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The Fisher Folks Perspective of Ranking Pollutant Sources Impacting Fisheries Resources in the Niger Delta, Nigeria

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Abstract: The fisher florks perspective of ranking pollutant sources impacting fisheries resources in Nigeria was studied for a period of one year (January- December 2008) A survey of nine hundred artisanal fishers were carried out using structured questionnaire to obtain opinions on their perspectives regarding severity ranking of environmental factors identified to impact on fisheries resources and artisanal fishing in three states of the Niger Delta region. The states are Bayelsa, Delta and Rivers state. Kendall coefficient of concordance ranking techniques, Likert mean and Likert mean of means analysis were employed to analyze the opinion of the respondent fishers in each of the state. Nine environmental factors that had been identified via literature as most commonly impacting on fisheries resources were analyzed. The factors are; Incidence of crude oil pollution, Industrial pollution, Thermal pollution, Sewage pollution, Gas flaring, Erosion, Flooding, Siltation and physical obstruction of water bodies. The severity of the impact of each of the listed factors was found to be in a descending order of magnitude from the first to the last in all the three states surveyed. This study has therefore validated and generalized that crude oil related incidences as often claimed in various literatures exacts the most severe impacts on fisheries resources of the states studied. For an effective result in terms of remediation measures, it is therefore recommended that top most priority be accorded crude oil pollutant sources, followed by other factors based on the identified magnitude of impacts established by this study for each factor.

Key words: Fishers folks, fisheries Nigeria, pollutant sources, ranking, resources

INTRODUCTION

All over the world, it is an established fact that the Delta area is the most fragile ecological environment. With the spate of oil exploration and exploitation activities within the Niger Delta area for over four decades, the environmental ecology and its resources (fisheries prominently inclusive) is being degraded day in day out. Of the resources available in the Niger Delta, oil is by far the most valuable to the national economy. However, the benefits to the Niger Delta region are less obvious. From extraction in the Niger Delta to arrival at a terminal or refinery, there are a number of pollution outlets from the oil stream. Oil development can degrade the environment; impair human health and appropriate social deceptions (Horsefall and Spiff, 1998).

FMANR/JPC (1974) recognized early, the important influence environmental factors exact on fisheries resources in the country.

Thus, in its agricultural development plan for Nigeria - (1973-1985), it emphasized environmental research policy specifically for fisheries as follows:

- Research should be conducted on the effects of pollution from petroleum, industrial wastes and sewage as a means of monitoring their incidence and effecting adequate remedial and or control measures.
- Studies should be conducted in the different bodies of waters to obtain information on the environmental factors affecting fish production. These will include oceanography, hydrometeorology, geology, planktology and productivity.

These research policies underscore the important influence that environmental factors have on the conservation and management of fisheries resources in Nigeria.

Various authors have identified several environmental parameters that have significantly been affecting the fisheries resources and their associated fisheries in Nigeria and Niger Delta in particular.

Awosika (1991) reported that coastal erosion constitutes an environmental problem within the Niger Delta area that has negatively impacted on her fisheries resources and still has the potential for far more adverse

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consequences. The following erosion geophysical data and projections as reported by Awosika (1991) is a clear attestation of the danger that erosion menace in the Niger Delta portends for fisheries.

"Large parts of the Nigerian coast line are devastated by coastal erosion. Analysis of historical hydrographic charts and aerial photographs as well as data from studies carried out by the Nigerian Institute for Oceanography and Marine Research (NIOMR) pointed to widespread erosion along the 800km national coastline. Annual rates of erosion at NIOMR erosion monitoring stations along the Niger Delta exceed 20m annually at Ugborodo/Escravos, 16-19m annually at Brass, 15-20m at Koloma, 20-24m annually at Bonny and 10-14m annually at Imo/Rivers entrance respectively. The very high rates of coastal erosion along the Niger Delta area are linked to a number of factors, which include:

- The frequency of near storm conditions
- Intensive wave climate
- Vulnerable sediment characteristics
- Nature of shore and off shore topography
- Negative land use practices
- Reduction in sediments input by rivers due to damming.

Superimposed on these local factors are large-scale factors like the regional subsidence of the Nigerian geosynclines and the global rise in sea level as a result of global climate change. Latest projections of sea level increase predict a sea level rise of between 65 -35cm by the end of 21st century (Awosika, 1991).

Rise in sea level will exacerbate coastal erosion and flooding of the coastal areas thereby dislodging coastal fishing settlements and infrastructure, as well as change the general inshore and ocean dynamics. Coastal mangroves, which serve as nursery grounds for a large variety of fishery products, will also be decimated. Increased salinity of ground water, estuaries, creeks and deforestation are other adverse impacts of expected sea level rise.

Horsefall and Spiff (1998) equally collaborated the seriousness of erosion problems in the Niger Delta when they reported that in the Niger Delta, riverbanks, stream bank and river bed erosion is a major problem. Since erosion in the Niger Delta is indicated to take place in the aquatic environment it implies adverse consequences for the fisheries resources and the various fisheries that are based on them, particularly the artisanal fishery.

The mangrove swamp of the Niger Delta is another highly productive area of the region in terms of fisheries resources. For example a lot of brackish finfish and shellfishes abound in this area. Examples include the crabs, oysters, clams, periwinkles etc. These fisheries resources support a wide array of fishers and thus serve a very important means of livelihood for the practitioners. However, the mangrove region of the Niger Delta is yet another area that is seriously being devastated by adverse environmental occurrences. For example, (Antai, 1991) reported that the mangrove swamp in particular of the Niger Delta ecological zones is consistently destroyed due to the construction of roads, housing, petroleum refining plants, petrochemical industries, saw mills, habours etc. The report asserted that the Niger Delta mangrove ecosystem is thus fast deteriorating. Some of the factors said to be responsible for this include crude oil discharges, sewage discharges, wastes from satellite industries located along the coast and agricultural chemicals. One noticeable reason for pollution in the mangrove swamp with discontinuous vegetation is the ease and rapidity with which tidal currents spreads pollutants.

The adverse effects of pollutants in the aquatic environment on the flora and fauna (fishes inclusive) need no emphasis. Management plans for the mangrove swamp are urgently needed. Antai (1991) concluded that such plans must consider natural ecosystem (environment), the inhabitants and their activities. The magnitude of the damage on the artisanal fisheries resources by oil pollution in Niger Delta can be said to have increased at the same rate, as the growing economic prosperity of crude oil in the country. Hence, Anyaegbunem (1996) remarked that the importance of crude oil in developing economies, where it constitutes a main stay is almost absolute. Thus, oil spillage, a common feature of petroleum exploration cannot but be entertained.

Commenting on the consequences of crude oil pollution on fish and other natural resources it was reported by Adewale (1985) that it has deleterious effects on living resources, impairs water quality and creates imbalance in the ecosystem. There are other associated activities in the oil industry that bring pollution in their train. Notable are pollution arising from the depth charges during seismic activities at the exploration stage, deck drainage, gas flaring, debalasting effects of oil tankers, effluent discharge at the refining stage among others. The adverse effects of crude oil pollution are largely responsible for the downward trend in fish catches, generally recorded by most artisanal fishers operating in waters prone to oil pollution (Adewale, 1985).

Consequently, it could be inferred that the impact of environmental factors as indicated by erosion, flooding and oil pollution contributed immensely in recent years towards undermining the production and by extension the socio-economic situation of artisanal fisheries and its operators in the country, especially in the Niger Delta.

Horsefall and Spiff (1998), sums the situation up by reporting that environmental degradation is a major cause of productivity losses and poor human health in the Niger Delta.

Ajana (2003) justified "over exploitation and environmental factors" as being mainly responsible for poor fisheries production levels, particularly in the Niger Delta, by reporting the situation thus:"It is becoming increasingly evident that the exploitation of aquatic resources by artisanal as well as industrial sub sectors is uneconomical in the country. Good sizes of such species as croakers (*Scianidae* spp.), the Giant African thread fins (*Galeoides decadactylus*) and Red snappers (*Lutjanidae* spp.), that used to abound in our waters have virtually disappeared, giving rise to juveniles in catches. The reasons centre on indiscriminate fishing, destruction of breeding sites and the adverse effects of pollution by oil slick from petroleum activities all over the swamps of the Niger Delta".

Similarly, Horsefall and Spiff (1988) noted that the signs and symptoms of ecological degradation in the Niger Delta have already started manifesting. These include gradual disappearance of seasonal fishes e.g. mudskipper, oysters, periwinkles and the giant clam.

According to the NDES (1997), of all the fish species of the region, it has been reported that sixteen (16) fish species are endemic in Niger Delta region, while another twenty-nine (29) are near endemic. It has also been reported that fresh water catfish has disappeared from much of its range. Also reported disappearing from the region in many lakes is *Pathodon bulcozi* (puffer fish). *Pathodon bulcozi* is a highly valued ornamental fish even outside the shores of this country, which has high export potential as aquarium species.

Industrialization, urbanization, obnoxious fishing activities/over fishing, coastal erosion, land reclamation, lack of general knowledge of hydrodynamics of the water body and water pollution, mainly from oil exploration and refining have all contributed immensely to the depletion of fisheries resources of the region. However, the major culpable factor is the oil exploration and production activities within the region (Awosika, 1991, Horsefall and Spiff, 1998; Ajana, 2003). For example, Akankali and Oronsaye (1998) show a typical pattern of decline in fish catch from artisanal fisheries (kg) in between the pre and post oil spill periods in the Niger Delta region (Table1).

Population of some commercially important fish species along with algal densities was studied. The most critical environmental variable considered was salinity. In the study it was found that plankton abundance decreased from 89,218.5 cells per litre of water to 186 cells per litre of water between January and June. Similarly Bonga emigrated out of the estuary leading to Zero abundance in June. Bonga emigration and the collapse of plankton density are clear indicators of variability in the environmental parameters in the Estuary. The local fishers stand to benefit from this information in their fishing operation, by using the knowledge of salt content of the water system as an aid to tracking of Bonga population.

Table 1: Analysis of Fish Catch (Weight Data -Kg)

Sample No.	Before oil spills	After oil spills	Differences
1	75	15	60
2	80	25	55
3	70	30	40
4	65	10	55
5	70	30	40
6	90	20	70
7	85	45	40
8	65	0	65
9	78	35	43
10	110	60	50
.	.	.	.
.	.	.	.
.	.	.	.
60	70	0	70

Source: Akankali and Oronsaye (1998)

Oil pollution is one of the many environmental factors, which contribute to the deterioration of the fresh, brackish and marine environments. Oil pollution from some of the coastal establishments was a major factor responsible for the decline of fish seeds from about 100 million in 1985 to 51.7 million in 1989. Studies in the effect of Port Harcourt crude and refined oil on aquatic productivity revealed among other things that shellfish (shrimps and oysters) were more susceptible to oil pollution than juvenile and adult fish. Susceptibility of the fish species to the pollutants also varies. Hatching of eggs was delayed and reduced in lower concentrations and inhibited at higher concentrations of water-soluble fractions of the Nigerian Bonny light crude oil. The obvious implications of these antecedents are the degradation and depletion of the fisheries resources of the Niger Delta region. These add to socio-economic and nutritional losses to both the artisanal fishers and the teaming population of the region that get their major source of animal protein from the sub-sector (Abowei *et al*., 2008).

Without doubt therefore, the need for the sustainable exploitation, conservation and management of the region fisheries resources is quite imperative. Considering the adverse impacts of the environmental factors adversely impacting the fisheries resources of the Niger Delta, this research was designed to evaluate the opinion of the artisanal fishers of the region on their rating of the severity of the common and important pollutant sources.

MATERIALS AND METHODS

This study was carried out for a period of one year (January – December 2007) in predominantly fishing Local Government Areas of Rivers, Bayelsa and Delta States, which by ecology are coastal states. They are located within the South-South geopolitical zone of Nigeria and in terms of Geographic and Geomorphologic zones, the states can be said to constitute the core states of the Niger Delta region where adverse environmental effects, especially from crude oil production activities

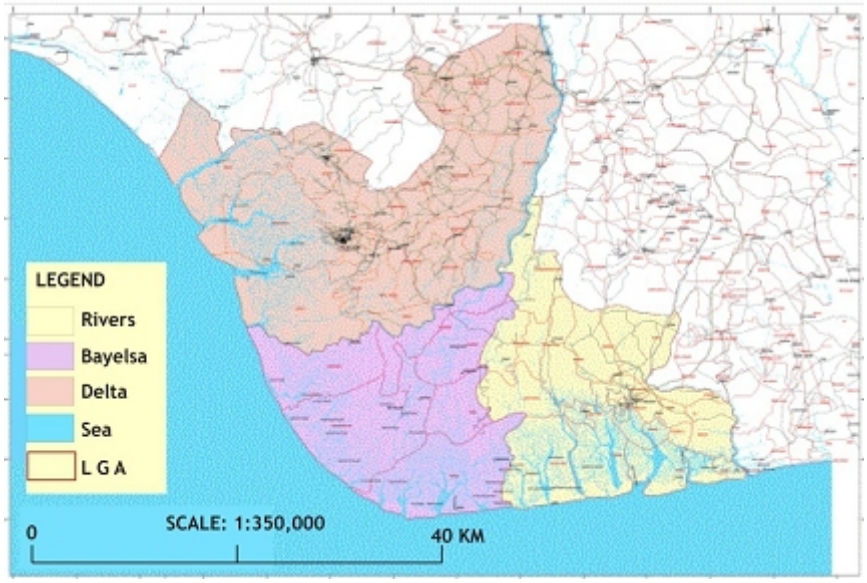

Fig. 1: Map of Niger Delta showing states of the study

have been known to negatively impact on fisheries resources over the years. Figure 1 shows the map of the Niger Delta states covered by the study. The reason for choosing these states is that they are largely river-rine and are rich in fish stocks that support artisanal fisheries activities.

The sample consist of fishing individuals, families and registered fishing cooperatives that are involved in artisanal capture fisheries based on the classification of the Niger Delta artisanal fishery into ten fishery types. Viz;1. Long line and hook fishing 2. Cast net fishing 3. Drift net fishing 4. Set net fishing 5.Trap-fishing 6.Seine net fishing 7. Collection of periwinkles, crabs and oyster 8. Cray fish fishing 9. Hand net fishing 10. Fence fishing. The classification is based on the type of gears used for a particular fishery (Alfred-Ockiya, 2000).

The population of artisanal fishermen are usually large and widely dispersed and are known to share a common characteristics of crafts, gears, catch, methods of capture e.t.c., within a given fishery and locality. To ensure that the study sample is representative and robust, the study employed the cluster random sampling technique. A cluster comprises a fishing community in a local government area of each state. Communities were selected from the LGA's based on the guidance of the states' Agricultural Development Agencies extension personnel. In each community, focused group discussions were held with contact fishermen of the State Agricultural Development Programmes upon which a sample frame was drawn. Thereafter, simple random sampling was engaged to determine the study respondents.

A total of four hundred (400) fishers were served with the study questionnaire in each state giving an aggregate of 1200 fishers. Based on the questionnaires that where properly completed, three hundred per state were eventually selected and used for the analysis. The basis for using a sample size of three hundred respondents per state is derived from the rule-of-thumb for a minimum sample size selection given by Tabachnick *et al.* (2003) who recommended that for testing beta coefficients, which states that a minimum sample size of will be required for a population size of up to …….

Kendall's coefficient of concordance was used to test the level of agreement among the respondents on how severe the identified environmental pollutants impacts adversely fisheries resources.

The test statistics is thus:

$$K = K = \frac{12\sum D^2}{M^2(N)(N^2-1)} \quad (1)$$

Where

M = Number of identified environmental pollutants that adversely impacts fisheries resources

N= Number of respondents sampled in the various categories

D = Difference of the sum of ranking from the mean of the Sum of ranks.

The Kendall coefficient of concordance ranks factors based on respondents rating of the presented factors. Scores are the horizontal summation of the product of response and the corresponding rank (the smaller the score value, the higher the ranking or importance attached to that factor).

A five (5)-point Likert Mean Analysis summation ranking scale was used to determine the accepted pattern of response to applicable questions. The five (5)-point summation ranking scale for rating pattern of response and its application based on the "Likert scale" or "Summated rating scale" is as follows:

SA = Strongly Agree = 5
A = Agree = 4
UD = Undecided = 3
D = Disagree = 2
SD = Strongly Disagree =1
∑Ranks = 15
Mean of Ranks = 3.0

The mean response value for each question is 3.0. Where a response mean is up to and above 3.0, we regard that statement as significant. Any item that has a mean response value of 3.0 and above in this study was therefore considered to be the most prevalent or dominant perspective of the respondents on specified variables on conservation and management of fisheries resources of the Niger Delta. Responses to individual items were interpreted based on the Likert mean, which indicated respondent's level of agreement to each applicable item.

The Likert mean of mean values was also computed in interpreting response to questions especially those on factors affecting conservation and management of fisheries resources. The logic was to be able to ascertain the significance or otherwise of the average opinion of the respondents on questions that had multiple responses. This involves a hypothetical assumption that the question being responded to has a significant influence on the adoption of conservation measures.

The hypothetical assumption is set up thus:

LMm Hypothesis: That a particular variable has a positive response outcome or that it has a significant impact on the willingness of the respondents to adopt conservation measures within the context of this study.

*The Likert mean of mean statistic is computed thus:

$$LMm = \sum(Lm) / (nLm) \quad (2)$$

Where;
LMm = Likert mean of means
∑ (Lm) = Sum of the Likert means and
nLm = Number of Likert means

*The Likert mean of means analysis concept (Eq. 3) is an innovation of this research. It was developed for determining the significance or otherwise of the opinion of the respondents on items that is mutually exclusive and has multiple responses.

Table 2: Likert Scale Range and Interpretation

Scale point	Range	Interpretation
1	0.1 – 0.99	strongly Disagree
2	1.0 – 1.99	Disagree
3	2.0. – 2.99	Undecided
4	3.0 – 3.99	Agree
5	4.0 – 5.00	Strongly Agree

RESULTS AND DISCUSSION

The respondent's opinion on their level of agreement concerning pollutants reported to adversely affect fisheries resources and artisanal fishing in the Niger Delta states covered by the study as analyzed using Likert scale is shown in Table 2.

The Kendall rank established the degree of agreement among the respondents on their rating of the severity levels of the impacts of each listed environmental pollutant sources impacting fisheries resources in the Niger Delta (Table 3).

The result indicate that oil pollutants, general industrial pollutants, thermal pollutants, gas pollutants, and physical obstructions (debris and other tangible wastes, such as vegetation, logs and equipment dumped in water ways) were all considered the respondent fishers to have significant impact on the fisheries resources and artisanal fishing in the Niger Delta states covered by the study, based on their Likert mean values. The other pollutants; sewage (domestic pollutants), erosion, flooding and siltation were found to be insignificant environmental problems of fisheries resources and artisanal fishing in the states of the study based on the opinion of the respondents, with Likert mean values of 2.80, 2.90, 2.85 and 1.30 respectively.

The pollutant sources listed in Table 3and 4 are the ones often cited to adversely affect fisheries in the Niger Delta region (Horsefall and Spiff (1988), NDES (1997), Akankali and Oronsaye (1988) and Abowei *et al.* (2008). Considering that the Likert mean of means of the responses is significant (LMm = 3.12), the pollutants are considered to generally have significant impacts on the fisheries resources and artisanal fishing of the Niger Delta. This is consistent with the reports of Powell (1993), Awosika (1991), Anyaegbunem (1996), Akankali and Oronsaye (1988) and Abowei *et al.* (2008), which affirmed that most of these pollutants, especially the ones emanating from crude oil production activities adversely affects the fisheries of Niger Delta.

According to the Kendall ranking result shown in Table 4, incidence of oil pollution is considered as the most severe pollutant impacting on fisheries resources in the area of study. The score values gave the following ranking results for each pollutants; Incidence of oil pollution = 1, Gas flaring = 2, Industrial pollution = 3, Thermal pollution = 4, Erosion = 5, Siltation = 6, Sewage = 7, Physical obstruction = 8 and Flooding = 9.

Table 3: Level of agreement on environmental pollutant sources impact

Dimensions (Pollutants)	Numeric/Percent response					
	Strongly Agree	Agree	Undecided	Strongly Disagree	Disagree	Mean
Incidence of oil pollution	449(49.66)	237(26.33)	96(10.66)	15(1.66)	120(13.33)	4.03
Industrial pollution	351(39)	261(29)	123(13.66)	114(12.66)	45(5)	3.94
Thermal pollution	291(32.33)	273(30.33)	108(12)	150(16.66)	78(8.66)	3.61
Sewage pollution	162(18)	141(15.66)	135(15)	300(33)	144(16)	2.80
Gas flaring	276(30.66)	261(29)	150(16.66)	129(14.33)	84(9.33)	3.57
Erosion	150(16.66)	123(13.66)	225(25)	327(36.33)	45(5)	2.90
Flooding	120(13.33)	129(14.33)	228(25.33)	342(38)	27	2.85
Siltation	144(16)	210(23.33)	267(29.66)	237(26.33)	18(2)	1.30
Physical obstructions of water ways by wastes and equipment	132(14.66)	261(29)	180(20)	240(26.66)	87(9.66)	3.12

LMm = 3.12

Table 4: Kendall ranking of environmental pollutant sources

		1	2	3	4	5	6	7	8	9	*Score	**Rank
1	Incidence of oil pollution	304	220	206	85	75					2073	1
2	Gas Flaring	301	240	186	103	70					2101	2
3	Industrial pollution	220	201	200	171	108					2446	3
4	Thermal pollution	75	119	122	150	160	224				3423	4
5	Erosion		120	120	160	230	260				3950	5
6	Siltation			66	130	134	140	200	230		5468	6
7	Physical obstruction of waterways by waste and equipments				60	67	116	196	221	240	6571	8
8	Sewage pollution				44	50	150	200	221	235	6550	7
9	Flooding					4	10	233	228	425	7360	9

*: The individual scores for each factor is a summation of the product of the responses to each item and the respective ranks

**: The lower the value of the rank the more severe the impact of the pollutant is considered to be

The results of the ranking of the severity of environmental pollutants affecting fisheries resources based on the responses of the artisanal fishers in the Niger Delta implicating crude oil related sources of pollutants(incidence of oil pollution, gas flaring, industrial and thermal pollution with Kendall rank score values of K = 1, 2 and 3 respectively (Gas flaring, Industrial pollution and thermal pollution) as the most severe factors. This collaborates' the findings of Akankali *et al.* (2008) where the opinion of institutional perspectives equally ranked pollutant sources from crude oil related activities to be the most severe impacting on fisheries resources (Abowei *et al,* 2008; Horsefall and Spiff, 1998).

Akankali and Oronsaye (1998) cited in the literature review for this study further validates the opinion of the artisanal fishers implicating crude oil related pollutant sources as the most severe environmental factors adversely impacting fisheries resources and fishing in the Niger Delta region. Even though crude oil related activities is implicated by the respondents as the most severe pollutant sources, the relatively high Kendall rank score value (k = 5) rated erosion as one of the environmental factors adversely affecting fisheries resources conservation and management in the Niger Delta, is in line with the report of Awosika (1991), that implicated erosion as a major ecological problem leading to subsidence of fishing shores which adversely affects fisheries resources and fishing in the region.

CONCLUSION

The findings of this study-implicated crude oil related pollutant sources as having the most sever impacts on fisheries resources and artisanal fishing in the area of study. This result is expected considering the high magnitude of crude oil exploration, exploitation and refining activities that takes place in the area of study. The Niger Delta and the three states studied in particular constitute the oil hub of Nigeria. The environmental damage over the years of non attention towards curtailing and remediating its impacts to bio-resources of which fisheries is prominently inclusive is therefore quite enormous.

The findings of this study implicating crude oil related pollutant sources as the most severe sources, serves as a good empirical guide for areas of high priority in policy formulation for the effective remediation of adverse environmental impacts on fisheries resources of Niger Delta.

Public enlightenment campaigns should be embarked upon, to bring to the attention of all stakeholders, especially the crude oil companies of the need to operate in the most environmentally friendly manner within the Niger Delta.

The remediation of erosion impact, especially on coastal fishing communities in the region should also be accorded priority, as means of halting or reversing the

subsidence of coastal artisanal fishing communities as has been reported by Awosika (1991). The devastating impacts of erosion often lead to fishers' loss of landed and mobile assets, such as their houses and fishing capital. Sometimes it can even lead to loss of lives, thereby making erosion impacts generally considered to be salient as one of the costliest.

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