

SECTION A: SCIENCE, TECHNOLOGY AND ENVIRONMENT

An Overview Of Environmental Impacts Of Illegal Crude Oil - Refining In Rivers State

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Abstract

Oil exploration and exploitation has been on-going in Rivers State and the entire Niger Delta since the mid-1950s. Crude oil since then has become the mainstay of Nigeria's economy. The continual exploration of crude oil in the areas has led to environmental degradation. The negligence of Government on the people, and negative externalities from the extraction process have also affected the sources of the livelihood of the locals badly. These have made the people to agitate for resource control and engage in militancy, kidnapping, pipeline vandalism, crude oil theft and illegal refining of crude oil. The local refining of crude has led to serious environmental consequences. The study is qualitative and exploratory in approach. Therefore, secondary data will form the basis of data collection through comprehensive relevant literature. The study highlights some reasons for illegal crude oil, operational stages of legal and illegal crude oil refining, and environmental pollution of the air, land and water. Suggestions are put forward to curtail the illicit practices of crude oil refining.

Key words: *Illegal, crude oil, environment, degradation, externalities.*

Introduction

Oil exploration and exploitation have been on-going in Nigeria since 1957 and oil is seen as the lifeblood of modern economy and has now become the most essential commodity in the world. Nigeria cannot survive without oil. Smil (2008) used the “lifeblood of modern world” having considered the importance of the commodity. Feyide (1986) aptly stated that; “oil is raw material as well as a convenient and effective source of energy. In the form of energy, it increases man’s capacity to get work done. As a raw material it provides the feedback for the fast-expanding industry in the world. All over the world the lives of people are affected, and the destinies of nations are probably determined by the results of oil industry operations. Oil keeps the factories of the industrialized nations working and provides the revenues which enable oil exporters to execute ambitious national and economic development plans.

Nigeria being a mono-economy nation, largely depends on the oil sector for its economic survival. The Nigerian economy is dependent on the exploitation of crude oil and the nation’s future is very much tied to the commodity (Okere, 2013). Indeed, oil and gas resources from the Niger Delta region accounts for over 90% Nigerian export and foreign exchange earnings, and over 70% of total revenue for the country (Ekuerhare, 2002). This informs Wilson (2012) to state that the increase or otherwise in crude oil production affects directly the revenue base and development programmes of the Nigerian state. Despite the importance attached to oil as the mainstay of the country’s economy, fetching millions of petrodollars to the country each day, the people of the Niger Delta still live in abject poverty. The people suffered enormous negative externalities engendered by oil extraction and production including oil spills and gas flaring which destroy the local livelihood (Ojo, 2010). This environmental degradation and food insecurity have predisposed the local people to fight for resource control. This agitation has led to militancy and continual demand for equitable oil revenue allocation from the topside Nigerian federation, and insistence on corporate social responsibility from the oil companies. From this point, the people started involving themselves in all forms of criminality such as kidnapping, pipeline vandalism, crude oil theft and illegal refining of crude oil. Crude oil refining has become one of the major economic activities in Rivers State. Based on this, this paper examines the environmental effects of crude oil refining in the state.

Study objective

The purpose of this study is to critically examine the environmental impacts of illegal crude oil refining in Rivers State with the following objectives:

1. Reasons for illegal crude oil-refining
2. Operational stages of refining crude oil
3. Operational procedure of refining illegal crude oil
4. Environmental impact of illegal crude oil refining.

Study area

Rivers State is located between 4°30’ – 5°30’N and longitude 6°40’ – 7°20’E (OSG 2014). The state is located in the Niger Delta region of Nigeria.

The total land area is approximately 10378 square kilometers. It has a total population of 5,198,716 and a population density of 501 persons per square kilometer (NPC, 2006).

The topography of the state which is part of the Niger Delta started about sixty-five million years ago. The predominant sequence of alluvial deposition in the delta basin is that of massive continental sandstones and shales (Adoki and Adoki, 1998). Generally, the economically exploitable petroleum deposits, being lighter and more gaseous, occur within the sandstone and shale sequence. The drainage of the state is synonymous with the drainage of the entire Niger Delta characterized by a maze of water ways, creeks and swamps criss-crossing the relatively low-lying plains. The nature of the drainage system in the state is complex. Water is discharged through mostly large and medium sized natural channels, although rills, rivulets and small perennial streams may be identified. The larger rivers such as Orashi, Otamiri/Imo River system, the Sombreiro, new Calabar River and the coastal creeks often have widths above 100 metres, especially at the middle of the lower courses (Adoki et al, 1998). According to Courante, Powell and Michael (1985), the Rivers State creek waters can be classified as brackish, lagoonal, tidal white, non- tidal white, tidal black, tidal clear, non- tidal clear and savannah waters. The state enjoys humid tropical climate considering the latitudinal location. The temperature averages 27°C. The annual range varies from 1°C to 3°C. Diurnal range is between 6°C and 8°C. It may be 8°C. It may be 8°C to 10°C in the dry season, especially during December to January and only 6°C in July – September when rainfall peaks are expected (Ede, 1995). Rainfall in the state is remarkably spatial in magnitude. This is determined by proximity to the coast and also by elevation. Rainfall stations such as Bonny, Opobo and Mbiama exhibit some highest values of between 3000mm and 4500mm (NDBDA, 2011). The soil of Rivers State is formed by the accumulation of sedimentary deposit transported by the Niger and Benue Rivers (World Bank, 1995). Soils of Rivers State have spatial characteristics. These range from soils of the coastal plain Terrace to Soils of the Beach-ridge zone. The vegetation of the state falls into three principal types; Mangrove swamp forest, fresh water swamp forest and lowland rainforest. All the types of vegetation in the state are economically viable and sustain the livelihood of the people.

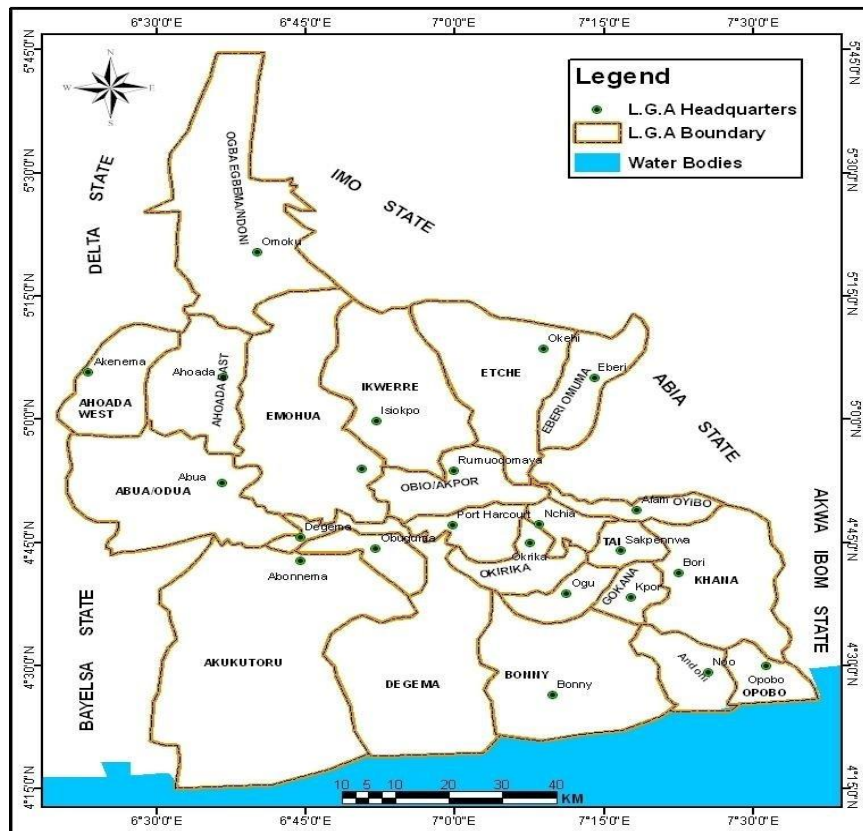


Figure 1: Map of Rivers State

Methodology

This study essentially focuses on the environmental impacts of illegal crude oil-refining in Rivers State. The study is qualitative and Exploratory in approach. To achieve the objective of this study, secondary data formed the basis of data collection, interpretation and analysis. Data were collected through a comprehensive review of relevant literature on the subject of inquiry. The thrust of analysis was systematically carried out under selected sub headings designed to address the salient aspect of the paper's objective.

Reasons for illegal crude oil-refining

According to Adegbite (2013), Igbuku (2014) and Mernyi (2014), there are many reasons for oil theft which later graduated to local crude oil-refining or artisanal-refining popularly known as "Kpo Fire" among the people, as a result of the explosion that often occurred. The reasons vary from the mundane to the absurd. They include:

- Poverty
- Ignorance
- Greed
- Lack of respect for national economic survival
- Get-rich syndrome
- Lack of gainful employment

- Exploiting the loopholes in the criminal justice system to circumvent the law
- Evolving culture of impunity from the wrong perception that some people are above the law
- Weak institutional structure to checkmate criminals
- Bad governance (corruption, incompetence)
- Community-industry expectation mismatch

As noted by Brock (2012), due to years of neglect, marginalization and underdevelopment of the Niger Delta by the Federal Government and the multinationals oil companies (MNCs) operating in the region, there are different organized groups of oil-theft.

Operational stages of refining crude oil

Crude oil needs to be processed before it can be used. In the refineries, three major types of operations are performed to refine the oil into finished products. These include; separation, conversion and treating.

Separation

This is the first stage where molecules are separated through atmospheric pressure according to their molecular weight. During the process which is known as topping, the oil is heated at the bottom of a 60-metre distillation column at a temperature of 350 to 400°C, causing it to vapourize. The vapours rise inside the column while the heaviest molecules, or residuals remain at the bottom without vapourizing. As the vapours rise, the molecules condense into liquids at different temperatures in the column. Only gases reach the top where temperature has dropped to 150°C. The liquids found in the columns are collected on trays located at different heights of the column. Each tray collects different petroleum cut with highly viscous preservation hydrocarbons like asphalt bitumen at the bottom and gases at the top. The heavy residuals left over after atmospheric distillation still contain many products of medium density. The residuals are transferred to another column where they undergo a second distillation to recover middle distillates like heavy fuel oil and diesel.



Plate 1: Legal refinery

Conversion

After separation, more heavy hydrocarbon molecules are left behind. To meet demand for higher products, the heavy molecules are cracked into two more higher ones. The conversion process is carried out at 500°C. This is known as catalytic cracking because it uses a substance called catalyst to speed up the chemical reaction. This process converts 75% of the heavy product into gas, gasoline and diesel. The yield can be increased further by adding hydrogen, a process called hydrocracking or by using deep conversion to remove carbon. The more complex the operation, the more it costs and the more energy it uses. The refining industry's ongoing objection is to find a balance between yield and the cost of conversion.

Treating

Treating involves removing or significantly reducing molecules that are corrosive or cause air pollution, especially sulphur. For instance, the European unionsulphur emission standards are very stringent since January 1, 2009, gasoline and diesel sold in Europe cannot contain more than 10 parts per million or 10 milligram per kilogramme of sulphur. The purpose of these measures is to improve air quality and optimize the effectiveness of catalytic converters used to treat exhaust gas. For diesel desulphurization or sulphur removal is performed at 370°C.

Operational procedure of local or illegal crude oil-refining

This has become a major activity in the Niger Delta region. The neglect of the region by Government in terms of development has caused the people to venture into oil-theft which bring about local-refining of crude oil in the region. The operational procedure is at variance with the legal refineries that involved the different stages of distillation processes. The equipment is not calibrated, no standard form of measurement. The temperature is not well-regulated during separation. All these inadequacies result to serious environmental challenges in the region. It causes fire outbreaks and deaths among the operators. The operation is carried out in the Niger Delta like a local craft industry where all the procedures are done manually, see plate 2, 3 and 4. The local oil refiners believe that the "government and oil companies are collecting our oil, and we don't have jobs, no money, so we have to collect the oil and refine our own". The analysis of reports from different researchers has shown the massive growth in artisanal oil-refining in the Niger Delta. Local-refining is now entrenched and having a major impact on communities, economy and stability, unless urgent action is taken. Local-refining has grown swiftly over the past four years, providing communities with employment opportunities and filling the supply gap of refined fuel in the Niger Delta. The increased scale of the local refining business explains why the campaigns to end it are met with stiff resistance or an unpredictable backlash. Researches have shown the local industry to be worth about \$28m (4.4BN) per month or \$336m (52.8BN) per annum. This far exceeds the revenue received by the affected communities via local government, and makes illegal refining, by far the highest valued local employer.



Plate 2: Illegal refinery



Plate 3: Illegal refinery distillation column



Plate 4: Checking the illegal refined products

Environmental impacts of illegal crude-refining

The human environment is divided into three; Land, air and water. The activities of local crude refining affect all the spheres of the environment. Oil spill has become a common norm as a result of poor handling of the equipments and rapturing or forceful removal of crude oil from the pipe lines. In what follows, we are going to examine the impact on different facets of the environment.

Land

Oil spillage and discharges from the nonstandard refining sites contaminates the soil. Yabarade and Tanee (2016) reported that local refining of crude oil has contributed to an increase in the toxicity level of the soil which has led to alteration of its chemical properties. The pollution of the soil by hydrocarbon components from local crude refineries has resulted in reduced agricultural productivity through the loss of soil quality. In a study carried out by Ewetola (2013) on the effect of crude oil pollution on some soil physical properties revealed that the affected parts are saturated hydraulic conductivity, macro porosity, total porosity and bulk density of which affect the soil quality. Bakpo (2016) also revealed the concentration of heavy metals in the soils of Crude oil polluted sites. Contamination of the soil by crude oil has been reported to adversely affect germination reduce crop yield and also lead to premature death of plants. In Gokana, and indeed the Niger Delta region, the heavy concentration of crude petroleum product in the soils has adversely affected the vegetation of the area. The morphological and physiological components are badly affected. Beside these effects, vegetation around local refining sites is used as fuel to attain the required temperature during the distillation process.



Plate 3: Discharged crude on water

Water

The water quality of the region is very poor due to crude oil pollution. Most of the untreated waste waters are discharged into the nearby streams, rivers and creeks. They are mainly point source pollution since it is coming from only one source (Petroleum). This is against the general motive of water pollution which is at nonpoint source pollution (different causes). In the water bodies the thickness of the crude is so serious that the penetration of sunlight into it is very difficult, thereby causing destruction of aquatic organisms through eutrophication. This is because the excess nutrients and the algae bloom are all destroyed. In the creeks, all the species of mangrove are gone because they cannot survive the adverse condition caused by crude oil pollution. The aquatic organisms such as fishes, crabs, periwinkles, etc, are now very difficult to see in our waters.

Air

This is popularly known as atmospheric pollution. The final stage of crude oil refining is treating, aimed at reducing the sulphur content of the product to improve air quality. But this measure is not found in the local refining process. This is one of the reasons for oil pollution in Gokana and Rivers State popularly known as “black soot”. Although air pollution is associated with both natural processes such as cosmic dust, volcanic activity, the dust formed as a result of destruction of buildings, quarry activities, etc, as well as, with man-made or anthropogenic processes associated with the development of industry, agriculture and public utilities, transport activity and others. Since November 2016, Rivers State and environs have been affected by strange soot menace in the air. The presence of the soot has been suspected responsible for cardiovascular diseases (Renner and Esther, 2018).



Plate 6: Crude oil on Water and Air

In another report by the Rivers State ministry of environment, in February 2017, the Ministry of Environment declared air pollution an “Emergency Situation” in an attempt to address the problem of soot. A three-man committee was set up comprising the then Commissioner for Environment, Professor Roseline Konya; Special Duties, Mr Emeka Onowu, Information, Dr Austin Tam-George. The major terms of reference of the committee were to investigate the source of the pollution and find the way forward. A test conducted on the soot sample to ascertain its content and source showed that the soot is petroleum based, being the result of incomplete combustion of petroleum products (Renner and Esther, 2018). The result of other tests conducted by the Ministry showed that the soots in the atmosphere of Port Harcourt is 11 times higher than WHO permissible range of PM 2.5. The soot as a type of air pollutant has the diameter of about 1mm – 2.5m. As a pollutant, it comprises a variety of other pollutants like chemical acids, metals and dust particles. It can take the form of a solid or liquid gaseous state. Soot particles are emitted into the air while some others form gas particles that can travel thousands of miles from their source. It is therefore considered a threat to public health.

Hydrocarbon pollutants on public health

These can occur in a number of ways which include, but not limited to the following:

Acid rain

This is a term used to describe the many ways in which acids fall from the sky. Rain, snow, fog, dry gases and particles may contain acids sulphur dioxide. Acid rain harms plants, animals, fishes and building surfaces.

Sick Building Syndrome

This is indoor air pollution that takes place in the environment, homes, offices, etc. The soot in the air has resulted to this syndrome. Sometimes people have symptoms that do not point to any illness and are hard to trace to a source. Some of the symptoms include the following:

- Dry or burning in the nose, eyes and throat
- Stuffy or runny nose
- Sneezing
- Fatigue
- Headache
- Dizziness
- Nausea

Further health implication

Petroleum hydrocarbon came into people's bodies when they breathe air, bath, eat fish, and drink water that is contaminated. Members of fishing communities risk exposure to petroleum if they bath, drink or collect shell fish in contaminated water.

Climate change

Global warming is an increase in the Earth's average temperature. This, in turn causes climate change. The gases released during the local refining process of crude oil, such as carbon dioxide and methane, trap the heat of the earth. This causes changes in rainfall patterns and triggers a wide range of changes in plants, wildlife and human life. The hydrocarbon released in the air combine with dust and water droplets to form a thick fog thereby forming a microclimate. This is noticeable in the morning hours.

Challenges on security and socio-economic loss

Oil-theft and illegal local refining activities lead to loss of revenues to the Nigerian Government and the oil firms that own the assets from which the oil is stolen. Consequently, pipeline vandalism, river and land pollution, environmental degradation, increased criminality are prevalent and insecurity in the Niger Delta region. Here are the major impacts under the following sub-headings;

Insecurity

The destruction of pipelines and oil-theft are a serious threat to national peace and security, particularly, as Nigeria depends heavily on oil export for survival. Apart from economic losses, negation of investment, oil exploration and production security risks and damage to equipment, illegal refining and bunkering, fuel conflicts and militancy through increased armed proliferations and drug-abuse, which have destabilized the Niger Delta region (Garuba, 2012).

Most of the oil thieves and illegal bunkerers exchange the crude oil for heavy arms at high seas while others use the proceeds to import arms into the region, with the aim of using them to secure their illegal activities in the region. The arms are used for attacks and protection from different gangs and security agents. Every group has arms and is battle-ready to enable it to remain in business. This has led to insecurity of lives in the region.

Socio-economic losses

Oil theft and illegal bunkering is seen as the biggest threat to Nigeria economy. Its socio-economic impacts include environmental degradation, loss of economic activities for the communities, loss of revenues to the government leading to inadequate funding for development projects and increased criminality in the Niger Delta region.

Measures to curb local crude oil-refining

The upsurge of local refinery requires multilateral and concerted efforts to address the problem. All stakeholders in the oil industry, the oil communities, and security forces should be involved in solving the menace. Some possible suggestions include the following:

1. Modular refinery is a possible way out. Government should introduce the use of modular refinery where the people involved will be trained to know the technology of oil-refining. Better still, the youths can form clusters to avoid littering the area with refineries.
2. Formation of cooperatives. They can form cooperatives to enable them to access government or bank sponsorship.
3. To avoid oil-theft, the oil majors should adopt the use of technology to secure their pipelines and establish the Right of Way (RoW) to their pipelines to enable security officials to easily identify areas where there are breaches.
4. There should be constant review of corporate social responsibilities of oil major to host communities, and improve the opportunities for the restive youths, as well as, massive environmental resuscitation and provision of crude product to the people in order to give them a sense of belonging.
5. The Federal Government should embark on the speedy development of the Niger Delta region in order to pacify its inhabitants for the years of marginalization and neglect. This can help to gradually heal their wounds and move them to support the security agents in their quest to tackle illegal oil bunkering.
6. The government and oil companies operating in the area should be able to provide employment opportunities for the youths.

7. The government should address the socio-economic foundation of illegal bunkering through the alleviation of poverty and job creation targeted at the youths, who must be made to come out of the creeks.
8. Government and the oil companies should establish joint mini-refineries to absorb illegal refineries and engage local communities.
9. The government cannot completely eradicate illegal refineries. Instead, it should identify and engage those involved, by turning their illegality to legality, and ask them to form groups, and issue licenses and guide on the standard of production.
10. The Government should set up a task force to monitor their activities and by doing so, make more money through and also help cushion the supply chain.
It should be hoped that the burning of illegal refineries also pollutes and degrades the environment.

Prospects of modular refineries in Nigeria

In Nigeria, setting up modular refineries at strategic locations within the Niger Delta will help in the following areas:

- ❖ Supporting the low production of the existing refineries. Modular refineries will help to meet the rapid petroleum produces local demand with relatively low capital cost.
- ❖ Drastically help to minimize our reliance on imported products.
- ❖ Totally remove the incidence of subsidy
- ❖ Encourage private investors, since start-up capital is low, compared to a conventional refinery.
- ❖ Remove the vandalization of pipelines.
- ❖ Ensure optimal use of our resource which has multiplier effects on the economy.
- ❖ Reduce insecurity
- ❖ Reduce environmental degradation.

Conclusion

In this paper, an attempt has been made to examine the phenomenon of oil-theft and illegal refinery in the Niger Delta region with a view to situating its causes, impacts and implications on the environment, security and the socio-economy. The increase in oil theft and illegal bunkering in the Niger Delta is an economic crime against the Nigerian state; it undermines development strategies, and engenders social disorder. It constitutes serious economic, security environmental challenges to the region. To stop illegal bunkering, the paper recommends some measures and posits that multi-dimensional approach and concerted efforts are needed to put an end to oil-theft in the country.

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