



Assessment of the Impact of Flared Gas and Oil Spilled on Human Health and Environmental Degradation: Evidence from the Niger Delta Region, Nigeria

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Abstract: Flared gas produce emissions that have the potential to contribute to global warming and climate change. Oil spills destroy the aesthetic values of land and water sources such as drinking, recreation, fishing and farming. the discharge of these explorative activities results to challenge on human health and environmental ill-quality and degradation of the ecosystem. The objective of the study is to examine the impact of flared gas and oil spilled flaring on human health and environmental degradation in the Niger Delta region. Primary data were sourced from field surveys from the use of questionnaires administration while secondary data were sourced from documentary and established materials while. A total of 307 copies of questionnaires were designed and administered to the 15 selected communities a crossed the 6 states that constitute the region. Information from these data was got from two (2) sets of respondents. From this total number, 300 were administered to residents of the 15 selected communities while the remaining were administered to staff of the Commission, at 1 each per state headquarters and 1 copy administered in the office of the Ministry headquarters in River's state. In each of these communities, a default number of 20 copies of questionnaires were distributed in the selected communities. The questionnaires were administered through systematic random sampling techniques Both the descriptive and inferential statistical techniques of 2-Way ANOVA were used for the study. The results showed that that the impact of flared gas and oil spilled on human health does not vary significantly on environmental degradation among the states of the Niger Delta region. The likely common ailments from a polluted environment for human health are that oil pollution generates air-borne diseases, like diphobia, chromatisa, delivum, heart attack, skin disease, dysentery, typhoid fever, asthma, pneumonia emphysema. Oil spills destroy the land's aesthetic values and farmland pollution as well as the quality of water sources such as drinking, recreation, swimming, fishing, and domestic use. The study recommends that there should be justice for resource control and allocation. Places, where natural resources are exploited with major effects on the environment, biodiversity loss and threats to human health and safety should be adequately rewarded and compensated.

Keywords: Gas Flaring, Oil-Spills, Human Health, Environmental Degradation, Niger Delta Region

1. Introduction

It has been estimated that Nigeria has over 120 trillion cubic feet of natural gas reserves currently flared and about 2

billion standard cubic meters of these gasses consist of methane and natural gas liquids such as ethane, propane, pentane and butane. Methane gas, if further treated can be used as feedstock for acetylene used in welding chemicals, ammonia can be used in fertilizer, plastics, and explosives,

methanol used in adhesives, fuel, polyesters fibers, carbon black used in tires, rubber, paint, and printing ink, oxo alcohols used in detergents and lubricants, hydrogen cyanide used in nylon and iron-ore reduction used in iron and steel. Natural gas liquids have high market values and can find applications either in raw forms as solvents and feedstock for the production of various chemicals and liquid fuels or fractionated into their components [9, 18, 19, 29]. Gas flaring reduces the risk of fire and explosion on land surfaces but produces emissions that have the potential to contribute to global warming and climate change. Gases such as carbon dioxide, sulphur dioxide, nitrogen oxide, hydrocarbons and suspended particulate matter are known to cause acid rain, smog and depletion of the Ozone layer which is responsible for numerous diseases on plants, animals and human beings. Oil spills are where crude oil spills on the surface of flowing water bodies destabilized the physics and chemistry of the natural state of the water. Discharge substances from oil spills are leached and washed into streams and rivers such as in the cases of the Niger Delta region resulting in contamination and degradation of the land and water resources. In essence, oil spills destroy the aesthetic values of water sources such as drinking, recreation, fishing, and farming, biodiversity loss and environmental in-balance in the ecosystem [6, 9, 24]. Gas flaring and oil spills are associated with areas of crude oil exploration and refining activities of its products. On a broad scale, the operations of these activities have a negative impact on human health and the safety of the environment at large. From the global view, the activities of gas flaring are generally discouraged as its operation releases toxic components into the atmosphere and contributes to extreme weather conditions, global warming and climate change [6, 11, 29].

In Western Europe with improved technology, about 92% of the associated gas exploited are re-injected into the ground owing to its impacts on human health and environmental quality but this cannot be said in developing countries like Nigeria. Oil spill connotes the contamination of the land and water resources from the activities of crude oil exploration and spills of its contents on the surface of the land ecosystem, which are further leached and washed into streams and rivers bodies of human habited areas such as the moderately-dense Niger Delta region. Just as gas flaring depletes atmospheric conditions of man and other living organisms, so also, oil spills destroy the aesthetic values of land and water sources such as drinking, recreation, fishing and farming [9, 19, 21]. The combination of the impacts of gas flaring and oil spills affects the environmental quality of clean air, clean water, and clean land and the gradual loss of biodiversity in a given area such as the Niger Delta region [8, 9, 12, 13, 19, 29]. Since the discovery and exploration of crude oil began in 1964 in Olobiri Community in Bayelsa State by Nigeria Agip Oil Company some 58 decades ago, millions of barrels of crude oil are lifted off the coast of the Niger Delta region on daily basis. The drilled crude from the rivers and creeks crisscrosses the communities inhabited by impoverished locals. These indigenous communities who are largely

fishermen and farmers are affected by the decades-long environmental devastation, coupled with the threat of extinction of certain species of living organisms. The threats from oil activities are becoming worrisome by the day on human health and safety, pollution of air, water and water resources and this call for environmental sustainability [6, 9, 21]. The Aegis of Environmental Rights Action (ERA, 2009), observed that about 1,000 unidentified oil spills are recorded annually in the Niger Delta region in the past few years in the region and mainly from Bayelsa and Delta states respectively. In recent times and with the pace of both increased illegal activities of oil bunkering and oil thefts in the region and with a projection of 1% from the initial figure of ERA of 2009, in 2022 the figure would have risen to 13,000 oil spills are recorded annually in the Niger Delta region [3, 10, 19, 18, 24, 27]. Shell Petroleum Company reported in 2011 that 1,010 oil spills, with 110,535 barrels or 17.5 million liters lost. In 2014, oil spills of 26,286 barrels or 4.1 million liters were lost. In addition, the Nigerian National Petroleum Corporation's (2021), yearly reports state that between 2016 and 2020, Nigeria flared 1,252.26 trillion cubic meters of natural gas into the atmosphere. About 77 percent of the gas flaring and oil spills occurred mainly in the 4 oil-producing states of Akwa Ibom, Bayelsa, Delta and Rivers. These 4 states are among the highest oil and gas producers in the nation. Presently, Akwa Ibom being the 2nd highest oil-producing state after Bayelsa, Rivers and Delta in the pecking order has witnessed the 1st highest oil spills since the inception of gas flaring and oil exploration in the region. On January 16th 2010, a gas explosion claimed the lives of a handful of expatriates and much indigenous staff of Shell Multinational Company in Akwa Ibom. The striking memories from the effects of oil spills in the Bonga community as well as the gas explosion in the Kouluama community in 2008, 2009, 2012 and 2013 repeatedly all in Bayelsa state were some of the devastating effects on human health and safety of the environment [18, 19]. On October 19th 2013 oil spills from the platform of Mobil Oil Company in Eket LGA (Akwa-Ibom), constitute severe damage to aquatic life and water contamination to the ecosystem. On May 15th, 2021 only the state of Akwa Ibom recorded 26 oil spills from Shell Petroleum Company while on November 4th 2021, Nembe Bayelsa state witnessed a devastating oil spill that had a deep dive into the infamous Santa Barbara community [4, 6, 7, 9, 16, 18, 19, 21].

Of recent, the communities of Brass, Tone-Brass, Sagbama, Olobiri, Ogoni and Torobi in Bayelsa and Delta states, are currently on the radar for environmental pollution from oil spills and gas-related activities. The struggle for justice and mercy for the effects of environmental degradation in the region had led to the death of seasoned icons and environmental activist Sir, Ken Saro-Wiwa on Nov 10th 1995 and agitation on the struggle for justice still counting. The combination of reports from accumulated spills with non and less environmental cleanup has contaminated the Niger Delta region's water and land resources. These have led to the survey of trace metals that have accumulated in crops and

harmful, potentially carcinogenic hydrocarbons such as polycyclic aromatic hydrocarbon and benzo (a) pyrene and naturally occurring radioactive materials from plants to the human food chain [4, 9, 16, 17, 18, 19, 20, 22]. Furthermore, operations of the oil industries have endangered conflicts and impacted wetlands, water bodies and sanitation problems within the region. Given this, the activities of the industry will spell danger and cost implications to maintain because any damage was done to the environment's run-down capital, which sooner or later reduces the value of its recurrent services if emissions on land, air and water resources are not checked and reduced by 2050). However, the frequent cases of pollution and environmental devastation of land and water resources had led to the constant fleeing of residents of the interiors of Egbema and Ebocha communities of Ogbia-Egbema Ndoni Local Government areas of River state that depend on fishing and farming for livelihood to uplands and urban center for better living conditions. Since gas flaring and oil spills are associated with negative impacts of (a) bush burning, (b) land barrenness, (c) stillbirth, (d) eye blindness, (e) mortality, (f) extreme weather conditions, and (g) climate change has been prevailing in the region and these call for urgent measures by government and private sectors [6, 10, 13, 18, 19, 22, 23].

Though government and private sector partnerships have made some giant strides in the management of environmental degradation in the past and still counting the region is still faced with these challenges mainly in the socioeconomic lives of the people in particular and the environment in general. If these challenges are not adequately managed in time, it would lead to threats to the life of residents and environmental ill-quality, degradation and imbalance of the ecosystem within the region. These indices informed the reason for this research as the study is meant to determine the impact of flared gas and oil spilled on the livelihoods of the people of the Niger Delta region. Many studies on environmental degradation have been carried out in the region but few of these studies have effectively combined the impact of gas flaring and oil spills on human health and the environmental degradation of the region and this is the research gap. In order to achieve this, the objective of this paper is to examine the impact of oil spills and gas flaring on human health and the pace of environmental degradation in the Niger Delta region, South-South, Nigeria. The choice of Niger Delta region is pre-determined by a combination of factors such as (a) the presence and nature of gas flaring and oil spills, (b) health challenges (c) the pace of environmental degradation (d) neglect and (e) call for environmental justice, call for this research.

2. Conceptual Clarification

2.1. Environmental Quality

The concept of environmental quality is concerned with the value of human health, safety, environmental benefits of man and living creatures and environmental sustainability on

the components of the ecosystem. This connotes clean air, clean land and clean water and human hygiene. The studies of Wright, R. T and Nebel, B. J. [14, 31], as cited by Agbebaku, H. U. [5], state that the variables of environmental functions the essential for man's existence and sustainability. Environmental quality depicts the healthy, conducive and friendly state of the atmosphere, hydrosphere and lithosphere to sustain man and other living organisms of the biosphere. The study of Cunningham, W. P and Cunningham, M. A. [12, 14], states that any environment that is mixed with the threats of (a) smoke (b) fumes (c) smooth (d) carbon monoxide (e) carbon dioxide (CO₂), (f) sulphur dioxide (g) methane gas (CH₄), (h) lead (i) toxic chemicals (j) particle matters, and (k) fluid substances which are fundamentals to areas where gas flaring and oil spills occurred promote environmental in-balance and cause disease and other health challenges to human. These challenges humans are experienced in the Niger Delta region due to the influence of these variables on environmental quality [6, 12, 26].

2.2. Environmental Degradation

This connotes deterioration or malfunction of the components of the environment through emissions and depletion of natural resources of air, water and soil and extinction of wildlife and plant species in the components of ecosystems. The Ozone layer (O₃) depletion has resulted from more destructive rays of Infra-red 51%, Ultra-violet 8% and Gamma-ray 41% into the earth and parts of these destructions from the effects of gas flaring activities have resulted in partial eyes blindness, skin cancer, excessive heat and global warming of the Niger Delta region. Furthermore, the intervention of man on the earth for adaptation and oil exploration has contributed to excessive heat of extreme weather conditions and rainfall, thereby leading to environmental in-balance, challenges and the consequent. When the environment becomes less valuable, less resourceful and less accommodating; the term environmental degradation is gradually experienced. In addition, the effects of deforestation, gas flaring: oil spillage, carbon dioxide and bush burning, have a significant influence on environmental in-balance and the prevalence of degradation. of the ecosystem. The combination of one or all of the above leads to environmental degradation. Surveys have shown that from the 6 geo-political zones in Nigeria, apart from natural causes, anthropogenic factors from human activities of gas flaring and oil spills have grossly pruned the Niger Delta region to environmental challenges and degradation than other regions. For example, when human habitats of land and water sources are polluted, aquatic life destroyed, biodiversity lost and natural atmospheric resources depleted; the environment is hurt, altered and degraded and all these indices are experienced in the region call for urgent attention for sustainability [4, 9, 12, 18, 22, 28, 30].

2.3. Impacts on Human Health

Sulphur dioxide in the atmosphere from gas flaring areas

acts as a pungent suffocating irritant gas on the upper respiratory tract under moderate exposure leading to damage to the human respiratory system. Sulphur compounds affect visibility, reduction of sunlight, unpleasant smells, irritation and smarting in the eyes, nose and throat. Furthermore, associated areas of gas flaring and oil spills are fraught with environmental quality of clean air, safe drinking water, food chain and secure shelter for humans. Reducing emissions of greenhouse gases through gas flaring, and improving automobiles, food and energy-use choices can result in improved health, particularly through reduced air pollution and water contamination. The combination of variables of emissions, contamination and extreme temperatures contribute directly to adverse cases of health challenges such as cancer, neurological, cardiovascular and respiratory disease, loss of human sight, and reproductive and developmental effects. Deformities in children, lung damage, skin problems and an increase in mortality rate are reported cases in the region. In addition, hydrocarbon compounds that are known to cause adverse changes in hematological parameters are prevalent in the region. In addition, Radioactive pollutants (from mining and refining of Uranium, Thorium and nuclear power plants) enter humans through food and water and accumulated in the blood, thyroid gland, liver, bones and muscles. These human health challenges affect blood-forming cells negatively which could give rise to anemia (aplastic), pancytopenia and leukemia particularly among elderly people as observed in the region [2, 6, 9, 12, 18].

2.4. Impacts on the Environmental Degradation

The environment whether physical and human play a significant role in ensuring environmental balance and sustainability. Any default interventions and alterations by human actions such as gas flaring and oil spills on the physical components of the environment have positive and negative impacts on the human environment. These impacts degrade the environment, resulting in environmental in-balance that hindered environmental quality. Given this, the impacts of gas flaring and oil spills were examined from a broad view of physical and human activities of the region from the perspectives of (a) climate (b) crop production (c) environmental balance (d) pollutants of materials (e) pollutants on water and land resource, and (f) pollutants on wetland and ecosystem [4, 6].

2.4.1. Physical Indices

a. Climate: Natural gas flaring emanating from hydrocarbon exploration has been internationally and locally acknowledged as a significant source of greenhouse gas emissions and a major contributor to extreme weather conditions, global warming and climate change. During the combustion process, gaseous hydrocarbons react with incomplete combustion and carbon monoxide (CO₂)-complete combustion. These gases result in greenhouse emissions that enhance climate change, Ozone depletion and environmental degradation. Gas flaring and oil spills cause

acid rain, air pollution hot and harsh weather conditions, abnormal rainfall pattern and the extinction of plant species while extreme climatic conditions on oil spills (Figure 2) results in the death of aquatic life, drinking water sources, land pollution and biodiversity loss. However, the duo of these activities together with harsh climatic conditions results in severe ailments in the region [6, 9, 18, 22].

b. Environmental In-Balance: The ecosystem by default functions to maintain and sustain the global environmental balance of its elements. Anything that alters normal functions and bio-network creates an in-balance in the ecosystem. The infiltration of flared gases and oil spills liquid substances into the ecosystem constitutes an environmental in-balance. The effect these affect the physical components of the ecosystem, human and aquatic life and other living creatures of the ecosystem. The inclusion of hazardous gases into the atmosphere, water and land resources has positive and negative reactions to incoming and outgoing radiations. Once these occur, there are bound to be alterations in the physics and chemistry of the lower atmosphere and translation on environmental in-balance of the ecosystem. For instance, Carbon gas in the atmosphere at 1%, causes environmental in-balance in the ecosystem, but where it's less than 1%, causes a deficiency of oxygen to animals and where it's above 1%, it causes the death of plants. Furthermore, there is an accurate balance between human-being gets from oxygen and the amounts of released oxygen by plants (21% to 78%), [4, 11, 28].

c. Pollutants on Wetland and Ecosystem: Climatic variations and exploration activities in the Niger Delta region wetlands are changing rapidly raising concern for the wetlands' management that is currently lacking for the Niger Delta. The wetland ecosystem services are eroded through oil and gas exploration, dredging invasive plant infestation and wetland reclamation needs to be resuscitated. The failed resuscitation of pollutants in the ecosystem would result in skewed and reduction, mass fish migration, loss of aquatic life, water pollution, infiltration of the food chain and poverty. People have to buy goods that previously could be obtained from the wetlands. Since key pressures to wetland pollutants and management are anthropogenic understanding, the role of the institutions on ecosystem restoration is imperative in the region to boast their primary activities of fishing and farming as well as sources of water supply [1, 6, 19, 20].

2.4.2. Human Indices

a. Crop Production: Crops cultivation in the region are more to the food of subsistence farming than cash crops owing to the swampy and mangrove terrain of the region. The spatial variability effects of gas flaring on the growth and development of crops such as cassava (manihotesculental), watermelon (talinumtriangulare), plantains, cocoyam, waterleaf and pepper (piper spp) crops. A study of data collected on soil and atmospheric temperature and moisture at intervals, starting at 40m from the flare point to a distance of 140m lengths and widths of

crop leaves, the height of crop plants and cassava yields were measured at specified distances. The amino acid, ascorbic acid, starch and sugar constituents of the cassava yields were determined and the results suggest that a spatial gradient exists with the effects of gas flares on crop development. Retardation in crop development manifests in decreased dimensions of leaf lengths and widths of cassava and pepper crops closer to the gas flare point. Statistical analysis also confirms that cassava yields are higher at locations further away from the flare point. In addition, the high temperature around the waterleaf crop, on the other hand, appears to thrive better around the gas flare point. The implication of these is on human health as these crops are mainly cultivated and consumed by the locals, low yield of certain crops and extinction of plant species [6, 10, 22, 27].

b. **Pollutants on Materials:** Air pollution affects materials by soiling building surfaces, metallic objects, clothing and structures. The sulphuric acid present in the air is responsible for the damage to cloth materials and fabric, which leads to bleaching and discoloration and is caused by acid rain. Hydrogen sulphide corrodes materials such as paints, electrical contacts and textiles. The reduction in air quality we breathe is a result of emissions of pollutants from flared gases, traffic congestions, automobiles, and burnt refuse in our immediate environment. Furthermore, the effects of air pollution on vegetation result in gaseous pollutants such as sulphur dioxide which are diffused into plants (photoxicants) and this led to the destruction of the photosynthetic activity of the plant. Damage to plants ranges from the collapse of the leaf tissues, bleaching or colour changes, and reduction in growth rate to complete death of the plant. Other gaseous pollutants responsible for these damages include chlorine, hydrogen chloride, ammonia and mercury [2, 10, 11, 22, 27].

c. **Pollutants on Water and Land Resources:** Water and land resources are the worst affected by the effects of gas flaring and oil spills. The water ecosystem will become polluted for human consumption and habitable for aquatic life. The initial reliance on water sources for drinking and other desired uses would be contaminated for the locals and the cost implication and distance covered to get quality water supplies. There will be a loss of aquatic life a major occupation and dependent for livelihood in the absence of gainful employment from private and government establishments. On the other hand, oil spills on the land rendered the soil uncultivated, loss of plant species and biodiversity loss as can be observed on Figure 2 [6, 9, 18, 22].

3. Materials and Methods

3.1. Study Area

The study area is the Niger Delta region, South-South, Nigeria. The region approximately lies within Latitude 6°35'N and 8°40'N and Longitude 5°30'E and 9°32'E of the Greenwich Meridian. The region is regarded as the oil-producing state of Nigeria and functions as the field training ground and administrative offices for oil and gas and service

companies on exploratory activities. The Niger Delta region is made up of 6 states namely; Akwa-Ibom, Bayelsa, Cross-River, Delta, Edo and Rivers. The region is an oil-producing state of the nation and each state gets 13% oil venue derivation allowances from the Federal Government of Nigeria in addition to their monthly allocations accrued to the 36 states of the Federation. The region sits directly on the Gulf of Guinea on the Atlantic Ocean in Nigeria. It is typically considered to be located within 9 Coastal Southern Nigeria States, which includes all six states from the South-South Geo-Political Zone, Ondo from the South-West, Abia and Imo states from South-East Geo-Political Zones. Activities of the region are coordinated and managed by a Commission and the Ministry of Niger Delta Affairs. The Ministry of Niger Delta Affairs is situated in Abuja while the Head Office of the Commission is located in River's State. The Commission which was established in 2000 has a branch office in each of the 6 states of the region. The region has territorial boundaries-ties with the coast of River-Niger hence the name Niger-Delta Development Commission. The list of oil exploration companies that depicts havoc in the region is as follows: Chevron, Shell, Conoil, Fort Oil, Addax, Total, Oando, LNG, NNPC and Exxon Mobil. These oil companies are in all 5 states except in Edo state [6, 10, 18, 19]. The region is physically characterized by a tropical climate. The region records the highest degree of temperature (36.1°C) in February and March and the lowest degree of temperature (19.4°C) in April and May. The mean annual temperature of the region is 316.4 (°C) and 922.2 (°F) and the mean daily sunshine hours are (6.9) respectively. The region is characterized by a relatively flat and simple undulating topography of about 78.64 meters above sea level. The region is characterized by mangrove, swampy and rainforest vegetation that is comprised majorly of dense forest and grassland, shrubs and light vegetation, rivers, creeks and the Atlantic Ocean waters [9].

The Niger Delta region is defined officially by the Nigeria Government as an area that extends over about 70, 000km² (27,000sq mi) and makes up 7.5% of Nigeria's landmass [6, 18, 24]. The socioeconomic characteristics of the region are a mix of primary, secondary and tertiary. Primary activities in the region are more with the interior communities which include (a) the traditional institution and mining industries and (b) rudimentary activities of black-smithing, soap making and bakery. These are in addition to their traditional farming, lumbering, hunting, fishing, sewing, tapping and petty trading occupations. Secondary and tertiary services and activities in the region are more to large villages and urban centers that range from waste generation, education, housing, money lending, transportation, medical, skills acquisition, commercial, entertainment, photography and hospitality, internet and the combinations of e-commerce, e-banking e-transport and e-commerce. Furthermore, Political characteristics comprised of the indigenous people of the region are more of the Ijaws, the 4th largest tribes in Nigeria and mixed of other minor tribes [9, 18]. The Ijaws are in Delta, Bayelsa, and Rivers states, the Ibibio are in Akwa-

Ibom and Cross-River states, the Kweri's and Kalabari are in River state and the Benis in Edo state. In addition, other minority sub-tribes in the region are; Esan, Estako, Urhobo, Efik, Owan, Itsekiri, Ika and Agbo respectively. Each of these states is divided into senatorial districts, constituencies, wards and pollen units. The region has a population threshold of over 60 million inhabitants put together [15]. Settlement formation within the region range from (a) camp, (b) creeks (c) coastal or riverine (d) hamlet, (e) small village, (f) large village, (g) towns, and (h) cities metropolises. In terms of population threshold, the region is the 3rd largest populated area in Nigeria after South-West and North-Centre. The oil-producing areas are located within the hinterland order wise known as the offshore and onshore drills. The hinterland of the region is where oil exploration is carried out and these areas constitute the offshore creeks of camps, hamlets, small and large settlement formations as well as large towns with human populations from over 20,000 to 30,000 inhabitants.

Communities within the region are led by village heads and institutions of traditional leaders [6, 10, 15, 18, 22, 25].



Source: Google Map, 2022.

Figure 1. Map of the 6 South-South States that Constitute the Niger Delta Region of Nigeria.



Figure 2. The Drawing Line Between an Oil-Spilled and Natural Vegetated Ecosystem in Ogoni Land, Rivers State of the Niger Delta Region. Residents in these areas are in Pain and Tears of their land resources from the activities of oil exploitation from flared gas and oil spilled. The devastating effects of acid rain still haunt the region. The level of degradation and processes of restoration is a function of time factor and cost implication.

3.2. Methodology

Materials used for this study include the use of figures, tables and questionnaires administration and these formed the research instruments. The research methods for clarity were categorized into types of data used, sample frame, sample population, sampling method and data analysis. Under types of data, both primary and secondary data sources were used for this study. Secondary data were sourced from documentary materials and established sources from academic journals, conference papers, theses, textbooks, maps, and internet sources such as data from the National Population Commission, Federal Office of Statistics, Ministry of Niger Delta Affairs and Niger Delta Development Commission. Primary data were sourced

through the process of field and reconnaissance surveys, questionnaire administration and granted interviews. For the purpose of determining the population size for primary data collection, field survey, the sample frame and sample population in addition to questionnaires administration used for the study were got from the region. Information from these data was got from two (2) sets of respondents. One of the respondents was from residents of 6 states of the region while the other sets of data were got from the staff of the NDDC state Offices and the Ministry of Niger Delta Affairs in River State. To get primary data, residents of the affected communities and staff of the Commission and Ministry of Niger Delta Affairs were used as the frame. The study area was constituted of the 6 states of Akwa-Ibom, Bayelsa, Cross River, Delta, Edo and Rivers and Local Government areas where gas flaring and oil spills activities were carried out and

the effects of environmental devastation on the region. For the purpose of this study, 80% of the communities per Local Government area and of the 6 states where were randomly selected for the study. In doing this, the list of communities and companies where flared gas and oil spills were carried out and have impacted negatively on the region and devastating effects on human health and environmental degradation were examined for the study. The list of the oil-producing companies and communities used for the study are as follows: (a) Batan, Ididi, Ogoni, Otumara and Sagara communities in Rivers state, with Shell, Agip and Chevron petroleum development companies as defaulting offenders (b) Ekpa, Kwale and Escravos communities in Delta state, with Shell, Agip and NNPC petroleum development companies as defaulting offenders (c) Nembe, Brass, Ebedei, Goi, Olobiri and Bodo communities in Bayelsa state, with Shell petroleum development companies as defaulting offenders, and (d) Eket community in Akwa-Ibom with Exxon Mobil Petroleum Development Company are the defaulting offenders.

These Communities in their wards, Local Government areas and States within the region were selected and these communities served as the sample frame and were used for questionnaires administration for the study. For data collection, staff of the Commission, Ministry and residents of the communities in the 6 states were used for the study area, questionnaires were designed and distributed among the residents and staff Commission and Ministry of the study area. To do this, 0.01% of the population of the residents and staff of the Commission and Ministry selected sawmills and settlements. Given this, a total of 307 copies of questionnaires were administered. From this total number, 300 were administered to residents of the 15 selected communities while the remaining were administered to staff of the Commission, at 1 each per state headquarters and 1 copy administered in the office of the Ministry headquarters in River's state. To this end, a default number of 20 questionnaires were distributed in each of the 15 selected communities as stated above except for communities in Cross River and Edo states with no cases of gas flaring and oil spills that have been recorded but constitute part of the region

of study. The distribution of 300 copies of questionnaires in the selected communities and states outside the 7 administered to institutional staff was administered through systematic random sampling techniques. In each of the chosen communities, a systematic random distribution was made of 3 street intervals selected in each of the 15 selected communities for questionnaire administration. For instance, in Rivers State with 5 selected communities, that is Batan, Ididi, Ogoni, Otumara and Sagara a sub-total of 20 questionnaires was administered which brought the number administered questionnaires to 100. In Delta State with 3 selected communities, that is Ekpa, Kwale and Escravos a sub-total of 20 questionnaires were administered each per community which brought the number of administered questionnaires to 60. In Bayelsa State with 6 selected communities, that is Nembe, Brass, Ebedei, Goi, Olobiri and Bodo communities a sub-total of 20 questionnaires were administered each per community which brought the number administered questionnaires to 120. While in Akwa-Ibom State with 1 selected community, that is Eket community a sub-total of 20 questionnaires were administered per community which brought the number administered questionnaires to 20. However, data from various sources were analyzed using the appropriate descriptive and inferential statistical techniques. The descriptive analyses used for the study were percentages, figures and tables. The inferential statistical techniques for this study were the use of 2-Way Analysis of Variance (ANOVA) Statistical Analyses. This technique was used to test the stated hypothesis of there is no significant variance in the impact of flared gas and oil spill on human health and environmental degradation of the Niger Delta region, South-South, Nigeria.

4. Results and Discussion

The results from questionnaires administration and tests carried out on the impact of flared gas and oil spilled on human health and environmental degradation of the Niger Delta region, were summarized and presented in Tables 1 to 10 respectively.

Table 1. List of Gas Flare Stations that Alloy Oil Spills and Defaulting Companies in the Region.

State	Community of Gas Flaring Stations that Alloy Oil Spills	Production and Defaulting Companies
Akwa-Ibom	Eket	Exxon Mobil Petroleum Development Company as Defaulting Offender.
Bayelsa	Nembe, Brass, Ebedei, Goi, Olobiri and Kouluama.	Shell Petroleum Development Companies as Defaulting Offenders
Cross River	None	None
Delta	Ekpa, Kwale and Escravos	Shell, Agip and NNPC Petroleum Development Companies as Defaulting Offenders
Edo	None	None
Rivers	Batan, Ididi, Ogoni, Otumara, and Sagara	SShell, Agip and Chevron Petroleum Development Companies as Defaulting Offenders.

Source: Fieldwork, 2022

Table 1 showed a list of gas flare stations that alloy oil spilled and defaulting companies in the Niger Delta region. The Table revealed that Bayelsa state has the highest number of 6 communities with activities of gas flare stations that

alloy oil spills. This is followed by River's state with 5 communities. Next was delta state with 3 communities and Akwa-Ibom state with 1 community located at Eket. From the Table, Cross River and Edo states have no record yet of

the case of gas flaring and oil spills.

Table 2. State Where Gas Flaring and Oil Spills Are Generated.

State	Frequency	Percent
Akwa-Ibom	20	6.7
Bayelsa	120	40
Cross River	-	0
Delta	60	20
Edo	-	0
Rivers	100	33
Total	300	100.0

Source: Fieldwork, 2022.

Table 2 showed the states where gas flaring and oil spills are generated in the Niger Delta region. The generation of these variables was higher in Bayelsa state than in other states within the region. From the Table, Bayelsa state represents 40% of the total generation of flared gas and oil spilled in the region. This is followed by River's state with

33%. Delta state comes third with 20% while Akwa-Ibom state with 6.7% respectively. The states of Edo and Cross River were tied with 0% as there have been no records of such threats in these states. The analysis indicates that the pace of environmental degradation on human health and the environment in Bayelsa state is severed from threats of flared gas and oil spill in the region. Furthermore, the significant effects of these threats on the socioeconomic lives of the people would be in terms of (a) poor environmental quality of clean air, water and land, (b) health challenges (c) pollution of farmland, hunting and death of aquatic life (d) changes in climatic variability such as acid rain, biodiversity loss, extreme weather conditions (See Figure 2). The settlements of Nembe, Brass, Ebodei, Goi, Olobiri and Bodo communities (all in Bayelsa state) have witnessed one form of gas flaring and oil spilled in the past and still counting into the future.

Table 3. Nature and Composition of Environmental Degradation per State.

State	Nature of Environmental Degradation	Composition of Emission	Frequency	Percent
Akwa-Ibom	Gas Flaring, Oil Spills, Moderate Emissions, Loss of Biodiversity, Acid Rain, Flood, Erosion, Extreme Temperature and Household Waste	Hazardous, Non-Hazardous and Infectious	50	16.65
Bayelsa	Gas Flaring, Oil Spills, Loss of Biodiversity, Acid Rain, Flood, Erosion, High Emissions and Land Excavation, Household Waste, Congestion, deforestation, Extreme Temperature, Epidermis, Heat Waves and Housing.	Hazardous, Non-Hazardous and Infectious	50	16.65
Cross River	Loss of Biodiversity, Acid Rain, Flood, Erosion, Low Emissions, Heat waves and Household Waste.	Hazardous and Non-Hazardous	50	16.65
Delta	Gas Flaring, Oil Spills, Loss of Biodiversity, Acid Rain, Flood, Erosion, Household Waste, Moderate Emissions, and Epidermis	Hazardous, Non-Hazardous and Infectious	50	16.65
Edo	Flood, Erosion, Household Waste, Deforestation, Low Emissions,	Hazardous and Non-Hazardous	50	16.65
Rivers	Gas Flaring, Oil Spills, Loss of Biodiversity, Acid Rain, Flood, Erosion, Household Waste, Congestion, Extreme Temperature, High Emissions and Land Excavation, population growth and Housing.	Hazardous, Non-Hazardous and Infectious	50	16.65
Total			300	100.0

Source: Fieldwork, 2022.

Table 3 showed the nature and composition of environmental degradation in the region. From the Table, it was revealed that the nature and composition of degradation in the region vary from state to state with Bayelsa, Rivers Delta and Akwa-Ibom in order sequence having more threats of degradation than in Cross River and Edo states with no trace and records of gas flaring and oil spills. The Table further shows that the environmental quality of clean air, water and land will be higher in the latter states than in the

former. Other indicators of environmental degradation and severity of weather conditions vary from state to state. The frequencies and percentages from the Table were tied in all the states. This is due to the default number of questionnaires administered per state. The severe weather condition in Cross River state is a function of heat waves and extreme temperatures that have spread in space of time and seasons from emissions and proximity of the activities of oil exploration companies in the region.

Table 4. Nature of Environmental Degradation State by State in the Region.

State	Variables in %								
	Gas Flaring	Oil Spills	Flood	Erosion	Deforestation	Pollution	Pipeline Vandalization	Waste	Biodiversity Loss
Akwa-Ibom	09.0	15.7	14.5	07.5	08.2	10.8	28.5	10.6	09.7
Bayelsa	43.0	54.4	28.4	32.4	07.3	24.9	43.7	09.7	44.7
Cross River	0	0	07.3	15.7	13.4	07.1	18.6	14.6	06.8
Delta	18.3	12.8	26.2	18.4	30.2	21.0	04.5	13.8	12.6
Edo	0	0	05.0	08.3	18.3	06.6	03.4	18.1	04.8
Rivers	29.7	17.1	18.6	17.7	22.6	30.6	02.3	33.2	21.4

Source: Fieldwork, 2022.

Table 4 showed the responses on the nature of environmental degradation state by state in the region. From the Table, it was revealed that Bayelsa state has the highest cases of flared gas in the region with 43.0%. This is followed by Rivers with 29.7% and Delta with 18.3%. on spilled oil, the sequence of occurrence is almost the same with flared gas because both variables are close associates. Bayelsa state has the highest cases of spilled oil with 54.4%. This is followed by Rivers with 17.1% and Akwa-Ibom with 15.7% respectively. The activities of erosion and floods go hand in hand just as gas flaring and oil spills. From the Table, Bayelsa state has the highest counts of erosion and floods with 28.4% and 32.4% counts respectively. This was followed by Delta and Rivers with 26.2% and 18.4% for the former and 18.6% and 17.7% for the latter respectively. Degradation of atmospheric pollutants apart from gas flaring but from automobiles and industrial activities was highest in Rivers at 30.6%, Bayelsa at 24.9% and Delta at 21.0% respectively. Furthermore, biodiversity loss was higher in Bayelsa at 44.7%, Rivers at 21.4% and Delta states at 12.6% respectively. Loss of biodiversity species could result from the combination of gas flaring, oil spills, deforestation, urbanization, acid rain and extreme climatic conditions in the region. The threat of household wastes was the least in Bayelsa and Akwa-Ibom than in other states with 09.7% and 10.6% counts respectively. This could result from poor human attitude by the majority of the residents that discard

waste materials into flowing water and canals in Bayelsa state. On the other hand, the people of Akwa-Ibom and Cross River are very conscious of sanitation and indiscriminate waste management.

Table 5. Perception of Residents on Ranking of Environmental Quality in the Region.

Ranking of Environmental Quality	Frequency	Percent
Very Good	20	6.7
Good	31	10.3
Fair	103	34.3
Poor	146	47.9
Total	300	100.0

Source: Fieldwork, 2022

Table 5 shows the responses of residents on their perception of the ranking of environmental quality of their ecosystem in terms of clean air, clean water, clean land and human health in the region. From the Table, the majority of the respondents which represents 47.9% responded to the poor environmental quality of their ecosystem. This is followed by responses from the fair environmental quality and this account for 34.3%. Responses on good perception account for 10.3%, while responses for very good quality account for 6.7%. The reasons for very good environmental quality could be from states/areas with less or no impact of oil spills and gas flaring on environmental degradation or where there is no recorded case of such.

Table 6. Responses from Staff of NDDC and MND on Environmental Compliance by Oil Exploration Company.

Assessment Variables	Frequency	Percent
Failure to Abide by Environmental Law	2	30
Non-Compliance with Global Standards and Practices	1	10
None Registered Operators	0	0
Change of Approach of Exploration	1	10
Need Stepper Measures from the Government	3	50
Total	07	100.0

Source: Fieldwork, 2022

Table 6 showed responses from staff of the NDDC and MNDA from the 6 states and the headquarters office on the level of environmental compliance of the activities of oil exploration in the region. From the Table, it was revealed that all the operators of the companies were fully registered with the appropriate agencies. This is due to the 0% response as indicated by the staff of the Ministry and Commission.

Responses from failure to abide by environmental laws were the major reason affecting the exploration of flared gas and oil spills in the region as 30% of the respondents testified to this. Responses from non-compliance to global standards and practices represent 10%, while the change in approach and stepper measures from the government were tied as 60% attested to this.

Table 7. Impact of Gas Flaring and Oil Spills on Socioeconomic Activities in the Region.

State	Variables in %						
	Urbanization	Industry	Medicals	Human Capital Devt.	Job Opport	Primary Activity (Fishing, Farming Hunting & Petty Trade)	Govt. Presence
Akwa-Ibom	11.4	15.6	18.7	14.5	14.2	14.5	14.2
Bayelsa	24.5	13.6	23.4	13.3	13.3	06.6	22.4
Cross River	09.8	06.4	07.3	14.6	09.4	17.1	08.4
Delta	19.1	21.7	18.3	19.5	22.2	19.7	19.2
Edo	07.1	03.5	04.2	21.4	04.3	34.5	06.4
Rivers	28.1	30.2	28.1	16.7	26.6	07.6	29.4

Source: Fieldwork, 2022.

Table 7 showed responses on the impact of gas flaring and oil spills on socio-economic activities in the region. From the Table, it was revealed that the counts for urbanization and industrialization were higher in River's state with 28.1% and 30.2% respectively. This was followed by Bayelsa with 24.5% and Delta with 19.1% respectively. Human capital development was higher in Edo at 21.4% and Delta at 19.5% than in other states. Job opportunities were lower in Edo with 04.3% and in Cross River states with 09.4%. This could be due to a combination of factors such as a lack of industries and government establishments. The combination of primary activities such as farming, fishing and hunting was higher in states like Edo, Delta and Cross River and Akwa-Ibom than in other states. This could be due to fewer activities of oil

spills and the fertility of the soil if a comparison is made. The percentage for medical facilities and the presence of government were higher in rivers with 28.1% and 23.4% in Bayelsa. The same responses can be said for government presence in Rivers, Bayelsa, Delta and Akwa-Ibom states with 29.4%, 22.4%, 19.2% and 14.2% respectively others where a comparison is made. However, a combination of factors could be responsible such as the nature of the terrain and revenue generation to the nation. Furthermore, the presence of oil exploration companies in Rivers, Bayelsa, Delta and Akwa-Ibom has compelled the people to pay less attention to human capital development and crop production. With SSCE and ND and semi-skilled qualifications, they decided to earn a living from opportunities from the companies established within their region.

Table 8. *Nature of Environmental Degradation State by State in the Region.*

State	Variables in %								
	Gas Flaring	Oil Spills	Flood	Erosion	Deforestation	Pollution	Pipeline Vandalization	Waste	Biodiversity Loss
Akwa-Ibom	09.0	15.7	14.5	07.5	08.2	10.8	28.5	10.6	09.7
Bayelsa	43.0	54.4	28.4	32.4	07.3	24.9	43.7	09.7	44.7
Cross River	0	0	07.3	15.7	13.4	07.1	18.6	14.6	06.8
Delta	18.3	12.8	26.2	18.4	30.2	21.0	04.5	13.8	12.6
Edo	0	0	05.0	08.3	18.3	06.6	03.4	18.1	04.8
Rivers	29.7	17.1	18.6	17.7	22.6	30.6	02.3	33.2	21.4

Source: Fieldwork, 2022.

Table 8 showed responses on the nature of environmental degradation state by state in the region. From the Table, it was revealed that Bayelsa state has the highest cases of gas flare with 43.0%. This is followed by Rivers with 29.7% and Delta with 18.3%. For oil spills, the sequence of occurrence is almost the same with gas flaring as they are close associates. Bayelsa state has the highest cases of oil spills with 54.4%. This is followed by Rivers with 17.1% and Akwa-Ibom with 15.7%. The activities of flood and erosion go hand in hand just as gas flaring and oil spills to some extent. From the table, Bayelsa state has the highest counts of floods and erosion with 28.4% and 32.4% respectively. This was followed by Delta and Rivers with 26.2% and 18.4% for the former and 18.6% and 17.7% for the latter respectively. Degradation from atmospheric pollutants apart from gas

flaring but from automobiles and industrial activities were highest in Rivers at 30.6%, Bayelsa at 24.9% and Delta at 21.0% respectively. Furthermore, biodiversity loss was higher in Bayelsa at 44.7%, Rivers at 21.4% and Delta states at 12.6% respectively. The loss of biodiversity species could result from the combination of gas flaring, oil spills, deforestation, urbanization, acid rain and extreme climatic conditions in the region. The threat of household waste items was the least in Bayelsa and Akwa-Ibom than in other states with 09.7% and 10.6 counts respectively. This could result from the poor attitude of the majority of the residents that discard waste materials into flowing water and canals in Bayelsa state. On the other hand, the people of Akwa-Ibom are very conscious of sanitation and waste management.

Table 9. *Variables Used to Compute the Hypothesis.*

Types of Environmental Degradation	Environmental Quality	Impact of Gas Flaring and Oil Spills on Socioeconomic Activities	Response From Staff of NDDC on Attitude of Oil Exploration Company on the Environment
Gas Flaring and Oil Spills	Clean Air	Urbanization	Failure to Abide by Environmental Law
Flood And Erosion	Clean Water	Human Capital Development	High Measures and Remedy to Host Community
Pollutants	Clean Land	Job Opportunity	Moderate Measures and Remedy to Host Community
Pipeline Vandalization	Safety of Human Health	Primary Activities	Low Measures and Remedy to Host Community
Loss of Biodiversity	Environmental Balance	Government Present	Need Stepper Measures from the Government

Source: Fieldwork, 2022.

Table 10. Analysis of Variance in the Types and Nature of Gas Flaring and Oil Spills on Environmental Degradation of the Environment Does Not Vary Significantly among States of the Niger Delta Region.

2-Way ANOVA		Sum of Squares	Df	Mean Square	F	Sig.
Types of Environmental Degradation	Between Groups	9.157	1	9.157	16.757	.000
	Within Groups	44.265	299	.546		
	Total	53.422	300			
Environmental Quality	Between Groups	29.467	1	29.467	5.600	.020
	Within Groups	426.220	299	5.262		
	Total	455.687	300			
Impact of Gas Flaring and Oil Spills on Human Health	Between Groups	1.686	1	1.686	8.447	.005
	Within Groups	16.169	299	.200		
	Total	17.855	300			
Response From Staff of NDDC and MNDA on Attitude of Oil Exploration Company on the Environment	Between Groups	1.353	1	1.353	5.720	.019
	Within Groups	19.153	299	.236		
	Total	20.506	300			

Source: Fieldwork, 2022

Table 10 shows the 2-Way Analysis of Variance of the nature and impacts of gas flaring and oil spills on human health and environmental degradation in the region showing the significant level of variance among states of the study area. From a significant point of view, the test of variance of the stated hypothesis indicates that the impact of flared gas and oil spilled on human health does not vary significantly on environmental degradation among the states of the Niger Delta region.

5. Conclusion and Recommendations

Crude oil exploration mitigates gas flaring and oil spills through the air, water and land pollution thereby creating harmful air pollutants in these ecosystems. Given this, gas flaring causes a range of environmental problems. The foods we eat and the water we drink comes from environmental resources. A clean environment is a determinant of healthy air, water and land free from pollutants from anthropogenic factors such as the mixed and threats of (a) smoke (b) fumes (c) smooth (d) carbon monoxide (e) sulfur dioxide (f) methane gas (g) lead (h) toxic chemicals, and (i) particle matters from combustion caused diseases and health problems to human and others biotic organisms which man depends on. The fitness and healthy state of man is a function of the quality of food and water intake and the qualitative state of the environment we lived. The likely common ailments from a polluted environment for human health are that oil pollution generates air-borne diseases, like diphobia, chromatosa, delivum, heart attack, skin disease, dysentery, typhoid fever, asthma, pneumonia emphysema.

On the other hand, a filthy and degraded environment repels environmental quality and environmental deterioration. Oil spills on the land ecosystem gradually led to the excavation of earth covers and destruction of the landscape thereby rendering the land to harsh sun rays and soil infertility. Oil spills destroy the land's aesthetic values and farmland pollution as well as the qualities of water sources such as drinking, recreation, swimming, fishing, and

domestic use. There is the loss of aquatic lives, which has a devastating impact on the livelihood of fisherfolk households who solely depend on fishing and farming as their source of income since most communities where these activities are exploited are surrounded by water. The study recommends that there should be justice for resource control and allocation. Places, where natural resources are exploited with major effects on the environment, biodiversity loss and threats to human health and safety should be adequately rewarded and compensated. Finally, where natural gas is left without flaring, it will cause fire or explosion, hence the need for the gas to be utilized or flared but this should be done in line with the best practices and standards, with fewer effects on human health and cause of anthropogenic environmental degradation.

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