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Effect of Oil Spills on Artisanal Fishery in the Niger-Delta, Nigeria

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Abstract

This Research assess Effects of oil Spills on Artisanal Fisheries in the Niger-Delta, Nigeria the Study used both primary and secondary Sources of data, the findings of the research revealed that there is the lack of effective integrated management of coastal areas, embedding Artisanal Fishery sub-sector into policy, legal and institutional frameworks, lack of assistance from Government and awareness of any government activities on Sustainable Development Goals (SDGs):However, there were community Artisanal fisheries and Fishermen's organisations practising an exclusive rights-based regime, regulating activities of members to ensure harmonious fishing conduct, imposing fines and sanctions for non-compliance in the course of effective monitoring and enforcement. Life on land impacts negatively on life below water via Pollution, waste, discards, catch by lost or abandoned gear, catch of non-target species, both fish and non-fish species. International agreements, treaties and commitments on fishing as well as national/state artisanal fishing legislative requirements are not known to the artisanal fishers. Measures are not in place to reduce and mitigate coastal / marine pollution and degradation, and protect the environment and give traditional and customary resource users the right to a certain level of environmental quality as part of their livelihood. The level of enforcement of compliance

with waste related policies, laws and regulations to address and regulate coastal and marine disposal/pollution is poor. No adequate infrastructure and resources for effective coastal and marine waste management Coastal and marine waste management do not conform to international accords/treaties and commitments to address coastal/ marine pollution. No monitoring systems in place for the coastal environment to identify environmental degradation from all sources as early as possible for prevention, rather than clean-up.

Keywords: Effects, oil, spill, Artisanal, Fisheries, Resources

Introduction

Recent United Nations General Assembly resolutions have emphasised the key roles that Supreme Audit Institutions (SAIs) can play in the achievement of the Sustainable Development Goals (SDGs), made up of 17 Goals, 169 Targets and 230 Indicators. This Audit applied One (1) of the Four (4) Approaches in the key roles of SAIs undertaking performance audits that examine the effectiveness of key government programs that contribute to specific aspects of the SDGs. Of particular interest was to find out:

i. The extent of implementation of SDG 16 on strong institutions to monitor and enforce coastal environmental compliance and code for responsible fisheries for sustainable artisanal coastal fishery, as well as relates in part to transparent, efficient, and accountable institutions;
ii. Whether coastal Artisanal Fisheries resources are sustainably managed to the achievement of the SDG 2-zero hunger, SDG 8-Fishing (decent work & well-being), and
iii. The impacts of Oil spill pollution on Fishery resources SDG 14 – Life Below Water, SDG 3-good health & well-being
iv. Environmental issues are of great interest to the public as they affect all areas of life. Engaging in an environmental auditing requires identifying issues that really matter to people and crucial to achieving the Sustainable Development

v. Goals (SDG)/2030 Agenda. Nigeria has a coastline of approximately 853km facing the Atlantic Ocean; terrestrial zone is about 28,000 km^2, whereas the continental shelf is about 46,300km^2. This coastline lies between latitude 4^o 10' to 6^o 20' N and longitude 2^o 45' to 8^o 35' E. The Nigerian coast is composed of four distinct geomorphology units namely the Barrier-Lagoon Complex; the Mud Coast; the Arcuate Niger Delta and the Strand Coast. In 1956, Royal Dutch Shell discovered crude oil at Oloibiri, a village in the Niger Delta, and commercial production began in 1958. Today, there are about 606 oil fields in the Niger Delta, of which 360 are on-shore and 246 offshore" (https://www.researchgate.net/profile/Peter_Nwilo, May 2005). Shell was responsible for 14,000 tons of crude oil in the Niger Delta, more than 7,000 spills between 1970-2000. Ultimately, it led to the 26 million pounds fine for Shell that occurred 30 years later (George Ibenegbu May 31, 2017) and requires about 30 years to clean up the mess. The UNEP report in 2009 revealed that oil spillage polluted 1,000 square kilometres areas in the Niger Delta, conditions not ideal for living. Spillage sources -Pipeline and tanker incidents (50%), Sabotage (28%), Oil production operations (21%), and non-function equipment (1%).

vi. Fish provides nutrients and micronutrients that are essential to cognitive and physical development, especially in children and are an important part of healthy diet. The right to fish carries with it the obligation to do so in a responsible manner so as to ensure effective conservation and management of the living aquatic resources. Fisheries management should promote the maintenance of the quality, diversity and availability of fishery resources in sufficient quantities for present and future generations in the context of food security, poverty alleviation and sustainable development.

The Study Area

Location

The Niger Delta is located in the Atlantic coast of Southern Nigeria and is the world's second largest delta Kadafa (2012). The Niger Delta area has a coastline that extends for about 450 km in the east-west stretch Agbeja (2010), Kadafa (2012). Its geographic location is between Aboh at 5° 33′ 49″ N, 6° 31′ 38″ E in the North and Palm point (4° 16′ 22″ N, 6° 05′ 27″ E) in the South. The east

to west limit is between Benin River estuary (5° 44′ 11″ N, 5° 3′ 49″ E) in the west and Imo River estuary (4° 27′ 16″ N, 7° 35′ 27″ E) in the east Agbeja (2010). The Niger Delta Region lies roughly over an area of 112,100 square kilometres, and holds about 12% of the total land area of Nigeria (Igben, 2014). The region is bordered in the south by the Atlantic Ocean and to the east by the Republic of Cameroun. To the west, the region is bordered by the southwestern states of Lagos, Ogun and Osun. The states of Benue, Kogi, Enugu, Ebonyi and Anambra border the region to the north (Igben, 2014). It extends along the coast from the river's basin in the west of Bonny River with characteristic extensive interconnection of creeks. It is the most important drainage feature of the Niger Delta Basin River system with about 2% of the surface area of Nigeria.

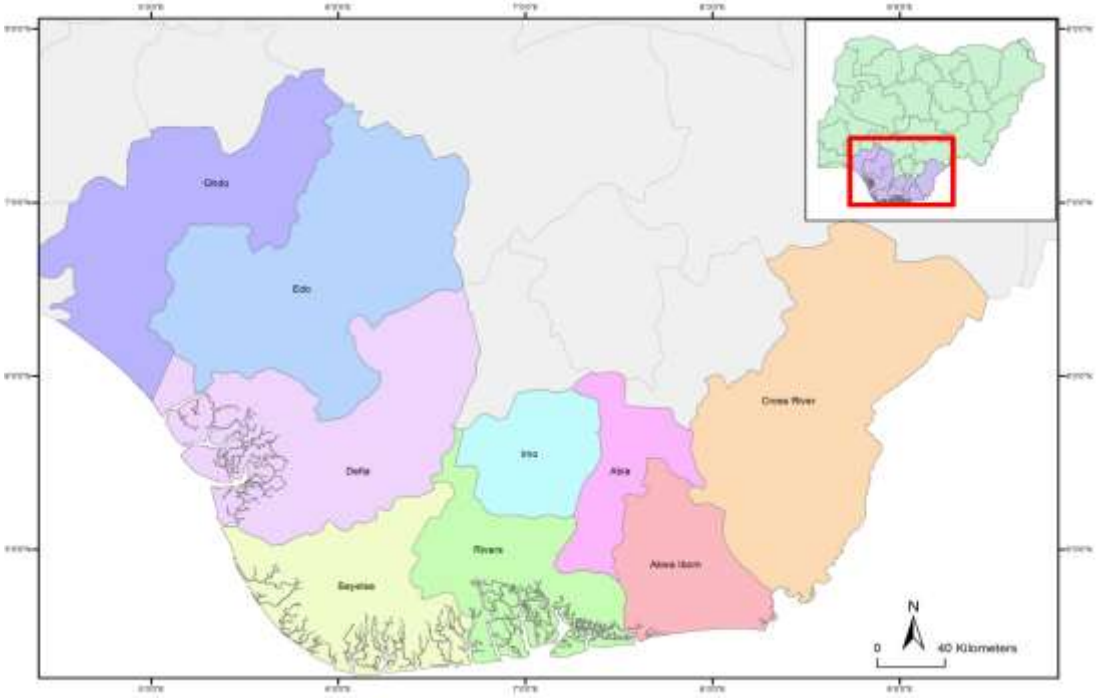


Fig. 3.1 Nigeria showing Niger Delta Region
Source: AGIS, 2020

Materials And Methods

Sources of Data

Data for this audit were derived from primary and secondary sources. Of particular importance was the primary source of data as far as this audit was concerned, because of the originality of such data from the respondents. Secondary data on the other hand were collected from relevant literatures,

journals, magazines, papers (articles), online publications, and other research works.

Data Analysis

The data collected were analysed using descriptive statistical techniques of frequency and %ages to see the distribution of responses to the issues raised.

Results and Discussion

Sources and Nature of Fishing Water Pollution

The results of the investigation show fish water pollution in the area of study is caused by both natural and human activities, with the human activities predominating in the study area, such as dumping of waste on open water bodies, use of chemicals in both fishing and farming, oil spills and flood.

These sources of water pollution constitute threat to the sustainability of fishing practices, especially that the areas used for the study are areas of high concentration of oil exploration and exploitation activities. Again, fishermen deliberately use chemicals to poison fish for easy harvest and farmers use agro-chemicals like fertilizers that often get washed away to nearby water bodies within the basin during rainy season.

The pollution of fishing waters takes the forms of total or partial contamination, growth of germs and presence of solid particles in water, among others (Table 4.13). The nature of water pollution takes the form of visible contamination of water, growth of germs, among others (Table 4.15).

Table 4.15: Nature of Water Pollution

Source of Water Pollution	Frequency	Percentage (%)
Contamination of water resources	45	38.5
Growth of germs	4	3.4
Taste and coloured water	24	20.5
Solid particles in water	31	26.5
Others	13	11.1
Total	**117**	**100**

Source: Fieldwork, 2020.

The area of study is part of the Niger Delta Region of Nigeria that has been consistently facing problems of environmental degradation due to oil

exploration and exploitation that started in the late 1950s. Many environments based human activities are responsible and are affected negatively, including fishery, by environmental pollution. For example, fish can be substantially affected in some circumstances when oil spills into shallow or confined waters. When exposed to oil adult fish may experience reduced growth, enlarged livers, changes in heart and respiration rates, fin erosion and reproduction impairment. Fish eggs and larvae can be especially sensitive to lethal and sub-lethal impacts. Oil also contains many toxic substances that often are easily dissolved in water. These compounds may cause death or illness among aquatic organisms. Fishes are affected by the oil both by physical attachment and by intoxication by water soluble toxic substances within the oil. As fishes are mobile animals, they have the possibility to escape affected areas to new environment. However, the worst impact of pollution on fish was the contamination of their breeding grounds, which was the dominant phenomenon in the study area.

As it is with most human activities, government cannot be relied upon for the cleaning up of the pollution and maintaining a safer environment for human activities, including fishing, to be sustainable. Majority of the fishermen said that there were no measures put in place by government to protect the environment in order to raise it to a certain level of quality that will guarantee the fishermen's sustainable livelihood (Table 4.17).

Table 4.17: Public Measures to Protect the Fishing Environment

Measure	Frequency	Percentage (%)
Yes	29	24.8
No	88	75.2
Total	**117**	**100**

Source: Fieldwork, 2020.

In the absence of public measures to protect the fishing environment, the fishing communities have put in place some measures to ensure environmental protection, such as regulation of fishing activities, prohibition of fishing activities in some lakes and rivers due to their spiritual importance (traditional worship centres) and restriction on the killing of fingerlings. Other measures put in place include selling of lakes to fishermen in fishing season to guide against uncontrolled fishing activities and the traditional measure of sacrifice, based on the belief that there would be calamity and the fishing environment would not be protected if that was not done. The need to protect the fishing environment gave rise to the measures the fishing communities came up with (Table 4.17). According to most of the fishermen, without those measures' problems such as reduction in biodiversity of fish stocks and indiscriminate dumping of wastes on natural water bodies, among others, would have

persisted, with their negative consequences on poor catch, loss of income and hunger.

The Extent and Effects of Oil Pollution on Fishery

The results of water equality for fishing, obtained through laboratory analysis, are presented for several variables and their values, that include PH, temperature odourless/colourless, Pbs, Znz and Cu2t, among others, are presented and interpreted alongside the recommended values permissible for sustainable fishing practices (Table 4.18).

Table 4.18: Biological and Physico-Chemical Parameters of Water on Fisheries.

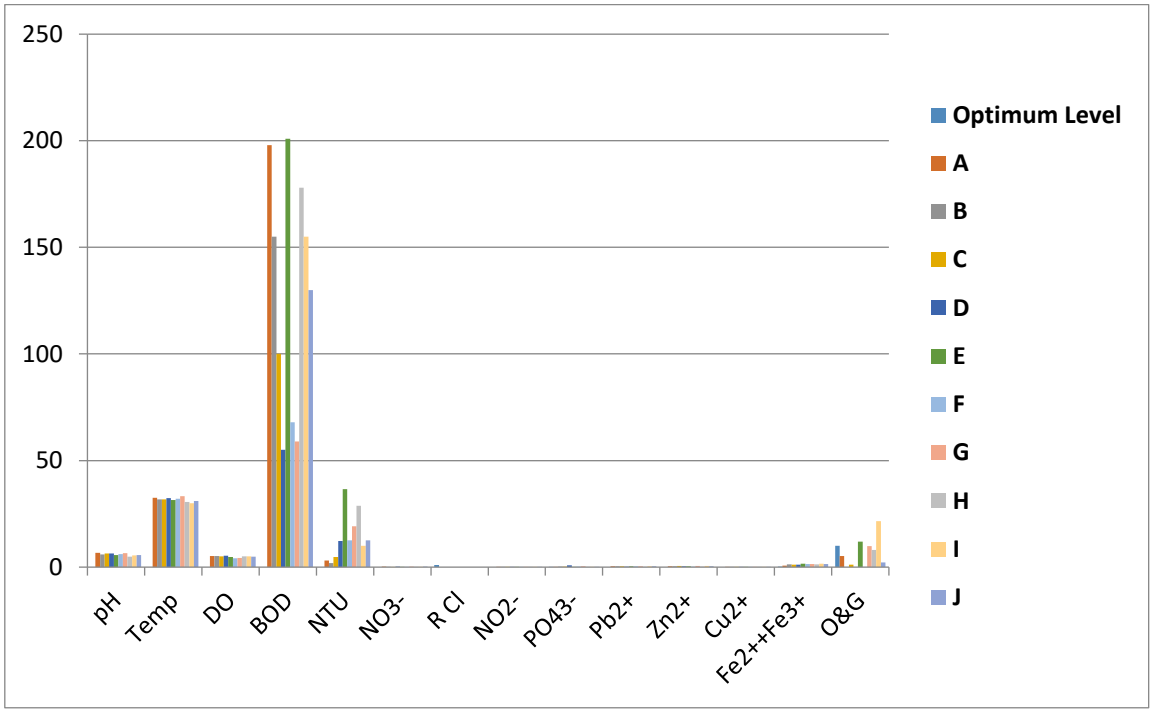
Parameter	Optimum Level	Method	A	B	C	D	E	F	G	H	I	J
pH	6.5-8.5	ASTM-D1293-84	6.73	5.92	6.35	6.37	5.63	6.10	6.60	4.97	5.51	5.70
Temp	26-32°C	Thermometer	32.5	31.7	31.8	32.3	31.4	32.0	33.3	30.5	30.0	31.0
TDS	2000	SM-1030-E	4255	650	352	363	20.0	142	205	18.0	41.0	65.0
DO	.>3.0ppm	ASTM-D888	5.22	5.19	5.11	5.42	4.81	4.12	4.33	5.10	5.01	4.92
BOD	<10ppm	SM-5210-B	198	155	100	55	201	68	59	178	155	130
NTU	5:00NTU	ASTM-D1889	3.14	1.89	4.82	12.3	36.5	12.6	19.2	28.8	9.98	12.6
TH	<200	SM-2340-B	1080	635	445	341	98	56.0	445	125	154	215
NO_3^-	20mg/l	SM-4500-NO_3-	0.25	0.12	0.16	0.18	0.11	0.07	0.19	0.09	0.11	0.21
SO_4^{2-}	<250mg/l	SM-4500-SO_4^{2-}E	220	38.0	25.0	25.0	<1.0	13.0	14.0	<1.0	4.0	4.0
R Cl	1.0	SM-4500G	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NO_2-	3mg/l	SM-4500-NO_2^-	0.108	0.080	0.076	0.058	0.051	0.084	0.088	0.078	0.051	0.088
PO_4^{3-}	0.05	ASTM-D-515	0.02	0.27	0.24	0.82	0.09	0.25	0.32	0.05	0.13	0.12
Pb^{2+}	<1.0mg/l	SM-3500-PbA	0.44	0.39	0.43	0.19	0.41	0.32	0.40	0.10	0.35	0.35
Zn^{2+}	<1.0mg/l	SM-3500-Zn	0.46	0.35	0.61	0.35	0.35	0.30	0.57	0.28	0.51	0.44
Cu^{2+}	<1.0	SM-3500-CuA	0.10	0.13	0.09	0.09	0.11	0.11	0.10	0.08	0.13	0.07
Fe^{2+}+Fe^{3+}	0.3	SM-3500-FeA	0.73	1.35	1.21	1.13	1.53	1.52	1.51	1.27	1.56	1.45
CFU/100 mi	400	SM-9222-D	280	211	154	43	386	88	97	325	201	235
O&G	10.0	SM-5520F	5.20	<0.10	1.10	<0.10	11.9	<0.10	9.80	8.10	21.6	2.20

Source: Fieldwork, 2020.

The biological properties that affect aquaculture include biological oxygen demand (BOD) which determines the suitability of water for fish farming. Like other animals, fish take in oxygen and give out carbon IV oxide (Co2) during respiration, and fish aerobic metabolism requires dissolved oxygen. From table 4.7 the values of biological oxygen demand (BOD) for all the sampled water bodies are in excess of the standard range of 3-20 mg/1 as recommended (Boyd, 2003).

The raw values for the water parameters investigated are presented graphically to further show how their levels of presence in water bodies, in terms of their optimum and minimum occurrence (Figure 4.1).

Bio-statistical representation of Physico-chemical and Biological properties of pH; Odourless/Colouless, Temperature and DO;NTU; NO3;; R Cl; NO2-; PO43-; Pb2+; Zn2+; Cu2+, Fe2++Fe3+,: O&G, and BOD, for water samples collected from 10 Fishing community rivers in Edo and Delta States. In Edo State, the fishing communities visited included:GeleGele (A); Illushi (B); UdabaEkperi (C); Agenebode (D), and Idogbo (E), while Delta State fishing communities rivers were:OgbeIjoh (F); Uzere (G); Effurun (H); Uwherun (I), Igbide (J).



Graph 1: Bio-statistical representation of Physico-chemical and biological parameters on fisheries.

The obtained values of the biological and physico-chemical properties of the water sampled from different sources are compared with the standards of the Nigerian Federal Ministry of Environment which stipulate qualities and guidelines for uniform effluents limits in Nigeria. These limits are permissible values above which any effluent can impact negatively on an aquatic body, and hence leading to unsustainable fishing practices. For the PH values, for example, half of the fishing locations are within the permissible optimum limit of 6.5- 8.5 with the remaining half having PH values below the optimum limit (Table 4.18). These pH values are compared with the pH values in Table 4.19.

Table 4.19: pH Tolerance Levels and its Effect on Aquaculture

pH Levels	Effects on Water on aquaculture
<4.0	**Acid death point**
4.0-5.0	**No production**
6-5-9.0	**Desirable range for fish production**
9.0-11.0	**Slow growth**
>11.0	**Alkaline death point**

Source: Lawson 1995 and, Tarazona and Munoz 1995.

The implication of these results for fish farming is that the optimum limit of 6.4-8-5 is a desirable range of condition for fish production, while above is for slow growth of fish production and below 6.5-85 pH level, it indicates unfavourable fish production and therefore unsustainable fishing practices.

Furthermore, Table 4.18 shows that the total dissolved solids and salinity for all locations were within limits except for Gele-gele in Edo State. This might not be explained by human activities in the area alone but most likely due to the nature of the river water because of the presence of high dissolved salts.

The biological oxygen demand (BOD) analysed values for all the stations in the study area of Delta and Edo States were above the Nigerian Federal Ministry of Environment permissible limits of 50.0mg/L (Table 4.18). This indicates the presence of high organic loads due to human and animal activities like faeces and washing of butchered animals in the area.

Table 4.18 also shows that the turbidity values were only slightly above 5.0mg/L and this cannot have much significant effect on fishing practices as the water might be constantly agitated sometimes by human intervention activities

and this could lead to less transparency at some areas. The values of nitrate, sulphate and phosphate were all below permissible limits and thus could not impact negatively on the quality of water for fishing practices. Excess of these nutrients could be detrimental to aquatic life causing algal bloom, proliferation of micro-organisms and depletion of dissolved oxygen. Therefore, the nitrate, sulphate and phosphate nutrients ensure clean water for fishing practices, and thus make them sustainable.

It was found that residual chlorine values were negligible showing that the waters had not been used for recreational purposes before. Small amount of residual chlorine is good for fish production and this suggests that excess chlorine amount is not good for aquatic life and so not conducive for fish production and associated fishing practices.

Again, toxic metals such as lead, cadmium, copper and zinc did not exceed permissible limits (Table 4.18). This implies that there were no negative effects of industrial activities in the area, on the quality of water for fish production and its associated practices. The values of alkalinity were low and this significantly shows that the waters were poorly buffered. A slight change or introduction of very low acid or basic constituents could lead to a sharp change in pH values and this has a detrimental effect on aquatic life, and thus makes fishing practices unsustainable.

The values for total iron were within permissible limits and so permit a healthy aquatic production, and a sustainable fishing practice. The total coliforms were within the permissible limits (Table 4.18) but with the exception of Idogbo community, where the values of total coliform were relatively high. The high values of total coliforms observed in Idogbo community could be explained by the presence of human and animal activities, such as deposition of faecal matters, especially that the community abattoir was close to the river.

Of all the communities investigated, Idogbo seems to have a relatively polluted water which does not meet the basic requirements for fishery and fishing activities. For example, the values of oil and grease for Idogbo were above the permissible concentration limit of 10mg/L (Table 4.18). The high oil and grease levels in Idogbo community could easily been seen in areas where crude oil exploration and exploitation were done. Oil bunkering, which involves loading and off-loading of crude oils and diesels from boats and barges. These oil activities could lead to crude oil spills and thus provide the main reason, among others, for water pollution. The implication of high oil and grease contents in

water could lead to breathing difficulties in fishes and clog fish gills, and thus unfavourable for fish production and its associated fishing practices.

Coastal Artisanal Fishery Management

In this section the effects of oil spill are discussed in relation to SDG 16 which is about responsible fisheries for sustainable artisanal coastal fishery. Here the role of strong institutions to monitor and enforce coastal environmental compliance and code for responsible and sustainable fishing were discussed.

The results of investigations conducted suggest the existence of weak institutions to monitor and enforce coastal environmental compliance and code for responsible fisheries for sustainable artisanal coastal fishery. The institutions that appeared weak include the Federal Ministry of Agriculture and Rural Development, Federal Ministry of Environment, the Fisheries Department of State Ministry of Agriculture and Natural Resources, and State Ministry of Environment, National Institute for Freshwater Research (NIFFR), Nigerian Institute for Oceanography and Marine Research (NIOMR), Cat-fish Farmers Association of Nigeria (CAFAN), Fadama Projects, and Water and Sanitation Hygiene (WASH) Programme, with responsibility to educate and persuade fishermen to do the right thing with respect to the environment, before enforcement of non-compliance.

The fishermen opined the absence of strong institutions as required under SDG 16 to monitor and enforce coastal environmental compliance and code for responsible fisheries for sustainable artisanal coastal fishery. All the identified agencies of government for artisanal fisheries sub-sector lacked coastal management policies, plans and strategies for sustainable protection and conservation of coastal fishery resources and artisanal fishery sub-sector was not embedded into policy, legal and institutional frameworks for the integrated management of coastal areas. It was found that majority of the fishermen agreed that the identified fishery authorities were never included in the coastal management planning process. Some of them claimed not to know the agencies of government that are responsible for artisanal fishery sub-sector,

All the fishermen claimed that government officials from fishery department rarely visited the artisanal fishing community. However, according to provisions of Article 10.1.3 of FAO Technical Guidelines for Responsible Fisheries, States should develop, as appropriate, institutional and legal frameworks in order to determine the possible uses of coastal resources and to

govern access to them taking into account the rights of coastal fishing communities and their customary practices to the extent compatible with sustainable development. Also, the fishermen claimed that there was no public awareness of the need for the protection and management of coastal resources and the participation in the management process by those affected, especially the artisanal fishermen as required under Article 10.2.1.

It was found that the artisanal fishing communities self-administered their fishing activities with community rules, restrictions, regulations and prohibition of use of chemicals which attracts 5 years imprisonment for default. The 10 fishing communities under investigation managed artisanal fisheries at the community level by common practices that have been established and are enforced based on the interests of the people. Many artisanal fisheries feel that federal regulations of their fisheries are unnecessary and that these regulations would just hamper a process that is working perfectly fine on its own. Many artisanal fishermen feel a sense of stewardship for their area of the ponds/river/sea. It is not just a way to make money, it is their very livelihood. As such, they often feel that they must protect it and undertake practices to best get what they need with as little negative impact as possible.

The Agencies of government exhibited low commitment by deploying grossly inadequate resources to monitor and enforce coastal environmental compliance and code for responsible fisheries for sustainable artisanal coastal fishery. The fishermen disclosed that the government agency officials were inadequate and not dedicated to their duties, with little or no awareness of their existence. The officials of government, on their part, claimed that they faced serious resource constraints that hampered their operations, and these included high cost of renting a boat to move round the riverine areas, absence of viable fishermen cooperative societies, lack of boats and vehicles for monitoring, and mostly female nursing mothers in the artisanal fishery sub-sector. Some government officials claimed that they rarely used their personal cars, airtime for official business.

The role that government Officials ought to play are played by the fishing communities and associations by creating committees that monitored fishing activities with the imposition of fine as much as N5,000:00 for violators of community rules and regulations, and total banishment from the community if deemed necessary. The artisanal fishermen had no record of agencies of government imposing sanctions, fines and prosecuting against coastal polluters or non-compliance to coastal and marine legislations.

The fishing community sanctions on their members were not strong enough to act as deterrent to would-be coastal polluters and transgressors as there were instances of undue influences from above to evade imposition of sanction for serious environmental transgressions. The institutions that exist are weak and

incapable for effective monitoring and enforcement of coastal environmental compliance and code for responsible fisheries for sustainable artisanal coastal fishery. This means that there were no indicators on ground showing likely achievement of the 2030 SDG goals and associated targets, as according to the fishermen, SDGs are always on paper, with no actual effort to achieve them in the study area.

Furthermore, there were no details of reports on monitoring and enforcement of artisanal fishing legislative requirements mentioned by agencies of government, and fisheries authorities, lacked the capacity to monitor the coastal environment and have access to the information in such a form as to enable them to identify impacts on the fisheries sector as well as from the fisheries/aquaculture sector. The best practices required government to establish or promote the establishment of systems to monitor the coastal environment, as part of the coastal management process, using physical, chemical, biological, economic and social parameters.

Implications of Oil spills on Livelihood

The implications of oil spills on livelihood are discussed taking into account the Sustainable Development Goals (SDGs) numbers 2 and 8 that specifically deal with zero hunger (SDG 2) and fishing decent work and well-being (SDG 8). The SDGs numbers 2 and 8 attempt to show if coastal artisanal fisheries resources are sustainably managed to the achievement of the Sustainable Development Goals 2 (zero hunger) and 8 (Fishing decent work and well-being). The results of investigation have shown that majority of the fishermen (70.3 % of them), represented by the leaders of the fishing associations, were of the opinion that coastal artisanal fisheries resources were not sustainably managed to the achievement of SDG 2 on zero hunger and SDG 8 on fishing decent work and well-being (Table 4.20).

Table 4.20: Sustainable Resource Management on SDG 2 and SDG 8

Status of Management	Frequency	Percentage (%)
Managed	11	29.7
Not Managed	26	70.3
Total	**37**	**100**

Source: Fieldwork, 2020.

The lack of sustainability in the management of fishery resources was the combined results of the fact that artisanal fishermen had to contend with the loss of income, longer distance to fishing points, poor catch and low income, hunger due to large scale fish mortality and pollution damaged fishing materials, among others. Water pollution discourages fishing activities as pollution makes fishing

activities difficult, leads to reduction in the volume and stock of fish in the water and this can result to great losses for farmers. Apart from pollution leading to losses in profit from fish farming, the fishermen are also, health wise, affected by the presence of black oil, in addition to losses in economic trees.

Plate 1: Artisanal Fishing as source of food for Livelihood.

Artisanal fisheries can be subsistence or commercial in nature, with fishermen catching enough fish to feed their families and selling the surplus in community markets. The level of awareness, economic and financial status of the artisanal fishermen could truncate the achievement of SDGs 2 and 8 and therefore not feasible. The fishermen unanimously agreed that fisheries authorities appeared to lack skills and experience in policy and institutional analysis and in all aspects of sectoral planning that could ensure that the activities and interests of the sector were incorporated into coastal management planning in a way that could maximise the contribution of the sector to economic and social welfare. It was investigated that majority of the fishermen (95.4 %) confirmed the inadequacy of artisanal fisheries management resources, human resources, funding, vessels, vehicles, equipment as one of the signs that showed that Government is not interested in developing aquaculture. Again, most of the fishermen (81 %) said there were instances of over and illegal fishing and improper fishing methods involving use of chemicals, mosquito nets to kill fingerlings, and use of explosives in the process of catching fish. The existence of strong institutions would have prevented or, at least, minimized cases of illegal and over fishing and the use of harmful practices like using chemicals in fishing. Therefore, lack of strong institutions to monitor and enforce compliance of fishing standards is a major hindrance to the attainment of SDG 16, aimed at achieving responsible fisheries for sustainable artisanal coastal fishery. The extent oil spills pollution impairs sustainable artisanal fishery and achievement of some Sustainable Development Goals (SDGs) such as: SDG 2 (Zero hunger); SDG 3 (Pollution/erosion); SDG 8 (Fishing, decent work & well-beings); SDG

14 (Life below water), and SDG 16 (Strong institutions) in the Niger-Delta areas of Nigeria. The relationship between SDG 14 and other SDGs is unique in that any threat to life below water, negatively impact on other SDGs as conveyed in the Figure 4.7.

Oil spills pollution remains the greatest threat to sustainable/responsible artisanal fishery in the Niger Delta. Pollution and degradation of coastal and marine areas (SDG 3-pollution/erosion) impact negatively on depleting fishery resources (SDG 14-Life below water) and took the forms of: Indiscriminate dumping of refuse on natural water bodies; Death of fishes via fish poisoning/use of chemicals for fishing, and Contamination of water. Oil and grease levels as was the case of Oil and Grease values for Idogbo above permissible concentrations of 10mg/L, can be attributed to crude oil exploration, bunkering, loading and offloading of diesels from boats, and crude oil spills. High oil and grease contents in water can lead to breathing difficulties in fishes and clog fish gills. BOD5 for all stations were above FMEnv permissible limits of 50.0mg/L or in excess of the standard range of 3-20mg/l recommended by Boyd (2003). This shows the presence of high organic loads due to human and animal's activity like faeces and washing of butchered animals in the area.

Alkalinity values were low. This is significant showing that the waters are poorly buffered. A change or introduction of very low acidic or basic constituents can lead to a sharp change in pH values and detrimental effect to aquatic life. Total coliforms were within permissible limits but were relatively high for Idogbo Community. Faecal matter from human and animal activities and especially if the river was close to an abattoir can result to very high values of total coliforms, no effects of industrial activities in the area as shown by the low level of Toxic metals such as lead, cadmium, copper, zinc within permissible limits.

Total Dissolved solids and Salinity for all locations are within limits except for Gele-gele. This may be due to most likely the nature of the river water characterised by the presence of high dissolved salts. Turbidity values were only slightly above 5.0mg/L. This may not be too significant an effect as the water may be constantly agitated sometimes by activities and this may lead to less transparency at some areas some times.

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