC affiliate stations and NNPC mega stations having waste water going into the public drains. A high number of RPOs with wastewater going into public drains will result in the contamination of water bodies around the premises of RPOs and could cumulatively be detrimental to plant and animal health.

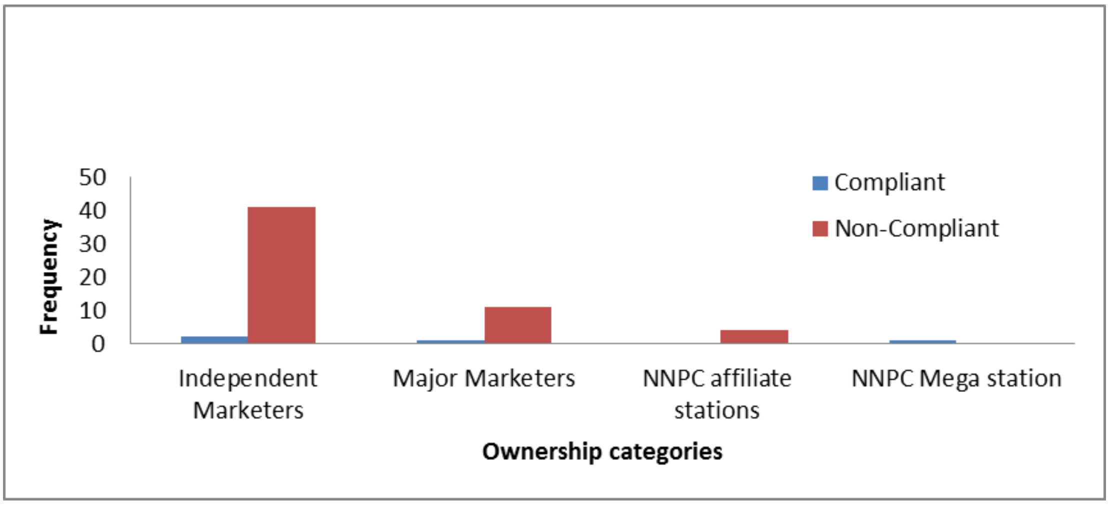


**Figure 4.7: Compliance against Waste Water Discharge into Public Sewers at RPOs**
Source: Author's fieldwork (2016)

*4.4.3.2 Provision for oil/water separator at the RPOs in the study area*

The provisions for the oil/water separator at the RPOs is provided for in PART VII, Section B, Subsection 4.3.1.2 of the EGASPIN (2002) which states that the effluents should not be discharged to the highway of public sewers. These effluents shall pass through efficiently operated oil/water separator. Table 4.13 presents the findings on the compliance of the RPOs to the provision stating that all RPOs should have an efficiently run oil water separator. It is evident that only 6 RPOs in the study area have oil water separator onsite representing just 10%. On the other hand a total of 54 of the RPOs in the study area do not have oil water separator onsite.

In Figure 4.8, it is shown that all of the 43 RPOs owned by independent marketers in the study area do not have oil/water separator onsite. Also 5 of the RPOs of the total 12 owned by major marketers have an oil/water separator and the NNPC mega station has an oil water separator in the study area. None of the NNPC affiliate stations were compliant to this provision.

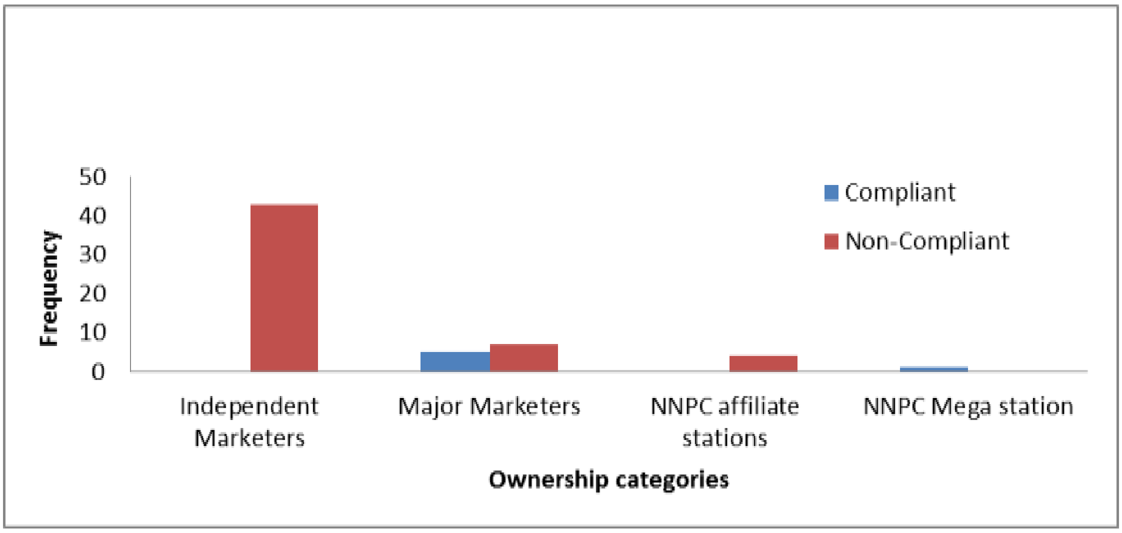


**Figure 4.8: Compliance to Provision for Oil/Water Separator at RPOs**
Source: Author's fieldwork (2016)

The absence of oil water onsite most of the RPOs may be linked with the financial implication of its acquisition and the technical knowledge required for its operation. The absence of oil water separator onsite most of the RPOs signifies that oil based products washed off the forecourts of RPOs are passed into public gutters without removing the oily contents from the water released. Over time, this could have negative impacts on the environment around most of the RPOs. According to McHugh et al., (2015), most gasoline constituents are highly soluble in water and have the potential to threaten public water supply for tens to hundreds of years.

4.4.4 Waste management practices at the RPOs

The waste management practices at the RPOs were examined and the findings are presented in Table 4.14. Waste generated at RPOs is likely to include empty storage containers and packaging, general litter, by-products of any vehicle maintenance (including petroleum products, coolants, degreasing agents, sediment, rubber particles, detergents), and other hazardous materials (South Australian Environmental Protection Agency, 2009). As provided in PART VII, Section B, Subsection 4.3.1.6 of the EGASPIN of 2002, refuse containers shall be provided for the recovery of oil rags, empty cans, etc. and disposed in accordance with public health and sanitation procedures satisfactory to the Director of Petroleum Resources.

**Table 4.14 Waste Management Practices**

| **Provisions for environmental management** | **Compliant** | | **Non-compliant** | |
|---|---|---|---|---|
| | **Frequency** | **Percentage (%)** | **Frequency** | **Percentage (%)** |
| Refuse containers for the recovery of oily rags and empty oil cans | 37 | 61.7 | 23 | 38.3 |
| Differential segregation of spent lubricants and other wastes | 3 | 5.0 | 57 | 95.0 |

Source: Author's fieldwork (2016)

*4.4.4.1 Refuse containers for the recovery of oily rags and empty oil cans*

From Table 4.14, it is evident that 37 of the RPOs in the study area representing 61.7% are compliant to the provision in the EGASPIN that states that RPOs must have refuse containers for the recovery of oily rags and empty cans. On the other hand, 23 of the RPOs in the study area representing about 38.3% are not in compliance to the provision for refuse containers for the recovery of oily rags and empty oil cans.

Figure 4.9 shows the compliance to the provisions for refuse containers by ownership categories at the RPOs in the study area. It is shown that 21 out of the 43 owned by independent marketers in the study area are compliant to this provision. 11 out of the total 12 of the major marketers have refuse containers. All the NNPC affiliate stations and the NNPC mega station in the study area have refuse containers for the waste generated on the premises of their facilities.

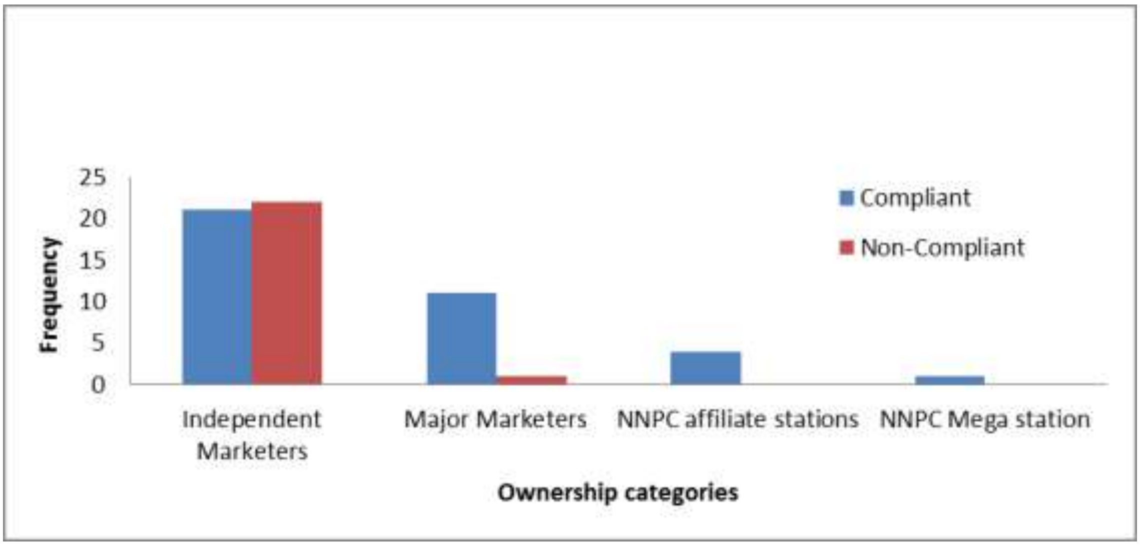


**Figure 4.9: Presence of Refuse Containers at RPOs**
Source: Author's fieldwork (2016)

*4.4.4.2 Differential segregation of spent lubricants and other wastes generated*

Guidelines for differential segregation of spent lubricants and other wastes generated at RPOs is provided for in PART VII, Section B, Subsection 4.3.1.5 of the EGASPIN which states that spent lubricants shall be differentially segregated from the other oily effluents. Table 4.14 indicates that only 3 of the RPOs in the study area representing 5% practice differential segregation of waste generated onsite at the RPOs. Also 57 of the RPOs representing 95% of the total number are not in compliance as stipulated by the regulatory agency. This is consistent with findings of Oladepo, Ilori and Taiwo (2014) where most of the firms surveyed in South-Western Nigeria did not practice waste segregation at source. According to Babayemi and Dauda (2009), this is majorly due to the absence of facilities for waste segregation at source. Absence of differential segregation of wastes at RPOs signifies that all wastes generated are dumped in the municipal solid waste streams including wastes which require special handling; this could have a detrimental effect on the environment as RPOs are known sources of potentially toxic wastes in the form of spent lubricants, used engine oil and coolants.

Figure 4.10 shows the compliance of the RPOs by category to the provision for the differential segregation of wastes at the RPOs in the study area. As shown in Figure 10, only 1 of the 43 retail petrol stations owned by independent marketers in the study area practice differential segregation of waste with only 2 out of the 12 stations owned by major marketers practicing differential segregation. None of the NNPC affiliate stations and NNPC mega stations complied with differential segregation of their waste in the study area.

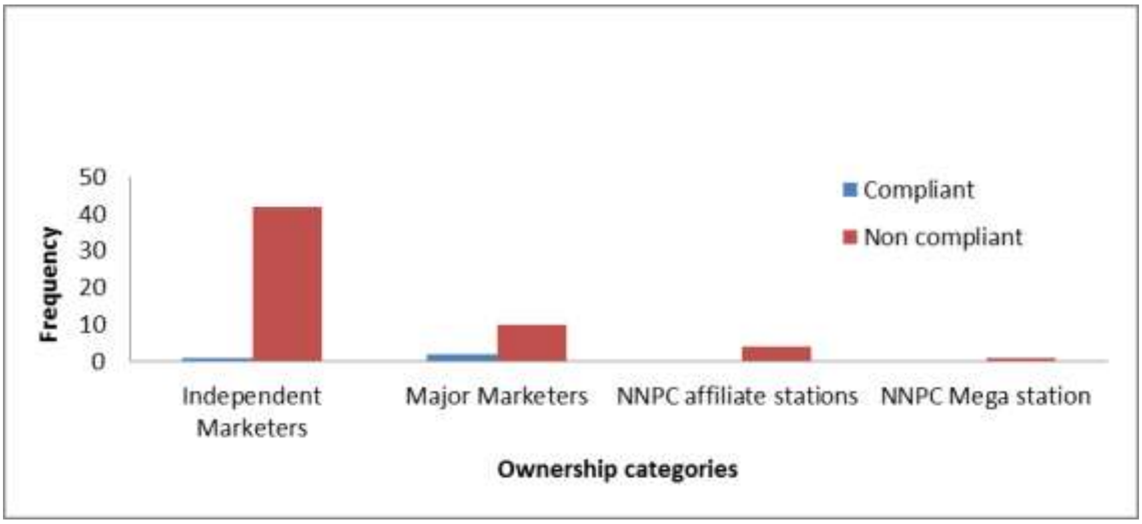


**Figure 4.10: Presence of Differential Segregation Mechanism at RPOs**
Source: Author's fieldwork (2016)

4.4.5 Air quality management practices

There are currently no provisions for air quality management practices at RPOs in the EGASPIN; however the Institute of Petroleum (2002) recommends Vapour Recovery Systems (VRSs) for tanker discharge and petroleum products dispensing activities. None of the RPOs surveyed had systems in place that prevents vapours from escaping during tanker discharge and dispensing activities in the study area. A common feature amongst the RPOs in the study area was the presence of vent pipes that rose 3 to 6 meters in height above the ground, and were connected to USTs to release excess vapours and prevent the pressurization of the tanks. During tanker offloading and fuel dispensing activities, petrol vapour escapes into the environment and this practice exposes the staff and the residents close to the RPOs to Volatile Organic Compounds (VOCs) which have been reported by Al-Salem and Khan (2010) to have detrimental effects on plant and animal life.

### 4.4.6 Frequency of environmental compliance audits

Data on the frequency of environmental compliance audits conducted at the RPOs was collected and the data is presented in Figure 4.11.

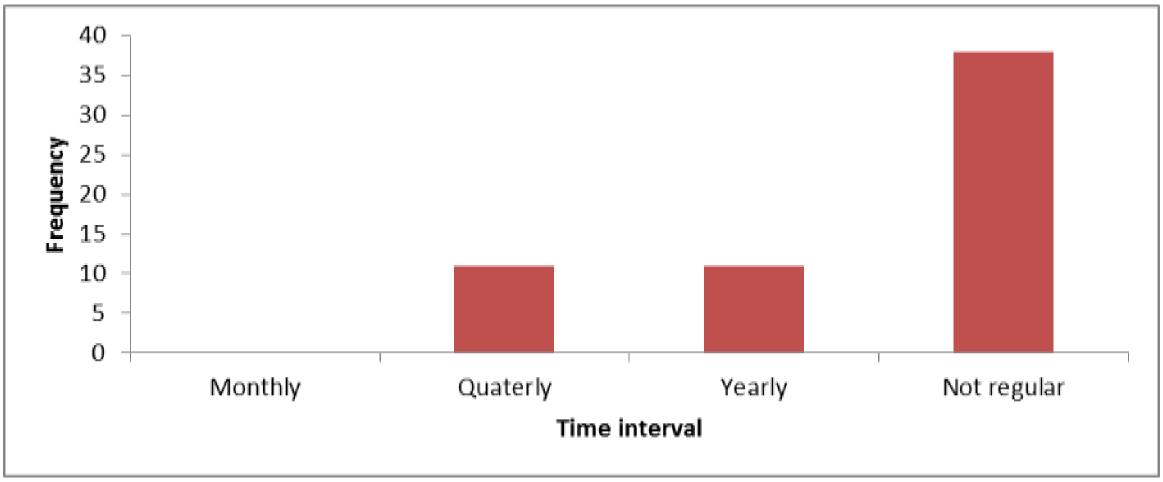


**Figure 4.11: Frequency of Environmental Compliance Audits at the RPOs**
Source: Author's fieldwork (2016)

Figure 4.11 shows that out of the total 60 RPOs surveyed, 11 representing 18.3% claim they carried out environmental compliance audits quarterly, with 11 also stating the environmental audits of their facilities are carried out yearly. On the other hand, 38 representing 63.3% of the RPOs state that environmental compliance audits of their facilities are carried out, although not at regular intervals. The management of the RPOs are tasked with the responsibility of conducting environmental compliance audits and as a result of this finding, current status of compliance among the RPOs may remain unknown to the operators of the RPOs and the relevant regulatory body. This can be a limiting factor in any future compliance promotion drive set up by the relevant regulatory body. As stipulated in the EGASPIN, operators of RPOs shall conduct environmental compliance audits to facilitate the management and control of environmental practices and assessing compliance with the management system and regulatory requirements. The frequency as a minimum of conducting these audits should be quarterly (DPR, 2002).

### 4.5 Factors that Militate Against the Environmental Compliance of the RPOs

In line with objective three of this research, this section presents the results of the factors that militate against the compliance of RPOs in the study area to environmental regulations. The extent to which the respondents agreed to statements under the factors of knowledge feasibility, capital adequacy, monitoring and enforcement practices and technical feasibility was obtained through the use a Likert scale based questions. The combined responses of the 60 station managers and 205 station workers are presented in subsections below.

#### 4.5.1 Knowledge feasibility

Table 4.15 presents the findings on the extent to which respondents agreed that knowledge feasibility influenced environmental compliance in the study area.

**Table 4.15: Response Scores for Knowledge Feasibility at the RPOs**

| Statement | Response categories (%) | | | | |
|---|---|---|---|---|---|
| | NA | LE | ME | GE | VE |
| The station has employed skilled workers to manage oil products | 19.6 | 30.9 | 34.0 | 9.1 | 6.4 |
| The station employees advice the management on the requirements of compliance | 18.1 | 35.5 | 29.1 | 10.2 | 7.2 |
| The stations staff contribute positively to compliance to regulations | 10.9 | 18.1 | 25.7 | 35.8 | 9.4 |
| The station staff are regularly educated on compliance to regulations | 25.3 | 37.4 | 21.9 | 10.9 | 4.5 |
| The fuel station is responsible for financing the education of staff | 24.2 | 27.5 | 23.4 | 17.0 | 7.9 |
| The station has an environmental management plan for achieving compliance | 19.2 | 31.3 | 23.0 | 15.1 | 11.3 |

Source: Author’s fieldwork (2016)

Regulated groups besides being motivated must have the ability to comply. This means they must know they are subject to requirements and they must understand what steps to take to create compliance (INECE, 2009). A total of 34.0% of the respondents agreed to a moderate extent that the RPOs in the study area have employed skilled workers to manage oil products. Also, 35.5% of the respondents agreed to a little extent that the station employee advice the management of the RPOs on the requirements of compliance. The contribution of the staff to compliance to regulation has a high rating as 95 of the total surveyed population agreed to a great extent to that statement. However, the education of staff on the compliance to regulations scores very low as 37.4% of the total population agreed to a little extent. Also, 27.5% of the respondents also agreed to a little extent to the statement on the financing of the education of the staff by the retail petrol stations. On the availability of an environmental management plan for achieving compliance, 31.3% of the total surveyed population agreed to a little extent that the RPOs have a management plan for achieving compliance.

According to Lan and Munro (2012), human capital is an important internal factor that drives facilities compliance to environmental regulations. In order to adopt new technologies to achieve environmental compliance, firms must have corresponding stock of human capital to acquire the requisite technical and economic information for achieving compliance. As gleaned from responses to statements under the factor of knowledge feasibility, it is deductible that human capital and its development amongst RPOs in the study area is low. This may consequently be a bane to RPOs drive to achieve environmental compliance. This assumption is further strengthened by Dasgupta, Hettige and Wheeler (2000) who in their analysis of the extent of adoption of ISO 14001 type environmental management practice by firms in Mexico, observed from that firms with highly educated workers have significantly greater environmental management effort and compliance.

### 4.5.2 Capital adequacy

Table 4.16 presents the findings on the extent to which respondents agreed that capital adequacy influenced environmental compliance in the study area.

**Table 4.16: Response Scores for Capital Adequacy at the RPOs**

| Statement | Response categories (%) | | | | |
|---|---|---|---|---|---|
| | **NA** | **LE** | **ME** | **GE** | **VE** |
| The management has adequate finance to implement regulations | 19.2 | 30.2 | 33.2 | 9.1 | 8.3 |
| The management avails resources to implement regulations | 19.2 | 33.6 | 29.1 | 9.8 | 8.3 |
| The station has enough finance to invest in an environmentally compliant station | 23.0 | 28.3 | 26.0 | 14.7 | 7.9 |
| The station has enough funds to employ qualified staff | 29.4 | 23.4 | 21.1 | 14.0 | 12.1 |

Source: Author's fieldwork (2016)

***Key:*** *NA=not at all, LE=little extent, ME=moderate extent, GE=great extent, VE= very great extent*

From Table 4.16, 30.2% of the respondents agreed to a little extent that the management of retail petrol stations have adequate finance to implement regulations. Similarly, it is also agreed to a little extent by 33.6% of the respondents that the management avails resources to implement these regulations. On the availability of funds to employ qualified staff, 29.4% of the respondents did not agree at all to this. Also, 28.3% of the respondents agreed to a little extent that the retail petrol stations have enough finance to invest in an environmentally compliant station. As gleaned from Table 4.16, it is evident that capital adequacy among the RPOs in the study area is low. This can be a limiting factor in achieving environmental compliance as funding by facilities is required to a considerable extent in meeting compliance targets.

### 4.5.3 Monitoring and enforcement practices

The responses to the statement under the factor of monitoring and enforcement practices are presented in Table 4.17. From Table 4.17, it can be deduced that 33.6% of the respondents agreed to a little extent that the regulatory body place emphasis on environmental concerns on the operation of RPOs. Similarly, 35.5% of the respondents also agreed to a little extent that the regulatory body monitor implementation of environmental regulation. Also, 29.4% did not agree at all the highest number did not agree at all that sanctions are placed on environmental defaulters amongst the retail petrol stations in the study area. On whether rewards are granted on environmental compliant stations, 40.8 % did not agree at all to this.

**Table 4.17: Response Scores for Monitoring and Enforcement Practices at the RPOs**

| Statement | Response categories (%) | | | | |
|---|---|---|---|---|---|
| | **NA** | **LE** | **ME** | **GE** | **VE** |
| The regulatory body place emphasis on environmental concerns | 18.5 | 33.6 | 27.2 | 12.1 | 8.7 |
| The regulatory body monitor implementation of environmental regulation | 30.9 | 35.5 | 18.9 | 11.7 | 3.0 |
| Sanctions are place on environmental defaulters | 29.4 | 25.3 | 21.1 | 12.8 | 11.3 |
| Rewards are granted on environmental compliant stations | 40.8 | 26.4 | 15.8 | 13.6 | 3.4 |

Source: Author's fieldwork (2016)

***Key**: NA=not at all, LE=little extent, ME=moderate extent, GE=great extent, VE= very great extent*

As gleaned from Table 4.17, it is deductible that monitoring and enforcement activities by the relevant regulatory body in the study area are weak. This may discourage environmental compliance and the activities of RPOs may lead to harmful negative impacts on the environment. According to Cohen (1998), the consequences of ignoring monitoring and enforcement issues can be disastrous for environmental quality and for general social welfare. The importance of monitoring and enforcement activities is stressed by Gray and Shadbegian (2005), who stated that a traditional regulatory structure with rigorous monitoring and enforcement practice remains the number one motivator for many facilities' environmental compliance decisions.

### 4.5.4 Technical feasibility

The responses to the statement under the factor of technical feasibility are presented in Table 4.18. As presented in the Table 4.18, 27.5% of the respondents agreed to a little extent that the regulatory body recommends best available technology for environmental management. On the ease of acquisition of relevant technology for environmental management, 33.2% of the respondents did not agree at all to this statement. The technological equipment used at the retail stations were agreed to a moderate extent to be state of the art by 30.9% of the respondents, while 36.6% of the respondents agreed to a little extent that the best available technology for environmental management was in use at the retail petrol stations.

**Table 4.18: Response Scores for Technical Feasibility at the RPOs**

| Statement | Response categories (%) | | | | |
|---|---|---|---|---|---|
| | **NA** | **LE** | **ME** | **GE** | **VE** |
| The regulatory body recommends best available technology for environmental management | 19.2 | 27.5 | 26.8 | 14.0 | 12.5 |
| It is easy to acquire relevant technology for environmental management | 33.2 | 27.2 | 23.4 | 11.3 | 4.9 |
| The technological equipment used in the petrol station is state of the art | 26.8 | 27.9 | 30.9 | 6.8 | 7.5 |
| The best available technology for environmental management is used in the petrol station | 28.3 | 36.6 | 21.1 | 8.3 | 5.7 |

Source: Author's fieldwork (2016)

***Key:*** *NA=not at all, LE=little extent, ME=moderate extent, GE=great extent, VE= very great extent*

It can be seen from Table 4.18 that technical feasibility of the RPOs in the study area in achieving environmental compliance is low. According to INECE (2009), a lack of technical support can be a barrier to environmental compliance. Technical support is required in the form of technological equipment to achieve environmental compliance. An absence of technological equipment among RPOs in the study area will result in lower environmental compliance rate and hence, negative environmental impacts.

These findings are consistent with Mintzberg (1991) who stated that the general challenges that face RPOs environmental compliance is with issues such as strenuous financial resources, lack of technological support (for case of independent investors), lack of effective industry regulatory authorities and poor infrastructure.

### 4.5.5 Relationship between the factors militating against environmental compliance by the RPOs

The relationship between capital adequacy and other factors (monitoring and enforcement practices, technical feasibility and knowledge feasibility) was tested using the cross tabulation analysis and results of Chi-Square ($X^2$) and Cramer's V obtained therefrom (presented in APPENDIX V) are interpreted in the subsections that follow.

#### *4.5.5.1 Relationship between capital adequacy and knowledge feasibility among the RPOs*

The results obtained from the cross tabulation analysis indicated a relationship between the factors of capital adequacy and knowledge feasibility of the RPOs in the study area. Here a *p*-value of 0.000 ($p<0.05$) was obtained, hence the null hypothesis which stated that "there is no relationship between capital adequacy and knowledge feasibility among the RPOs" was rejected. This signifies that knowledge feasibility is dependent on the capital adequacy of the RPOs. The Cramer's V value of 0.909 obtained also showed a very strong relationship between capital adequacy and knowledge feasibility of the RPOs in the study area. This shows to a very large extent that low capital adequacy amongst the RPOs leads to a low knowledge feasibility of the RPOs towards achieving environmental compliance.

#### *4.5.5.2 Relationship between capital adequacy and monitoring and enforcement practice*

A *p*-value of 0.000 ($p<0.05$) was obtained from the cross tabulation analysis of the factors of capital adequacy and monitoring and enforcement practices, hence the null hypothesis which stated that "there is no relationship between capital adequacy and monitoring and enforcement practices" was rejected. This signifies that there is a relationship between the capital adequacy and monitoring and enforcement practices in the study area. Weak monitoring and enforcement practices translates into low capital adequacy as funds required for environmental compliance may be made available if the monitoring and enforcement practices of DPR can be considered as rigorous. The Cramer's V value of 0.677 obtained also showed a moderately strong relationship between capital adequacy and monitoring and enforcement practices in the study area.

#### *4.5.5.3 Relationship between capital adequacy and technical feasibility among the RPOs*

The results obtained from the cross tabulation indicated a relationship between the factors of capital adequacy and technical feasibility among the RPOs in the study area. Here a *P-value* of 0.000 ($p<0.05$) was obtained hence the null hypothesis which stated that "there is no relationship between capital adequacy and technical feasibility among the RPOs" was rejected. This signifies that technical feasibility is also dependent on capital adequacy of the RPOs in the study area, as funds are required for the acquisition of the required technological support for achieving environmental compliance. The Cramer's V value of 0.724 obtained also showed a moderately strong relationship between capital adequacy and technical feasibility of the RPOs in the study area.

# CHAPTER FIVE

# SUMMARY, CONCLUSION AND RECOMMENDATIONS

## 5.1 Summary of Findings

This study was aimed at assessing the environmental compliance of RPOs in Lokoja Metropolis, Kogi State, Nigeria. An observational checklist and two sets of interviewer administered questionnaires were used to assess the operational characteristics of RPOs in the study area, the compliance of the RPOs to environmental laws and regulations and the factors militating against compliance in the study area.

The results of the data analysis on the operational characteristics of the RPOs in the study area indicated that 71.7% of the RPOs in the study area were under the ownership of independent marketers. It was also deduced that all the RPOs were unevenly distributed across different routes in the study area with Okene Road having the highest concentration with 13 RPOs. It was inferred that most of the RPOs in the study area are moderately sized judging from the number of pumping bays at individual RPOs with 84.9% of the total number having 6 pumps or less.

Furthermore, results on the compliance of the RPOs to environmental laws and regulations in the study area were presented under the following categories of stormwater management practices, soil and groundwater management practices, wastewater management practices and general waste management practices. Results reveal that 98.3% of the surveyed RPOs had concreted forecourt. However compliance was low in other categories as only 18.3% of the RPOs had monitoring procedures to detect leakages from underground storage tanks (USTs). Similarly, 95% of the RPOs were not compliant to the provision against the discharge of liquid waste into public gutters.

General compliance was adjudged to be generally low, but an analysis of the compliance by ownership categories revealed that RPOs owned by independent marketers generally performed poorly, the stations owned by major marketers generally performed well.

Data was collected on the factors militating against compliance of RPOs to environmental regulations under the factors of knowledge feasibility, capital adequacy, and technical feasibility and monitoring and enforcement practices. Analysis of the data collected reveal that knowledge feasibility, capital adequacy and technical feasibility among the RPOs was generally low as 37.4% of the respondents agreed to a little extent that RPO employees are regularly educated on compliance to environmental regulations. Also, 33.6% of the respondents also agreed to a little extent that the management of RPOs avails resources to implement required regulations. It was also revealed that the monitoring and enforcement practices of the relevant regulatory body were generally weak as 30.9% of the respondents completely disagreed that the regulatory body monitors implementation of regulations.

The findings indicated that knowledge feasibility of the employees of RPOs was generally low; however contribution of employees to compliance was adjudged to be high. The capital adequacy of RPOs was adjudged to be low judging from the responses and the sizes of the RPOs in the study area. Monitoring and enforcement was weak as sanctions were not placed on defaulters and potential violators were not deterred from violating again. Under the monitoring and enforcement practices, it was also discovered that monitoring and enforcement was weak, this is particularly due to the response scores obtained which signifies weak monitoring activities by the regulatory body, also absence of incentives to promote compliance among RPOs. The findings of this study also indicated that capital adequacy of the RPOs had a major role to play in the environmental compliance of the RPOs as a cross tabulation analysis indicated a strong relationship between capital adequacy and technical feasibility, monitoring and enforcement practices and knowledge feasibility among the RPOs in the study area.

### 5.2 Conclusion

RPOs have been regarded as an integral part of the modern society for its role in meeting the energy demands of an oil-dependent society. They are indispensable in their roles as sales point for petroleum based energy products like kerosene, petrol, diesel, cooking gas etc. and in recent times have diversified into the provisions of service like automobile lubrication, automobile repairs, car wash, and retailing activities carried out at convenience stores onsite. Despite their importance to the society however, RPOs generally have the potentials for degrading the environment where they are localized. Due to this, their operations are expected to be guided by a defined set of environmental laws and regulations. The results of this study indicate that majority of the RPOs in the study area like most parts of the country are under the ownership of independent marketers. The result of an assessment of the compliance of RPOs to environmental laws and regulations in Lokoja Metropolis exposes a gap between compliance imperatives and the present status of compliance in the study area. Non-compliance of the RPOs exposes the environment to heightened risk of air, soil, and groundwater pollution. The low compliance rates observed in the study can be tied to weak enforcement and monitoring activities by the regulatory body, inadequate technical and knowledge feasibility and capital adequacy of the organizational structure of the RPOs.

### 5.3 Recommendations

On the basis of the findings of this research, the following recommendations are made

1. The level of awareness of employees at the RPOs to environmental laws and regulations guiding the operation of their facilities was generally low. This is a major

determinant of compliance. Hence, DPR should make education and sensitization of the employees at RPOs a priority.

2. Monitoring and enforcement of regulations was considered to be low, as emphasis was not placed on environmental concerns by the primary regulatory bodies in the study area. Programs to establish relationships between enforcement program personnel and managers of regulated facilities should be put in place by DPR.
3. The magnitude of environmental issues/provision contained in the EGASPIN can be considered to be overwhelming for a single document. Thus some vital requirements for environmental management RPOs are missing. Guidelines on specific aspects of environmental management at RPOs should be developed by DPR and National Environmental Standards and Regulations Enforcement Agency (NESREA) should thus be made to take care of these deficiencies.
4. The relevant technologies required at the RPOs should be made available by DPR and incentives should be granted to RPOs in a bid to encourage compliance in the study area.

## REFERENCES


Abdullahi, Y.R., Alkali, R.G. and Mustapha, I.J. (2012). The role of environmental impact assessment in the environmental performance of filling stations in Kaduna Metropolis. Retrieved February 8, 2015 from www.researchgate.net/publication/267213582

Afolabi, O.T., Olajide, F.O. and Omotayo, S.K. (2011). Assessment of safety practices in filling stations in Ile-Ife, South Western Nigeria. *Journal of Community Medicine and Primary Health Care*, 23(1):9-15.

Agha, G.U., Irrechukwu, D.O. and Ziga, M.M. (2004). The development of environmental guideline and standard for the petroleum industry in Nigeria: a systematic approach and future challenges. In Proceedings of the 7th Society for Petroleum Engineers International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production: SPE Conf. Paper 88640-MS.

Agusto and Co. Limited (2008). Industry report: Downstream oil and gas. Retrieved May 18, 2016, from http://s3.amazonaws.com/zanran_storage/Content

Aina, E.O. (1991). *The Making of the Nigerian Environmental Policy*. (Monograph). Ibadan University Press. pp. 17-25.

Akinlo, E.A. (2012). How important is oil in Nigeria's economic growth? *Journal of Sustainable Development*, 5(4):165-179.

Alabi, M.O. (2009). Urban sprawl, pattern and measurement in Lokoja, Nigeria. *Theoretical and Empirical Researches in Urban Management*, 13(4):45-53.

Alabi, M.O. and Enete, I.C. (2012). Using multi-criteria decision model and GIS to determine land suitability for development purposes in Lokoja, Kogi State, Nigeria. *Journal of Environmental Management and Safety*, 3(4):111-123.

Alaci, D.S.A, and Chup, C.D. (2015). Reflecting on green urbanism for sustainable urbanization in Nigeria. *Journal of Contemporary Urbanology*, 2(1):11-21.

Al-Salem, S.M. and Khan, A.R. (2010). Monitoring and modelling the trends of primary and secondary air pollution precursors: The case of the state of Kuwait. *International Journal of Chemical Engineering*, 12(2):1-12. doi:10.1155/2010/879836.

Ambituuni, A., Amezaga, J. and Emeseh, E. (2014). Analysis of safety and environmental regulations for downstream petroleum industry operations in Nigeria: problems and prospects. *Environmental Development*, 9(2):43-60.

Australia EPA (2003). *Environmental risk management at retail fuel outlets*. Victoria: Author.

Ayodele, S.J. (2011). Spatial distribution of petroleum filling station in kaduna North. Retrieved on 5th May, 2016 from www.srib.com/samuel_ayodele1

Babayemi, J.O. and Dauda, K.T. (2009). Evaluation of solid waste generation, categories and disposal options in developing countries: A case study of Nigeria. *J. Appl. Sci. Environ. Manage*, 13(3) :83-88.

Bainbridge, R. (2000). Analyzing the market for convenience stores: The changing convenience store industry. *Appraisal Journal*, 68(4):427-432.

Bank of Industry (2017). Micro small and medium scale enterprise. Accessed November 2, 2017 from www.boi.ng/smedefinition

Blamah, N.V., Vivan E.L., Tagwi M.U. and Ezemokwe, I.U. (2012). Locational impact assessment of gasoline service stations along Abuja-Keffi Road and environs in Karu, Abuja, Nigeria. *Journal of Environmental Management and Safety,* 3(5):106-123.

Campos-Candel, A., Llobat-Estellés, M. and Mauri-Aucejo, A.R. (2007). Desorption of BTEX from activated charcoal using accelerated solvent extraction: Evaluation of occupational exposures. *Journal of Biochemistry*, 387(1):1517–1523.

Chan, T., Padmanabhan, V. and Setharaman, P. (2005). *Modelling locations and pricing decisions in the gasoline market: A structural approach*. Retrieved January 12, 2008 from: http://www.olin.wustl.edu/workingpapers/pdf/2005-08-018.pdf

Cohen, M. (1998). Monitoring and Enforcement of Environmental Policy. In T. Tietenberg and H. Folmer, (Eds.), *International Yearbook of Environmental and Resource Economics.*

Davidson, R.D., Courage, C. and Rushton, L. (2001). Benzene in the Environment: An Assessment of the Potential Risks to the Health of the Population. *Occup Environ Med*, 58(1):2-13.

De Sousa, T.B. (2015). Environmental Impacts Management of a Brazilian Gas Station: A Case Study. *Global Journal of Researches in Engineering: Industrial Engineering*, 15(3):23-32.

Department of Environment and Climate Change (2001). *Environmental action for petrol service station*s. Sydney South: Author.

Department of Petroleum Resources (2002). *Environmental guidelines and standards for the petroleum industry in Nigeria (EGASPIN)*. Lagos: Author.

Department of Petroleum Resources (2016). List of retail petrol stations in Lokoja. Obtained from Department of Petroleum Resources field office, Lokoja, Kogi state.

Dukiya, J.J. and Okhimamhe, A.A (2013). Spatial analysis of political capital citation using remote sensing and GIS; a case study of Lokoja. *Ethiopian Journal of Environmental Studies and Management,* 6(3):333-341.

Ehinomen, C. and Adeleke, A. (2012). An assessment of the distribution of petroleum products in Nigeria, *Journal of Business Management and Economics*, 3(6):232-241.

Energy Information Administration (EIA). (2012). *Annual energy review 2011*. US Energy Information Administration, DOE/EIA-0384(2011).

Enger, E.D. and Smith F.B. (2006). *Environmental science: a study of interrelationship*. (10th ed.). McGraw Hill. New York

European Fuel Oxygenates Association (1999). *Guidance for the Design, Construction, Modification and Maintenance of Petrol Filling Stations*. Retrieved July 4, 2006 from http://www.efoa.org

Fadeyibia, I.O., Jewob, P.I., Opoolaa, P., Babalolaa, O.S., Ugburoc, A. and Ademiluyia, S.A. (2011). *Burns and fire disaster from leaking petroleum pipes in Lagos, Nigeria: an 8 year experience*. Burns 37, 145-152.

Fang, L., Kilgour, D.M. and Hipel, K.W. (2012). Compliance models for enforcement of environmental laws and regulations. *Conflict Resolution*. 2 (1):47-54.

Friedman, E.J. (1978). *Encyclopaedia of Real Estate Apprising*. Third Edition. Englewood Cliffs, N.J. pp.1283-1299.

Gonzalez-Flesca, N., Vardoulakis, S. and Cicollella, A. (2002). BTX concentration near stage II implemented petrol station. *Environmental and Resource Management*. 9(2):169-174.

Gray, W and Shadbegian, R. (2005). When and why do plants comply? Paper mills in the 1980s. *Law and Policy*, 27(2):238-261.

Gunningham, N.A., Kagan, R.A. and Thornton, D. (2005). Social license and environment protection: Why businesses go beyond Compliance, *Law & Social Inquiry*, 29(2):307-41.

Hanekom, P. (2001). *Guidelines for the Construction and Upgrade of Filling Stations and Associated Tank Installations.* Agricultural, Conservation, Environmental and Land Affairs.

Harwood J. (2006). Life beyond petrol. *Marketing Week*, pp. 24-33

Haveman, P. (1992). Public Participation International Best Practice Principles. *International Association of Impact Assessment*. 12(2):48-49.

Heyes, A. (2000). Implementing environmental regulation: enforcement and compliance. *Journal of Regulatory Economics*, 17(2):107-129.

Institute of Petroleum (2002). *Guidelines for soil, groundwater and surface water protection and vapour emission control at retail petrol stations.* London: Author.

International Network for Environmental Management and Environmental Compliance (2009). *Principles of Environmental Compliance and Enforcement Handbook.* Retrieved July 5, 2016 from http://www.epa.gov/nscep/

Iwayemi, A. (2008). Nigeria's dual energy problems: policy issues and challenges. International Association for Energy Economics. 31st IAEE International Conference, Istanbul, Turkey, June 18-20.

Jo, J.A.G and Durwood, Z. (2005). The importance of international environmental enforcement networks: INECE as an example. *Environmental Law network international review*, 2(1):13-21.

Kagan, R.A. & John T.S. (1984). The Criminology of the Corporation and Regulatory Enforcement Styles. In Enforcing Regulation. Edited by K.Hawkins & J.Thomas. Boston: Kluwer-Nijhoff.

Kanyi, J. (2015). *Factors affecting environmental best practice compliance among retail fuel service stations in Thika east sub county, Kenya*. (Master's dissertation, University of Nairobi, Kenya).

Krejcie, R. and Morgan, D.W. (1970*). Determining sample size for research activities.* Educational and psychology measurement, pp. 608.

Lan, J. and Munro, A. (2012). *Environmental compliance and human capital: evidence from Chinese industrial firms*. GRIPS discussions paper 12-05. National Graduate Institute for Policy Studies, Japan.

Lawal, M.O. (2005). The geographical location of retail outlets/service stations in the Nigerian petroleum industry. *Indonesian Journal of Geography*. (37)2:103-111.

Matsho, J. (2010). *The Retail Petrol Industry in South Africa.* (Master's dissertation, University of Zululand, South Africa).

Mbhele, P.P. (2007). *The Remediation of Soil and Water Contaminated by Heavy Metals and Hydrocarbons Using Silica Encapsulation*. (Master's dissertation, University of Witwatersrand, South Africa).

McHugh, T.E., Rauch, S.R., Paquette, S.M., Connor, J.A. and Daus, A.D. (2015). Life cycle of Methyltert-Butyl Ether in California public water supply wells. *Environ. Sci. Technol. Lett*, 2(1):7−11.

Mintzberg, H. (1991). The Structuring of Organizations, Prentice-Hall, New York.

Mitchell, R.B. (1996). Improving Compliance with International Environmental Law, 1996 pp. 3-28.

Monney, I., Dramani, J.B., Aruna, A., Tenkorang, A.G. and Osei-Poku, F. (2015). Health and safety in high-risk work environments: A study of fuel service stations in Ghana. *Journal of Environmental and Occupational Science*, 4(3):132-140. DOI: 10.5455/jeos.20150903100137

Moschini, L.E., dos Santos, J.E. and Pires, J.S.R. (2005). Environmental diagnosis of risk areas related to gas stations. *Brazilian Archives of Biology and Technology*. 38(4): 657-666,

Mshelia, A.M., John. A. and Emmanuel, D.D. (2015). Environmental Effects of Petrol Stations at close Proximities to Residential Buildings in Maiduguri and Jere, Borno State, Nigeria. *IOSR Journal of Humanities and Social Science,* 20(4):1-8.

National Population Census (2006). Kogi state population gazette. Issued by the National Population Commission, Nigeria.

Netz, J. and Taylor B. (2002). Maximum or minimum differentiation? Location patterns of retail outlets. *Review of Economics and Statistics*, 84(1):162-182.

Nieminen, P.M. (2005). *Environmental protection standards at petrol stations: a comparative study between Finland and selected European countries*. (PhD thesis, Tempere University of Technology, Finland).

NNPC (2010). Annual statistical Bulletin. Lagos: Author.

NNPC (2015). Annual statistical Bulletin. Lagos: Author.

OECD (2007). Small businesses and environmental compliance. Review and possible application of international experience in Georgia. Paris: Author.

Ogbodo, S.G. (2009). Environmental protection in Nigeria: two decades after the Koko incident. *International Law,* 15(1):169-181.

Ogundahunsi, D. S. (2014). Locational analysis of fuel stations, in Ilesa, Osun State, Nigeria. *International Journal of Development Strategies in Humanities, Management and Social Sciences*. 4(2):245-258.

Okonkwo, U.C., Orji, I.N. and Onwuamaeze, I. (2014). Environmental impact assessment of petrol and Gas filling stations on air quality in Umuahia, Nigeria. *Global Journal Of Engineering Research,* 13(1):11-20. DOI: http://dx.doi.org/10.4314/gjer.v13i1.2

Oladepo, O.W., Ilori, M.O. and Taiwo, K.A. (2014). Assessment of the waste generation and management practices in Nigerian food industry: towards a policy for sustainable approaches. *American Journal of Scientific and Industrial Research,* 6(1):12-22.

Olokesusi, F. (1992). Environmental impact assessment in Nigeria; current situations and direction for the future. *Journal of Environmental Management*, 35(3):163-171.

Olorunfemi, S.O., Eke, E., Chukwuemeka, A.E. and Eno, E.O. (2014). Performance assessment of motorcycle operation as a means of urban mobility in Lokoja, Nigeria. *Journal of Transportation Technologies*, 18(1):83-109.

Olukoya, E.O., Ana, G.R.E.E. and Oloruntoba, E.A. (2016). Assessment of soil contamination with monocyclic aromatic hydrocarbons and heavy metals in residential areas sited close to fuel filling stations in Ibadan Metropolis. *Journal of Environment Pollution and Human Health.* 4(3):60-65.

Oluleye, O. (2014). *Deregulation of the downstream petroleum sub –sector. The journey so far*. Paper presented at a seminar organized for the Executives of CBN at kwara Hotel, October, 2004.

Omali, A.O (2014). Hydrogeophysical investigation for groundwater in Lokoja Metropolis, Kogi State, Central Nigeria. *Journal of Geography and Geology*, 6(1):147-161.

Periago, J.F., Zambudio, A. and Prado, C. (1997). Evaluation of environmental levels of aromatic hydrocarbons in gasoline service stations by gas chromatography. *Journal of Chromatography*, 7(78):263–268.

Plaza, G.A., Wypych, J., Berry, C. and Brigmon, R.L. (2006). Utilization of monocyclic aromatic hydrocarbons individually and in mixture by bacteria isolated from petroleum contaminated soil. *World J Microbiol Biotechnol*, 12(3):1211-1312.

Reid, K. (2004). Leveraging Convenience. *National Petroleum News*. Pg. 11-26

Rocha, S.P.B., Soares, E.J.O. and Medeiros, D.D. (2011). A model for evaluating environmental impacts in gas stations. *Management of Environmental Quality,* 22 (6): 803-825.

Rogers, E. (2003). *Diffusion of Innovations*. 5th ed. The Free Press, New York USA.

Russel, C.S. (1990). Public Policies for Environmental Protection. Prentice-Hall, New York.

Salihu, A.C., Nabegu, A.B., Abdulkarim, B. and Mustapha, A. (2016). Analysis of the factors affecting facilities compliance to environmental regulations in Minna, Niger state, Nigeria. *World Scientific News,* 45(2):174-184.

Samuel, B.A, Ogoro, M. and Amanoritsewo, O.J. (2015). Petrol filling stations' location and minimum environmental safety requirements in Obio Akpor LGA, Nigeria. *International Journal of Scientific Research and Innovative Technology,* 2(11):2313-3759.

Sartorius, K., Eitzen, C. and Hart, J. (2007). *Examination of the variables influencing the fuels retail industry.* University of Witwatersrand, South Africa. ACTA commercii 2007.

Selznick, P., (1985). *Focusing organizational research on regulations*. Regulatory policies and social sciences. R.G Noll (Ed.) 363.

Shukla, A., Pekny, J. and Venkatasubramanian, V. (2011). An optimization framework for cost effective design of refuelling station infrastructure for alternative fuel vehicles. *Computers and Chemical Engineering,* 35(8):1431-1438.

Smalley, S. (1999). Measuring convenience of gas stations. *Appraisal Journal,* 12(11):339-347.

South Australian EPA (2015). *Retail petrol stations guidelines. An assessment of retail petrol stations*. Adelaide: Author.

Sparrow, M.K. (2000). The Regulatory Craft: Controlling Risks, Solving Problems, and Managing Compliance. pp. 346.

Steinemann, A. (2008). Improving alternatives for environmental impact assessment. *Environmental Impact Assessment Review,* 21(1):3–21.

Uba, G. (2013). *Investing in Petrol Marketing Business*. This Day Live Accessed from http://www.thisdaylive.com/articles/investing-in-petrol-marketing-business/159167/

Uchegbu, S.N. (2002). *Environmental Management and Protection*. Spotlite Publishers, pp. 113-114.

Ukoje, J.E. (2016). Impacts of rapid urbanisation in the urban fringe of Lokoja, Nigeria. *Journal of Geography and Regional Planning*. 9(10):185-194. DOI: 10.5897/JGRP2016.0591

Ukoje, J.E., Makanjuola, M.I. and Oluleye, E.K. (2014). Analysis of urban expansion and Land Use/Land Cover change in Lokoja, Nigeria. Paper presented at the second regional conference on remote sensing and geographical information systems applications: space based technology for disaster management and mitigation, held at the Federal University Lokoja, Kogi State, Nigeria. November 10th-13th, 2014.

Vivan, E.L., Leo, D. and Ekpo, C.G. (2013). Impact assessment of the operation of petrol stations on the socio-economic environment of Karu, Nasarawa State, Nigeria. *Journal of Environmental Management and Safety*, 4(1):106-119.

Vives, A. (2006). Social and environmental responsibility in small and medium enterprises in Latin America. *The Journal of Corporate Citizenship*, 12(1):39-50.

Weirauch W. (2000). Fuel retailing is changing in Europe. *Hydrocarbon Processing*, 9(1):12-22.

World Health Organization (WHO). (2010). “Why urban health matters”, Geneva Switzerland, http://www.cbsnews.com/stories, 2010.

Yunusa, A.M., Nabegu, A.B. and Yusuf, R.O. (2016). Assessment of the constraints in the environmental management plan of filling stations in Kaduna metropolis, Nigeria. *World Scientific News*. 56(1):178-188.

**Appendix I**

**DEPARTMENT OF GEOGRAPHY**
**AHMADU BELLO UNIVERSITY, ZARIA**
**QUESTIONNAIRE SURVEY**
**Station managers/supervisors**

Dear Respondent,

My name is Dauda Awwal and I am undertaking a thesis as part of my M.Sc. in Environmental Management at Ahmadu Bello University, Zaria. My research seeks to investigate the compliance of retail petrol stations to environmental regulations in Lokoja, Kogi state. This research is for academic purposes and the information provided will be treated with absolute confidentiality.

**Section A: General Information**

1. What is your highest educational qualification?

   (a) Primary school cert. (b) Secondary school cert. (c) Tertiary institution cert.

2. How long have you been working in this petrol station?

   (a) Less than 1 year (b) 1-5 years (c) 6 -10 years (d) over 15 years

3. How long has this petrol station been in operation?

   (a) Less than 1 year (b) 1-5 years (c) 6-10 years (d) over 15 years

4. What is the general appearance of the petrol station?

   (a) Very good (b) Good (c) Poor (d) Very poor

**Section B: Environmental Management Practices**

5. Are you aware of the environmental laws and regulations relating to your operation?

   (a) Yes (b) No

6. If yes, which of the regulations are you conversant with?

   ………………………………………………………………………………………
   ………………………………………………………………………………………

7. How often do you regularly monitor oily discharge and stormwater drainage?

   (a) Weekly (b) Monthly (c) Yearly (d) Never

8. How often do you conduct environmental compliance audit?

    (a) Monthly (b) Quarterly (c) Yearly (d) Bi-annually

**Section C: Factors that Influence the environmental compliance of retail petrol outlets**

Below are statements to identify that factors that influence your compliance to environmental regulations. Please indicate the extent to which you agree to each.

### Technical Feasibility

**1= Not at all, 2= little extent, 3= Moderate extent, 4= Great extent, 5= Very great extent.**

| Statements | Response ratings | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| The station has employed skilled workers to manage oil products | | | | | |
| The stations employees advice the management on the requirements of compliance | | | | | |
| The stations staff contribute positively to compliance to regulations | | | | | |
| The stations staff are regularly educated on compliance to regulations | | | | | |
| The fuel station is responsible for financing the education of staff | | | | | |
| The station has an Environmental Management Plan for achieving compliance | | | | | |

### Capital Adequacy

**1= Not at all, 2= little extent, 3= Moderate extent, 4= Great extent, 5= Very great extent.**

| Statements | Response ratings | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| The management has adequate finance resource to implement regulations | | | | | |
| The management avails resources to implement required regulations | | | | | |
| The station has enough finance to invest in an environmental compliant station | | | | | |
| The station has enough funds to employ qualified staff | | | | | |

### Monitoring and Enforcement Practices

**1= Not at all, 2= little extent, 3= Moderate extent, 4= Great extent, 5= Very great extent.**

| Statements | Response ratings | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| The regulatory body place emphasis on environmental concerns | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| The regulatory body monitor implementation of environmental regulation | | | | | |
| Sanctions are placed on environmental defaulters | | | | | |
| Incentives are granted to environmental compliant stations | | | | | |

## Technical feasibility

**1= Not at all, 2= little extent, 3= Moderate extent, 4= Great extent, 5= Very great extent.**

| **Statements** | **Response ratings** | | | | |
|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** |
| The regulatory body recommends best available technology for environmental management. | | | | | |
| It is easy to acquire relevant technology for environmental management | | | | | |
| The technological equipment used in the petrol station is state of the art. | | | | | |
| The best available technology for environmental management is used in the petrol station. | | | | | |

*Thank you for participating*

**Appendix II**

**DEPARTMENT OF GEOGRAPHY**
**AHMADU BELLO UNIVERSITY, ZARIA**
**QUESTIONNAIRE SURVEY**
**Pump attendants/station workers**

Dear Respondent,

My name is Dauda Awwal and I am undertaking a thesis as part of my M.Sc. in Geography, specializing in Environmental Management at Ahmadu Bello University, Zaria. My research seeks to investigate the compliance of retail petrol stations to DPR standards on best environmental practice in Lokoja, Kogi state. This research is for academic purposes and the information provided will be treated with absolute confidentiality.

**Section A: Personal Information**

1. What is your highest educational qualification?

   (b) Primary school cert. (b) Secondary school cert. (c) Tertiary institution cert.

2. How long have you been working in this petrol station?

   (b) Less than 1 year (b) 1-5 years (c) 6 -10 years (d) over 15 years

**Section B: Awareness to Environmental regulations**

3. Are you aware of the environmental laws and regulations relating to your operation?

   (a) Yes (b) No

4. If yes, which of the regulation are you conversant with?

   ……………………………………………………………………………………………

**Section C: Factors that Influence Compliance to BEP**

Below are statements to identify that factors that influence your compliance to environmental regulations. Please indicate the extent to which you agree to each.

**Skill Competence**

**1= Not at all, 2= little extent, 3= Moderate extent, 4= Great extent, 5= Very great extent.**

| **Statements** | **Response ratings** | | | | |
|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** |
| The station has employed skilled workers to manage oil products | | | | | |
| The stations employees advice the management on the requirements of compliance | | | | | |
| The stations staff contribute positively to compliance to regulations | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| The stations staff are regularly educated on compliance to regulations | | | | | |
| The fuel station is responsible for financing the education of staff | | | | | |
| The station has an Environmental Management Plan for achieving compliance | | | | | |

## Capital Adequacy

**1= Not at all, 2= little extent, 3= Moderate extent, 4= Great extent, 5= Very great extent.**

| **Statements** | **Response ratings** | | | | |
|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** |
| The management has adequate finance resource to implement regulations | | | | | |
| The management avails resources to implement required regulations | | | | | |
| The station has enough finance to invest in an environmental compliant station | | | | | |
| The station has enough funds to employ qualified staff | | | | | |

## Monitoring and Enforcement Practices

**1= Not at all, 2= little extent, 3= Moderate extent, 4= Great extent, 5= Very great extent.**

| **Statements** | **Response ratings** | | | | |
|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** |
| The regulatory body place emphasis on environmental concerns | | | | | |
| The regulatory body monitor implementation of environmental regulation | | | | | |
| Sanctions are placed on environmental defaulters | | | | | |
| Incentives are granted to environmental compliant stations | | | | | |

## Technological Advancement

**1= Not at all, 2= little extent, 3= Moderate extent, 4= Great extent, 5= Very great extent.**

| **Statements** | **Response ratings** | | | | |
|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** |
| The regulatory body recommends best available technology for environmental management. | | | | | |
| It is easy to acquire relevant technology for environmental management | | | | | |
| The technological equipment used in the petrol station is state of the art. | | | | | |
| The best available technology for environmental management is used in the petrol station. | | | | | |

*Thank you for participating*

**Appendix III**

## Observational checklist

1. Location of the Retail Petrol outlet:________________________________________
2. Ownership category:_____________________________________________________
3. Number of pumping bays:________________________________________________
4. Petroleum products sold:_________________________________________________
5. Service facilities onsite:_________________________________________________

| **Environmental management indicators** | **Yes** | **No** |
|---|---|---|
| **Stormwater Management Practice** | | |
| Presence of stormwater drains on and around the premises of the stations | | |
| Presence of concrete forecourt (fuel dispensing area) | | |
| Availability of spill kits onsite | | |
| Presence of oily residue on drains | | |
| Presence of petroluem products spill prevention and countermeasurers plan | | |
| **Soil and groundwater management practices** | | |
| Evidence of ground contamination anywhere on the site | | |
| Presence of monitoring procedures to detect leakages from underground storage tanks | | |
| Presence of groundwater monitoring wells | | |
| Presence of spill management plan | | |
| Records of periodic checks for water /sludges in tanks | | |
| **Waste water management practices** | | |
| Presence of oil/water seperator onsite | | |
| Release of wastewater into public gutters/drains | | |
| **Air quality management practices** | | |
| Presence of vapour recovery system for fuel deliveries | | |
| Presence of vapour recovery piping for fuel dispensing activities | | |
| Systems in place to stop pollutants leaving the premises | | |
| **Waste management practices** | | |
| Refuse containers for the recovery of oily rags, empty oil cans etc. | | |
| Differential segregation of wastes such as spent lubricants. | | |

## Appendix IV

Cronbach's Alpha reliability Test Statistics for Likert Scale Items

**Reliability Statistics**

| Cronbach's Alpha | N of Items |
|---|---|
| .833 | 18 |

**Item-Total Statistics**

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| KF1 | 48.3500 | 65.823 | .442 | .824 |
| KF2 | 48.5500 | 65.638 | .487 | .821 |
| KF3 | 48.2500 | 69.423 | .320 | .829 |
| KF4 | 48.8750 | 63.907 | .611 | .814 |
| KF5 | 48.2500 | 61.679 | .634 | .812 |
| KF6 | 48.7750 | 66.692 | .412 | .825 |
| CA1 | 48.2500 | 65.936 | .489 | .821 |
| CA2 | 48.6500 | 69.310 | .319 | .829 |
| CA3 | 48.3750 | 67.163 | .375 | .827 |
| CA4 | 48.4750 | 71.692 | .117 | .839 |
| ME1 | 48.6000 | 62.810 | .551 | .817 |
| ME2 | 48.7750 | 65.615 | .538 | .819 |
| ME3 | 48.7500 | 67.731 | .424 | .825 |
| ME4 | 49.3000 | 63.344 | .606 | .814 |
| TF1 | 47.9500 | 70.510 | .180 | .837 |
| TF2 | 48.8250 | 67.328 | .467 | .823 |
| TF3 | 48.6000 | 70.400 | .230 | .833 |
| TF4 | 48.6250 | 68.035 | .355 | .828 |

KF= Knowledge feasibility

CA= Capital Adequacy

ME= Monitoring and enforcement Practices

TF= Technical Feasibility

**Appendix V**

**Crosstab Results Output**

**Capital Adequacy * Knowledge Feasibility**

**Chi-Square Tests**

| | Value | df | Assymp. Sig (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 875.692[a] | 16 | .000 |
| Likelihood Ratio | 679.718 | 16 | .000 |
| Linear-By-Linear Association | 254.019 | 1 | .000 |
| N of valid cases | 265 | | |

a. 8 cells (32.0%) have expected count less than 5. The minimum expected count is 1.41

**Symmetric Measures**

| | | Value | Approx. Sig. |
|---|---|---|---|
| Nominal by Nominal | Phi | 1.818 | .000 |
| | Cramer's V | .909 | .000 |
| N of Valid Cases | | 265 | |

**Capital Adequacy * Monitoring and Enforcement Practices**

**Chi-Square Tests**

| | Value | df | Assymp. Sig (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 485.760[a] | 16 | .000 |
| Likelihood Ratio | 456.452 | 16 | .000 |
| Linear-By-Linear Association | 217.806 | 1 | .000 |
| N of valid cases | 265 | | |

a. 9 cells (36.0%) have expected count less than 5. The minimum expected count is .66

**Symmetric Measures**

| | | Value | Approx. Sig. |
|---|---|---|---|
| Nominal by Nominal | Phi | 1.354 | .000 |
| | Cramer's V | .677 | .000 |
| N of Valid Cases | | 265 | |

**Capital Adequacy * Technical Feasibility**

**Chi-Square Tests**

| | Value | df | Assymp. Sig (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 555.114[a] | 16 | .000 |
| Likelihood Ratio | 475.453 | 16 | .000 |
| Linear-By-Linear Association | 222.344 | 1 | .000 |
| N of valid cases | 265 | | |

a. 9 cells (36.0%) have expected count less than 5. The minimum expected count is 1.25

**Symmetric Measures**

| | | Value | Approx. Sig. |
|---|---|---|---|
| Nominal by Nominal | Phi | 1.447 | .000 |
| | Cramer's V | .724 | .000 |
| N of Valid Cases | | 265 | |

**APPENDIX VI: RPOs in Lokoja Metropolis**

| S/No | Name of station | Address (route) | Functional status | Category |
|---|---|---|---|---|
| 1 | Lati and Associates Ltd. | Ganaja road | Not functional | IPM |
| 2 | Emmaliz Enterprise Ltd. | Ganaja road | Functional | IPM |
| 3 | TOTAL | Ganaja road | Functional | MM |
| 4 | A.G. Nasa Petroleum Ltd. | Ganaja road | Not functional | IPM |
| 5 | Diato Oil Ltd. | Ganaja road | Functional | IPM |
| 6 | TEXACO | Ganaja road | Not functional | MM |
| 7 | Samy Investment Resource | Ganaja road | Functional | IPM |
| 8 | NNPC | Ajaokuta road | Functional | AS |
| 9 | Mohibra Investment Ltd. | Ajaokuta road | Functional | IPM |
| 10 | Shalom Oil and Gas Ltd. | Ajaokuta road | Not functional | IPM |
| 11 | NNPC | Ajaokuta road | Functional | AS |
| 12 | Alternative Impression Ltd. | Ajaokuta road | Not functional | IPM |
| 13 | Manajot Nigeria Ltd. | Ajaokuta road | Functional | IPM |
| 14 | Solag Resource Ltd. | Ajaokuta road | Functional | IPM |
| 15 | Moharco Oil and Gas | Ajaokuta road | Not functional | IPM |
| 16 | Steadfast Petroleum Ltd. | Ajaokuta road | Functional | IPM |
| 17 | TOTAL | Ganaja road | Functional | MM |
| 18 | NNPC | Ganaja road | Functional | IPM |
| 19 | Richidolas Petroleum | Ganaja road | Functional | IPM |
| 20 | M.S.S Budan Nigeria Ltd. | Ganaja road | Functional | IPM |
| 21 | Khasaru Nigeria Ltd. | Ganaja road | Functional | IPM |
| 22 | Dokkalhairu Investment | Murtala Mohammed way | Functional | IPM |
| 23 | Yisab Oil and Gas | Murtala Mohammed way | Functional | IPM |
| 24 | OANDO | Murtala Mohammed way | Functional | MM |
| 25 | FORTE OIL | Murtala Mohammed way | Functional | MM |
| 26 | TOTAL | Murtala Mohammed way | Functional | MM |
| 27 | MOBIL | Murtala Mohammed way | Functional | MM |
| 28 | Da’aro Petroleum Nig. Ltd. | Old market road | Functional | IPM |
| 29 | Afhat Investment Ltd. | Old market road | Functional | IPM |
| 30 | Masters Energy | Old market road | Functional | IPM |
| 31 | MRS | NATACO | Functional | MM |
| 32 | NNPC | NATACO | Functional | AS |
| 33 | AB Filling Station | NATACO | Functional | IPM |
| 34 | Alh. Mustapha and Sons | NATACO | Functional | IPM |
| 35 | NCEA Oil | NATACO | Not functional | IPM |
| 36 | Reception Service Pet. Ltd. | NATACO | Functional | IPM |
| 37 | Nisi Petroleum | NATACO | Functional | IPM |
| 38 | NIPCO Petroleum | NATACO | Functional | IPM |
| 39 | Biodun and Associates | NATACO | Functional | IPM |
| 40 | AYM Shafa Pet. Ltd. | NATACO | Functional | IPM |
| 41 | NNPC | NATACO | Functional | AS |
| 42 | CONOIL | Okene road | Functional | MM |
| 43 | Musa Mohd. & Co. Ltd. | Okene road | Functional | IPM |

| | | | | |
|---|---|---|---|---|
| 44 | Alasnu Nigeria Ltd. | Okene road | Functional | IPM |
| 45 | Habso Pet. and Co. Ltd. | Okene road | Functional | IPM |
| 46 | CONOIL | Okene road | Functional | MM |
| 47 | TOTAL | Okene road | Functional | MM |
| 48 | Manajot Nigeria Ltd. | Okene road | Functional | IPM |
| 49 | Soppavic Nigeria. Ltd. | Okene road | Functional | IPM |
| 50 | Bunvic Investment Ltd. | Okene road | Functional | IPM |
| 51 | Geug Petrol Station | Okene road | Not functional | IPM |
| 52 | OANDO | Okene road | Functional | MM |
| 53 | TOTAL | Okene road | Not Functional | MM |
| 54 | Forte Oil | Okene road | Functional | MM |
| 55 | Elyo Hazak Investment | Okene road | Functional | IPM |
| 56 | NNPC | Okene road | Functional | MS |
| 57 | Dejorab Ventures Ltd. | Stadium road | Functional | IPM |
| 58 | Toni Nig. Ltd | Barrack road | Functional | IPM |
| 59 | Biodun and Associates | Barrack road | Functional | IPM |
| 60 | C. Johnson Nigeria Ltd. | Barrack road | Functional | IPM |
| 61 | Manajot Nigeria Ltd. | Barrack road | Functional | IPM |
| 62 | Poosab Nigeria Ltd. | Barrack road | Functional | IPM |
| 63 | Emmaliz Oil | Barrack road | Functional | IPM |
| 64 | Biodun and Associates | Barrack road | Functional | IPM |
| 65 | Saklad Multi Concept | Barrack road | Not functional | IPM |
| 66 | Heroes Nigeria Ltd. | Barrack road | Functional | IPM |
| 67 | Mary Hovarex Co. Ltd | Barrack road | Not functional | IPM |
| 68 | NIPCO Petroleum | Barrack road | Not functional | IPM |
| 69 | Tunwunmi Ventures Ltd. | Barrack road | Functional | IPM |
| 70 | Blue Crown Investment Ltd. | Barrack road | Functional | IPM |
| 71 | Shalfab Pharm Ltd. | Barrack road | Functional | IPM |
| 72 | Alex Delly Investment Ltd. | Barrack road | Functional | IPM |

Source: Department of Petroleum Resources (2016)

IPM= *Independent Product Marketer*

MM= *Major Marketer*

AS= *NNPC Affiliate Station*

MS= *Mega Station*