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Research article

THE ECONOMIC EFFECT OF OIL SPILL ON FISHERIES AND TOURISM

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ABSTRACT

This research work on estimating short term economic damages from the oil spill in Bonny fishery and tourism was done to find out the short term economic damages/harm done on fishery and tourism activities, bonny dwellers & Niger Deltas at large etc, the research adopted a multiple regression model in its analysis, the study revealed that oil spills are due to sabotage and operational activities, the study also revealed that oil spill have done more harm than good in bonny fishery and tourism, such as destruction of aquatic organisms, joblessness, high mortality rate, loss of revenue to fishers and the government, hunger and many others. The study therefore made recommendations that would help to ameliorate the damage effect of oil spill on bonny fishery and tourism.

KEY WORDS: Oil spillage, fishery tourism aquatic life Environment.

1.0 INTRODUCTION

An oil spill is the release of a liquid petroleum hydrocarbon into the environment, especially marine areas, due to human activity, and is a form of pollution. The term is mostly used to describe marine oil spills, where oil is released into the ocean or coastal waters. Oil spills may be due to releases of crude oil from tankers, offshore platforms, drilling rigs and wells, as we as spills of refined petroleum products (such as gasoline, diesel) and their by-products,

heavier fuels used by large ships such as bunker fuel, or the spill of any oily refuse or waste oil. Another significant route by which oil enters the marine environment is through natural oil seeps.
The oil penetrates into the structure of the plumage of birds and animals, reducing its insulating ability, thus making the birds more vulnerable to temperature fluctuations and much less buoyant in the water. It also impairs or disables birds' flight abilities to forage and escape from predators. As they attempt to preen, birds typically ingest oil that covers their feathers, causing kidney damage, altered liver function, and digestive tract irritation. This and the limited foraging ability quickly causes dehydration and metabolic imbalances. Hormonal balance alteration including changes in luteinizing protein can also result in some birds exposed to petroleum.

Environmental effects: Most birds affected by an oil spill die unless there is human intervention. Some studies have suggested that, even after cleaning, less than 1% of oil soaked birds survive. Marine mammals exposed to oil spills are affected in similar ways as seabirds. Oil coasts the fur of Sea otters and seals, reducing its insulation abilities and leading to body temperature fluctuations and hypothermia. Ingestion of the oil causes dehydration and impaired digestions. Because oil floats on top of water, less sunlight penetrates into the water, limiting the photosynthesis of marine plants and phytoplankton. This, as well as decreasing the fauna populations, affects the food chain in the ecosystem.

1.1 OVERVIEW OF ISSUES

The Bonny area of Niger Delta is one of the 10 most important and productive wetland and marine ecosystems in the world. It is still rich in biodiversity but this has been damaged. The 20 plus million inhabitants depend upon its biodiversity for their livelihoods and their survival. Nigerian scientists claim that 60% of the fish caught in West Africa breed in the coastal marine ecosystem which includes the vast Delta mangroves.

The terrestrial and marine environments have both been badly injured and one of the primary causes is the oil industry and associated industries including the production of plastic bags. The Delta is one of the 5 most severely petroleum damaged eco systems in the world. It may even be worse than other notoriously impacted regions such as Azerbaijan, Kazakhstan, Siberia and Ecuador.

1.2 OVERVIEW OF DAMAGE

Oil and gas activities have caused damage in several forms to the Bonny area and Niger Delta. In exploration, seismic lines have cleared significant forest areas, and seismic crews have generated thousands of tons of waste, all disposed untreated directly into the ecosystem. In transportation, laying of several thousand miles of oil and gas pipelines across Delta habitats has resulted in significant habitat damage and loss, pipeline and tanker spills, and storage tank spills. And in refining, toxic sludge discharges and process spills pollute waterways, flaring and stack emissions pollute the atmosphere, and refined products (particularly petrochemicals) further enter the ecosystem. Economically, this destruction had led to total fluctuation in the living condition. Apart from spending money to buy basic food stuff from other farmers, it is also evident that their diets are also prone to serious adjustment.

The dependency rate has also increased tremendously. Before the oil spills begin their damage, every youth has a livelihood in the water (fishery) or land (farming) which the spill has completely destroyed and therefore such supportive tendencies are no longer seen in the village , thus, increasing the burden on each family head (Father).

2.0 LITERATURE REVIEW

2.1 INDUSTRY NATIONALIZATION AND NIGERIA'S PETROLEUM INDUSTRY DEVELOPMENT (1970-1979)

In May of 1971 the Nigerian federal government, then under the control of General Yakubu Gowon, nationalized the oil industry by creating the Nigerian National Oil Corporation via a decree. Following the war with Biafra, the government felt it necessary to secure and gain more control over the oil industry. Nationalization of the oil sector was also precipitated by Nigeria's desire to join OPEC, which required that member states acquire 51% stake and became increasingly involved in he oil sector. Although the Nigerian government had maintained involvement in the industry prior to 1971, this was accomplished mainly through business deals on concessions of the foreign firms in operation. The creation of the NNOC made government participation in the industry legally binding. The federal government would continue to consolidate its oil involvement throughout the next several decades.

However, it was during the years of Gowon and his successors Murtala Mohammed and Olusegun Obasanjo known officially as the Heads of the Federal Military Government of Nigeria, who ruled amidst the oil boom of the 1970s that the political economy of petroleum in Nigeria truly became characterized by endemic patronage and corruption by the political elites, which plagues the nation to this day. At both state and federal government levels, power and therefore wealth has typically been monopolized by select interest groups who maintain a strong tendency to 'look after their own' by financially rewarding their political supporters. At the state or community level this means that interest groups in power will reward and protect their own; this is typically based on ethnic/tribal or religious affiliation of the interest group. The heavy patronage based on tribal affiliation has fuelled ethnic unrest and violence throughout Nigeria, but particularly in the Niger Delta states, where the stakes for control of the immense oil resources are very high. At the federal level, political elites have utilized patronage to consolidate power for the ruling government, not only by rewarding their political friends in the federal government, but also by paying off major interest groups at the state or tribal level in order to elicit their cooperation. Inevitably these financial favors are distributed unequally and inefficiently, resulting in concentration of wealth and power in the hands of a small minority. Nigeria is in fact ranked by the Corruption Perceptions Index as the sixth (ranked 152 out of 159 countries surveyed) most corrupt nation on Earth and maintain the second lowest ranking in Africa, ahead of only Chad. Following the NNOC's genesis, the Nigerian government persisted in garnering control over oil revenues, in1972 it declared that all property not currently owned by a foreign entity is legally the property of the government, which gained jurisdiction of the sale and allocation of concessions of foreign investment. The military regime oversaw the implementation of a number of other important milestones related to oil.

1974 participation in oil industry by government increases to 55percent. 1975 Decree 6 increases federal government share in oil sector to 80%, with only 20% going to states. 1976: First exploration and development venture by NNOC undertaken and drills to uncover commercial quantities of petroleum off-shore.

1978: Perhaps most importantly, the federal government created the Land Use Act which vested control over state lands in control of military governors appointed by the federal military regime, and eventually led to Section 40(3) of the 1979 constitution which declared all minerals, oil, natural gas, and natural resources found within the bounds of Nigeria to be legal property of the Nigerian federal government.

1979: In an effort to establish further control over the industry, the government merges and restructures the NNOC and the Ministry of Petroleum to form the Nigerian National Petroleum Corporation, an entity which would exert more power over the allocation and sale of concessions than the NNOC. By 1979, the NNPC had also gained 60 percent participation in the oil industry.

2.2 IMPACT OF PETROLEUM ON THE ENVIRONMENT IN THE NIGER DELTA

The Niger Delta is comprised of 70,000 km^2 of wetlands formed primarily by sediment deposition. Home to 20 million people and 40 different ethnic groups, this floodpain makes up 7.5% of Nigeria's total land mass. It is the largest wetland and maintains the third-largest drainage area in Africa. The Delta's environment can be broken down into four ecological zones: coastal barrier islands, migrove swamp forests, freshwater swamps, and lowland rainforests. This incredibly well-endowed ecosystem, which contains one of the highest concentrations of biodiversity on the planet, in addition to supporting the abundant flora and fauna, arable terrain that can sustain a wide variety of crops, economic trees, and more species of freshwater fish than any ecosystem in West Africa. The region could experience a loss of 40% of its inhabitable terrain in the thirty years because of extensive dam

construction in the region. The carelessness of the oil industry has also precipitated this situation, which can perhaps be best encapsulated by a 1983 report issues by the NNPC in 1983, long perform popular unrest surfaced:

We witnessed the slow poisoning of the waters of this country and the destruction of vegetation and agricultural land by oil spills which occur during petroleum operations. But since the inception of the oil industry in Nigeria more than twenty-five years ago, there has been no concerned and effective effort on the part of the government, let alone the oil operators, to control environmental problems associated with the industry.

Oil spillage is categorized into four groups: minor, medium, major and disaster. Minor spill takes place when the oil discharge is less than 25 barrels in inland waters or less than 250 barrels on land, offshore or coastal waters that does not pose a threat to the public health or welfare. In the case of the medium, the spill must be 250 barrels or less in the inland water or 250 to 2,500 barrels on land, offshore and coastal water while for the major spill, the discharge to the inland waters is in excess of 250 barrels on land, offshore or coastal waters. The disaster refers to any uncontrolled well blowout, pipeline rupture or storage tank failure which poses an imminent threat to the public health or welfare (Ntukekpo, 1996).

Oil spillage in Nigeria occurs as a result of sabotage, corrosion of pipes and storage tanks, carelessness during oil production operations and oil tankers accidents. In Nigeria, fifty percent (50%) of oil spills is due to corrosion, twenty eight percent (28%) to sabotage and twenty one percent (21%) to oil production operations. One percent (1%) of oil spills is due to engineering drills, inability to effectively control oil wells, failure of machines, and inadequate care in loading and unloading oil vessels.

Most of the oil pipes and tanks in the country are very old and lack regular inspection and maintenance. Thousands of barrels of oil have poured into the environment through some of the corroded pipes and tanks. A recent major occurrence was that at Idoho, an offshore platform in south-eastern Nigeria, where about 40,000 barrels of oil spilled into the environment. Sabotage is another major cause of oil spillage in the country. Some of the inhabitants of the rich Nigeria Delta engage in oil bunkering and from time to time damage and destroy oil pipelines in their efforts to collect oil from them.

Oil spill incidents have occurred in various parts and at different times along our coast. Between 1976 and 1998 a total of 5724 incidents resulted in the spill of approximately 2,571,113.90 barrels of oil into the environment. Some major spills in the coastal zone are the GOCON's Escravos spill in 1978 of about 300,000 barrels, Shell Petroleum Development Corporation's (SPDC's) Forcados Terminal tank failure in 1979 of about 580,000 barrels, Texaco Funiwa-5 blow out in 1980 of about 400,000 barrels, and the Abudu pipe line spill in 1982 of about 18,818 barrels (NDES, 1997). Other major oil spill incidents are the Jesse fire incident which claimed about a thousand lives and the Idoho Oil spill in January 1998, in which about 40,000 barrels were spilled into the environment (Nwilo et al, 2000). The most publicized of all oil spills in Nigeria occurred on January 17 1980 when a total of 3.7.0 million litres of crude oil got spilled into the environment. This spill occurred as a result of a blow out at Funiwa 5 offshore station. The heaviest recorded yearly spill so far occurred in 1979 and 1980 with a net volume of 694, 117. 13 barrels and 600,511.02 barrels respectively.

The table below shows data on oil spill incidents in the country between 1976 and 1998. The figure below shows the number of oil spill incidents per year in the country. It clearly indicates that the lowest oil spill incidents occurred in 1977, while the highest number of oil spill incidents happened in 1994. Figure 1.1 also shows quantity of oil spilled per year in the country. The lowest quantity of oil was spilled in 1989, while the highest quantity was spilled in 1979.

Table 1.0: Oil Spill Data from 1976-1998

S/No	Year	Number of spill incidents	Quantity spilled (barrels)
1	1976	128	26,157.00
2	1977	104	32,879.25

3	1978	154	489,294.75
4	1979	157	694,117.13
5	1980	241	600,511.02
6	1981	238	42,722.50
7	1982	257	42,841.00
8	1983	173	48,351.30
9	1984	151	40,209.00
10	1985	187	11,876.6
11	1986	155	12,905.00
12	1987	129	31,866.00
13	1988	208	9,172.00
14	1989	195	7,628.161
15	1990	160	14,940.816
16	1991	201	106,827.98
17	1992	367	51131.91
18	1993	428	9,752.22
19	1994	515	30,282.67
20	1995	417	63,677.17
21	1996	430	46,353.12
22	1997	339	59,272.30
23	1998	390	98,345.00
	TOTAL	**5724**	**2,571,113.90**

Source: Department of Petroleum Resources

2.3 IMPACTS OF OIL SPILL ON OUR ENVIRONMENT

Major oil spills heavily contaminate marine shorelines, causing severe localized ecological damage to the near shore community. The harmful effects of oil spill on the environment are many. Oil destroys plants and animals in the estuarine zone. It settles on beaches and kills organisms and marine animals like fishes, crabs and other crustaceans. Oil endangers fish hatcheries in coastal waters and as well contaminates the flesh of commercially valuable fish. Oil poisons algae, disrupts major food chains and decreases the yield of edible crustaceans. It also coasts birds, impairing their flight or reducing the insulative property of their feathers, thus making the birds more vulnerable to cold.

Oil on water surface also interferes with gaseous interchange at the sea surface and dissolved oxygen levels will thereby by lowered. This will in no doubt reduce the life span of marine animals. Micro-organisms also degrade petroleum hydrocarbons after spillage (Atlas, 1981; Leahy and Colwell, 1990; Atlas and Bartha, 1992).

In a bid to clean oil spills by the use of oil dispersants, serious toxic effects will be exerted on plankton thereby poisoning marine animals. This can further lead to food poisoning and loss of lives. Another effect of oil slicks is loss of economic resources to the government. When spilled, oil is not quickly recovered, it will be dispersed by the combined action of tides, wind and current. The oil will therefore spread into thin films, dissolve in water and undergo photochemical oxidation, which will lead to its decomposition.

On the Nigerian Coastal environment, large areas of the mangrove ecosystem have been destroyed. Oil spill has also destroyed farmlands, polluted ground and drinkable water and caused drawbacks in fishing off the coastal waters. There has been continuous regional crises in the Niger Delta area as a result of oil spill pollution of the coastal ecosystem. The oil producing states are now calling for control of oil resources in their respective states.

The Idoho oil spill of 1998 polluted coastal waters from Akwa Ibom State in the east to Lagos State in the west. Mobile Producing Unlimited commissioned a verification exercise to determine the extent and impacts of this oil spill. During the verification exercise, it was observed that the spill destroyed fishing nets, boats, and fishing ponds.

2.4 OGONI AND OIL

The Ogonis, whose population of 500,000, once made a living from farming and fishing. For over 30 years Shell and Chevron financed drilling on Ogoni land. This has increasingly pushed the population into the forests and mangrove swamps. Those who remain in the townships and villages are subjected to displacement and expropriation of their properties. The Ogoni have received virtually none of the $30 billion from oil pumped out of their lands, and they have been actively demonstrating against such injustices.

The movement for the survival of Ogoni people (MOSOP) and other Ogoni activities have on several occasions called on the Nigerian Federal Government to regulate the oil exploration, drilling, and processing activities of Shell Oil and other oil companies in the oil producing regions of Nigeria. Mr. Ken Saro-Wiwa, along with eight other MOSOP members, were arrested and charged with the murder of four traditional chiefs belonging to a pro-government group in the Ogoni region. The murders occurred during a bloody clash in May 1994 between Ogoni activists and Federal Government soldiers. On October 31, 1995, a Federal military tribunal sentenced them to death. On November 10, 1995 the Nigerian Federal Government hanged Ken Saro-Wiwa and eight others, in Port Harcourt. Ken Saro-Wiwa's final words before he was hanged were "Lord take my soul, but the struggle continues." (TED Case Studies, 1997).

Reactions by the international community after the Federal Government hanged Ken Saro Wiwa and eight other were swift and included:

i. Protest marches at Nigerian Embassies and Shell offices all over the world;
ii. Suspension of Nigeria from the Commonwealth of Britain (a group comprising of Britain and its former colonies);
iii. The withdrawal of ambassadors by several countries;
iv. Calls for a multilateral oil embargo and other sanctions by world leaders;
v. Plans for a United Nations General Assembly resolution condemning the executions.
vi. Protest actions by human rights groups such as amnesty international and environmental groups such as Green Peace;
vii. Calls by the European Union to impose economic sanctions;
viii. Imposition of a ban on arms sales to Nigeria by a number of countries;
ix. Protests in Nigeria by thousands of students and other individuals;
x. Under extreme pressure, the International Finance Corporation cancelled a proposed $100million loan and $80 million equity deal to Nigeria LNG, a company owned by the Nigerian Government and the top oil producers in Nigeria (Shell, Elf and Agip), to produce a gas plant and pipeline in the Niger Delta (TED Case Studies, 1997).

2.5 MANAGEMENT OF OIL SPILLS IN NIGERIA

A number of laws already exist in the Nigerian oil industry. Most of these laws provide the framework for oil exploration and exploitation. However, only some of these laws provide guidelines on the issues of pollution (Salu, 1999). According to the Federal Environmental Protection Agency, Lagos Nigeria, the following relevant national laws and international agreements are in effect namely:

a. Endangered Species Decree Cap 108 LFN 1990.
b. Federal Environmental Protection Agency Act Cap 131 LFN 1990.
c. Harmful Waste Cap 165 LFN 1990.
d. Petroleum (Drilling and Production) Regulations, 1969.
e. Mineral Oil (Safety) Regulations, 1963.

f. International Convention on the Establishment of an International Fund for Compensation for oil pollution Damage, 1971.
g. Convention on the Prevention of Marine Pollution Damage, 1972.
h. African Convention on the Conservation of Nature and Natural Resources, 1968
i. International Convention on the Establishment of an International Fund for the Compensation for Oil Pollution Damage, 1971.

References to Caps, volumes and pages are as in the laws of the Federal of Nigeria. Some of the acts and regulations on pollution given by (Oshineye, 2000) are given below:

i. The Mineral Oil (Safety) Regulations 1963, that deals with safe discharge of noxious or inflammable gases and provide penalties for contravention and non-compliance.
ii. Petroleum Regulations 1967 that prohibit discharge or escape of petroleum into waters within harbour area and make provisions for precautions in the conveyance of petroleum and rules for safe operation of pipelines.
iii. Petroleum Drilling and Production Regulation 1969 that requires licence holders to take all practical precautions, including the provision of up-to-date equipment approved by the appropriate authority to prevent pollution of inland waters, river water courses, the territorial waters of Nigeria or the high seas by oil or other fluids or substances.
iv. Oil in Navigable Waters Act 1968 that prohibits discharge of oil or any mixture containing oil into the territorial or navigable inland waters.
v. Oil Terminal Dues Act 1969 that prohibits oil discharge to area of the continental shelf within which any oil terminal is situated.
vi. Petroleum Refining Regulations 1974, which deals, among others things, with construction requirements for oil storage tanks to minimize damage from leakage.
vii. Associated Gas Re-Injection Act 1979 that provides for the utilization of gas produced in association with oil and for the re-injection of such associated gas not utilized in an industrial project. This is to discourage gas flaring. The Government has raised the penalty for gas glaring and this increase was due to the government's determination to protect the environment and ensure the optimal and functional use of Nigeria's gas resources.
viii. Oil Pipeline Act 1956 (as amended by Oil pipelines Act 1965) which prevents the pollution of land or any waters.

The Federal Environmental Protection Agency (FEPA), which was recently made part of the Ministry of the Environment is legally vested with the responsibility of protecting and sustaining the Nigerian environment through formulation and implementation of regulatory frameworks. The National Policy on the Environment (1989 comprises one of the instruments developed by the agency to carry out its tasks. The document describes guidelines and strategies for achieving the policy goal of sustainable development (Ntukekpo, 1996).

Due to increasing awareness in preventing and controlling spills in Nigeria, the Clean Nigeria Associates (C.N.A) was formed in November 1981. The C.N.A. is to maintain a capacity to combat spills of liquid hydrocarbons or pollutants in general. The Environmental Impact Assessment (EIA) decree No 86 of 1992 was promulgated to protect and sustain our ecosystem. The law makers EIA compulsory for any major project that may have adverse effects on the environment (Ntukekpo, 1996; Olagoke, 1996). The Decree was to control activities that have environmental impact on the host communities, facilitates the promotion and implementation of policy, encourage information exchange. It sought to assess the likely or potential environmental impacts of proposed activities, including their direct or indirect, cumulative, short term and long term effects, and to identify the measures available to mitigate adverse environmental impacts of proposed activities, and assessment of those measures. The guidelines made provisions for offshore operations, safety measures, liability and compensation (Ozekhome, 2001).

Effective response to a marine oil spill requires knowledge of the sensitivity of the coastal zone. This will enable the determination of priorities for protecting the most sensitive areas. In order to assist the decision-makers in choosing the areas of priority, coastal sensitivity maps of Nigeria including areas of ecological and socio-economic interest must be produced.

As part of an environmental baseline studies project for the Nigerian National Petroleum Corporation (NNPC), sixty coastal and two hundred riverine/estuarine stations were studied in 1984 and 1985. Data gathered at these stations were used in describing regional and site-specific shoreline types. The outer coastline of Nigeria was divided into five broad categories, and within these categories, the shoreline has been divided into Environmental Sensitive Index (ESI) shoreline types. In addition, an ESI scale was developed and applied for the tidally influenced Bonny/New Calabar mouth and estuary.

ESRI Professional Services was contracted to develop a widely useful set of standards and protocols foe generating Environmental Sensitivity Index (ESI) maps for coastal and inland interior areas of the Niger Delta in southern Nigeria. These protocols permit the efficient, consistent development of reliable ESI maps, concepts and procedures.

Development of the protocols was funded by the Oil Producers Trade Section (OPTS), whose member companies explore for, and produce oil within and offshore of, the Niger Delta. Nigerian regulatory requirements specify ESI mapping as part of contingency planning for oil exploration and production activities to better protect the delta's natural resources. Working with ESRI is co-contractor Environmental Resource Management Limited (ERML) of Nigeria.

A successful combat operation to a marine oil spill is dependent on a rapid response from the time the oil spill is reported until it has been fully combated. In order to reduce the response time and improve the decision making process, application of Geographic Information Systems (GIS) as an operational tool is suggested. Information on the exact position and size of the oil spill can be plotted on maps in GIS environment and a priority of the combat efforts and means according to the identified coastal sensitive areas can be carried out. GIS offers opportunities for integration of oil drift forecast models (prediction of wind and current influence on the oil spill) in the computer program framework (Milaka, 1995).

Required information for oil spill sensitivity mapping can be depicted on a set of thematic maps using GIS even though they can in theory be depicted onto a single sheet. With the use of GIS, however, all the relevant information or themes can be stored in the system and produced onto maps in a format that befits the need of the day. Alternatively, modelling exercises using the GIS can be conducted to assess the adequacy of any given oil spill contingency plan (Parthiphan, 1994).

The creation of regional spill response centres along Nigerian coastlines will help in managing oil spill problems (Smith and Loza, 1994). The centres will use oil spill models for combating oil spill problems. Using data collected with an airborne system to input one or several new starting point(s) into the model, will improve the accuracy of the further predictors (Sandberg, 1996). Oil spillage can also be treated or removed by natural means, mechanical systems, absorbents, burning, gelling, sinking and dispersion. Oil spillage can be removed by natural means through the process of evaporation, photochemical oxidation and dispersions (Smith 1977). Bioremediation can also be used for managing oil spill problems (Hoff, 1993; Prince, 1993).

An effective response to a marine oil spill requires knowledge of the sensitivity of the coastal zones. This will assist in determining priorities in event of an oil spill. In order to assist the decision-makers in choosing the areas of priority, coastal sensitivity index maps of Nigeria including areas of ecological and socio-economic interest must be produced at large and medium scales.

3.0 RESEARCH METHODOLOGY

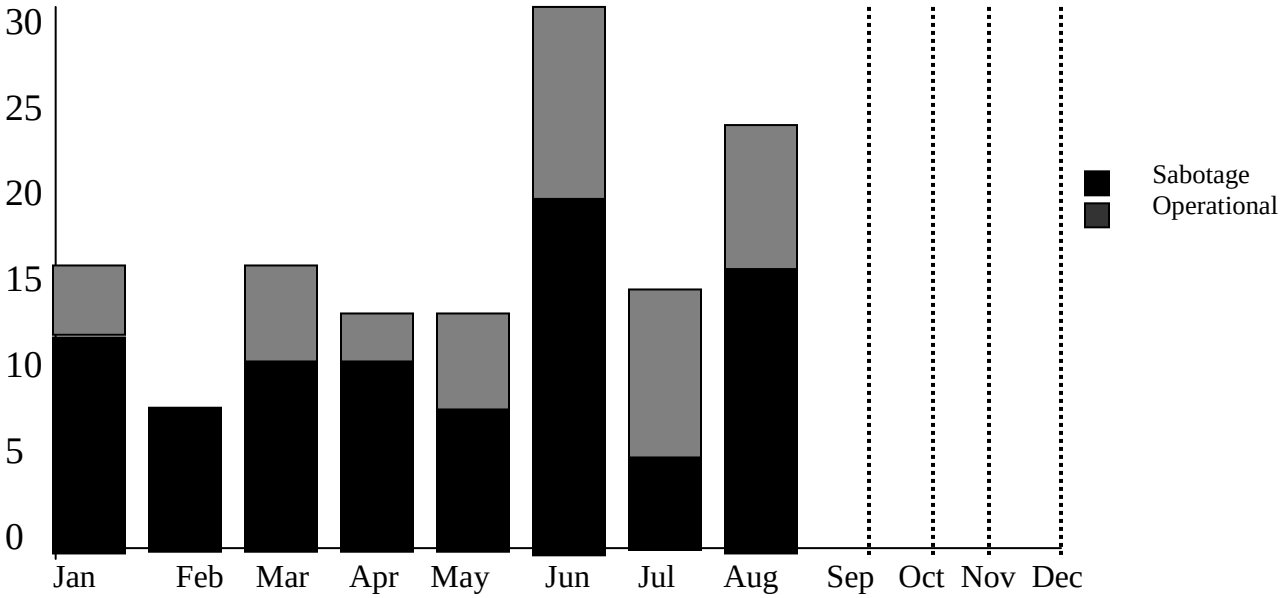
The methodology used in this research work is multiple regression model.

3.1 RECENT OIL SPILL DATA
DATA PRESENTATION AND ANALYSIS/INTERPRETATION

Table 1: Monthly Oil Spill incidents -2011 (number)

S/No	Month	Sabotage	Operational	Total
1	January	12	3	15
2	February	7	0	7
3	March	11	4	15
4	April	11	2	13
5	May	8	5	13
6	June	21	9	30
7	July	6	8	14
8	August	16	8	24
Total		**92**	**39**	**131**

Table 1 shows the monthly oil spill incident for the year 2011 (January-August). Within the months under review, month 6 recorded the highest number of spills incidents (30) followed by month 8 (24) and months 1 and 3 with (15) respectively, 7 also followed with 14. Month 2 recorded the least number of spill (7) followed by months 4 and 5 that recorded the same number of spills (13). The total number of spill incidents recorded for sabotage (92) is far greater than that of operational activity (39). While the total oil spill incident is 131.



Source: SPDC Oil Spill Statistics 2011
Figure 1

INTERPRETATION

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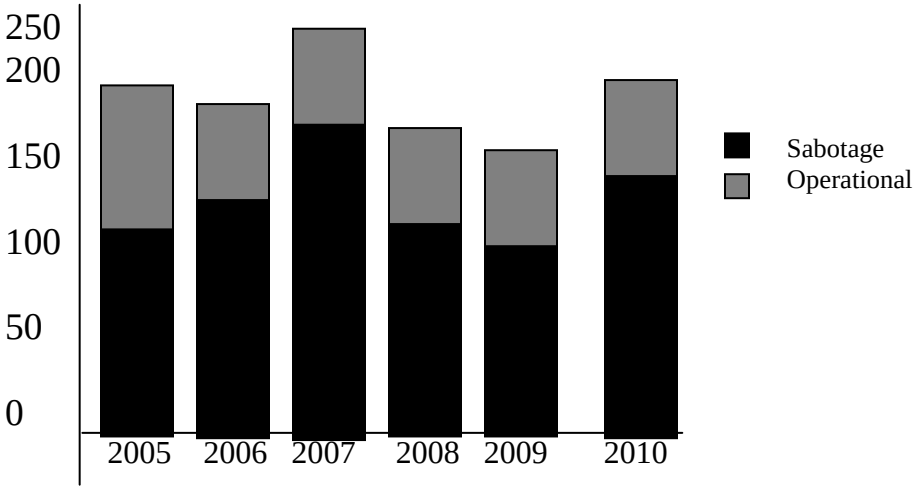
Table 2: Yearly Oil Spill Incident (2005-2010 number)

Year	**Sabotage**	**Operational**	**Total**
2005	113	62	175
2006	125	40	165
2007	200	50	250
2008	112	50	162
2009	100	50	150
2010	145	50	195
Total	**795**	**302**	**1097**

Source: SPDC Oil Spill Statistics 2011

Table 2 shows the yearly oil spill incidents; 2005-2010. The figures were also represented in spill incidents due to sabotage and



Source: SPDC Oil Spill Statistics 2011

Figure 2

INTERPRETATION

Table 2 shows the yearly oil spill incidents, 2005-2010. The figures were also represented in spill incidents due to sabotage and operational activities. In 2005 oil spill incidents for sabotage and operational activity respectively.

In 2006, oil spill incident was 125 and 40 sabotage and operational activities respectively, in 2007 spill incident for sabotage was peak with 200 while 50 for operational activities. In 2008 and 2009, oil spill incidents for sabotage act was 112 and 100 incidents respectively. Spill due to operational activity followed the same trend with 2007 through 2010 (ie 50 spill incident numbers) while 2010 oil spill incident due to sabotage was 145.

The total number of spill recorded under the review period was 795 and 302 for sabotage and operational activities- summing up a total of 1097 spill incidents.

The mean oil spill incident rate for the 6 year review is 182.8.

Table 3: Volume of Oil Spills/Month (bbl)

Month	**Sabotage**	**Operational**	**Total**
January	900	0	900
February	4600	0	4600
March	700	100	800
April	500	100	600
May	120	180	300
June	1000	1000	2000
July	0	250	250
August	900	500	1400
Total	**8720**	**2130**	**10850**

Source: SPDC Oil Spill Statistics 2011

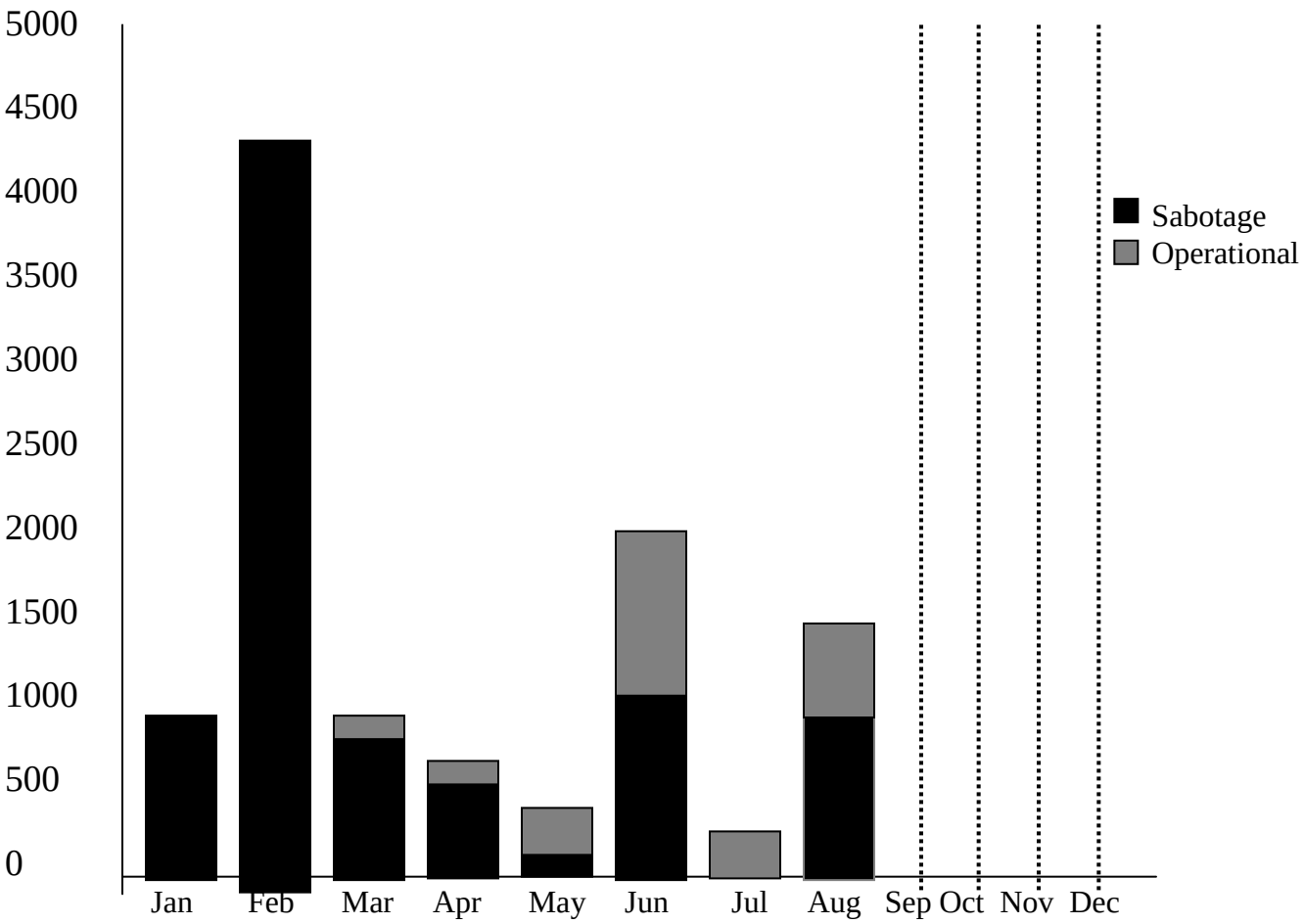


Figure 3

Source: SPDC Oil Spill Statistics 2011

INTERPRETATION

Table 3 represents the volume of spill in barrels for the year 2011. The volume of oil spill due to sabotage in January and February was 900 barrels and 4600 barrels (peak) respectively while no spill was recorded for operational activity during these months. During March and April, spills due to sabotage was recorded as 700 and 500 barrels respectively while spill due to operational activity recorded 100 barrels each for these months. In May, volume of oil spill was recorded as 120 bbls for sabotage as against 180 bbls for operational activity. Spill due to sabotage and operational activity for June recorded the same volume as 1000bbls. No spill was recorded for the month of July due to sabotage while 250bbls were recorded for operational activity.
In August 900bbls of oil spills was recorded for sabotage as against 500 bbls for operational activity.
The mean total volume of oil is 1,803bbls for the period under study.

Table showing volume of oil spill against the number of times incident in years
Table 4

Year	Volume	No of times
2005	14000	175
2006	20,000	165
2007	32,000	250
2008	100,000	102
2009	104,000	150
2010	73,000	195
Total	**343,000**	**1097**

Source: SPDC Oil Spill Statistics 2011

The above table 4 shows that in 2005, the volume of oil spill recorded was 14,000 bbl while the number of times occurred is 175. In 2006, 20,000 bbl was recorded as against 165 times this occurred. The highest spill incident occurred in 2007 as 250 while the volume spilled was 32,000bbl. In 2008, 100,000bbl was spilled in 102 incidents. 2009 recorded the highest volume of oil spill as 104,000bbl in 150 incidents while in 2010, only 73, spill volume was recorded in 195 times.

Table 5: Volume of oil spill in barrel/year

S/N	YEAR	SABOTAGE	OPERATIONAL	TOTAL
1	2005	12,000	2,000	14,000
2	2006	10,000	10,000	20,000
3	2007	20,000	12,000	32,000
4	2008	50,000	50,000	100,000
5	2009	102,000	2,000	104,000
6	2010	23,000	50,000	73,000
Total	**Total**	**217,000**	**126,000**	**343,000**

Source: SPDC Oil Spill Statistics 2011

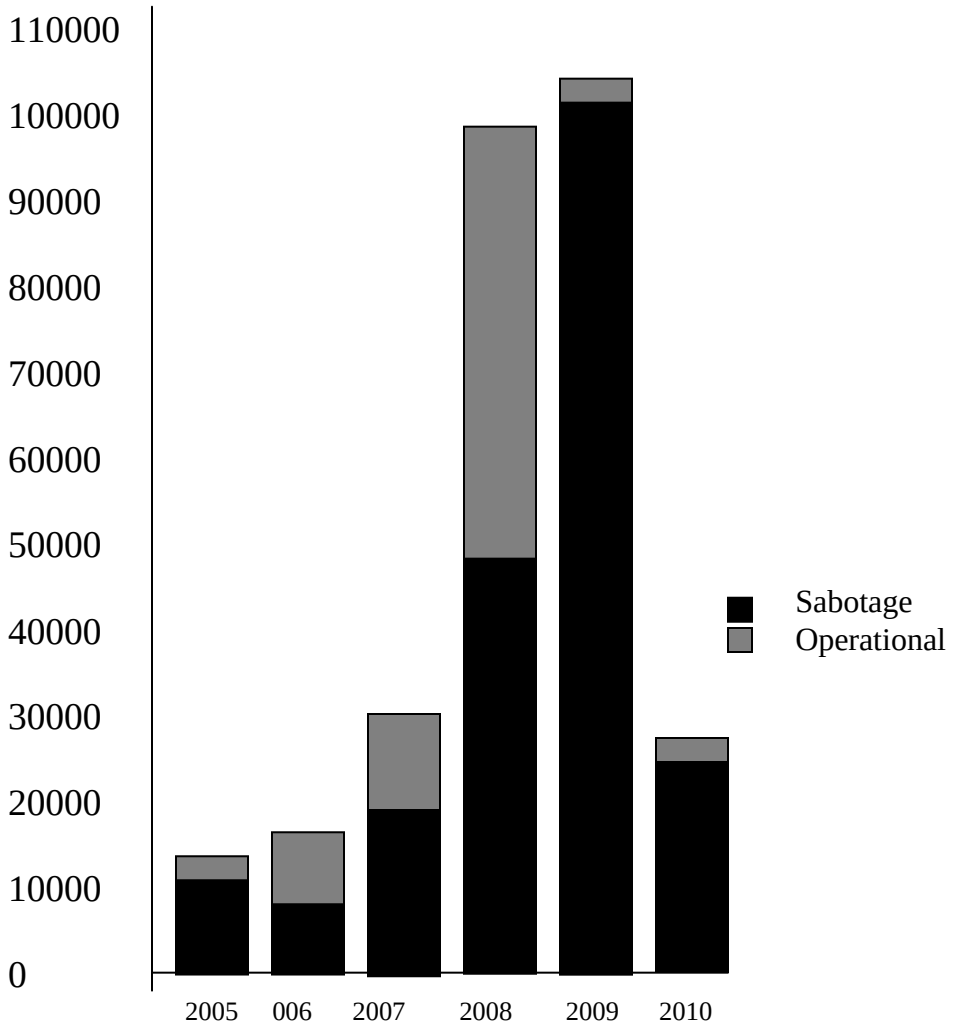


Figure 5

Source: SPDC Oil Spill Statistics 2011

3.2 ANALYSIS AND INTERPRETATION

From table 5, the volume of oil spill incident through sabotage increased rapidly from year 2005 through year 2009. In year 2010, the value reduced to 23,000 barrels. This indicates a high level of oil drilling sabotage in the Niger Delta (Bony) Area resulting to an increasing damage consequences on fisheries and tourism in the area.

It is also obvious that oil spill due to operational activities such as oil drilling activity is less in volume (barrel) compared to the spill incident due to sabotage. Though this increased from 2,000 barrels in 20005 to 50,000 barrels in 2009, in 2010, the volume spilled was 2,000 while spill due to sabotage was 102,000 barrels which was the peak volume of oil spill. This could be attributed as a result of less oil exploration activity. In 2010, the situation was brought to a decrease in oil spill bringing the total of oil spill to 73,000 barrels.

The total oil spill incident from 2005 to 2010 through sabotage is 217,000 barrels with a mean volume of 36,167 barrels per year for the period under study while the total oil spill incident through operational activity from 2005 to 2010 is 126,000 barrels with a mean volume of 21,000 barrels per year for the period under study.

On the other hand, the total volume of oil spilled is 343,000 barrels within the period while the mean volume of oil spill is 57,167 barrels per year.

Fisheries and other aquatic animals that depends on freshwater or saltwater for survival however will not survive. Hence aquatic organisms can only survive in water dependence on the level of salinity of the water (the amount of salt dissolve in a volume of water) hence it could either be saltwater life zones) (example is a coral) or freshwater life zone (example a lake).
Hence it very obvious that any discharge in the aquatic environment will cause a level of disturbance in the aquatic organisms in the form of the following. The level of dissolve oxygen, carbondioxide, turbidity, PH value, Hydro carbon (petroleum) contents etc.

3.3.1 ANALYSIS OF DATA

The data collected from the recent oil spills will be analysed using **REGRESSION MODEL** to estimate the level of damage by oil spill incident on fisheries and tourism, the volume (in barrel) of oil spill incident was used. The period used for this study is from 2005 to 2010.
NOTE: Assume that 1 barrel of crude oil per day approx 50 tons of crude oil per year.

I ton of crude oil = 1 metric ton of crude oil
= approx. 7.3 barrels of crude oil
(assuming a specific gravity of 83API)

1 US barrel = 158.984 liters
= 42 US gallons
= 34.97 imperial (Uk gallons)

Using regression Model to estimate the short term economic damage of oil spill on tourism and fishery; $Y = \beta_0 + \beta_1 X_2 + \beta_2 X_2 + ų$

Y	$X_1 10^3$	$X_2 10^3$	$X_1^2 10^6$	$X_2^2 10^6$	X^2	$X_1 X_2 10^6$	$X_1 x 10^3$	$X_2 x 10^3$
1	12	2	144	4	1	24	12	2
2	10	10	100	100	4	100	20	20
3	20	12	400	144	9	240	60	36
4	50	50	2500	2500	16	2500	200	200
5	102	2	10404	4	25	204	510	10
6	23	50	592	2500	36	1150	138	300
Total	**217**	**126**	**14,077**	**5252**	**91**	**4218**	**940**	**568**

Where X_1 = Spill due to sabotage

X_2 = Spill due to operational authority

βo, β_1 β_2 are constant

Y = the level of damage caused by X_1, X_2

$\Sigma (Y = \beta_0 + \beta_1 x + \beta_2 x_2)$

$$\Sigma y = n\beta_o + \beta_1 \Sigma X_1 + \beta_2 \Sigma x_2$$

$$\left\{ \begin{array}{l} \Sigma x_1 y = \beta_0 \Sigma x_1 + \beta_1 \Sigma x_1^{\,2} + \beta_2 \Sigma x_1 x_2 \\ \Sigma x_2 y = \beta_0 \Sigma x_2 + \beta_1 \Sigma x_1 x_2 + \beta_2 \Sigma x^2_{\,2} \end{array} \right\}$$

$$\begin{Bmatrix} 6 & 21700 & 126000 \\ 217000 & 14077.10^6 & 4218.10^6 \\ 126000 & 4218.10^6 & 5252.10^6 \end{Bmatrix} \begin{Bmatrix} \beta \\ \beta_1 \\ \beta_2 \end{Bmatrix} = \begin{Bmatrix} 21 \\ 940 \\ 568 \end{Bmatrix}$$

$$\beta = 6\begin{Bmatrix} 14077.10^6 & 4218.10^6 \\ 4218.10^6 & 5252.10^6 \end{Bmatrix} - 217000\begin{Bmatrix} 217000 & 4218.10^6 \\ 126000 & 5252.10^6 \end{Bmatrix} + 126000\begin{Bmatrix} 217000 & 14022.10^6 \\ 126000 & 4218.10^6 \end{Bmatrix}$$

$$\beta = 6(14077.10^6 \times 5252.10^6 - (4218.10^6 \times 4218.10^6) - 217000\,(217.10^3 x 5252.10^6 - 4218.106 \times 26.10^3 + 126000$$
$$(217.10^3 \times 4218.10^6 - 126.10^3 x 14077.10^6)$$

β = General Determinant

$\beta = 2.2456352.10^{20} - 1.31982872.10^{20} - 1.08157896.10^{20}$

$= 2.2456352.10^{20} - 2.47986616.10^{20}$

$= -2.3423096.10^{19}$ = General Determinant

For β_o,

$$\beta_o = \begin{Bmatrix} 21 & 217.10^3 & 126.10^3 \\ 940 & 140.77.10^6 & 4218.10^3 \\ 568 & 4218.10^6 & 5252.10^6 \end{Bmatrix}$$

$$\beta_o = 21\begin{Bmatrix} 14077.10^6 & 4218.10^6 \\ 4218.10^6 & 5252.10^6 \end{Bmatrix} - 217.10^3\begin{Bmatrix} 940 & 4218.10^6 \\ 568 & 5252.10^6 \end{Bmatrix} + 126.10^3\begin{Bmatrix} 940 & 14077.10^6 \\ 568 & 218.10^6 \end{Bmatrix}$$

$\beta_o = 21$ $(14077.10^6 x 552.10^6 - 4218.10^6 x 4218.10^6 - 217.10^3$ $940 x 5252.10^6 -$

$568 x 4218.10^6 + 126.10^3\,(940X4218.10^6 - 568X14077.10^6)$

$\beta_o = 1.178548.10^{21} - 5.51409152.10^{17} - 5.07882816.10^{17}$

$= 1.77895508.10^{21}$

But $\beta_o = (\beta_0) = \dfrac{177895508.10^{21}}{(\beta)} = \dfrac{}{-2.3423096.10^{19}} = -7594.9$

For $(\beta) = 6^6\begin{Bmatrix} & 21 & 126.10^3 \\ 217.10^3 & 940 & 4218.10^6 \\ 126.10^3 & 568 & 5252.10^6 \end{Bmatrix}$

$(\beta_1) = 6\ 940 \begin{pmatrix} 4218x10^6 & 217.10^3 \\ 568 & 5252.10^6 \end{pmatrix} -21 \begin{pmatrix} 4218.10^6 & 217.10^3 \\ 126.10^3 & 5252.10^6 \end{pmatrix} +126.10^3 \begin{pmatrix} 940 & \\ 126.10^3 & 568 \end{pmatrix}$

$(\beta)\ \ 6(940x5252.10^6\text{-}568x4218.10^6) -21\ (217.10^3x5252.10^6\text{-}126.10^3\ x\ 4218.10^6 +$

$126.10^3\ (217.10^3x568\text{-}126.10^3x940).$

$(\beta_1) \quad = 1.5246336.10^{13} – 1.2772536.10^{16} + 606816.10^{11}$

$(\beta_1) \quad = 4.792431034.10^{16}$

But $\beta_1 = (\beta_1) \quad = \quad 4.792431034.10^{16}$

$(\beta) \quad -2.3423096.10^{19}$

$=-2.046028003.10^{-3}$

For $(\beta_2) = 6 \begin{pmatrix} 217.10^3 & 21 \\ 217.10^3 14077.10^6 & 940 \\ 126.10^3 & 4218.10 \quad 568 \end{pmatrix}$

$(\beta_2) = 6\ 14077.10^6 \begin{pmatrix} 940 & 217.10^3 \\ 4218.10^6 568 & 126.10^3 \end{pmatrix} 940 \begin{pmatrix} 217.10^3 & 940 \\ 217.10^3 & 568 \end{pmatrix} + 21 \begin{pmatrix} 217.10^3 & 14077.10^6 \\ 126.10^3 & 4218.10^6 \end{pmatrix}$

$(\beta_2) = 6\ (14077.10^6x568\text{-}940\ x\ 4218.10^6)\text{-}217.10^3\ (217.10^3x568\text{-}940x126.10^3 +$

$21\ (217.10^3\ x\ 4218.10^6 – 126.10^3\ x\ 14077.10^6)$

$(\beta_2) = 2.4184896.10^{13} – 1.045072.10^{12} + 1.8026316.10^{16}$

$(\beta_2) = 1.804941989.10^{16}$

Therefore $(\beta_2) \quad = \quad 1.804941989.10^{16}$

$(\beta) \quad - 2.3423096.10^{19}$

$= \quad -7.705821591.10^{-4}$

$\therefore Y = \beta_o + \beta_1 + 1 + \beta_2 x_2$

$Y = -7594.9 - 2.046028003.10^{-3}\ x_1 – 7.705821591.10^{-}4\ x_2$

3.3.2 DISCUSSION

The negative signs of the x_1 ($-2.046028003.10^{-3}$) and x_2 ($-7.705821519.10^{-4}$) shows that there is an inverse relationship between growth in fishery production & tourism activities and oil spillage due to sabotage or operational activity.

This implies that increase in oil spillage due to operational activity or sabotage will lead to decrease in growth in fishery production and tourism activities and decrease in oil spillage due to sabotage or operational activity will lead to increase in fishery production and tourism activities.

An impact accident and the associated puncture of the hull will lead to water ingress and possibly also outflow of oil cargo and bunkers (NRC 1991). This spills will in turn pollute the water ocean which is the habitat for fishes and other aquatic organisms, this will in return have a negative effect in the life of fisher men in Bonny river who solely depends on it for their survival and daily bread (economic life).

Secondly, recreational activities will also be hampered because tourist will see such areas as unfavourable. This will in turn reduce the economic benefits that would have benefited bonny and Niger Delta at large.

Another short term consequence is the issue of hunger that would set-in in the area, this will at middle term increase the death rate or mortality rate of individuals who can no longer feed on bonny fishes without alternatives. The fishermen who do not have alternative job will increase the rate at which they give birth because they would always stay with their wives at home.

4.1 CONCLUSION

In conclusion, it is however economically disastrous considering the short term economic damages from the oil spill in Bonny fishes and tourism.

This study have estimated the short term economic damages from the oil spill in Bonny fishery and tourism.

The study has revealed that there is an inverse relationship between growth in fishery production & tourism activities in bonny and oil spillage due to sabotage and operational activities. It is therefore good to mention or state here that an increase in oil spill will increase the damage effect on bonny fishery and tourism because there will be very low rate of fish production, hunger, high rate of mortality, kwashiorkor prevalence, deficiency in some vital vitamins associated with marine organisms and decrease revenue due to tourism activities.

Oil spills have occurred several times along the Nigerian coast as a result of upsurge in oil exploration and exploitation activities. The causes of oil spillage along our coast are corrosion of oil pipes and storage tanks, sabotage and carelessness during oil production operations. The impacts of spillage on the Nigerian coastal areas are enormous. Lives have been lost, coastal habitats and ecology destroyed. These have led to calls for resource control by oil producing states in the country.

The GIS could be used to identify responders and provide information about the closest resources of oil spill response equipment and personnel. Planners to review could also use it where spill-fighting resources are deployed. The petroleum industry should work closely with government agencies, universities and research centers to reduce the frequency and impact of oil spills.

4.2 RECOMMENDATIONS

Based on the findings on this research work, the researcher therefore makes the following recommendations

- Indiscriminate oil drilling should be by law prohibited and adequate consequences should be placed on offenders.
- There is a need for a better understanding of the coastal ecology so as to evaluate the significance of the impacts generated by oil spill incidents. A thorough environmental impact assessment should be done prior to oil exploration and exploitation in oil rich regions. More funds should be provided by oil multinationals for environmental research, environmental protection and for provision of amenities and infrastructure in oil producing communities.

- There is a need to acquire real time or predicted meteorological data and medium scale digital maps of the coastal areas. Establishment of regional spill response centres along the coastline, and the use of data collected with an airborne system will help in managing oil spill problems in Nigeria.
- The petroleum industry should work closely with government agencies, universities and research centre to reduce the frequency and impact of oil spills. When a spill occurs, various government agencies and industries must start to immediately to clean the spilled oil and efforts made to minimize its impact on the environment.

Good compensation plan should be provided by oil companies and the government to these fishermen to help alleviate these short term sufferings.

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