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The Akankali Model for the Biodiversity, Fisheries Conservation and Management in the Niger Delta Nigeria

[1]J.A. Akankali and [2] J.F.N. Abowei
[1]Institute of Geosciences and Space Technology, Rivers State University of Science and Technology, Rivers State, Nigeria
[2]Department of Biological Sciences, Niger Delta University, Wilberforce Island, Bayelsa State, Nigeria

Abstract: This study was carried out to access the existence, level of knowledge and application if any amongst the institutional agencies of fisheries resources conservation model for the Niger Delta region focusing on relevant Institutions based in Bayelsa, Rivers and Delta States; developed a model called the Akankali biodiversity/fisheries resources conservation model. The objective of the model is to have a sustainability Index for the attainment of a conservation /management standard that will at all times result in a Biodiversity Balance (BB) between the rate of resource Exploitation/Intervention (EX/IN) and the rate of It's Replenishment /Regeneration (R_e R_e). The model is made up of two components that are in two stages (steps). The need to develop an indigenous model for the conservation and management of natural renewable biodiversity resources for the Niger Delta was informed by the paucity of such models that could provide an index for the sustainable exploitation of the economic flora and fauna resources of the region. The relevant institutions in the core Niger Delta fishing states of Bayelsa, Delta and Rivers and found that the institutional agencies personnel were not applying any scientific index (dices) for the conservation and management of fisheries resources in the region. Consequently, that study recommended that an indigenous model be developed in this regard that can be applied renewable natural resources conservation. The first component of the model is the biodiversity component. It captures a general model for the conservation and management of the biological natural renewable biodiversity resources. These resources essentially include forestry, wildlife and fisheries. The second component of the model is the demonstration of its application to a specific natural renewable resource type such as fishery, forestry and wildlife. For this study, this demonstration was applied to fisheries resources conservation and management.

Key words: Akankali model, biodiversity, fisheries conservation, management, Niger Delta, Nigeria

INTRODUCTION

The term conservation is synonymous with management as regards fisheries resources. Indeed, the two terms are closely interrelated. Fisheries conservation can be said to be an integral part of fisheries management. The latter term is a more encompassing process, while the former is a part of the more encompassing one. Hence, the two terms could be used interchangeably or together depending on the extent of meaning to be conveyed. However, for the purpose of distinction, the two terms would be separately reviewed as follows:

Nielsen and Lackey (1980) stated that fisheries management deals with fish and their biological characteristics and considerations of such things as who will use the resource, how much it will cost to manage effectively and how environmental changes will affect the resource. They proceeded to define a fishery in the broad perspective as a system composed of three interacting components, the aquatic biota, the aquatic habitat and the human users of these renewable natural resources.

According to Larkin (1980), a fishery comprises the fish, the other organisms, the environment in which the fish live and the people that catch the fish. It is a system and the manager manages it by influencing as he can, some or all parts of the system.

It can therefore be concluded that a fishery is a natural renewable resource that is of different types and varying components, which is subject to human management and utilization. One could therefore speak of the Bonga fishery (*Ethmalosa fimbriata*) in near shore coastal waters and the catfish (*Clarias* and *Chrysichthys* spp.) fishery in the inland waters, both of the Niger Delta regions.

Corresponding Author: J.F.N. Abowei, Department of Biological Sciences, Niger Delta University, Wilberforce Island, Bayelsa State, Nigeria

In order to fully appreciate the concept of fisheries management, it is pertinent to review the history/development of fisheries management concepts as analyzed by Larkin (1980):

- As early as 1878 there were restrictive regulations on fresh water fisheries of British Isles.
- In 1893, a British Selected Committee reorganized that depletion indeed occurred and recommended lower limits on the size of fish caught.
- The North Sea fisheries were substantially improved by the curtailment of fishing from 1914 to 1918. It therefore became logical to ask what the best level of fishing might be.
- The first perfection of the idea of fisheries management evolved with the recognition that a stock of fish should be harvested to provide a Maximum Sustainable Yield (MSY).
- There was the concept of a joint maximum sustainable yield, developed to depict the consequences of exploiting pairs or groups of species.
- The next concept was that of maximum economic return which is based on economic value of returns. This concept advocates that a fishery should be managed to ensure maximum economic net return, which would rarely and only coincidentally be the same as the management for maximum sustainable yield.

A more recent and embracing concept of fisheries management is that of Optimum Sustainable Yield (OSY) which emerged from the United States of America. It was more an attempt to articulate some principles than a recipe for day-to-day decisions. In other words, it incorporates a holistic approach to fisheries management that includes other concepts such as MSY, MEY, Aesthetic values and other social welfare values. There exist relationship of value for catch and aesthetic value to the level of fishing efforts. The following parameters are used to access the conservation/management status of the fisheries involved:

Pe = Profit from aesthetic experience
Pc = Profit from catch of fish
Pt = total profit
Vc = value of catch
Vt = total value
1/n = Number of fish caught
Y10 = weight of fish caught
E = fishing effort

In view of the above information on various concepts of fisheries management, it is essential to know the biology of the fish, the characteristics of the aquatic environment, the social and economic setting of the fishery and the technologies/uses it could be applied to tomorrow. That is the only way to effectively and efficiently manage fisheries resources that fulfill a wide range of interests.

From the preceding analysis, it is easily seen that fisheries management serves a wide range of interest that falls into four categories (Larkin, 1980):

- How to regulate the catch of fish.
- How to protect the fish and their environment from encroachment.
- How to rehabilitate the resource to compensate for the inadequacies of regulation.
- How to enhance the resource and augment natural productions.

With respect to each of these four aspects of management; it may be useful to gain knowledge by conducting investigations in research and experimentation. There is also, the question of how best to deploy managerial efforts across the domains of regulation, protection, rehabilitation, enhancement and the acquisition of knowledge.

As evident on the “how to” categories above, regulation of catch and the environmental components are very essential parts of fisheries management responsibility. Thus, 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.

The need to develop General Biodiversity Conservation arose from the recommendations that a sustainability model (index) be developed for the Niger Delta fisheries resources. The key points of the recommendations that gave rise to the developments of the models are as follows:

Biodiversity conservation policy: There should be a well-articulated and definite biodiversity conservation policy for the Niger Delta region. This is desirable judging from research empirical evidence that indicates the non-inclusion of environmental components in the models that have been deployed previously to determine the Maximum Sustainable Yield (MSY) of the regions fisheries. An Integrated sustainability model is therefore being proposed for the conservation of the biodiversity resources of the Niger delta. Under this concept the entire delta is considered as follows.

- A single entity that it’s biodiversity resources have to be managed based on a holistic approach that will have a common scientific sustainability index that will cut across the human, environment/habitat, flora and fauna interactive dynamics of the region.

- The principle of community participatory approach would be highly encouraged in conserving the biodiversity resources of the region.
- All core stakeholders within the region have to be collaborated with and should be seen to participate actively in the application of the model for the conservation and management of the bio-diverse resources of the Niger delta.

Most of the studies that have been conducted on the sustainable management of the Niger Delta fisheries resource have been based on stock assessment models that tend to predict the maximum sustainable yields from specific fisheries. For example, Deekkae *et al.* (2007) used Schaefer's surplus yield model to estimate the Maximum Sustainable Yield (MSY) and the corresponding optimum effort (Fmsy) to estimate fish production levels in Nigerian coastal waters.

Schaefer's model:

$$MSY = a^2/2b \qquad (1)$$

Where $a = 191.95$

$b = -0.280297019$

Similarly, Abowei and Hart (2008) employed the model developed by Henderson and Welcome (1974) to estimate the standing stock of finfish in the fresh reaches of lower Nun River, Niger Delta, Nigeria.

Handerson and Welcome formular:

$$S = B/A \qquad (2)$$

This model expresses the basic inter relationship between annual catch in wet weight, standing stock size (B) and area covered (A).

Thus, the reported biodiversity/fisheries resources conservation and management model for the Niger Delta is based on the concepts of resource management models as postulated by Ricker (1975). According to Ricker (1975) the fundamentals of models used in stock assessment are based on growth, recruitment, natural and fishing mortality. Fish stock assessment evaluates the effort of fishing on a fishery as basis for fishery management decisions. However, this indigenous model being developed for the Niger Delta region takes into focus the special effect of environmental impact dynamics component, as the Niger Delta region ecology has been known in recent times 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.

RESULTS

The model components: The Biodiversity conservation /Fisheries resources conservation models is a theoretical concept that is intended to serve as an overview index for the conservation and management of the Niger Delta biodiversity/fisheries resources.

The model is in two stages (steps). The first component of the model is the biodiversity component. It captures a general model for the conservation and management of the biological natural renewable biodiversity resources. These resources essentially include forestry, wildlife and fisheries. The objective of the model is to achieve in principle conservation /management objective that will serve as an index for biodiversity balance (BB) between the rate of exploitation/intervention (EX/IN) and the rate of replenishment /regeneration. This model can only accommodate either or both positive and negative (±) minimal alterations in the environment or ecosystem (i.e the resource base).

The positive alterations are those occurrences impacting on the resource; either natural or artificial those are advantageous to the continued optimum abundance of the resource. The negative alterations are those occurrences impacting on the resource; either natural or artificial those are disadvantageous to the continued optimum abundance of the resource. The definition of the minimal alteration is a range, which is assumed to have zero (0) value once within the acceptable range. It is ascribed the value of (0) since any alteration within the acceptable range is considered not to have any significant impact on the resource of interest.

The minimal alteration range is also natural renewable resource type specific. For example, the minimum and maximum range of ± alteration in the resource base for capture fisheries or logging should be based on stock assessment studies for the fishery or trees of interest. The result of such study should establish the exploitation/intervention rates that will not impair natural regeneration of the resource base below the level that it cannot be sustainable. The second stage of the model is the demonstration of its application to a specific natural renewable resource type such as fishery, forestry and wildlife. For this study, this demonstration was applied to fisheries resources conservation and management. This component involves the substitution of the variables in the Biodiversity model with that of fisheries resources variables as in Eq. (1) and (3).

The first stage of the model is descriptive or qualitative. It cannot result in quantitative analysis. The second stage involves a quantitative analysis, which can result in precise values (Eq. (2) and (4)). Eq. (2) and (4) were derived from Eq. (1) and (3).

The results from Eq. (3) can only result to a maximum value of one (1), which is described as a state of resource conservation/management equilibrium. This equilibrium status is only achievable in principle.

However, the model serves as a benchmark or index for the resource managers' to evaluate the performance of their conservation/management programmes.

$$BB = EX/IN = \pm\ M\ A \tag{1}$$

Where
BB = Biodiversity Balance
EX/IN = Exploitation/Intervention Activities
MA = Minimal Alteration within acceptable range = 0
± = 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 alterations in the biodiversity status and the environment.

However, the BB values as contained in Eq. (1) can only be qualitative and non quantitative. In other to achieve quantitative values, Eq. (1) therefore leads to the development of Eq. (2) that has a quantitative analysis of BB, thus:

$$BB = R_0 = R_e R_e = \frac{R_e R_e}{R_0} \tag{2}$$

Where
R_0= Rate of biodiversity resources output from the ecosystem or environment.
$R_e R_e$ = Renewal/Regeneration rates of the biodiversity resources

The absolute BB Value that can result from this Eq. (1)

The model application

$$FrB=EX/IN= \pm\ M\ A \tag{3}$$

Where:
FrB = Fisheries resources Balance
EX/IN = Exploitation/Intervention Activities
MA = Minimal Alteration within acceptable range = 0
±Negative(-) or positive(+) alterations

$$FrB = R_0 = R_e R_e = \frac{R_e R_e F_r}{R_0 F_r} \tag{4}$$

Where
R_0F_r = Rate of fisheries resources output from a given water body
$R_eR_eF_r$ = Renewal/Regeneration rates of fisheries resources from a given water body

The absolute FrB Value that can result from this Eq. (1)

DISCUSSION

Since the maximum value of FrB (Fisheries resources balance) that can result from the model's Eq. (1). The proof of this maximum value of 1 is demonstrated thus:

If for example the variables in Eq. (4) are assigned the following values;

$R_e R_e F_r =$ 10kg of fish per 100m^3 of water body per day
R_0F_r = 10kg of fish per 100 m^3 of water body per day
MA = 0 (Within defined acceptable range)
FrB = 10/10 = 1

The result of the demonstration could be described as a state of 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 benchmark.

For this model to be applied the stock assessment statistic on the rate of fish replenishment for the target fishery must be predetermined. In other words tagging experiments and other stock assessment strategies needs to be carried out to determine the rate of recruitment of juveniles into the fishery for a particular year class.

Examples of alteration measures to be considered under this model may include crude oil spill on breeding or nursery ground and the practice of public aquaculture by stocking open waters with juveniles in order to augment natural productivity. The alteration/intervention measures are therefore to be factored into the regeneration/renewal rates when applying this model to any biodiversity resource consideration of interest. The acceptable range of minimal alteration measures for any biodiversity resource of interest has to be defined in order for the resource to continue to thrive based on this model. Any value outside the acceptable range is therefore an indication that the resource of interest and other associated resources may be under a serious threat from environmental impacts on its biology and ecology. Hence the focus of the managers of the resource would be not only to resuscitate the resource, but essentially the degenerated environment and ecology in such a case.

CONCLUSION AND RECOMMENDATION

It is in a presentation of this nature to make overriding recommendations on the subject of focus.

Biodiversity conservation policy: there should be a well-articulated and definite biodiversity conservation policy for the region. This is desirable from research and impractical evidence.

The Integrative method is being proposed for the conservation of the bio-diverse resources of the Niger delta. Under this concept the entire delta is considered as follows.

- A single entity that its bio-resources have to be managed with a holistic approach (environmental degradation)
- The principle of community participatory approach would be highly encouraged in conserving the bio-diversity resources of the region.
- All skate holders within the region (especially the multinationals have to be collaborated with and should be seen to participate actively in the conservation of the bio-diverse resources of the Niger delta.)

Consistency of conservation policies: Conservation policies for the Niger delta should reflect the following:

- Long term: spanning between five to ten years before major review can be made.
- Conservation policies should be in conformity with regional and national development/rolling plans.
- Dynamism- within the framework of consistency, the conservation policies for the Niger Delta should have an appreciable level of flexibility to be able to adapt to spontaneous ecological and socio-economic perturbations.

Proactive action: it is very important that the bio-diversity conservation programmes and project of the delta should be largely proactive.

Monitoring and enforcement: An efficient monitoring and enforcement programme to ensure compliance and regulation of the biodiversity conservation programme within the enabling policy framework should be put in place.

Reviews: There should be periodic review of the bio-diversity conservation programmes or projects based on the following parameters

- different local ecological zones
- the entire region
- Socio-economic effects of biodiversity conservation on the people of the region and beyond.

Data bank: A realistic database for the bio-diversity resources of the region should be established. The NDES database is a commendable effort in this regard. However, such a database should be managed on a day-to-day basis, in order to constantly reflect the ever-changing nature of the ecology and bio-diverse resource of the Niger delta.

The scopex conservation biodiversity balance equation:

$$BB = EX/IN = + \text{ or } -M \qquad (1)$$

Where
BB = Biodiversity balance
EX/IN = Exploitation/Intervention Activities
MA = Minimal Alteration

Equation 1, therefore implies that BB is achieved when exploitation of resources/intervention measures in an ecosystem results in minimal alternations in the biodiversity status. However, the BB status is relative.

Equation 1, therefore leads us to the development of a second equation that has a quantitative analysis of BB. Thus:

$$BB = R_0 = R_e R_e = \frac{R_e R_e}{R_0} \qquad (2)$$

Where
R_0 = Rate of biodiversity resources output from ecosystem
$R_e R_e$ = Renewal/Regeneration rates of the biodiversity resources

The perfect BB Value that can result from this Eq. (1)

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