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THE NIGERIAN OIL INDUSTRY AND ENVIRONMENTAL POLLUTION

The paper reviews the development of the Nigerian Oil Industry up to the present time. It examines in detail the environmental hazards which oil production has caused particularly to aquatic, plant and human lives. To avoid an ecological disaster, recommendations for effective environmental laws and the setting up of relevant disaster committees are made.

1. INTRODUCTION

Oil prospecting began in Nigeria as far back as 1908 by a German company in the Araromi area of Ondo State. This pioneering effort was short-lived due to the outbreak of the first world war in 1914. In 1937, Shell D'Arey (now Shell Petroleum Development Company of Nigeria) returned to the oil prospecting scene and was awarded the sole concessionary rights that covered the whole territory of Nigeria. Its activities were again interrupted by the second world war and were resumed in 1947. It was not until 1956, after investments exceeding 30 million naira, that the first commercial oil find was made at Oloibiri (Rivers State). The first oil shipment took place in 1958, and by 1961, other companies such as Mobil, Gulf, Safrap (now Elf), Amoseas (now Texaco/Chevron) joined the oil race.

Production increased from 5,000 barrels per day (b/d) in 1957 to 17,000 b/d in 1960. By 1966, daily production rate has reached 450,000 b/d attaining a peak value of 2.4 million b/d in the second quarter of 1979 (the oil boom era). Since then, the industry has featured prominently in the Nigerian economy and has consistently accounted for about 90% of the country's foreign exchange earnings and 74% of the total annual revenue. Annually, the industry spends billions of naira to explore, ex-

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exploit, process, transport and market the crude oil and its associated products, in operations that are diverse and complex.

Activities in the oil and gas industry are classified as the upstream and downstream segments. The upstream segment covers all activities related to the exploration, discovery and extraction of oil, its treatment, transportation and delivery to designated locations such as export terminals or processing plants (e.g. refineries).

The downstream segment comprises all other activities following delivery to process plants. These include refining and subsequent conversion to petrochemical products, transportation and marketing of the finished products and related ancillary services.

Crude oil is produced predominantly in the southern regions of Nigeria from areas covered with wetlands of the Niger Delta. These wetlands also produce annually about 100,000 tons (fresh-weight) of fish for the communities whose main occupation is fishing.

Both the upstream and downstream activities of the oil industry leave behind varying degrees of environmental degradation resulting from such phenomena as oil spills, well blow-outs, pipe-line ruptures, equipment failures, tanker loading disasters, etc. When these disasters occur, many communities are exposed to serious health hazards as well as loss in revenue. These incidences give rise to social and political disaffection (AINA [2], ENE [4]).

In the 1990s, environmental issues have become increasingly important in the socio-economic development of many industrialised nations. In Nigeria, environmental policies and regulations can be conveniently characterised as minimal and poor even in terms of developing countries' standards. Several industrial wastes are discharged recklessly by producing and servicing industries. Most industries appear ignorant of the basic environmental regulations. Those that are familiar with these regulations often collude with those responsible for enforcing the regulations. Decades of unstable policies in the country arising from the existence of many unstable governments have not helped the situation. Time has, therefore, come when we must worry about the effects on the environment – our health, wildlife and plants, aesthetics – of these industrial activities.

2. THE NATURE AND CONSEQUENCES OF ENVIRONMENTAL POLLUTION

Environmental pollution started with bush burning and the combustion of firewood some 500,000 years ago. It increased in intensity with the advent of industrial revolution and its scale presently is frightening. In Nigeria, the oil boom era marked the beginning of significant growth in the Nigerian industrial scene. The oil industry has been in the forefront of this growth.

As the emphasis on oil exploitation began to gather momentum, the unpleasant aspects of the oil business – viz, environmental pollution, degradation and habitat spoilage – began to capture the scene. The nature and scope of environmental pollution which result from the activities in the oil industry vary extensively. The activities include:

combustion (including gas flaring) of petroleum and related products,
unhealthy disposal of drilling muds and chemicals used during oil production and processing,
indiscriminate channelling of liquid and semi-liquid wastes into nearby streams and rivers,
high-level noise from the machinery,
oil spills,
uncontrolled disposal of the spent products from the downstream segment of the industry.

The combustion of petroleum products in automobiles and in power-generating stations and the unabated gas flaring at most of the oil-well locations and refining plants release into the atmosphere gases (carbon, sulphur and nitrogen oxides) and particulate matter. High levels of carbon dioxide in the atmosphere cause global warming, while condensation of sulphur oxides causes acid rains. In addition, some of the gases and particulate matter emitted in the process are either toxic or cause severe irritation to the eyes and skin. People that suffer from asthma and bronchitis develop health complications. Other socio-economic and environmental impacts of gas flaring/combustion of petroleum products include:

- (i) destruction of vegetation and associated wildlife,
- (ii) acidification of fresh water, lakes and streams and damage to buildings and other structures by acid rains,
- (iii) thermal pollution of air, land and water resulting in the destruction of both plant and marine life and the alteration of the ecosystem,
- (iv) damage to soil and crops by heat and the attendant loss of sources of livelihood.

Drilling of oil wells constitutes an important stage in oil exploitation. Some aspects of this operation give rise to environmental pollution. Drilling muds and chemicals employed such as corrosion inhibitors, scale preventers, paraffin solvents, etc. contain components which are toxic or cause irritation of the body organs. Clays (which constitute a high percentage of drilling muds) are not toxic but on prolonged or excessive inhalation of the dust particles can cause silicosis among the rig workers. Furthermore, if the drilling muds used are not properly treated and disposed of, aquatic animals become vulnerable when muds are discharged into fresh water bodies. Waste and storage pits used by drilling companies often constitute potential source of pollution because of their likelihood to contain oils and salt water. These have the ability to migrate to any nearby water table and to contaminate it. Furthermore, associated salt water produced in the course of drilling for crude oil contains traces of barium, cadmium, mercury and lead. These are substances that have serious health consequences when ingested by living organisms. Strictest care must be exercised in the disposal of associated salt water.

Noise naturally accompanies heavy industrial machinery used in oil well operations. In contrast to aesthetic considerations or the contamination of water resources systems, exposure can impair the hearing organs. It is therefore necessary that protective measures should be taken against loud noises (i.e. noises above 90 db).

Despite extensive preventive measures taken in the course of oil production and processing, petroleum and petroleum products are often spilled on land and into the water ways. Those that are spilled on land create three potential hazards, viz:

- fire and explosion,
- contamination of the ground water,
- degradation of the environment.

Since many crude oils and petroleum products are flammable, the danger or risk of fire and explosion is increased when people that are not familiar with the physical characteristics of these products attempt to handle oil spills. When crude oil and its products escape onto the land by accidental spills or equipment failure, the impact on the environment will be volume-dependent. For relatively small oil spills, the damage to the land will be small due to high rates of surface evaporation. However, for large spills, a sizeable quantity of the oil may permeate into the soil.

A large percentage of the oil production operations in Nigeria occurs in the wetland areas where free water exists very near the soil surface. In these areas, sufficient water is present to provide a major part of the water supply needs of the communities. The risk of oil migrating to the watertable when large spills occur is very high. Oil spills that flow on the surface and into the water bodies damage the wetlands that have become the habitat of some rare or threatened animal and plant species. Aquatic plants, depending on their type, suffer various forms of damage. The surface (or floating) and the non-deep-rooted sub-surface types suffer complete disintegration and death in oil polluted areas, while the aquatic plants rooted in the sediment (e.g. water lily (*Nymphaea*) with floating leaves) lose their leaves.

Those that are not destroyed by the spill are eventually destroyed during the clean up exercise. In addition, plants whose leaves and barks are coated with oil suffer loss of photosynthesis and respiration.

For the marine animals – crabs, shrimps, molluscs, fishes, reptiles, etc. – the harmful effects of oil spill may be physical or chemical. Physical effects are caused by the oil coating the organisms or their immediate environment causing loss of buoyancy and asphyxiation. Oxygen up-take in water is also reduced due to a lower dissolved oxygen concentration which may result in possible death of the organisms. Chemical effects depend on the composition of the oil. Saturated hydrocarbons of low boiling point (up to octane) can produce anaesthesia and narcosis in lower animals. Benzene, toluene and naphthalene can cause local irritation of the respiratory system or depression of the central nervous system. Many may be mutagenic or carcinogenic.

AINA [2] in an environmental report summarised the ecological effects of oil spills as follows:

- decrease in fishery population and damage to wildlife (including birds and marine animals),
- risk to human health resulting from eating contaminated sea-foods,
- decrease of aesthetic values due to unsightly oil slicks on the farmlands and coastline beaches,

complete modification of the marine ecosystem through elimination of some species; there is also a subsequent decrease in ecological diversity, longer recolonization and restoration time.

Large volumes of petroleum and petroleum-related products are used each year in diverse applications throughout the country. Major consumers of these products include power-generating stations, automobiles, metallurgical, chemical and allied industries. Waste products from these applications are often discharged, treated or untreated, into the atmosphere (for gaseous emissions), burrow pits, farmlands and water drainage systems with grave environmental consequences. For example, tetra-ethyl lead is still added to petrol used in internal combustion engines. While tetra-ethyl lead in petrol is known to significantly improve the performance of these engines, lead fumes are toxic and can lead to retarded growth of children. Similarly, millions of gallons of used lubricants (e.g. spent engine oil) and wash chemicals are discharged without prior treatment into pits and water resource systems. It has become fashionable to see tankers loaded with either domestic or industrial wastes discharging these wastes into nearby bushes and streams. Some components of these wastes are volatile and toxic. In communities, where these disposal practices are rampant, many inhabitants suffer from varying degrees of body discomfort such as irritation of the eyes, nasal passages, skin rashes and the development of bronchial problems. Farmlands, fish farms, game forests and other agricultural set-ups are extensively damaged by such practices.

Most urban cities throughout the country have very poor waste management practices. Access roads through most of the cities are often blocked by heaps of uncleared domestic and sometimes industrial wastes. These wastes are composed of both degradable and non-degradable products. The biodegradable components of the waste decay very rapidly under the intense action of the sun and moisture to release foul-smelling and choking odours. The non-biodegradable components such as used polyethylene bags and bread wrappers, plastic containers, used tyres, etc., sometimes find their way into the urban drainage systems where they block the drainage pathways and cause severe flooding. There is also documented evidence (NWANKWOR and OKPALA [6], ACHI [1]) which shows that despite considerable improvement in living standards and job opportunities as a result of increased activities in the oil sector, some of the waste disposal practices have resulted in serious health hazards and environmental degradation.

It is, however, worthy to note that while the oil industry in Nigeria ranks high in the ladder of environmental polluters, it is also most responsive in combating pollution.

3. SOME REPORTED OIL SPILLS AND EFFECTS

It has been pointed out earlier that oil spillages in Nigeria have resulted from the following major causes:

well blow-out,

pipeline leakages/ruptures,
 off-shore/on-shore drilling accidents,
 sabotage by aggrieved communities and unscrupulous individuals.

Between 1976 and 1990, nearly 3,000 oil spill accidents were reported by the oil companies operating in Nigeria. Within this period, about 2.4 million barrels of crude oil were released on land and the coastal environment. These include:

Funiwa V oil well blow-out (near the town of Sangana) released over 400,000 barrels of crude oil. Compensation paid to the affected communities and clean-up exercises cost 10 million USD.

Eruemukohwarien (1984) and Okoma 1 village near Ahaoda (1985) pipe-line leakage. Over 250,000,

Satrapa Obasi 21 well blow-out.

Shell-Bp 11 oil well blow-out.

Oil producing communities have suffered extensively various forms of environmental degradation, deprivation and spoilage. When an oil spill occurs, there is usually considerable variation in pH and soil mineral contents (e.g. Mg, K, Ca, Na, P, etc.). These variations result in poor quality and adverse effect on soil texture. AKINGBADE [3] observed that fishes, snakes, frogs, toads and snails found in oil producing areas, which suffer oil spills, had in their body organs varying levels of petroleum hydrocarbons. Aquatic organisms are vulnerable to crude oil. For oil concentrations in water as low as 0.001–0.01 ppm and water pH below 6.5, fish egg production and hatchability were significantly reduced. Shrimps population has become a convenient index for assessing the effect of oil spills in the Nigeria coastal waters. In the short term by embryonic mortality and in the long term by population structure. Studies on the effects of oil spills show that shrimps (*Desmocarid*) showed reduced fecundity and massive mortality of advanced embryos 2–3 months following an oil spill. In heavily polluted areas, embryonic mortality continued 7–8 months after the spill, and was concurrent with high fecundity. The initial reproductive losses accounted for smaller population and differences in population structure for at least up to 11 months following a spill (Institute of Pollution Studies, RSUST, 1986).

4. THE NEED FOR EFFECTIVE ENVIRONMENTAL PROTECTION LAWS

The effectiveness and success of maintaining a clean and healthy environment, and preservation of our ecosystem depend on the availability of appropriate and well-formulated policies and legislations, creation of public awareness of the consequences of environment pollution, and the existence of relevant legislative bodies which can strictly enforce these laws. Ignoring of protection laws would lead to a steady deterioration in our health standards and increase the likelihood of major industrial accidents and ecological disasters.

The oil industry in Nigeria is relatively young. It is a conglomerate of multinational outfits. With the exception of the Federal Government owned 'Nigerian Na-

tional Petroleum Corporation' (NNPC), other members of the conglomerate are foreign. Their operations are heavily profit oriented and the parent companies exert very loose control in whatever universal corporate environmental safety standards and practices that exist.

Most environmental laws in Nigeria have been slow in evolving and are usually hurriedly promulgated whenever a major disaster occurs. For example, Decree No. 42, 1988, was promulgated by the Federal Military Government of Nigeria shortly after dumping of drums of toxic wastes in Koko, Nigeria.

The earliest law that directly relates to the activities in the oil industry is the petroleum Decree of 1969 called *The Drilling Production Law*. This decree requires that in accordance with 'good oil-field practice', all operators in the oil industry should take necessary precautions to prevent the escape of petroleum and its related products onto the land or into our water ways. Any waste oil or other run-offs from the fields should be discharged or drained into receptacles constructed in compliance with oil safety regulations. As activities in the oil sector gathered momentum, more decrees were brought into existence, all aimed at making operators in the field comply with laid down international regulations and standards.

The most relevant of these decrees are:

- (i) The Associated Gas Reinjection Act of 1980.
- (ii) The Federal Environmental Protection Agency (FEPA) Decree of 1988.
- (iii) The Environmental Impact Assessment (EIA) Decree of 1992.

These decrees are very appropriate to our environmental aspirations and needs but the machinery set-up to achieve the desired objectives have failed to realize the major objective of protecting the environment. Gas flaring has continued unabated in most oil producing areas. The environmental consequences are varied ranging from destruction of farmlands and forests to acidification of streams. Globally, excessive emission of carbon dioxide into the atmosphere results in global warming and the attendant green-house effect.

The Federal Environmental Protection Agency (FEPA) is a body established by the Nigerian Government and charged with the primary role of advising and making recommendations to the government on policy matters to the environment. FEPA has successfully produced national guidelines and standards for the petroleum, petrochemical and other related industries. Despite the authority invested in this agency and similar ones like the Department of Petroleum Resources (DPR) which enables them to impose stiff penalties on any offending companies, it is generally observed that while some operators in the oil sector show serious concern for the state of the environment, others, however, do not. Before the advent of serious oil business in 1957, Nigeria could be described as being marginally polluted. The situation is now different. To forestall steady and continuous degradation of the environment, there must be in place strictly enforced national environmental standards applicable to all operators. The nation must strive to hand over to future generation an unpolluted environment.

5. RECOMMENDATIONS

The foundation has been laid for realising the above objectives through the provision of relevant environmental protection laws. For now, these laws lack the necessary will-power that could lead to a reduction in ecological damage caused by the activities in the oil industry. The laws deal mostly with measures that are needed to prevent pollution but are very silent on the consequences that follow actual oil pollution. ENE [4] reports that the major impediment to the imposition of strict liability against polluting companies lies in the belief that 'gains' accruing from the flow of capital arising from direct foreign investment in the oil industry far outweighs the damages caused to the environment. Consequently, pollution of the environment arising from oil spills and indiscriminate dumping of crude oil sludges, etc., is often settled by 'marginal monetary compensation' to the rulership and elites in the affected communities. This has become the trend in this present era of severe economic stress. Factors such as profit and maximum production completely overshadow all other factors, and lip-service is paid to safety and environmental protection.

The Federal Government of Nigeria should seriously address the issue of environmental protection by:

1. Introducing the use of fiscal measures such as eco-taxes and land-fill levies. These measures will encourage compliance with laid down regulations. It will also encourage all operators in the oil sector to practise waste recycling.

2. Instituting functional disaster committees in strategic areas in the oil producing and transporting regions. These committees must be made up of experts in matters relating to the environment, e.g. hydrologists, pollution engineers, ecologists, soil scientists, etc.

3. Creating a disaster relief fund which is to be primarily funded by all operators in the oil industry. Such money will be used for clean-up operations and payment of compensation to the affected communities.

4. Introducing regular enlightenment /educational programmes for communities in the oil producing areas since many are ignorant of the hazards that could follow oil spills.

The need for public enlightenment on the hazards of oil spills is highlighted in a true-life story in which a cattle-breeder led his cows across a polluted river near a refinery. The cows were wet, having passed through the river. Ahead, portion of the bush near the river was on fire. On getting near the bush there was a sudden flash, and the cows were all burnt to ashes. The cattle-breeder, who could not believe his eyes, ran to the nearby village, telling everyone that 'some evil spirit' has set his cows on fire. He was not aware that the spilling of some petroleum products from the refinery into the river was the evil spirit after all.

6. CONCLUSION

The ability of any society to maintain a balance between industrialization and a healthy environment depends on compliance, on the part of the operators with appro-

appropriate legislations and public awareness of the health consequences of a polluted environment. The oil industry in Nigeria is a big polluter. The process of combating environmental pollution is an expensive one. For Nigeria as a nation, two options are available: to maintain a pollution-free environment now or face the harmful effects of environmental pollution later. If action is delayed now, the cost of the latter option will be enormous to the future generation. Nigeria must join the race now.

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NIGERYJSKI PRZEMYSŁ NAFTOWY A SKAŻENIE ŚRODOWISKA

Opisano rozwój nigeryjskiego przemysłu naftowego aż po dzień dzisiejszy i dokładnie zbadano zagrożenia, jakie stanowi on dla życia w zbiornikach wodnych, a także roślin i ludzi. Podano zalecenia, jak stanowić prawo, które efektywnie chroniłoby środowisko, i jak powoływać komisje zapobiegające katastrofom ekologicznym.

