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Oil and Gas Multinational Companies' Activities in Nigeria: The Challenges in Methods of Waste Management in Niger Delta.

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Abstract: *Quality environment is the highest wealth possessed by man. Distortion in the ecosystem auspicates danger to its inhabitants. This study was conceived to examine the challenges in the methods of waste management in Niger Delta region, Nigeria.Stratified sampling technique was adopted in the selection of 124 samples for the study. Structured questionnaire was used to elucidate responses from the primary sources while Secondary source came from text books and journal materials which afforded us information for literature review. Properly filled questionnaires were sorted, transcribed and the content analyzed using descriptive statistics of tables, frequency distribution and percentages and bar graphs. Results showed high devastating environmental impacts of waste management due to lack of improvement in the methods adopted. More regulations on waste management methods, outright ban of on-site burial, ocean dumping, landfills, surface discharge and deep-well injection approaches, and adoption of waste reduction methods were recommended.*
Keywords: *Oil and Gas, Multinational, Challenges, Waste Management, Niger Delta*

I. Introduction

Long before now, the question of waste management method in the oil and gas sector remains a big headache for the oil and gas industry. It has brought nations, communities and oil and gas exploration companies on collision.The industry itself spans the drilling, completion, production, and work-over, pipelining and marketing trades. Each phase of the industry has its own unique waste management concerns. To understand the regulatory structure, one must comprehend the types of wastes generated by the industry.Waste oils are hazardous waste as they display some hazardous properties. Waste oils that are found in rivers, lakes and streams threaten aquatic life. Indeed, a litre of waste oil can contaminate a millionlitres of water. Severe soil contamination can result from waste oils being left on the ground. The production of oil and gas generate waste gases that need to be controlled in a manner that protects the environment. But a major problem with oil and gas exploration activities is the inability of governments and their regulatory agenciesto control and prevent environmental pollution and other associated problems. Oilspillage, gas flaring and venting have caused loss of lives, and have adverselyaffected human health and the environment. These adverse effects have led to theclamor for strict environmental regulation of oil and gas operations, in order tocontrol, reduce or prevent pollutions arising from exploration and exploitationactivities.

The quest for greater income generation made Nigeria to redirect her productive base to oil and gas in abandonment of agriculture. This was as a result of the oil boom in the 1970s; the Nigerian government shifted emphasis from the farmlands to the oil fieldswith excessive exploration and exploitation of the Niger Delta environment and made Nigeria a mono-economy. It further created excessive wealth for the national economy while the oil producing communities were left with socio-economic and ecological crisis (Akpomuvie, 2011). The negative impact of exploration activities of oil and gas companies have greatly dwindled general livelihoods of the people especially the people of Niger Delta. Over 90% of the nation's export earnings and about 70%of revenue accruing to the federation account is generated from the Niger Delta amidst ecological devastation and underdevelopment of the region (Omene, (2001).World Bank (1995) report observed that cases of water borne diseases and poortransportation in the Niger Delta are the worst in the country. Predominantly, the cause of environmental degradation in the Niger Delta is oil spillage and gasflaring arising from oil exploration and exploitation. This concern, however does not reduce the importance ofother environmental issues such as bush burning, erosion of various configuration, indiscriminate waste disposaletc. The problems of development in the Niger Delta region are numerous and complex. Accidents do occur periodically in the course of various processes and activities in the production, refining and distribution of petroleum products resulting from accidental discharges attributed to equipment failure, malfunctioning, deterioration occasioned by corrosion, ageing of pipelines, deliberate or wilful acts of vandalization (about 900 cases reported in year 2000), neglect in carrying out proper maintenance and or even human error. In the process of various production and marketing activities, different solid, semisolid, liquid, gaseous materials may be released into the environment. The

exploration, development, and production ofoil and gas reserves vary markedly from region toregion. For example, wells range in depth from 30feet in some areas to more than 30,000 feet in others;with an average depth of about 5,000 feet (7, 117).Production can range from fewer than 10 barrels perday for thousands of small 'stripper" wells to about11, 500 barrels per day. Only 14 percent of total productioncomes from stripper wells, yet they account forabout 70 percent of all oil wells (117); becauseof their large numbers and potential environmentalimpacts, these wells pose significant regulatorychallenges (Oil and Gas Wastes, 1992).

Exploration and exploitation operations have generate significant wastes, the primary categories being produced water,rilling waste, which includes rock cuttings and fluids produced from drillinga new wellbore, and associated wastes, which cover a variety of small waste streams such as completion fluids, work-over fluids, and oily sludges from tank bottoms. While operational best practices have reduced the amount of waste generated over time, waste from operations can nonetheless affect biodiversity. The large volumes of drill cuttings, along with potentially hazardous substances in the muds that coat the cuttings as they are extracted, can make disposal of such waste challenging, particularly for offshore operations.Furthermore, decommissioning of onshore and offshore oil and gas wells can have negative environmental and social impacts if not properly managed, including land use impacts, soil and groundwater contamination, and erosion.

The Niger Delta has a complex and extensive system of pipelines running across the region and large amounts of oilspill and gas leakage incidences have occurred through the pipelines and storage facility failures, these failures could have been caused bymaterial defects, pipeline corrosion, ground erosion but the oil companies blame most of the spills on sabotage. TheDepartment of Petroleum Resources contends that 88%of the oil spill incidences are traceable to equipment failure. Main causes of oil spills in the Niger Delta are vandalism, oil blowouts from the flow stations, accidental anddeliberate releases and oil tankers at sea (Nwilo and Badejo, 2005: Adati ,2012).Areas such as the Arctic and certain shore-lines with mangroves and swamps are highly ecologically sensitive, and externalities from exploration and exploitation operations in these areas can be extremely damaging to biodiversity and ecosystems. Operations in these areas also entail more complex and expensive cleanup operations should there be hydrocarbon spills or leaks. As oil and gas companies attempt to access more remote, ecologically sensitive locations like the Arctic and deep-water resources and develop unconventional resources, such as oil sands requiring larger land area and generating more waste, risks that exploration and exploitation operations will affect biodiversity, and therefore company value, could be exacerbated.

Oil and gas Multinational companies havecontinuously adopted several waste management methods such as; land farming, Incineration, Thermal desorption, Deep-well Injection, land spreading, onsite burial and others. Despite these methods, the impact of oils and gas exploration has transcended todestruction of the aquifers, mangroves, farmlands, pollution of drinkable water and death of fishes. Oil spills and gas flaring have also caused cancers, infertilities among inhabitants, high mortality rates, and corrosion of house roofs leading to re-roofing of houses more often in the Niger Delta region, starvation, communal conflicts, youth restiveness, militancy and general poverty among other effects.Eteng 1997, stated that "Oil exploration and exploitation has over the last four decades impacted disastrously on the socio-physical environment of the Niger Delta oil bearing communities, massively threatening the subsistent peasant economy and the environment and hence the entire livelihood and basic survival of the people.These significant risks, with low probability of occurrence but high potential impact have been managed over the decades while the impacts remain unabated. In this regard, several methods have been adopted in managing oil and gas wastes without success. It is imperative to investigate the activities of oil and gas multinational companies in Niger Delta with a view to finding existing improvements in theMethods of Waste Management.This is the gap that this study attemptsto fill.

Objective of the Study

The main objective of the study is to investigate the challenges in methods of waste management by oil and gas multinational companies in Niger Delta. The specific objectives of the study are: -

i. Find out the methods of waste management in the oil and gas multinational companies in Niger Delta region, Nigeria.
ii. Identify the effects of oil and gas waste generation by the oil and gas multinational companies in Niger Delta Region, Nigeria.
iii. Ascertain the extent of challenges in the methods of waste management by oil and gas multinational companies in Niger Delta region, Nigeria.

Giving the forgoing, the study provides answers to the following research questions;

(i) What are the methods of waste management in the oil and gas multinational companies in Niger Delta region, Nigeria?
(ii) To what extent are the effects of oil and gas waste generation by oil and gas multinational companies in Niger Delta region, Nigeria?

(iii) To what extent are the challenges in the methods of waste management by oil and gas multinational companies in Niger Delta region, Nigeria?

II. Theoretical Framework and Literature Review

An understanding of the type of wastes generated by the oil and gas exploration and production industry is necessary before embarking upon an analysis of the applicable waste management practices. This study focuses on Exploration and production wastes such as oily wastes, gas plant waste, drilling wastes and production wastes.

Theories of waste management such as Zero Waste, Cradle-to-Cradle/Cradle-to-Grave etc, have been propounded to relate oil and gas waste to environmental degradation in areas of operation all over the world. While Zero waste entails a process of eliminating waste generation from the onset of exploration, Cradle-to-cradle focuses on designing industrial systems so that materials flow in closed loop cycles; meaning that waste is minimized, and waste products can be recycled and reused. Zero waste focuses on going beyond simply dealing with issues by addressing problems at the source and by re-defining problems (McDonough *et al.*, 2003).

However, this study is predicated on the Zero waste.Zero waste theory according to Spiegelman, (2006) cited in Davidson, (2011) refers to waste management and planning approaches which emphasize waste prevention as opposed to end of pipe waste management. Zero waste encompasses more than eliminating waste through recycling and reuse; it focuses on restructuring production and distribution systems to reduce waste (Young *et al.*, 2010). An important consideration of the zero waste philosophy is that it is more of a goal, or ideal rather than a hard target. Even if it is not possible to completely eliminate waste due to physical constraints or prohibitive costs, zero waste provides guiding principles for continually working towards eliminating wastes (Snow and Dickinson, 2001) and there are many successful cases around the world which resulted from the implementation of the zero waste philosophy (Townend, 2010). The zero waste philosophy has been adopted as a guiding principle by several governmental organizations as well as industries (Snow and Dickinson, 2001; Townend, 2010). Zero waste involves the elimination of waste from the outset; it requires heavy involvement primarily from industry and government since they are presented with many advantages over individual citizens. In fact, zero waste will not be possible without significant efforts and actions from industry and government (Connett and Sheehan, 2001). Meanwhile, governments have the ability to form policy and provide subsidies for better product manufacturing, design and sale; and the ability to develop and adopt comprehensive waste management strategies which seek to eliminate waste rather than manage it (Snow and Dickinson, 2001). Due to the heavy involvement of industry in eliminating waste, extended producer responsibility is often an essential component of zero waste strategies (Spiegelman, 2006).

Oil and gas exploration companies are mandated within the stipulated statutory regulatory laws to practice methods needed to carry out Hazardous and Solidwaste management operations. The regulatory laws made it clear for any company that generates waste to(under compulsion) remove it. It also sets tasks and responsibilities to effectively focus on all relevant clients, and employees on appropriate handling, storage, collection, transportation, recovery, disposal, monitoring and reportingof waste generation within their areas of operation.

Regulations guiding the management of hazardous and solid waste inoil exploration and exploitation as contained in sectionI.15 of 1991 (No. 102 Vol. 78, August, 1991) defines the requirements for groundwater protection, surface impoundments, land treatment, waste piles, landfills, incinerations etc. It also describes the hazardous substance tracking programme with a comprehensive list of acutely hazardous chemical products and dangerous waste constituents. It also spelt out the requirements and procedures for inspection, enforcement and penalty.

The regulation stipulated in the National Effluent Limitation Regulation section. I. 8 of 1991 (No. 42, Vol.78 August, 1991), made it mandatory for industries with wastes facilities to install anti-pollution abatement equipment on site based on the available Best Available Technology (BAT) for detoxification of effluent and chemical discharges. The regulation is specific to each category of waste generating facility with respect to limitations of solid and liquid discharges or gaseous emissions into the ecosystem. Appropriate penalties for convention are also specified in the regulation.

In furtherance, the Pollution Abatement Regulation section I. 9 of 1991 (No. 42, Vol.78 August, 1991), imposes restrictions in the release of toxic substances and stipulate requirements for pollution monitoring units, machinery for combating pollution and contingency plan by industries; submission of lists and details of chemicals used by industries to Federal Ministry of Environment; requirement of permit by industries for the storage and transportation of toxic waste; the generator's liability; strategies for waste reduction; permissible limits of discharge into public drains; protection of workers and safety requirements for Environmental Audit (or Environmental Impact Assessment of new projects) and penalty for contravention.

Gas flaring is another outcome of oil exploration which results to acidic rainwithin the Niger Delta region. It involves the burning of gas into an open air in the process of curde oil extraction from a developed well. It is one of the most contentious energy and environmental issues facing the world that has persisted for decades. The World Bank estimated that the annual volume of natural gas being flared and vented globally in 2011 is about 140 billion cubic meters (bcm).In the early development of oil and gas production, operators did not consider natural gas as a useful product and therefore burned it off at the well or vented it into the atmosphere, through a process called gas flaring. Gas flaring is the controlled burning of unutilized natural gas that is associated with crude oil when it is pumped from the ground (Ajugwo, 2013).

Cumulative environmental impact of these flaring activities result in contaminant build up on land, shallow ground water, greenhouse effect and general global warming and have also caused high concentration of acidic rain within the region.Gas flaring has also led to loss in biodiversity, with forest and economic crops being destroyed. The dominance of grasses and shrubs insome parts of the region is indication of loss of natural forest. The concentration of acid in rain water appears to be higher in the Niger Delta region. Apart from the above issues the toxicity to humans causing respiratory illness, have led to kidney disease, neurological disease and potential death. The heat generated from gas flaring kills vegetation around flaring area, destroys mangrove swamps and salt marshes, suppresses the growth and flowering of some plants, induces soil degradation and diminishes agricultural productivity (Tominiyi*et al*, 2014).

Studies have shown that oil and gas activities have resulted in the devastation of Niger delta in various ways. Ezeigbo et al, (2013) in their study conducted in Imo State on "Microbiological Effects of Gas Flaring on Agricultural Soil atIzombe Flow-station, Imo State, Nigeria, using soil sample analysis, showed that that flaring exerts adverse ecological effects on the soil and a decrease in microbial load of the soil samples as distance approaches the Flow-Stack.

Another study in Bayelsa State by Beulah and Obot, (2013) on "Perceived Effects of Gas Flaring on Socio-Economic Well-Being of Farming Households in Ogbia Local Government Area, Bayelsa State, Nigeria, using tables, percentages, means, rank and frequency distribution, revealed that strong perception that gas flaring has negatively impacted on their well-being over time and posses serious effects on livelihood activities.

Further study by Kaddafiand Adati on Environmental Impacts of Oil Exploration and Exploitation inthe Niger Delta of Nigeria, using descriptive method to obtain logicaldeductions and sequential presentation of facts from thedata obtained, found out that oil and gas exploration and exploitation activities has affected the livelihood of the indigenous people who depend on theecosystem services for survival, leading to increased poverty and displacement of people.

Emoyan*et al*, (2008) in their descriptive study on " The Oil and Gas Industry and the Niger Delta, Nigeria: Implications for the Environment", revealed that oil and gas exploration and exploitation in Niger Delta has caused environmental pollution, biodiversity depletion, social destabilization, underdevelopment of host communities, global warming and associated elevated flood risk.Damages linked to oil spills and gas flaring was from consumptive rather than productive or industrial sources, as with most pollutants in the Niger Delta and Nigeria at large due to devastating impacts of oil and gas wastes on the environment (Raji and Abejide, 2000).

III. Methods of Waste Management

Waste or oil spills from the oil and gas activities can be can be caused through blowout, pipeline corrosion, equipment failure and sabotage, accidental spills, overflow of tanks, valve failure, over pressure, sand cut through erosion, and engineering error (HRW, 1999). However, processes of managing these wastes include;

Annular injection; Annular injection is a disposal method where pumpable wastes are injected into the surface casing or production casing annulus. Annular injection is not suitable for continues disposal due to possible corrosion of the production casing string. Where the surface pipe is breached by corrosion during long term injection service, the injected fluids may enter usable water.

Deep well injection - This is a liquid waste disposal technology thatuses injection wells to place treated or untreated liquid waste into geologic formations that have no potential to allow migration of contaminants into potential potable water aquifers.It involves controlled emplacement of fluids into selected, deeply buried geologic formations through specially designed and monitored wells. The effect of industrial effluent is even more insidious than domestic sewage. The most dangerous form of this pollution is what is known as deep well injection where industries in order to save expenditure on effluent treatment plants instead, inject the pollutants deep into the earth's crust where they pollute the aquifers which contain pure water way below the earth's surface which has collected over several thousands of years.A typical injection well consists of concentric pipes, which extend several thousand feet down from the surface level into highly saline, permeable injection zones that are confined vertically by impermeable strata. It is also designed to receive waste from the well (Brower *et al*, 1989).

Landfarming; thelandfarming system involves the control and repeated application of waste on a soil surface in order to biodegrade hydrocarbon constituents. The landfarmingmethodology includes addition of water, nutrients and other materials to enhance the biodegradation process in the waste/soil mixture.

Landspreading; this type of treatment process is similar to landfarming. However, it involves one time application of liquid or solid waste to a site, to reduce organic content of the waste. The practice reduces the potential for accumulation of waste components in the soil, as might be the case of landfarming sites that receive multiple applications of waste.

Incineration; this is the use of combustion to convert wastes into less bulky materials. The incinerator is usually equipped with a pollution control device to remove incomplete combustion productsand reduce sulphur and hydrogen emissions. Incinerators are usually used to destroy organic wastes which pose high risk to health and the environment.

Thermal desorption; is an environmental remediation technology (a non-oxidizing process) that utilizes heat to increase the volatility of contaminants such that they can be desorbed (separated) from the solid or oily waste. The volatilized contaminants are then either collected or thermally destroyed.

Landfills; landfills are specially constructed and monitored facility designed to accommodate burial of large volume of wastes.The term landfill relates to waste disposal mainly within a void space although landraise. It is generically referred to as landfill and refers to waste disposal mainly above pre-existing ground levels. Landfill is usually an engineered and preplanned procedure not to be confused with on-site burial. It is commonly used for the disposal of solid and semi-solid wastes (Philips, 2000).

On-site Burial;This is the placement of waste in man-made or natural excavations, such as pits or landfills. In this method, wastes are buried in the same pit (the reserve pit) used for collection and temporary storage of the waste mud and cuttings after the liquid is allowed to evaporate. It is not a good choice for wastes that contain high concentrations of oil, salt, biologically available metals, industrial chemicals, and other materials with harmful components that could migrate from the pit and contaminate usable water resources.

Waste generation is an inevitable occurrence in oil and gas exploration and exploitation. Any activity aimed at reducing waste generation is an effective strategy to solve the environmental problems associated with oil and gas waste. Waste prevention means the reduction of quantity and quality of waste at source, reduction in the use of raw materials and energy and the promotion of the re-use.Generation of waste in the oil and gas industry could be minimized through improvement or modification of processes of oil exploration and exploitation.

IV. Challenges in the Selected Methods of Waste Management

Devastating effects of oil and gas exploration and exploitationhave manifested as a result of waste management approaches adopted by oil companies. Improvement in the waste management methods may play leading roles in ameliorating the effects of oil and gas wastes on the environment. The challenges are tabulated according to the methods as shown in table 1;

Table 1:Selected methods of Waste Management and their inherent challenges

S/N	Methods of Waste Management	Challenges
1.	Annular injection	If the surface pipe is breached by corrosion during long time injection service, the injected fluid may enter usable water sources.
2.	Deep-Well injection	There is great concern for the ever-increasing contamination of groundwater by improper hazardous waste disposal.
3.	Land Farming/Specialized Farming	Destroys soil fertility when applied on the soil surface, which can biodegrades hydrocarbon constituents and affect grasses for livestock grazing.
4.	Landspreading	Destroys soil fertility
5.	Incineration (Biomass)	Flared gases produced during this process contain residues that can pollute the environment. Incinerated waste produces ash that contains toxins. If not handled properly, these toxins can lead to environmental problems when toxicity levels become high.
6.	Thermal Desorption	Organics (contaminants) are not easily destroyed in the

		process. Soil structure is usually destroyed.
7.	Landfills	The problem with landfills is that they can pollute the underground water by leaching toxic substances from certain types of garbage, into the ground. The situation is worsened when rain falls on the landfill and quickens the flow.
8.	On-site Burial	Contaminates underground water

Source: Text books

V. Materials and Methods

The study was conducted between November, 2014 and January, 2015in theNiger Delta Region, Nigeria. It consists of present day Bayelsa, Delta and Rivers State. In 2000, federal government of Nigeria included Abia, AkwaIbom, Cross River, Edo, Imo and Ondo States in the region with more than forty ethnic groups. The Niger Delta is divided into three extractions namely; Delta, Edo and Ondo States for Western or Northern Niger Delta, Central is comprised of Bayelsa and Rivers States while East is comprised of AkwaIbom and Cross River States. Temperature range is between 23-31ºC and vegetation found in the Niger Delta region includes the saline water swamp, Mangrove swamp and the rain forest. Major seasons are the dry (November-February) and wet seasons (October – March). The region hosts several oil and gas multinational companies. The climatic and soil condition of the study area favor the extensive production of various food crops such as yam, cassava, maize, vegetables plantains and cocoyam.

Figure 1: Map of Niger Delta Region.

Source: Internet (Wikipedia), 2015.

A sample population of one hundred and thirty-five (135) waste remediation companies was selected for the survey study.The nine (9) states that made up the region were divided into three zones. Out of the three zones, three (3) states were selected for the study, namely; Rivers, Delta and AkwaIbom State. From the three states, nine (9) waste remediation companies were finally selected for the study, namely; Halden Nigeria Limited,Zitadel Limited,Umbarank Consult Limited for Rivers State, Dukoria International Limited, Fisomah Services,and Silver Star for Delta State,Eddynco Nigeria Ltd, Deduco Nig. Ltd and De Mbarukas Limited for AkwaIbom State. Questionnaires and personal interviews were used to obtain information from the respondents. Out of One hundred and thirty-five administered questionnaires, One hundred and twenty-four (124) correctly filled questionnaires were retrieved and used for analysis.Collated data were sorted, transcribed and the content analyzed usingdescriptive statistical tool (tables, frequency distribution and percentages) and bar graph to ascertain the challenges in the methods of waste management.

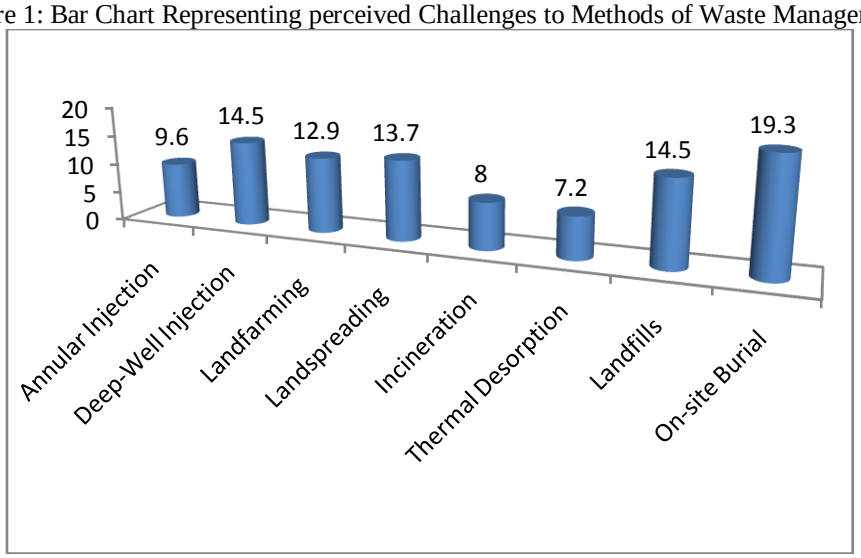
VI. Analysis of Data

Table 2; Distribution of respondents on challenges in methods of waste management (N= 124)

Extracts: Questions bordering on challenges of Waste disposal methods	Frequency	Percentages (%)
Annular injection	12	9.6
Deep-well injection	18	14.5
Land farming or Specialized farming	16	12.9
Landspreading	17	13.7
Incineration (Biomass) method	10	8.0
Thermal Desorption	9	7.2
Landfills	18	14.5
On-site burial	24	19.3
Total =124	**100**	

Source: Survey Field Data, 2015**.**

Figure 1: Bar Chart Representing perceived Challenges to Methods of Waste Management



Source: Generated from Field Data Results, 2015

VII. Results and Discussion of Findings

Analysis results on table 2 revealed challenges associated with each of the selected waste management methods. Responses to annular injection method showed 12(9.6%). As a method that is not suitable for continues disposal due to possible corrosion of the production casing string, possibility of corrosion, causing leakages of waste into the aquifer can contaminate underground sources of drinkable water. Responses to deep-well injection method were 18(14.5%). It is second to the highest amongst the adopted disposal methods with agreat concern for the ever-increasing contamination of groundwater. Oil and gas multinational companies in order to save expenditure on effluent treatment plants instead, inject the hazardous waste/pollutants deep into the earth's crust where they pollute the aquifers.Landfarming was recorded 16(12.9%) level of challenges, an indication that this method of waste disposal/management destroys soil fertility when applied on the soil surface, which can biodegrades hydrocarbon constituents and affectgrasses for livestock grazing.

The result of the analysis on incineration method showed 10(8.0%) challenges on the environment.Incinerated waste produces ash that contains toxins. Toxins contained in the flared gases increase toxicity of the air thereby causing environmental pollution.

About nine (9) respondents reported that organics (contaminants) in wastes disposed through Thermal Desorption methods are not easily destroyed in the process, rather 7.2% challenges are inherent in this method is the possible destruction of soil structure.The results further revealed that eighteen (18) respondents were against the use of landfills as method of waste management, reflecting about 14.5% as the level of challenges arising from the method. Landfills waste disposal method pollutes the underground water by leaching toxic substances from certain types of garbage, into the ground. This is worsened when rain falls on the landfill and quickens the flow.The analysis result also revealed that the highest of the challenges in selected methods of waste management is the on-site burial approach with 24 of the respondents reflecting (9.3%). Industrial chemicals and other materials with harmful components could migrate from the pit and contaminate usable water resources.

The overall impression created by the results explicate that all the methods of waste management adopted by oil and gas multinational companies have attendant effects on the Niger Delta environment and requires improvement/modifications.This is contrary to the Zero Waste theory which advocates for elimination of waste generation from the onset of oil and gas exploration as opposed to end of pipe waste management.

VIII. Conclusion and Recommendations

Effective waste management approaches can lower risks and magnitude of impacts of oil and gas exploration and exploitation on Niger Delta environment. This study discussedthe methods of waste management, its effect and challenges. More impacts were found to emanate from on-site burial, deep-well injection, landfills and landspreading methods. Improving the methods adopted is paramount in finding a lasting solution to poverty level of inhabitants and maintaining a sustainable development of the region. The study therefore recommends that;

i. There should be more enforcement in the regulation of exploration and exploitation activities of multinational companies by the government with specific emphasis on improvement in their methods of waste management.
ii. It has become rudimentary for the oil and gas companies to adopted easiest and cheapest approaches of waste disposal without recourse to waste composition and volume. In this regard, there is need for outright ban of most delicate approaches such as on-site burial, ocean dumping and deep-well injection approaches as waste contaminants pollute the water directly.
iii. It is will be more beneficial to study the direction of flow of existing surface water aquifer, soil conditions before landspreading of waste and conduct a site evaluation to identify environmentally sensitive features such as wetlands as waste minimization/reduction approaches before deciding on any waste management approach.

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