A Review of Some Factors Militating Against Sustainable Artisanal Fisheries Development in Niger Delta, Nigeria

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Abstract: This study justified the need for sustainable development of Niger Delta Artisanal Fisheries, citing over exploitation, obnoxious fishing practices, adverse environmental impact, decline in fish yield and species variations, despite the sectors dominant importance as a major source of domestic fish supply in the region and the country as whole. The basic methodology used in the study involved a review, analysis and discussions of relevant literature to the subject matter, especially of reported findings of researches carried out within the Niger Delta Region. Some factors were identified to be among some of the critical ones militating against the sustainable development of Niger Delta Artisanal Fisheries Resources, viz; Inadequate Conservation Policies and Programmes, Lack of effective capacity for implementation of conservation policies and measures, Absence of conditions that Encourage Willingness to Adopt Conservation Measures by Core Stake Holders (Fishers), Paucity of adequate scientific data for fisheries Resources conservation, Non Inclusion of Environmental Components in Fisheries Resources Conservation Models and Effects of adverse environmental impacts on Fisheries Resources. These factors were analyzed and discussed essentially within the context of relevant empirical research reports in the Niger Delta region, Nigeria. Recommendations were made based on proffered solutions to help enhance the sustainable development of the Niger Delta Artisanal fisheries subsector.

Key words: Biodiversity, conservation, environmental impact, fishing practices, production

INTRODUCTION

Fisheries development plan in Nigeria have spanned for a period of 44 years however, the major objective to make Nigeria self sufficient in fish production and supply is still a mirage Azionu *et al.* (2005). With about 14 million liters of inland water bodies, Nigeria could be self sufficient in fish production and in a major exporter of fish. The repeated episodes of declining yields and economic returns, stock collapse and crises of social dislocation and loss of biodiversity could be arrested if the contemporary fisheries management precepts and practice are adopted and vigorously sustained. The artisanal fisheries sector supplies about 90% of domestic fish need in Nigeria, with the balance coming from the industrial sector, largely regarded as fish imports. (FDF, 2007). The Niger Delta contributes more than 50% of the entire domestic Nigerian fish supply, being blessed with abundance of both fresh, brackish and marine water bodies that are inhabited by a wide array of both fin fish and non fish fauna that supports artisanal fisheries. Consequently, all studies focused towards the sustainable development of the subsector is highly justifiable, both

from the socio-economic and employment potentials of the sector. (Akankali and Abowei, 2010a).

In terms of ecological perspectives, the need to conserve and manage fisheries resources in a sustainable manner within the Niger Delta can be readily appreciated by first looking at a much broader concept of biodiversity. Biodiversity is the variety of organism species, their genetic variability and variety of ecosystems they inhabit, also called biological diversity. Biodiversity preservation is an environmental objective that addresses the environmental legacy left for future generations. Although plant and animal life can be replenished this natural ability does not assume the continuance of a species. The longevity of any biological species can be directly threatened by exposure to pollutants or by other human actions like commercial or sport hunting. But the major threat to biodiversity is the destruction of natural habitats, which affects the entire ecosystem (Callan and Thomas, 1996).

Fisheries resources of the Niger Delta like any of its kind elsewhere in the world constitute part of biodiversity resources. Hence they are vulnerable to the current spate of "worldwide extinction of species", this makes it very

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imperative for the fisheries resources of the Niger Delta to be optimally exploited, conserved and managed for sustainability. UNDP/FAO (1996) recognized the need for exploitation and conservation of Nigeria's fisheries resources from the inception of the pioneer marine biology research for stock assessment for commercial exploitation. Some of the recommendations then for the conservation of specified fisheries were as follows:

Prawn fishery: It was recommended that even though the Nigerian waters could maintain a sustainable yield of 2,500 tons annually, the fishery should be regulated through protection of nursery grounds. The need for appropriate policy formulation in this regard was emphasized.

Demersal fishery: For rational utilization of demersal stocks, the use of gear which allow escape of undersized fishes and the protection of nursery grounds. Research efforts in this regard were highly recommended until definite findings are obtained.

Creek fishery: The exploitation of fish by the local population was observed to be carried out sufficiently in the creeks and backwaters. However, the introduction of improved processing, preservation, transportation and distribution facilities was emphasized as a means of better utilization of catch. Also it would serve as an indirect means of conservation of fisheries resources.

These pioneering recommendations are a clear indication that the need for sustainable exploitation and conservation of the nation's fisheries has always been recognized from inception of fisheries studies in the country.

Several empirical evidences existing in literature shows that the fisheries yield from artisanal sources is on decline in Nigeria. According to FMANR/JPC (1974), "a maximum potential fisheries production on the basis for further development of the traditional coastal and brackish water canoe fishery of Nigeria (of which the Niger Delta fisheries resources largely supports) was estimated to be about 680,000 tons of fish by 1985". Yet over two decades after, it can be seen from Fig. 1, that the combined fisheries production from both industrial and artisanal sector (both the coastal and inland waters of the country), does not only show an irregular trend, but also falls short of the 1985 projections by FMANR/JPC (1974).

This poor production achievement as against projection persists, despite the considerable improvement in production technology/equipment (i.e., improved fishing efforts) over the years (Akinyemi *et al*., 1986). It can therefore be inferred that factors other than inadequate manpower and technology, such as over exploitation due to unregulated practices and adverse environmental
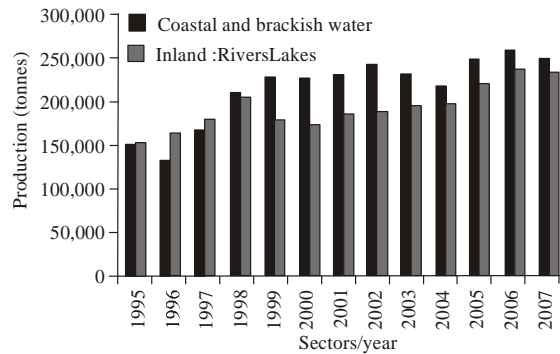

Fig. 1: Fish production in nigeria by sectors (FDF, 2007)

factors, are largely responsible for the consistently poor production levels.

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 (*Sciantidae* 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 center 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 (1998) 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. The preceding information clearly justifies the need to understudy the challenges militating against the sustainable exploitation and conservation of the Niger Delta Fisheries resources. However, the fisheries resources of Nigeria fall into the category of natural renewable resources. These resources could be impaired due to over exploitation and other adverse environmental factors like pollution and impact of climate change. Consequently, a review of the challenges of fisheries resource conservation in Nigeria is the main focus of this study.

RESEARCH METHODOLOGY

The information and inferences provided in this paper were derived essentially from reviews of literatures on empirical research findings of relevant studies conducted essentially within the Niger Delta, Nigeria on the challenges of sustainable development of her artisanal fisheries. Based on this review, six factors were identified, analyzed and discussed amongst others that militate against the sustainable development of the Niger Delta Artisanal Fisheries Subsector as follows.

Inadequate conservation policies and regulations: The major cause of over exploitation and waste in fisheries is the condition of free and open access to the resource. With a minimum number of assumptions, it is possible to derive some useful hypotheses regarding to several important aspects of resource over exploitation behavior. The reason of course is that no one in open access fishery is able to exercise entrepreneurial control over the application of variable resources to the fixed resource. Entry of efforts will proceed until all potential rents to the fish stock have been exhausted. The fishery and species are then left in a sub-optimal bio-economic equilibrium in which a harvest may be taken, but with fish stock that is too low and amounts of capital and efforts that are too high in terms of efficiency.

The result of a research conducted to evaluate the level of adequacy or otherwise of fisheries policies and regulations within the Niger Delta, based on the perspectives of institutional respondents, indicated a severe paucity. Both the middle level and Administrative cadre responses indicated that the fisheries policies and regulation are inadequate in the region with its Likerk mean (Lm) value above the "Undecided" range - Lm = 3.7. (Akankali, 2009). This result was derived from the analysis of an application of the five (5) point summation ranking scale of Likert mean for rating pattern of response that helps to determine the most prevalent opinion as shown in Table 1.

The "Undecided" Likert mean response value range for each question is therefore between 2.0-2.99. Therefore, where a response Likert mean is up to and above 3.0, that statement is considered as significant and otherwise where it is below this range. Thus, any item that has a mean response value of 3.0 and above in the reported study was therefore considered to be the most prevalent or dominant perspective of the respondents on specified parameters of interest. Consquently, the inference that there is paucity of adequate fisheries policies and regulations with a Likert mean value that is within the range of "Agree" which is between 3.0-3.99 (Precisely, Lm = 3.7).

The preceding is the classical scenario of the Nigerian artisanal fisheries as there is paucity of

Table 1: 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

Akankali (2009)

sustainability policy and measures based on sound scientific stock assessment results. More so, where such policies exist there is lack of implementation capacity, such as adequately trained manpower and equipment. Abowei *et al.* (2008), reported that the level of adequacy of conservation of fisheries conservation and management policies and regulations within the core Niger Delta states of Rivers, Bayelsa and Delta are grossly inadequate. Based on the responses of the core stake holders in this regard - personnel of relevant institutions and fisher folks, the results of the studies show that over 70% of the respondents in both categories concure to the gross inadequacy of fisheries resources conservation/ management policies and regulations in the Niger Delta region.

Lack of effective capacity for implementation of conservation policies and regulations: A critical challenge of sustainable development of artisanal fishery in Nigeria is the lack of adequate capacity for the implementation of the policies, laws and regulations that are supposed to moderate rate of resource exploitation (Abowei *et al.*, 2008).

The policies and regulations in the country for the sustainable exploitation and conservation of fisheries resources are quite enormous and have progressed over the years. The objectives behind them are equally commendable and ideal. However, the logistics and administrative framework for its implementation and enforcement are grossly inadequate (Nnoli, 1980). Thus, the laws and regulations for the conservation of fisheries resources have not been effective. Also, some of the laws can be said not to have been formulated based on sound scientific data on the nature of fisheries resource base, their biology, ecology and rate of regeneration (Abowei *et al.*, 2008). Thus, the implementation of the laws and their subsequent enforcement for conservation purpose are in most cases a source of conflict of interest between the users of the resource and the authorities.

The exact nature of national fisheries policy and regulations as it affects sustainable Artisanal Fisheries development in the country is best reflected in various fisheries policies, laws and regulations developed over the years in the country, as reported by Nnoli (1980). For example the sea fisheries decree of 1971 is mainly a prohibitive law against the following:

- Use of certain crafts or obnoxious fishing methods
- Inspection of fish handling, processing, preservation and marketing facilities against unapproved practices.
- A vital aspect of this law as it relates to artisanal fisheries is that it recognizes the first two nautical miles of the continental shelf as a non trawling zone for every boat, except research vessels. This zone is an important fishing ground for artisanal fishermen, especially those involved in the capture of shoaling species, such as Bonga fishery (*Ethmalosa* spp.) and Mullets (*Mugil* spp.) This law's restriction of mesh sizes at cod end (3" or 67 mm for fishing boats and 1¾ or 42 mm for shrimpers) and the size of fish to be caught not less than 3 cm is equally beneficial to artisanal fisheries resources conservation. This is because the juveniles of migratory species, that may have been caught as premature and deprived from being recruited into their respective fisheries may often times be spared by this regulation. The Sea Fisheries Act of 1971 is quite laudable towards the sustainable development of the Nigerian fishing industry. This is because it is conceived to be a highly protective piece of legislation for the weaker Artisanal Fisheries subsector as against the Industrial subsector. The latter has the potential to overrun the former if allowed to operate in the same environment unregulated. However, despite the high level of relevance of this piece of legislation in enhancing the sustainable development of the Nigerian Artisanal fisheries sector, the capacity for its implementation is very lacking (FDF, 2007).
- Essentially, Nigeria like most other developing countries lacks the finance, manpower and infrastructural requirements to effectively implement and enforce compliance to this legislation like most others that are geared towards the sustainable development of the Nigeria Artisanal Fisheries sector. The obvious implication of this is that the industrial trawlers often times operate within this non trawling zone, using undersized mesh sizes at their cod end to sweep the potential recruit of the future artisanal fisheries stock of the area. Hence, the spate of conflict of interest between the artisanal Fishers and the near shore coastal trawlers that sometimes results in violence within the Niger Delta coastal fishing communities is often in the increase.

The licensing regulation of 1972 is essentially a law for ensuring appropriate registration of all fishing trawlers operating in Nigeria waters. It has the objective of ensuring that adequate statistics of vessels and the state of compliance to relevant legislation are maintained. The legislation whereby adequately implemented, is also very vital for monitoring and controlling the industry total fishing efforts. The implication of this is that it could be a sound conservation tool for both the maritime and the inland water fisheries.

Whereas the Federal Department of Fisheries (FDF) actually registers such vessels to ensure that the fishing effort and other technical specifications for specific fisheries are complied with, there are numerous violators of this act. Reason for this is the inability of the Department to actually go out in the waters to accost the violators, due to lack the required vessels and equipment. There has been an instance whereby the Department collaborates with the Nigerian Navy to ensure compliance to this act. However, such efforts are still considered grossly inadequate, as fish stock protection and conservation is not the primary duty of the latter agency.

Paucity of adequate scientific data for fisheries resource conservation: Successful Sustainable development programmes for Artisanal Fisheries in Nigeria like elsewhere in the World should often be a function of sound scientific research results. The data from such scientific research basically include evaluation of resource base through population dynamics studies, based on extensive tagging experiments, rate of reproduction/recruitment into a fishery year class, migratory behaviors/patterns, ecological and environmental interactions of different species to mention but a few. These high level research are often relevant institution (Fisheries research institutes, Universities and organized multinational companies and international organizations such as F.A.O. with interest in promoting fisheries research) driven. Whereas the Nigerian situation has been supported by international bodies such as F.A.O in this regard, the core research issues of Nigerian Fisheries are largely the responsibility of Nigerian institutions. Unfortunately, these same institutions often times are grossly underfunded and therefore ill equipped in terms of manpower, equipment and infrastructure to carry out credible and far reaching researches that would enhance sustainable development of the Nigerian Artisanal fisheries.

The important role that relevant institutions are expected to play in ensuring optimum resource exploitation and conservation in Nigeria is shown by the Federal Department of Fisheries (FDF, 2007), via a chronicle of the problems of the institutions thus;

Apart from climatic and environmental changes certain institutional inadequacies are largely responsible for poor fish production in Nigeria, viz:

- Changes in government policy thus affecting fish production
- Poor funding of research and extension services in institutions and universities
- Lack of effective institutional support and linkages

- Monitoring, control and surveillance mechanisms not fully developed
- Illegal exploitation of the marine fisheries resources particularly by foreign vessels
- Poor management and non effective utilization of most of the nations numerous water bodies
- Shortage of competent and experienced manpower
- Lack of training and demonstration facilities for transferring technologies

Azionu *et al.* (2005) reported that fisheries development plan in Nigeria have spanned a period of 44 years. However, the major objective to make Nigeria self sufficient in fish production and supply is still a mirage. With about 14 million litres of inland water bodies, Nigeria could be self sufficient in fish production and in fact a major exporter of fish. The repeated episodes of declining yields and economic returns, stock collapse and crises of social dislocation and loss of biodiversity could be abated if the contemporary fisheries management precepts and practice are adopted and vigorously sustained.

It can therefore be inferred that it is only when the Nigerian Artisanal fisheries resources is promptly documented, monitored for necessary variations and projections for future status in terms of standing and projected stock reserves in line with anticipated exploitation pressure, becomes properly articulated based on credible scientific research results that it can become sustainable.

Absence of conditions that encourage willingness to adopt conservation measures by core stake holders (Fishers): A review on the challenges of sustainable development of the Artisanal Fisheries in Nigeria will be grossly in adequate if it fails to sought and elicit vital information on the opinion of the core stake holders (Artisanal Fishers) on their perceived/real challenges and apprehensions concerning resource conservation measures and other sustainable management practices. Cains (1980) and Amarasnighe (1987) collaborated the preceding assertion, by reporting that "without doubt, policies and regulations that seriously consider the input of core stakeholders in the industry in its conception has a very high level of acceptance and would be much easily implementable. Thus, the critical positive influence that core stake holders shall play, if their opinions and perceptions are properly taken into consideration in the sustainable development of the Nigerian Artisanal Fisheries cannot be over emphasized. Unfortunately however, there has been very little research in the area of scientifically evaluating the opinion of the core stake holders in this regard.

It has been reported that adoption of certain fisheries resources conservation measures leads to a significant level of lost lively hood, especially in the short run
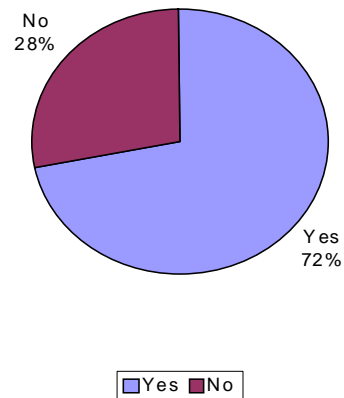

Fig. 2: Willingness to adopt conservation measures by fishers (Akankali, 2009)

Akankali (2009). In a study focused on evaluating factors that affect the willingness to adopt Best Management Practices (BMPs) by the artisanal fishers for the conservation and management of fisheries resources in the Niger Delta, Akankali (2009) reported the analyzed responses from artisanal fishers in Rivers, Delta and Bayelsa states viz;

The response of the fishers in the Niger Delta states on the question as to whether they are willing to adopt conservation measures indicate 71.66% answering in the affirmative, while 28.33% responded negatively. Among the respondents, willingness to adopt conservation measures is found to be high with a mean value of 0.67 (Fig. 2).

This means on the average that about 67% of the fishers are willing to adopt fisheries resources conservation measures.

The affirmation of majority of the respondents to adopt fisheries resources conservation measures is most probably traceable to the significant decline in the fisher catch over the years, even when the same or higher levels of fishing efforts are applied (Akankali and Oronsaye, 2006). This is considered a positive perception on the part of the Niger Delta artisanal fishers, as it is an indication of the existence of a seriously felt need on the part of the fishers for the conservation of fisheries resources as a means towards achieving sustainable optimum yields from their fishing efforts. Having reported this trait by the present crop of Fishers within the Niger Delta region, it is imperative that policy makers take advantage of it in mobilizing such Fishers to adopt sustainable practices such as open/closed season, closed areas and mesh size limitation etc. However, such policy issues should take into cognizance the issue of public enlightenment, Regulatory pressure, Environmental Stewardship, Severity of Damage to the environment, Economic circumstances, Institutional support, Information access, Educational qualification, Fishing experience, Legal structure of

fishing business and Age of the fishers. These factors were reportedby the study to significantly influence willingness to adopt conservation measures by the fishers within the three Niger Delta states of Rivers, Bayelsa and Delta.

Effects of adverse environmental impacts on fisheries resources: The relationship between the environment and aquatic life is a phenomenon, which determines the direction and nature of mans reliance on beneficial biotic resources of the aquatic environment. The future well being of the developing world's burgeoning population, especially in Africa, will depend upon wiser balance between exploitation and conservation of natural resources in order to achieve appropriate sustainable production systems that avoid environmental degradation. (FAO, 1991, cited by Yemi *et al.*, 2005). Jamabo and Ibim (2010) asserted that in the Niger Delta, 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 shell fish (shrimps and oysters) were more susceptible to oil pollution to juvenile and adult fish. Susceptibility of the fish species to the pollutants also varies. Hatching of eggs was delayed and the hatching rates were found to be inversely proportional to effluents concentrations. 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. 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 and Ajana, 2003). For example, Akankali and Oronsaye (2006) 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 (Table 2).

Non-inclusion of environmental components in fisheries resources conservation models: Considering the preceding information on the environmental impact on fisheries resources in the Niger Delta region, there is therefore the need for a critical evaluation of the environmental component of fisheries resources

Table 2: Analysis of fish catch within selected L.G.A. of Delta state, Niger Delta (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

Akankali and Oronsaye (2006)

conservation and management issues in Nigeria's Niger Delta, a region that can be described to be the fish basket of the nation. The associated adverse environmental impact of pollutants on fisheries resources in the region is quite high (Akankali and Abowei, 2010a). The development of a sustainability conservation index that incorporates the *environmental component* as a scientific tool for determining the optimum exploitation levels of the fisheries resources of the Niger Delta is very vital. This is more so in the absence of adequate enforcement capacity of regulatory measures and immense adverse environmental impacts of crude oil exploitation on the biodiversity/fisheries resources of the region. (Akankali, 2008).

Consequently, Akankali and Abowei (2010b) reported the development of an indigenous conservation model for the Niger Delta region - The Akankali Model for Biodiversity, Fisheries Conservation and Management. This model takes into focus the special effect of environmental impact dynamics component, as the Niger Delta region ecology has been known to be seriously devastated by crude oil spills and other associated pollutants. It is a model that is conceived as a single index that can be employed to sustainably exploit, conserve and manage the biodiversity resources of the region, be it wild life, forestry or fishery. A slightly modified and expanded version of the model as adapted from Akankali and Abowei (2010b) is expressed viz;

The Akankali model for biodiversity/Fisheries conservation and management:

$$BB = IN/EX = \pm M\,A \qquad (1)$$

where,
BB = Biodiversity Balance
IN/EX = Exploitation/Intervention Activities (IN = R_{e+} R_g and EX = R_0 in Eq. 2)
MA = Minimal Negative (-) or positive (+) Alterations

Equation (1) therefore, implies that BB is only achievable when exploitation of resources/intervention measures in

an ecosystem results in minimal positive or negative alterations in the natural biodiversity density.

However, the BB values as contained in model 1 can only be subjective or relative.

In other to achieve precise values, Eq. (1) therefore leads to the development of a second equation that has a quantitative analysis of BB, thus:

$$BB = [\ (R_{e+} R_g)/R_0 \ ] = \pm MA \qquad (2)$$
$$= (R_{e+} R_g) \ R_0$$

where, $(R_{e+} R_g)$ = Renewal plus Regeneration rates of the biodiversity resources.

The Re include all quantifiable improvements on the habitat, such as pollution abatement measures, while the Rg include all regeneration programmes such as public aquaculture and natural reproduction processes. Thus, we can have Re_1, $Re_2...Re_n$ and Rg_1, $Rg_2...Rg_n$ for both parameters depending on the dynamics of prevailing conditions in the environment.

$R_0 =$ Rate of biodiversity resources output from an ecosystem or habitat

The Ro include all channels of depletion of biodiversity resource of interest include direct exploitation and mortality due to adverse environmental impacts. Thus, it could range from Ro_1, $Ro_2...Ro_n$, depending on the identifiable channels of resource depletion implicated in the environment.

$\pm MA =$ Minimal alterations in the biological/ecological status (densities) of the habitat which could either be positive and negative

The ideal BB Values that can result from Eq. (2) = 1.

Therefore, the resource manager based on management goals decide the point within the range of BB to set his targets. Thus, the model serves as a benchmark or index for the resource managers' to evaluate the performance of their conservation/ management programmes. Where by the BB value is significantly less than the minimum standard set by the managers of the resource, it simply implies that the negative alterations in the aquatic environment, either in terms of impacts of pollutants and or exploitation levels are significantly higher than the positive alterations. These positive alterations measures would be essentially renewal/regeneration rates of the resource and anti pollution measures. When the value is approximately same or significantly higher than set targets, then the reverse becomes the case. Generally, it can be seen that the more the value of BB tends to be closer to (1), the more efficient the management system of that aquatic habitat is said to be. Similarly, values that tends to

significantly via off the ideal value of BB (1), portends that the management system of the concerned habitat to be less efficient.

Demonstration of Akankali model for biodiversity/ fisheries conservation and management with fisheries resources: Since the ideal value of BB, which when substituted by applying the model to fisheries resources management, becomes FrB (Fisheries resources balance) that can result from the model's equation = 1. The proof of this ideal value of "1" is demonstrated thus: If for example, the variables in Eq. (2) are assigned the following values:

$[R_{e+} R_g] F_r =$
10 kg of fish per $100m^3$ of water body per day
$[R_0]F_r =$
10 kg of fish per 100 m^3 of water body per day
$FrB = 10/10 = 1$

The result of the demonstration could be described as a state of "sustainable resource conservation equilibrium". This state of equilibrium may never be achieved in reality. However, it serves as a basis for the managers of the resource to determine the FrB level that will make the exploitation of the fishery resource sustainable, using the equilibrium status as a bench mark. For this model to be applied the stock assessment statistic on the rate of fish replenishment for the target fishery must be predetermined.

CONCLUSION AND RECOMMENDATION

Based on the challenges of Artisanal Fisheries development within the Niger Delta highlighted by this paper, it is obvious that the challenges of the fisheries subsectors are critical, but surmountable. The following recommendations are therefore suggested as a means of overcoming the challenges.

Inadequate conservation policies and regulations: Conservation policies and regulations should be developed to conform to scientific research findings that are focused on artisanal fisheries conservation and management for the various fisheries of the region.

Lack of effective capacity for implementation of conservation policies and regulations: There should be an enhanced re-equipping of all existing Agencies such as the Licensing, monitoring and Enforcement unit of Federal and states department of fisheries to ensure that they possess the requisite manpower and equipment that would enable them effectively implement conservation policies and regulations for the sector at all times.

Paucity of adequate scientific data for fisheries resources conservation: There should be a concerted effort by Government and all relevant Agencies to ensure that adequate researches are commissioned at all times that would enable policy makers and regulators to be appropriately guided in formulating relevant policies and regulations.

Absence of conditions that encourage willingness to adopt conservation measures by core stake holders (Fishers): Alternative economic ventures such as downstream activities and other allied activities during closed area/ seasons for conservation purposes, should be encouraged and supported by the relevant agencies, as a means of inducing the fishers to cooperate with defined conservation and management programmes uncompelled.

The effect of adverse environmental impact on fisheries resources: There should be more stern measures to discourage activities being carried out in such a manner that it will continue to constitute severe sources of environmental pollution within the waters of the Niger Delta region.

Non inclusion of environmental components in fisheries resources conservation models: While there should be a concerted effort to develop more models / index for fisheries resources conservation, awareness promotion and application campaigns by relevant stake holders should be stepped up to appreciable levels. The Akankali Model for the Biodiversity, Fisheries Conservation and Management and all such models should be applied in the conservation and management of the Niger Delta Artisanal fisheries resources. This measure shall provide a means of combating effect of adverse environmental impacts on fisheries resources in the Niger delta.

REFERENCES

Abowei, J.F.N., J.A. Akankali, C.C. Tawari and A.D.I. George, 2008. A review of conservation and management of fisheries resources; Niger Delta, Nigeria. J. Aquat. Environ. Stud. Rev., 1: 1-35.

Ajana, A.M., 2003. Economic Development of the Niger Delta: The Role of Fisheries. A Paper presented at the First Niger Delta Stakeholders Agricultural forum, Organized by Niger Delta Development Commission (NDDC), Port Harcourt.

Akankali, J.A., 2008. Factors affecting conservation and management of fisheries resources with in the Niger Delta: An Institutional environmental perspective. M.Phil. Research Thesis, Department of Environmental Management, Institute of Geosciences and Space Technology, R.S.U.S.T., Port Harcourt, Nigeria, pp: 56-70.

Akankali, J.A., 2009. Conservation and management of fisheries resources in the Niger Delta: Environmental Perspective of Fisherfolks. Ph.D. Research Thesis, Title. Department of Environmental Management, Institute of Geosciences and Space Technology, R.S.U.S.T., Port Harcourt, pp: 84-85.

Akankali, J.A. and J.A.O. Oronsaye, 2006. Economic Assessment of Crude Oil Pollution impact on Artisanal Fisheries in some Local Government Areas of Delta state,Nigeria. Proceedings of the 20th Annual Conference of Fisheries Society of Nigeria (FISON), Port Harcourt, 14th-18th NOV 2005. pp: 460-466.

Akankali, J.A. and J.F.N. Abowei, 2010a. The institutional perspective of pollutants impact severity on artisanal fisheries resources in Niger Delta, Nigeria. Curr. Res. J. Eco. Theory, 2(2): 76-81.

Akankali, J.A. and J.F.N. Abowei, 2010b. The akankali model for the biodiversity, fisheries conservation and management in the Niger Delta. Res. J. Mathe. Stat., 2(1): 32-36.

Akinyemi, O., A.M. Balogun and S.O. Talabi, 1986. Catch assessment of commercially important fin fish of Nigeria's trawling industry. J. West Afri. Fish., 1: 11-12.

Amarasnighe, O.T., 1987. The Role of fisheries in Implementing Management Strategies in the Reservoirs of Sri Lanka. Reservoir Fishery Management and Development in Asia: Proceedings of a Workshop Held in Kathmandu, Nepal, pp: 105-111.

Awosika, L.F., 1991. Geology, Hydrography, Coastal Erosion and Settlement Planning in Relation to the Artisanal Fishery Development in the Niger Delta: Proceedings of the 1991 Fisheries Development Extensionists Training Programme Course by IFAD held at UYO, pp: 36-41.

Azionu, B.C., S.I., Ovie, B. Adigun and B.Y. Atiribom, 2005. Prospects and Problems of Nigerian Inland Capture Fisheries: The Dimension of Sustainability. Fisheries Society of Nigeria, Book of Abstracts, pp: 49.

Cains, J.J., 1980. Fisheries Management Theory, 4th Edn., Publisher, Country, pp: 69-80.

Callan, S.T. and J.M. Thomas, 1996. Theory, Policy and Applications: Environmental Economics and Management. 3rd Edn., Books, Benfley New York, pp: 58-63.

Federal Department of Fisheries (FDF), 2007. Fisheries Statistics of Nigeria.

FMANR/JPC, 1974. Federal Ministry of Agriculture and Natural Resources/Joint Planning Committee. Traditional Coastal and Brackish Water Cause Fisheries. Agricultural Development, Nigeria, pp: 1973-1985.

Horsefall, M.J. and A.T. Spiff, 1998. Principles of Environmental Pollution. 1st Edn., Metro Prints, Port Harcourt, pp: 212-217.

Jamabo, N.A. and A.T. Ibim, 2010. Utilization and Protection of the brackish water ecosystem of the Niger Delta for sustainable fisheries development. World J. Fish Marine Sci., 2(2): 138-141.

Niger Delta Environmental Survey (NDES), 1997. Phase 1 Report, 2nd Edn., Publisher, Country, pp: 95-110.

Nnoli, N.E., 1980. Sea Fisheries Regulations-the role of Federal Department of fisheries in ensuring efficient fisheries inspection in Nigeria: Proceedings of the 1980 first Cross Rivers State Fisheries Conference, pp: 23-27.

Yemi, I.Y., A.O. Sanni and T.O.B. Ogunosun, 2005. In Lake Kainji Fisheries Society of Nigeria Book of Abstract, pp: 66.

UNDP/FAO, 1996. Fisheries Survey in the Western Region. FAO, WIR 74, pp: 22-28.