USING FISHERS KNOWLEDGE IN COMMUNITY BASED FISHERIES MANAGEMENT IN THE RIVER NUN ESTUARY, NIGER DELTA

Sabina NGODIGHA *, *Roland GBARABE* * and *Ayeibatonworio AUGUSTINE* *

* Isaac Jasper Boro College of Education, Department of Agricultural Education, Sagbama, Bayelsa State, Nigeria, NG-561101, alatari3004@gmail.com, woritimi@yahoo.com, augustine@yahoo.com

DOI: 10.2478/trser-2018-0014

KEYWORDS: fishers knowledge, community laws, conservation, management.

ABSTRACT

A study of fishers' knowledge in community based fisheries management practices in the Nun River estuary were conducted to assess the contribution of fishers' knowledge to fisheries resources conservation. The total number of fishers that operated in the area were 390, and 221 fishers were interviewed based on a minimum of 10 years fishing experience using the socio-ecological approach. The laws introduced are banned on the use of mesh size less than five cm and banned on chemical fishing. Fishers caught using chemicals to fish were arrested and handed over to the police for prosecution. The management method has enhanced conservation of fisheries' resources, which is a major source of livelihood for the people. It is therefore pertinent to introduce community based laws to check over exploitation of fisheries' resources in fishing communities in the Niger Delta.

RÉSUMÉN: Utiliser le savoir des pêcheurs dans la gestion communautaire des pêcheries de l'estuaire de la rivière Nun, Delta du Niger.

Une étude des savoirs des pêcheurs sur les pratiques communautaires de gestion piscicole dans l'estuaire de la rivière Nun a été effectuée afin d'évaluer la contribution des connaissances des pêcheurs à la conservation des ressources halieutiques. Le nombre total des pêcheurs opérant dans la zone est de 390, parmi-eux 221 ont été interviewés sur la base d'une expérience de pêche minimale de 10 ans, en utilisant l'approche socio-écologique. Les lois interdisent l'utilisation des maillages de moins de cinq cm et la pêche chimique. Les pêcheurs surpris en train de pêcher en utilisant des substances chimiques ont été arrêtés par la police et soumis à des poursuite judiciaires. La méthode de gestion a amélioré la conservation des ressources halieutiques, qui est une ressource majeure pour la subsistance des population. Il est donc pertinent d'introduire des lois communautaires pour veiller à la bonne exploitation des ressources halieutiques dans les communautés de pêcheurs du Delta du Niger.

REZUMAT: Utilizarea cunoștințelor pescarilor în managementul comunitar al pescăriilor din estuarul râului Nun, Delta Nigerului.

Pentru a determina contribuția cunoașterii pescarilor la conservarea resurselor piscicole a fost realizat un studiu al cunoștințelor pescarilor în practicile de gestiune comunitară a pescăriilor din estuarul râului Nun. Numărul total de pescari care operau în zonă a fost de 390 dintre care (pe baza criteriului de experiență minimă de 10 ani) au fost intervievați 221, utilizând o abordare socio-ecologică. Noua legislație interzice utilizarea de plase cu ochiuri sub cinci cm precum și pescuitul cu substanțe chimice. Pescarii prinși utilizând substanțe chimice pentru pescuit au fost arestați și trimiși în judecată. Metoda de management a îmbunătățit conservarea resurselor piscicole, una dintre principalele surse de trai pentru populație. Din acest motiv este pertinentă introducerea de acte comunitare de reglementare pentru a controla supraexploatarea resurselor piscicole în comunitățile de pescari din Delta Nigerului.

INTRODUCTION

In the cases when the prehistoric and historic records and/or fossils are not helping to understand some local fish communities status, threats, pressures and trends (Arratia and Mayden, 2004; Bănăduc et al., 2016) local fishers traditional knowledge can help in this respect (Roberts and Baird, 1995; Haggan et al., 2007).

The term fishers knowledge is inclusive of the persons who "fish" and those who rely upon marine and freshwater environment for their survival (Nigel et al., 2007). They are mostly composed of small-scale fishers, who in many parts of the world, have a vast amount of local ecological knowledge (LEK) about fishes and fisheries, which they depend upon for their livelihoods (Johannes, 2001; Sabai and Sisitka, 2013).

Fishers rely on their knowledge and skills for their livelihood, so it has always been "put to work" in the most useful sense. This category of knowledge is not only of academic interest. It is a specific way of life that progress constantly to address modifications in fisheries and fishers. It is attracting an increase of interest from non-fishers with an interest in fisheries. The use and incorporation of fishers' LEK are well recognized as an important component of collaborative or community-based management schemes. (Berkes, 2003)

In most cases, interactions between humans and their environment are influenced by feelings, behaviours, knowledge and beliefs. It is here that, fishers' knowledge play important and critical roles in the conservation process. Fishers' knowledge includes biological, socio-economic and cultural contexts in which fishers operate. Its value and usefulness is most often understood and studied in the case of data-poor fisheries where conventional fisheries' research and management methods are not applicable, (Johannes, 1998). In fact, fishers are the only available source of local, historical, place-based fisheries' information. They have to become proficient at figuring out changes in a fish stock distribution and abundance to survive in the industry.

There is ample proof that local people do their own explorations do substantial findings. Continous experiments and practice develop the knowledge, indicating that contributions from fishers as sources of data collectors or sources of knowledge offer some of the high potential benefits that can come from collaborative team work. It appears to be a means for coping with the conflicting dogma of scientific research that researchers know better because of their formal education; but fishers also know much because of their experiential background. (Sajise, 1993)

Due to the increase in population and a high demand for fish and fisheries' products, there has been a considerable increase in the rate of fish and shrimp exploitation in the estuary. Increasing pressure on coastal resources has caused a decline of many marine fish and shrimp stocks in Nigeria (Sotolu, 2010). The decline in fish abundance and size, is probably the cumulative result of years of indiscriminate overfishing and habitat degradation, caused by recruitment over fishing, chemical fishing and the landing of fish even before they have the chance to lay their eggs (which are not always checked or controlled). Combined with frequent boat movement and oil exploration and exploitation activities rampant in the Niger Delta (Ngodigha and Ogamba, 2017), fishing pressure appears to exceed the capacity of these resources to renew themselves, thereby leading to the decline of fisheries' resources. This study describes how fishers have applied their LEK acquired over the years to improve the management of wild capture fisheries in Nun River estuary, in the Niger Delta.

MATERIAL AND METHODS

The study is based on fishers using their knowledge to manage fisheries' resources in the Nun River estuary. Initial meetings held with local fishers described their knowledge on the state of the fisheries and management of aquatic resources. Semi-structured interviews were conducted to ascertain the use of fishers' knowledge in fishers' management in the Nun River estuary. Face-to-face interview were freely conducted with 221 informants. The informants were randomly chosen based on their years of fishing experience of 10 years and above. Fundamental principles for obtaining high-quality local knowledge (Johannes, 1981), was applied. The principal requirement is a "socio-ecological" approach, such that fishers were placed at their ease by spending high quality time with them.

During the interview, fishers were asked to provide information before the introduction of community fisheries management laws and after introduction of the laws based on status of their livelihood as fishers and the fish caught. Fishers were asked to assign their answers into categories. Fish caught were described as Very Bad (Worst, after introduction of community law), Bad after introduction of community law, Same (no difference), Good (better after introduction of law) and Very Good (much better, after introduction of law).

Fishers' livelihood was described as Very Bad (income is not sufficient to support the basic necessities), Bad (income from fishing is barely enough to support basic necessities such as food), Just okay (income enough to support basic necessities), Good (income from fishing is sufficient to support the family, provide food and education) and Very Good (income from fishing is sufficient to support the family, provide food, education, support to extended family members, and other social activities).

Fishers were asked if the number of hours spent fishing per trip and the number of trips per week were the same before and after introduction of the law. They were also asked if the same vessels and gears were used before and after introduction of the law.

Likert-type scale was used to analyse Fishers' responses. The five-point rating scale was used to assess landings and income. It had a rating of level one indicating strong dislike and was labelled "very bad", rating of level two indicating dislike was labelled "bad", level three − agreement level, indicating "No difference", level four − agreement level indicating "better" and level five − agreement level represents "much better".

Reliability attribute to a measure's ability to yield consistent value if multiple values are taken over time. Factor analysis was used to determine the reliability of semi-structured interviews on Fishers' relationships. Item analysis established internal consistency and was calculated by using the Cronbach's Alpha Coefficient. Cronbach's Alpha Coefficient is a measure of reliability that ranges from zero to one and the value of 0.6 is the generally acceptable lower limit. An alpha value greater than or equal to 0.7 is generally seen as a good indication of reliability of the questionnaire. (Hair et al., 1998)

Validity refers to the extent the measures correctly represent the concept or construct intended and how well the construct is defined by the measure (Hair et al., 1998). It was determined by applying factor analysis and item loading that 0.5 is the lowest acceptable limit.

Description of the project area. The study was conducted in the Nun River estuary in the Niger Delta. Nun River estuary lies between longitude 5°55' E and latitude 4°20' N (Fig. 1). There are predominately two seasons which are the rainy season (April-October) and the dry season (November-March). Monthly mean salinity ranged between nine psu and 21.3 psu with the highest during the dry season and lowest during the rainy season, and the surface water temperature is between 24°C and 27°C (Ngodigha et al., 2013).

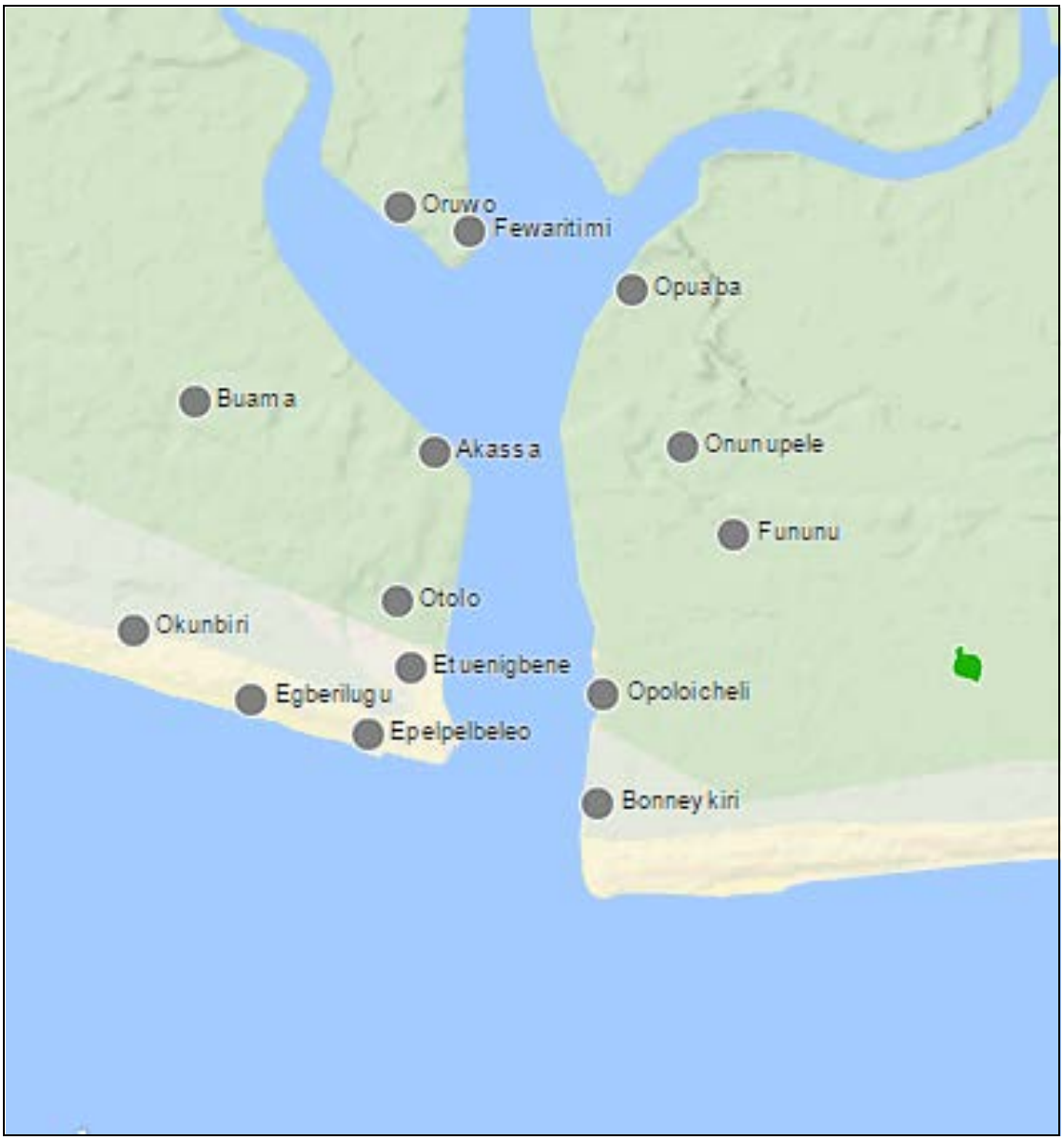

Figure 1: Map of project area.

RESULTS AND DISCUSSION

Fishing is one of the common occupations of the inhabitants of the Nun River estuary. During the rainy season most inhabitants of the area, irrespective of age and sex, are involved in fishing activities as it is believed to be the season of abundant catch, which have been learnt over the years. These fishers have lived in the community right from birth and have been fishing from a tender age with their parents with fishing as a way of life for the people in the Nun River estuary.

The frequently landed species are *Palaemon maculatus* and *Nematopalaemon hastatus* (locally known as crayfish), *Pseudotolithu selongatus, P. senegalensis* and *P. typus.* Other fish species common in the catch are *Trichiurus lepturus* (silverfish), *Pentanemus quinquarius* (threadfin), and *Ilisha africana* (shad), *Caranx hippos* (Horse mackerel), *Cynoglossus goreensis* (tongue sole), *Chilomycterus recticulatus* (puffer fish), *Drepane africana* (sickle fish), *Plectorhinchus macrolepsis, Cynoponticus ferox* (eel) and *Sphyraenid sphyraena.*

Fishers' knowledge is directly related to fishing success, so it is very important to them. Such knowledge is essential for successful fishing practices (Symes, 2008), in using the right fishing gear and mesh size. Hence, it is reliable with a high level of confidence. Repeated observations of daily activities can also increase the level of confidence (Williams and Bax, 2007).

Artisanal fishers embark on fishing activities based on the fishing calendar. The same fishing calendar is been used over the years. Fishing is based on the abundance of different fish species during the year. Though most fish species are caught all year round, fishers tend to concentrate their catch on the most abundant fish species at a given time in the estuary. The fishing calendar is based on fishers' experience gained over the years, which enables them to know when to harvest a particular fish with changes in the estuary. As reported by the fishers, the fishing calendar is influenced by changes in salinity concentration affected by the rains. During the rainy season when salinity is low, most of the inhabitants are involved in fishing activities because it is believed that most fishes are found in the estuary during this period. The low salinity may be due to the fact that the rains might have lowered the salinity, through high river discharge that might have lowered the salinities of estuaries in the Niger Delta and introduce silt and plant from the land to the water (Ngodigha et al., 2013).

Gears used by artisanal fishers before and after introduction of the law are mostly traditional and easily found in the locality. Fishers use gears such as cast nets, hand-lines, basket traps, long lines, gillnets and stow nets.

Artisanal fishers operate from the traditional dug-out, wooden canoes that are either motorized or non-motorized. The dug-out canoes used by artisanal fishers range between three-eight m. The vessels are categorized into small, medium and large with average lengths of three m, five m and eight m, respectively. A small canoe is manually powered and operated by one person, while the medium and large are operated by two or three persons on a fishing trip. The large canoes are powered by a 10 horse power out-board engine. These vessels were used by fishers before the law was introduced and after the introduction of the law.

Fishing trips ranged from three-five times a week. During the raining season fishers embark on more fishing trips that range between five-six times a week. Fishers embark on the same number of fishing trips before and after the law were introduced.

Fishers' local ecological knowledge is the basis of the development of community fisheries management law in the Nun River estuary. In fact, it is the most important and only factor associated with the establishment of specific regulations, based on observations and fishing experience.

Due to the steady decline in fisheries resources in the Nun River estuary, fishers in the area organized themselves to form the Fisherman's Union. In 2010, the union was introduced and implemented some community laws to manage the fisheries.

The ban on harvest of fingerlings in the estuary is another law introduced by fishers based on their local knowledge. They realised harvesting of fingerlings contributes tremendously to depletion of fisheries' resources over time. Fishers observed that landing of fingerlings has led to a steady decline of larger fishes, since the fingerlings are not allowed to grow to maturity before they are caught, hence the need to apply their LEK to improve their chances of getting better catches in the long term.

The fishers' union ban on the use of smaller mesh size is implemented to avoid the harvesting of juvenile fishes. The mesh size permitted in the Nun River estuary is > five cm. The ban allows fishes to grow to maturity before they are caught. The decision to ban the use of mesh size less than five cm is an idea of fishers based on their local ecological knowledge. During the dry season many fish species, especially juvenile ones, congregate in the estuary, (Nwosu, 2009), where they are potentially vulnerable to the different gears. Shrimp are caught in large quantities, juvenile fishes are caught as by-catch in the stow net (Ngodigha et al., 2015), as there is a large abundance of their food (Abowei et al., 2008), thereby preventing the young to grow up to maturity. Fishers had to propagate a law to ban juvenile fishing due to their knowledge on the effect of juvenile fishing on sustainability of the fishery.

The fishers union placed a ban on the use of chemicals to harvest fish. They noticed that whenever chemicals such as garmoline were used in harvesting fish in the estuary, it leads to the death of many fishes including both matured, gravid and juveniles. They also observed that target and non-target fishes were caught in the process. The water gets polluted from the chemicals. Fishes are poisoned and seen floating on the water surface.

Measures of sample adequacy of fishers relationship (Tab. 1) shows acceptable values of all the factors, ranging from 0.605 to 0.844. This indicates that the construct is defined by the measure. The high Cronbach's alphas (0.720) indicate that the measures are reliable and would yield consistent values in multiple measurements.

Table 1: Fishers factor loading of relationship; a Eigenvalue = 2.50, Percent of Variance Explained = 52.41.

Relationship	Factor 1[a] loading
Fishers cooperation	0.844[a]
Relationship with community	0.831[a]
State legislators relationship	0.811[a]
Extension services	0.812[a]
Community law	0.754[a]
Non-fishers relationship	0.723[a]
Relationship with other communities	0.715[a]
Credit facilities	0.652[a]
Legislators relationship	0.605[a]

Reliability and validity of fishers' relationships indicate a high level of cooperation amongst fishers. From the experience gained, fishers had to agree amongst themselves with cooperation from the community and other communities on formulating laws to conserve the aquatic resources. This attitude of fishers confirms findings of Ngodigha and Abowei (2015) that fishing experience, awareness, fishers' relationship with community, cooperation amongst fishers, relationship with other communities and fishers' positive attitude towards preserving nature are the factors that affect fishers' attitude towards conservation of aquatic resources in Ekperiama in the Niger Delta.

Fishers report that before the introduction of the law, fish caught were described as very poor. About 44.34% (Tab. 2) of fishers felt the landings were poor, 30.31% reported very poor landing, while 11% were indifferent. Livelihood was described as Bad from the report of about 16% of fishers and 55.20% felt livelihood was very bad. The income generated from fishing was barely enough to support the basic necessities of their families. Fish landings were generally very good after the introduction of fishing laws. About 84.16% fishers agreed fish landings have increased after the introduction of the law while 2.71% feels catch is the same.

As shown in table 2, 74.66% of fishers reported that their income after the introduction of the law is very good. They could support their families, provide food, education, and were even able to support extended family members as well as other social activities such as sending their children on vacation. A total of 14.48% agree that the introduction of the law is good. Income from fishing is sufficient to support the family, provide food and education. While 5.43% of the fishers felt their income after introduction of the fisheries law is enough to support basic necessities such as feeding, clothing and education of their children.

Table 2: Effect of fishers' community law on livelihood.

s/n	Effect of law	1	2	3	4	5	**Score**	**Points**	**Ranks**
1.	Catch before law	67	98	24	17	15	**478**	**2.16**	**X**
2.	Income before law	122	35	21	21	22	**449**	**2.03**	**X**
3.	Catch after introduction of law	5	4	6	20	186	**1041**	**4.71**	**xxx**
4.	Income after law	5	7	12	32	165	**1008**	**4.56**	**xxx**

2.00 – 2.99 (x) = very bad; 3.00 – 3.99 (xx) = Bad; 4.00 – 4.99 (xxx) = very good.

Fishers' report of very poor landing before the introduction of the law as against very good landing after the introduction of the law indicates the positive effect of the law on fishers' income. Majority of fishers are pleased with the fish landings after introduction of the law. Only a few of the fishers felt their income is enough to meet their needs after introduction of the fisheries law. This group of fishers are probably those engaged in illegal fishing activities. Implementation of the fishing law has grossly affected the catch which has a negative effect on their income. Generally, catch and income after introduction of the law was very good. Fishers support the fact that fisherman's law has significant positive effects on the income of the fishers. Most of them could support their families, provide food, and education. 5.43% of the fishers feel their income after introduction of the fisheries law is just enough to support basic necessities such as feeding, clothing and education of children. This indicates that community fishing laws by fishers can reduce over exploitation of fisheries' resources as well as poverty reduction in fishing settlements when fully implemented in the Niger Delta.

The consequences of violating fishers' fishing laws included payment of monetary fines ranging from #2,000 (€) to #6,000 (€) depending on the quantity of fish caught with the defaulters. Fishers caught using chemicals to fish were arrested and prosecuted by the police. Penalties placed on defaulters discouraged indiscriminate fishing in the estuary, hence, reduced pressure on the fisheries' resources leading to improvement in fish landings.

CONCLUSIONS

The introduction of fishermans' union law in Akassa has encouraged fisheries' resources management in the area. This has lead to an increase in catch, resulting in an increase in income and improvement of the standard of living for the local people. Increased participation by fishers can thus be both a means and an end (Sajise, 1993). Such local laws proposed and implemented by inhabitants of communities should be encouraged in all fishing communities in the Niger Delta so as to check overexploitation of fisheries' resources.

Government can also assist in sustaining the fishery resources by addressing the issue of crude oil pollution rampant in the Niger Delta as well as providing capital in form of credit facilities to fishers in the study area. Support from government especially at the local level will greatly improve fishing activities, increase fishers' income and improve socio-economic status of the fishermen.

ACKNOWLEDGEMENTS

The authors wish to thank to the numerous fishers operating along the Nun River estuary for their cooperation during the study.

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