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The Niger Delta Environment and Sustainability in Nigeria — A Mechanical Engineering Perspective

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Abstract

This paper presents the natural, artificial and socio-economic problems (environmental profiles) of an inhospitable, harsh and difficult terrain of the Niger Delta region of Nigeria, the activities of oil and gas multi-nationals and indigenous companies to plunder, pollute, degrade and make development of the region and its ecosystems unsustainable and calls for federal, state, and local governments, multi-nationals as well as indigenous oil and gas companies, individual groups and international agencies for concrete intervention to achieve sustainable development in the region. The study aims to provide answers to the concerns raised by environmental deterioration in the Niger Delta, such as whether the planet can support our existing way of life and whether there will be enough natural resources for future generations. In order to help oil and gas exploration, production, and distribution companies deal with efficiently maintaining their machinery and equipment, the study suggests certain practical maintenance techniques that are unique to the field of mechanical engineering. Preventive, corrective, predictive, and condition-based maintenance are some of these tactics. Combining these tactics will lessen the frequency of oil spills, stop the ensuing environmental deterioration in Nigeria's Niger Delta, and ultimately increase the region's sustainability.

Keywords: Niger Delta, Oil and Gas, ecosystems, maintenance strategies, environmental degradation, sustainability, global concern.

1. Introduction

Just like the Environmental Sciences discipline has attracted very serious attention at all levels of education and human activities in the world today, so also the Niger Delta environment in Nigeria, has become a global concern. The problem today associated with the people of Niger Delta in Nigeria ranges from environmental degradation, neglect, pollution (land, air and water) due to oil and gas exploration and production, poverty, underdevelopment, unemployment, flood and erosion to ecological damage and disaster, to mention a few.

The United Nations (UN) 1998 Human Development reports states that 48 per cent of the Nigerian population live below the bread line. It was further observed that the bitter reality of the situation of the Niger Delta people is not just that the poverty level gets worse day by day, but that among every ten people of the Niger Delta, more than four live in conditions of extreme poverty, earning less than ₦400 (Naira) per capita income. In 1984, Nigeria's per capita income was over $1000 (Dollars) and a sizeable percentage of its population also had fallen below poverty line with an increasing unemployment rate.

The questions which arise now and require our collective solution are, can the earth sustain our current lifestyles, and will there be adequate natural resources for future generations?

These questions are among the most important in environmental issues and management today. We depend on nature for food, water, energy, oxygen, waste disposal and other life support services. Sustainability

implies that we cannot turn our resources into waste faster than nature can recycle and replenish the supplies on which we depend. It also recognises that degrading ecological system, ultimately threatens everyone's well-being. Although we may be able to overspend nature's budget temporarily, future generations will have to pay the debts we leave them. Living sustainably means meeting our own vital needs without compromising the ability of future generations to meet their own needs.

The World Development Report (Wade, 2004), the fifteenth in its annual series, explores the link between economic development and the environment. The 1990 report on poverty (USA, 2000), report on development strategies (Mundial, 1991; Ott, 2024), constitute a trilogy on the goals and means of development. The main message of the report is the need to integrate environmental considerations into development policy making. The value of the environment has been underestimated for too long, resulting in damage to human health, reduced productivity, and the undermining of future development projects.

In line with the foregoing there is the need to examine the broad and specific environmental profiles of Niger Delta of Nigeria under the following outline:

2. Natural Environmental Issues

2.1. Flood and Coastal Erosion

The Niger Delta region is located in the heavy rainfall belt in Nigeria. It also has the largest creeks, rivers, seas and oceans channels and water ways (Abija et al., 2020). These are the natural resources endowed the people by nature. Because of its low-lying planes, seasonal rainfalls measuring 2000mm – 4000mm per annum inundates the cities and villages, posing great threat to the life and property of the people. Coastal erosions are also on the increase because of increase in traffic volumes and tidal waves occasioned by heavy marine vessels plying the waterways for various economic activities, that are on the increase daily by oil prospecting companies. There is therefore, the threat that coastal erosion, if not checked, could reduce available land for agriculture and food production, and the "built environment" concept. Further hazard and real threat from flood could lead to submerging the earth surface and total extermination of the human race on earth. This paper calls for on government at all levels, operators of oil and gas companies, individuals and international agencies such as United Nations, World Bank etc. to develop a concrete plan, by evolving several remediation actions to check flood and coastal erosion in the Niger Delta that suffer seasonal flooding by heavy rainfall and river floods.

2.2. Water Hyacinth

Water hyacinth is a wild plant that poses environmental problems to the people of Niger Delta. It grows in floating masses on the rivers, lakes etc. and hinders navigation. It also inhabits and completely rules out oxygen diffusion to the aquatic system. This will lead to suffocation of aquatic life and makes the environment unsuitable for biotic inhabitations. The ultimate result of all this is mass death of fishes and other living organisms in the water.

2.3. Subsidence

Oil exploration and extraction activities invariably are associated with withdrawal of huge quantities of subterranean (oil, water, gas) from wet fields. The Niger Delta people in future could suffer dangerous effect of ground movement otherwise known as "subsidence", horizontally and vertically caused by heavy withdrawal of fluid such as crude oil and gas from the ground. On the other hand, ground subsidence could result in the tilting and stressing of pipelines transporting oil and gas and surface structures perhaps with serious or even disastrous consequences and re-injection is really the best solution to this problem.

2.4. Siltation

Niger Delta region has the highest flood plains in Nigeria. Over the years, flooding has been contained by construction of drainages along the flood plains and building sewerage systems to evacuate the storm water in the villages and cities, and levees to check coastal erosion. More recently in the region drainages do not flow freely due to the silt and other heavy material/debris blocking the water channel and free flow of sewage. When this happens, excess water

overflows the open drainage and floods the land. Due to littering the drainage channel with heavy materials and debris, the water channel becomes blocked and silted, and can be improved upon by de-silting the process at regular intervals. Underground sewerage is recommended to obviate public nuisance to the open drainage systems.

2.5. Remediation

Remedial actions to ground subsidence due to petroleum extraction therefore require re-injection approach. It is really the best solution to this problem. Although it would not replace the whole of the withdrawn fluid (the steam phase having been used up). Natural recharge could well make up the difference.

3. Development Issues

3.1. Land Degradation/Soil Fertility

Oil pollution in the soil system spells far more hazardous consequences for soil borne vegetation and most soil living organisms than, is the case with air pollution. Man and other surface living creatures are no exceptions. Depending on the extent of spillage, the soil area under spill becomes soaked with oil. This means that there is a total occupancy of the interstitial pores of the system by oil. In such situations, oil continues to permeate to upper strata of the soil which forms the natural base of most organic interactions, percolating through the grains in different directions. The rate of percolation and the distance likely to be reached will depend much on the porosity and permeability of the soil. But whatever the area under this oil size, the local effect is in general, tremendously adverse to the entire pores, and inhabits or completely rules out the diffusion of oxygen into the soil system. This would lead to suffocation of soil life. Also, in the absence of soil aeration, reactions (organic or inorganic) proceeding under aeration are halted and the generation of organic nutrients required by plant is ruled out and thereby reducing soil fertility for agricultural activities of the people of Niger Delta (Nababa et al., 2020). Secondly, due to bio-emulsification in the system, soil water is no longer freely available to plant uptake and where available, would be rich in the content of water-soluble constituents of petroleum oil, some of which are toxic to plant health.

In the absence of good aeration and free soil water, temperature increase making the environment much more unsuitable for biotic inhabitation. Above all, is the toxicity intensity of certain hydrocarbon compounds and other intermediates of hydrocarbon oxidation. These may be extremely lethal that death of the organisms may be instantaneous on contact with or feeding on materials contaminated with those components. The ultimate result of all these is mass death of soil insects, worms, amphibians, reptiles, etc., as well as different species of other living animals including human beings. The more drastic effect on the higher classes of animals is the utter destruction of their food sources. This will perpetuate hunger and starvation.

From the foregoing, agriculture, commerce, industry and the general economy within the affected localities in the Niger Delta is drastically affected by pollution, and human health equally threatened.

3.2. Oil Spillage

Without doubt the greatest single environmental problem connected with petroleum exploitation, its transportation, and industrial and municipal effluents in the Niger Delta environment is spillage (Chinedu & Chukwuemeka, 2018; Nwilo & Badejo, 2005). The natural source of spillage comes through marine seeps, sediments, erosion and rain scavenging. And scavenging is the scrubbing of particulate oil materials introduced into the atmosphere through volatilization by rain water. The natural source constitutes a very small percentage of the total spills while the petroleum exploration source as a result of exploration drilling production and processing rock blow out of seismic dynamics, rupture, head leakage blows out, piping leakages to mention a few, constitute the highest spill-prone activities. The rate of oil spill has been rising with increasing tempo of petroleum production. Whereas in 1970 only one oil spill of about (150 barrels) was reported in the region. A year later, the number shot up to 14 (involving 15,110 barrels). In 1971 there were 105 oil spills, another 154 in 1978, 241 in 1980 and 216 in

1982 in the 12-year period from 1970-82, a total of 1,581 oil spills, involving nearly two million barrels of oil were reported. The number of spills from then till now has reached an alarming proportion. In this vein, it is anybody's guess how many cases went unreported, either because, individually, they were not considered by enough to enter the records or because, as all too often happens even today, the relevant firms and authorities simply refused or conveniently forgot to report them. It is also anybody's guess how accurate the spillage volumes actually have been. These have significant negative impact on the Niger Delta environment and ecosystem.

3.3. Air Pollution

Where the petroleum (or crude oil) when of high paraffinic composition contains much quantities of the hydrocarbons. These are methane (CH_4), ethane (C_2H_4), propane (C_3H_8), butane (C_4H_{10}), and in a very low concentration, pentane (C_3H_{12}). Other than these, it may also contain some non-hydrocarbon substances etc. When exposed in certain environments either on land or water body or under elevated atmospheric temperature and wind effect, the gaseous components mostly methane separate fast from the bulk into the atmosphere. Other pollution effects of oil spills include:

i. Loss of fish, crustaceans and other aquatic animals.
ii. Eutrophication of water bodies.
iii. Abandonment of fishing grounds and associated livelihood pursuits.
iv. De-vegetation and other forms of ecological damage.
v. Emigration of wildlife and the consequent decline of such food supply.
vi. Loss of drinking and industrial water and its important or derivation at extra cost.
vii. Destruction or reduction of agricultural and other related activities.
viii. Loss of recreational and artistic value of water bodies
ix. Increased economic and other burdens entailed in pollution clean-up, population resettlement and other aspects of rehabilitation.
x. Impairment of human health.
xi. Forced population movement/migration
xii. Worsened rural underdevelopment and bitterness of the affected individuals and communities.

3.4. Gas Flaring

Gas flaring from different oil locations in the Niger Delta also dumps good quantity of methane and carbon monoxide, probably due to incomplete combustion into the atmosphere (Ologunorisa, 2001; Osuoha & Fakutiju, 2017). Also due to the presence of sulphur, nitrogen and oxygen compounds in the oil bulk, gases as hydrogen sulphide (H_2S), sulphur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2) etc maybe evolved due to the atmosphere from various spill environments and are carried away kilometres in different directions by wind, causing air pollution. Global climate change is already affecting a wide variety of biological species, and loss in habitat. Further warming through uncontrolled human activities is likely to cause increasing severe weather events including droughts in some areas and flood in others and the Niger Delta is no exception. Already, rising sea levels are flooding low-lying islands and coastal regions. The following major adverse socio-economic and environmental impacts are associated with gas flaring and burning fossil fuel they include:

i. Atmospheric pollution by combustion contaminants.
ii. Thermal pollution of air, land and water.
iii. Destruction of vegetation and associated wildlife.
iv. Damage of building and other structures by acid rain.
v. Damage to soil and crops by deposition of primary and secondary contaminants.
vi. Photogenic pollution (i.e. light glare) both by day and, particularly, by night, a nuisance that is expected up to 50 kilometres away from oil wells.
vii. Loss of sources of livelihood.
viii. Severe discomforted misery, particularly when wind carries fumes, odours, lead and

combustion gases to communities in downwind locations.

ix. Human illness, and enforced modification of residential building to screen out some of the glare.

x. Greenhouse gases that trap heat in the atmosphere, leading to increase in Global temperature (Global warming effect).

3.5. Sewage and Waste Water

Sewage may be defined as the used water or liquid waste of a community which includes human and household wastes together with street-washings, industrial wastes and such ground and storm water as may be mixed with it. The constituents of sewage are:

i. Domestic sewage, which includes human excreta as well as discharges from kitchens, baths, lavatories etc. from public and private buildings.

ii. Industrial and trade wastes from manufacturing process such as tanneries, slaughter houses, distilleries, mills, laundries, chemical plants etc.

iii. Ground water or subsoil water entering sewers through leaks and

iv. Storm water which is rain water from houses, roads, along with surface water etc.

Sewer is an underground conduit used for the removal of sewage and sewerage, and constitutes the general process of removing sewage. The entire system of conduit and appurtenances involved is called server age system or sewer system. Lack of adequate sewerage systems in the Niger Delta degrades and pollutes the environment and encourages diseases such as malaria, and other tropical diseases. It is therefore one of the urgent development needs in the Niger Delta environment.

3.6. Water Pollution/Aquatic System

With a current population of more than 30 million humans, demographers report a transition to slower growth rates in most countries, present trends project a population between 45 and 55 million by 2050. Questions remain about whether resources and ecological services can support that many humans. In answer to those questions water may well be the most critical resource in the twenty-first century. Already at least 1.1 billion people lack access to safe drinking water and twice that many do not have modern sanitation. Polluted water and lack of sanitation are estimated to contribute to the ill health of more than 1.2 million people annually including the death of about 15 million children per year. About 40 percent of the world population live in communities where potable water demands now exceed supply, and by 2025 the United Nations (UN) project that as many as three-fourths of us could live under similar conditions. It is therefore no gain saying that Niger Delta people live in such conditions. Lack of potable water in the region that is water-prone is a serious cause for concern, as a close observer will agree that the cost of bottled water per day an individual consumes is more than the cost of food consumed by the individual. In the Niger Delta some of the major groups of water pollutants are:

i. Petroleum products.
ii. Industrial effluents.
iii. Eroded sediments.
iv. Infectious diseases.
v. Pesticides and insecticides.
vi. Domestic sewage and other oxygen demanding wastes.
vii. Solid wastes.
viii. Plant nutrients

The Niger Delta has two aquatic systems, the coastal and water ecosystems. The former as a breeding ground for fishes, amphibians and reptiles etc which do not survive when oil spills into these environments, while the latter is an environment for species of microbial flora and fauna and are more susceptible to oil pollution than others. Most of these live freely in water bodies or attracted to detritus particles. As hydrocarbon concentration increases, toxicity also increases, probably due to more effective dispersion and dissolution. This may lead to direct killing of the organisms by poisons from certain components, other water-soluble intermediates, or certain carcinogenic and mutagenic chemicals present in oil, probably as additives. Oil may destroy indirectly by inhibiting or completely eradicating oxygen dissolution through

coating water surface and asphyxiation, this leads to suffocation and death of these organisms.

3.7. Biodiversity Depletion

Wildlife habitants have changed from better to worse in Niger Delta since exploration of petroleum resources in commercial quantity began. This paper has already mentioned the adverse effects of oil exploration activities that introduces seismic dynamics in the wilderness, suffocation of soil life due to absence of soil aeration caused by oil spill water-soluble constituents of petroleum oil that are toxic to plants and some species of microbial flora and fauna. Indiscriminate bush burning results in reduction of plants and animal life. In other words, when a habitat is abused going by uncontrolled activities of man on the environment, it will deteriorate, resulting in a decline in animal numbers and diversity. The entire plant and animal community is therefore threatened.

3.8. Deforestation

Deforestation is a major environmental disaster. It is the removal of forest resources and other forms of vegetative cover from a site uncontrollably, without its replacement. It is also synonymous with desertification. World reports indicate that owing to increase in socio-economic activities, deforestation is in the increased. And in the final analysis, the main causes of deforestation in Niger Delta are:

i. Population growth and the expansion of economic activities, including logging or timber exploration
ii. Farming
iii. Bush burning
iv. Grazing
v. Firewood collection
vi. Urbanization
vii. Infrastructural development

Therefore, effective control mechanisms need to be put in place in order to protect the forest and wildlife, and control deforestation and environmental degradation, as a result of human activities in the Niger Delta region.

3.9. Low Agricultural Production

Soil pollution reduces. Soil fertility. Just as pollution in the marine environment reduces marine life of microbial organisms. Therefore, agricultural activities, including fishing in the Niger Delta, in the most recent times are below expectations. Cassava stems have started growth, including yam tubers and fish floats in our waters. In the absence of good aeration and free soil, water temperature increases, making the flourishing of crops difficult, and this could lead to low agricultural productivity. This is another source of hunger and poverty in the region.

3.10. Fisheries Decline

Fish provides over 40% of additional protein consumed by the Niger Delta people. Poor sewerage systems and oil pollution could result in the destruction of fish or aquatic life inside the water, reducing the quantity and quality of fish in the region.

3.11. Waste Management

Waste can be classified into two main broad headings, that is, municipal and consumer wastes and industrial and hazardous wastes. As waste can be seen as those materials no longer required by an individual or industry, solid wastes are all the wastes from human and animal activities that are normally solid and discarded as useless or unwanted. Industrial waste of any country depends on the industrial base of that country Even though there is no agreed definition of hazardous waste, some countries define hazardous waste only in terms of the danger to human health, while others include damage to the environment. Hazardous wastes may thus be defined in terms of their physical or chemical characteristics, e.g., flammability or toxicity, or in terms of the concentration of specific substances that they contain. The Niger Delta environment is severely subjected to the various wastes outlined. The management of urban solid waste constitutes one of the most immediate and serious environmental problems facing governments in African cities. The conventional municipal and waste approach based on collection and disposal has failed to provide efficient and effectiveness to urban dwellers the deplorable situation of the abundance of waste in many African cities is very common. We have them in Lagos, Nigeria; Accra,

Ghana; Kinshasa, Zaire; etc. In all these cases waste is dumped indiscriminately and poses an environmental health hazard. The prevalence of parasites, tetanus, malaria, hookworms, cholera and diarrhoea in Niger Delta and African cities can be attributed to the conditions in these cities. Evidence that the most uncontrolled dumping of waste materials at sea may damage the marine environment and concern about illegal dumping of toxic waste in countries without technical resources to deal with them has attracted International attention to control such actions. Waste dumped in storm drainage channels, creeks, lagoons, and around other water impoundment points typical in the Niger Delta creates serious environmental problems, which can lead to disastrous situations of epic proportions.

4. Socio-economic Problems

4.1. Education and Training

The Niger Delta, with a population of 15 million people or more (comparable to the sovereign states of Ghana or Kenya), has its essential priorities attached to education and training. Accessibility of the people toward education and training has increased over the years with the availability of primary, secondary, and university education but with a loss of skills acquisition training to cater for the less privileged group. However, poor financing, inadequate facilities and low rancher education has crippled the educational systems in a place that has more financial resources compared to other parts of Nigeria.

4.2. Food and Health

All available evidence shows that hunger and malnutrition are on the increase in the Niger Delta. Average calorie consumption level is now below the level needed for health, growth, and productive work. One of the basic reasons for this situation is the serious gap between the rate of population growth and the demand for food on the one hand and the rate of growth of food production on the other. While the rate of growth of the demand for food is estimated at more than 3% per annum, the annual growth rate of food production is estimated at between 1% and 1.59%. A recent World Bank report indicates that 13.7 million Nigerians are undernourished. All available data point to a broad suite of health services in the county Communicable, but largely preventable, diseases, like guinea worm, measles, and tuberculosis. typhoid, cholera, and dysentery ate still prevalent in Niger Delta.

4.3. Infrastructural Decay

There is an acute shortage of infrastructure (Housing, Roads and transportation Links and Networks) supply in the Niger Delta, and most of the housing stock lacks basic infrastructural facilities, like pipe-borne water, water closets, and electricity, etc. Rural and urban housing in the region falls well below minimum standard in all aspects. There is a high occupancy ratio in the region, with some cities like Port Harcourt and Warri, etc., having an average of three to four persons per room. Niger Delta roads are death traps and accident-prone; e.g., the East-West road that traverses Niger Delta states has been neglected and abandoned for decades without apology. The unsanitary condition in which the solid wastes are collected, processed, and disposed of, contributes greatly to urban environmental degradation. Several housing policies and programs are never actualized, and according to United Nations (UN) World Housing Survey, total housing requirements in Nigeria were 5,591,000 between 1970 and 1980, and these needs have not been fulfilled. Most cities in Niger Delta lack open spaces for recreation. The conditions under which people live and work, play crucial roles in determining their overall well-being. These conditions must be such that people's safety and security needs, physical, mental and spiritual health, comfort and self-fulfilment are adequately taken care of.

4.4. Economic Empowerment

Economic empowerment is another terminology for wealth creation. And creating an enabling environment for business opportunities, skills acquisition and training, and investment opportunities are all-inclusive. Talented youths in the Niger Delta in various human endeavours and sourced on the basis of their history and credentials are raw material input for this production process. Economic empowerment, if well planned and supervised, stands to substitute the graduate self-

employed program earlier initiated but never functioned.

4.5. Poverty and Environmental Degradation

Poverty is the single most appropriate word with which to describe the human condition in the Niger Delta today. And as the World Commission on Environmental and Development states in 'Our common future,' otherwise known as the Brundtland Report, poverty pollutes the environment, creating environmental stress in a different way. Those who are poor and hungry will often destroy their immediate environment in order to survive. They will cut down forests, their livestock will overgraze grasslands, they will overuse marginal land, and, in growing numbers, they will crowd into congested cities. The cumulative effect of these changes is so far-reaching as to make poverty itself a major global scourge. Poverty refers to a situation and process of serious deprivation or lack of resources and materials necessary for living within a minimum standard, conducive to human dignity and well-being. The international dimension of poverty also affects the environment and people through the new and callous practice of dumping toxic wastes and other products in the region, which Nigeria's Nobel Prize winner, Professor Wole Soyinka, has called the "poisoning of a continent," an expression of the global inequality. I therefore have no doubt that poverty is such a predominant and all-pervasive phenomenon in the Niger Delta region that it seeks intervention from world bodies such as the UN, which has already taken a bold initiative by establishing its African regional office in the River State capital—Port Harcourt.

4.6. Moral Decadence

Culture is the totality of socially transmitted behaviour patterns, art, beliefs, institutions, and all other products of human work and thought. Ethics is a concept of right and wrong conduct. Ethics tells us when our behaviour is moral or immoral. Ethics deals with fundamental human relationships, how we behave towards others, and how we want them to think and behave towards us. Because of the close relationship between culture and the environment, any campaign for environmental awareness, compliance, and conservation must be associated with environmental damage going on in the Niger Delta owing to unethical environmental neglect by oil exploration companies in the region. The youths and community leaders are the flashpoint of conflict with oil company operators daily for plundering the environment with nothing to show for it, such as education and skills acquisition for the people, health care delivery, gainful employment, social amenities, and modern infrastructural development.

4.7. Conflict Resolution

Ever since oil exploration and exploitation began, there has been continued disagreement in securing a safe ecological environment and better socio-economic conditions, among other things. In response to the demands of the host communities, the oil exploring companies have, in the recent past, made attempts to avert the conflicts between them and their host communities through the provision of social amenities. Even so, social dialogue between companies and host communities remains the key strategy for peaceful resolution of conflicts in the region. Other strategies include:

i. Provision of real employment opportunity for the youth.
ii. Compensation for ecological damage and land acquisition.
iii. Provision of social amenities and infrastructure.

In looking ahead and moving into the terrain of long-term solutions to youth restiveness, there should be a synergy of the federal government, state government, local government, and oil companies working in concert, and the following suggestions may be considered.

A concerted road development and transport program in the Niger Delta will solve a lot of security for the government by virtue of the fact that these roads will lead to oil platforms and open up the rural area for productive endeavours by the people. Indeed, a trans-Niger Delta highway or ring road project is more desirable in the heart of the region, not only for its political and socio-economic utility but also for the enhancement of national security.

4.8. Corporate and Good Governance

Good governance in Nigeria and the Niger Delta states is a demonstration of equitable distribution of available and limited resources to raise the standards of living of the people. Corporate is the institutional framework adopted to actualize the hopes and aspirations of the people. The Niger Delta people of Nigeria have been endowed with rich mineral resources and, in a democratic dispensation of government, ought to overcome problems of poverty, unemployment, and lack of basic and modern amenities and have access to meaningful socio-economic development and investment opportunities. Increased food supply and health services owing to massive investment for modern industries for processing locally sourced materials and reducing unemployment by creating jobs through industrial development. A close observation in the Niger Delta states, cities, and villages points to the fact that despite the wealth accruing from oil and gas production feeding the world, there seems to be a lack of welfare programs to mitigate the environmental hazards associated with petroleum exploration in the region. Take for example that Port Harcourt, Uyo, Calabar, Benin, and Warri, apart from Yenagoa, existed before Abuja—the federal capital. None of these old state capitals could compare favorably with Abuja today, in terms of the glamorous city outlook it has over its counterparts, where the money from petroleum exploration comes from.

i. Where are the LGAs found in the map of development, considering that they live close to the crude oil than every other setting
ii. Are we therefore in a corporate and good governance regime in the Niger Delta region?
iii. Where are the industries (small or large) to absorb the Niger Delta youths?
iv. Where is the economic empowerment program, such as supervised bank loans scheme for the talented youths of the Niger Delta?
v. Where are the programs for engaging our graduates after school in gainful employment?
vi. Do we have violent and restive youths in the Niger Delta?
vii. To discourage these, takes us to the answer to these few questions.

5. The Mechanical Engineering Perspective

From the mechanical engineering perspective, it is necessary to conduct regular maintenance of the equipment and machines used in oil and gas exploration, production and distribution, in order to improve the reliability of the machines (Ugoji et al., 2022; Wofuru-Nyenke, 2024). This is to avoid frequent unexpected machine breakdowns which can lead to increased costs and time wastage. The field of mechanical engineering offers several practical maintenance techniques that can help oil and gas companies manage the upkeep of their machinery and equipment. Preventive, corrective, predictive, and condition-based maintenance are some of these tactics. The term "preventive maintenance" describes the regular, planned inspections, cleanings, and oiling of equipment in order to prevent malfunctions and failures. Corrective maintenance is the term used to describe all repairs made to restore equipment to operational conditions following a failure. Using real-time data from sensors or monitoring devices to anticipate and stop breakdowns is known as predictive maintenance. This maintenance strategy basically utilises sensor data to predetermine when an equipment is likely to fail, so maintenance can be done just in time (Wofuru-Nyenke, 2021). Condition-based maintenance is defined as maintenance that is performed in accordance with the machine or equipment's real state as ascertained by sensors or diagnostics. When certain indicators, such as temperature or vibration, reach a threshold, this maintenance is carried out (Parvizsedghy et al., 2015; Prajapati et al., 2012).

Oil and gas exploration, production, and distribution companies around the world can use these maintenance tactics, among others, to enhance their operations. The corrective maintenance approach is the least suitable of these approaches for keeping these companies machinery and equipment in good working order. This is due to the fact that the method entails returning a machine to normal operating conditions, following downtime and potentially significant costs associated with machine breakdown.

Conclusion

Oil spillage is a major culprit in environmental deterioration, as is the unnecessary and avoidable flaring of massive quantities of natural gas into the atmosphere. Soil and coastal erosion and flooding affect the Niger Delta people adversely. Crop agriculture, which takes up half of the area of the Niger Delta, faces very serious environmental problems such as soil pollution, exhaustion, and unregulated use of pesticides, herbicides, fertilizers, and other chemicals. Nigeria's land use act had attempted to redefine people's right to land in the interest of socio-economic development, but its implementation leaves much to be desired.

Establishment of a comprehensive Niger Delta development plan and whether we have exports from the Moon and Mars, the essential priorities of the Niger Delta remain:

i. Education and training
ii. Efficient Health services
iii. Jobs and skill acquisition
iv. Infrastructure;
v. Portable water
vi. Power (electricity).
vii. Telecommunications
viii. Transportation
ix. Food
x. Housing
xi. Economic empowerment.
xii. Self-determination and National Integration

Various administrations have invariably informed the people of the Delta region that the enemy of the country is weak; therefore, (regrettably) the government can waste money in developing this inhospitable swamp land. What the government has failed to say openly is that this is the area that provides Nigeria with over 90% of its foreign earnings, and to develop the area could prevent further exploration, as the whole of the NIGER DELTA has already been leased out by the government to multinationals and several indigenous oil companies.

If sustainable development is today an increasing concern of governments, communes, non-governmental organizations (NGOs), community-based organizations (CBOs), and peoples of the world over, therefore all hands must be on deck in order to ensure sustainable development. That is, the government, the community, and the household must work together. Sustainable development is an approach that combines the development needs and aspirations of the present without compromising the ability of the future, while also maintaining ecological integrity. Environmental concerns, by their very nature, are common concerns capable of posing common threats.

Public policy in Nigeria up till very recently has always had a problem of adequately conceptualizing the environment in a holistic perspective. Policy, therefore, has often seen the environment, particularly in colonial times, as either a sanitation, public health, or wildlife and forestry preservation issue, but the environment is all of these and more than these.

Therefore, the following are recommended:

i. Government, communities, industries, private firms, non-governmental organizations, and CBOs must work together to plan for it, monitor it, and manage it.
ii. Provide effective policy on structural and non-structural flood and erosion mitigation measures in the Niger Delta.
iii. Abrogate unjust and obnoxious laws like the Petroleum Act of 1969, the Land Use Decree of 1978, etc., to pave the way to meaningful resource control as it is in other parts of the world.
iv. Pursue the very popularly demanded devolution of powers and functions.
v. Establish a true federal structure, including fiscal federalism.
vi. Establishment of pan - Niger Delta infrastructural development and allocation of derivation.
vii. Local government allocation of derivation fund.
viii. Adopt international standards in environmental pollution control and compliance.
ix. Pursue Millennium Development Goals (MDGs) through concrete United Nations

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