



## **Environmental Adult Education and Environmentally-Friendly Fishing in Rivers State**

**Dr. Kpeno Amon Ephraim**

Department of Adult Education /Community Development, Faculty of Education Ignatius Ajuru  
University of Education Port Harcourt, Rivers State, Nigeria  
kpenoephraim@gmail.com

**Abstract:** This paper seeks to examine the position of Environmental Adult Education in the adoption of environmentally-friendly methods of fishing in Rivers State of Nigeria. It seeks to review the concept of fishing and environmentally-friendly methods of fishing; identify the challenges faced by the fisheries industries in Nigeria; effects of fishing and fishing methods on the ecosystem; environmentally-friendly methods of fishing; ways to reduce fishing effort to sustainable levels; ways to optimise the catches of target species and minimise unwanted catches; ways to reduce the impact of fishing on habitat; ways to balance environmental and economic sustainability and environmentally-unfriendly methods of fishing. The paper revealed that the environmentally-unfriendly methods of fishing are fishing with nets with tiny holes among other things, have been discovered as their environmentally-unfriendly methods of fishing. The paper discovered that EAE needs to be taught to the adult population so that they may acquire the right knowledge to deal friendly with the environment. It was recommended among other things that staff of Rivers State Agricultural Development Programmes (RSADP) should be given environmental adult education to enable them have the knowledge to pass to the fisherfolk in their areas of jurisdiction; in order to promote environmentally-friendly methods of fishing among their clientele.

**Keywords:** Environmental adult education, environmentally-friendly methods of fishing.

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### **Introduction**

The global and local concern about growing environmental degradation has called for the need to help people transform their attitudes and practices. Consequently, education has been recognised as one of the important tools for conserving the environment through the cultivation of knowledge, skills, values and positive attitudes towards the environment among the people (Oduro-Mensah, cited in Mbalisi & Ugwu 2012). The need for and the importance of environmental adult education has been emphasised as a strategy for addressing the growing trend of environmental problems (Apel & Comazzi, 1996). For instance, the need for environmental education which was emphasised at the United Nations Conference on Human Environment in Stockholm in 1972 was meant to tackle the world's environmental crises. The Belgrade Charter (UNESCO, 2009), the Tbilisi Declaration (UNESCO, 1978), the Brundtland Report (WCED, 1987), the Rio Earth Summit (UNCED, 1992), and the Johannesburg (UN, 2002) were all out to tackle environmental issues and problems.

The very essence of man's existence can always be traced to the environment; that is why man has always depended on the environment for his survival, health and safety. Man's quest for the survival of his vast population has led to the various activities that has devastated and destroyed the environment. Clover, (2010) confirmed that in a world of food surpluses, the United Nations

estimated that about 850 million people are chronically undernourished, and at least 60 million face acute food shortages due to natural disasters or conflicts.

Agriculture, right from inception of Nigeria through the era of the colonial masters until the first republic in the 1960s has been the major source of revenue, employment, provision of food, foreign exchange earnings, among other things in Nigeria (Nwachukwu, 2006). In actualising this purpose, the fisherfolk were empowered through the various agricultural development schemes and projects. Consequently, notable agencies like Agricultural Development Programme (ADP), International Fund for Agricultural Development (IFAD), Shell Petroleum Development Company (SPDC) Agricultural Programme, Green River Project of the Nigerian AGIP Oil Company (GRP) have intervened by assisting to increase the small-holder fisherfolk to gain new skills, techniques and adopt new technologies to raise their level of production and improve on their level of living, especially in the areas where they have great expectation for crude oil and natural gas (Alfred-Ochiya et al., and Davies, in Tawari and Davies, 2010). These problems are as a result of the various factors like population pressure, poor agricultural practices and high rate of urbanisation (Johnson-Pynn & Johnson, 2005; Sheridan, 2004; URT, 1997). Education for awareness-raising and finding solutions for these issues and problems is considered necessary hence environmental adult education is recognised as education to attain quality life, healthy and well-conserved environment.

Clover et al, (2013) stated that soil scientists report that about two-third of all agricultural lands show signs of degradation. He agitated that biotechnology and intensive farming techniques are responsible for much of our recent production gains which often are too expensive for the poor farmers. He expresses doubt if one can find ways to produce the food one needs without further degradation; and if it happens, will that food be distributed equitably? This kind of argument in most instances, scare crop farmers away from adopting the environmentally-friendly methods of fishing and crop farming with a feeling that agriculture without outright chemicals additives cannot feed the population. However, Erickson and Erickson, (2010) confirms that environmentally-friendly methods can feed the whole world and sustain the environment alike. In the same vein, agricultural activities have been grouped among the causes of greenhouse gases which bring about climate change. For example, the emission of methane from cassava production and other dangerous chemical from fertilizers, pesticides, and insecticides as the case may be (Eheazu, 2012).

Rivers State is a state endowed with great potentials like petroleum resources, water resources, forest resources and many more which are meant to enrich her citizenry. Communities in Rivers State are fondly categorised as riverine and upland communities due to the geographical location of the state. The riverine communities are characterised with fishing while the upland communities are characterised with farming. The riverine local government areas of the state who are predominant fisherfolk are Andoni, Opobo/Nkoro, Okrika, Kalabari, and Bonny; though there are some minor fishers in other local government areas of the state that are not mentioned. The artisanal fishers in these areas produce fish, periwinkle, oyster, scallop, crayfish, prunes, lobsters, and many more shell fishes.

In cause of these productions, they degrade the forest and chase useful fauna (animals) to extinction as they fell trees especially mangrove trees for firewood which they use for smoking their fishes (their major method of fish preservation). The fisherfolk also lack health care delivery/sanitation and basic hygiene and many other means of protecting themselves and the ecosystem.

The above mentioned activities of the artisanal fisherfolk among the target population have over time cause havoc to lives and the entire ecosystem. They degrade the environment and endanger lives as the use of chemicals for fishing cause pollution in water, air and land. The use of tiny-sized (tiny holes) net/mesh causes extinction of fishes in the water; bush burning lead to extinction of most animals in the bush and some species of economics and medicinal plants. The use of chemicals pollutes the soil, destroys plant nutrients, and poisons the crops and human

beings. In the same vein, the process of transformation of farm produce like cassava to the secondary source such as gari, fufu and many more, emit methane which is one of the causes of climate change. Many more dangers experienced through these unfriendly activities endanger lives, properties and the ecosystem. It is therefore necessary that the fisher folk in the target areas are encouraged to take alternative methods for the sustenance of lives and the entire ecosystem

The upland local government areas of the state who are predominant farmers are Bori; Gokana; Oyigbo; Ahoada West/East; Etche; Ikwerre; Obio/Akpor; Ogba/Egbema/Ndoni; Abua/Odua; and some minor groups of farmers in other local government areas of the state not mentioned. The activities of these fisherfolks in the state coupled with the reckless exploitation from the oil and gas unit have degraded the environment thereby making live unbearable for the dwellers in the area. Poverty and insecurity has become the ‘food’ of the people since the water and land where the people get their livelihood from, have been turned to death trap through the use of indiscriminate chemicals and processes which are hazardous to human health and other non-human organisms.

This can be seen as the indigenes of Rivers State, both at the riverine and at the upland region devastate the environment through their methods of agriculture such as fishing with chemical which poisons the water, kill all category of fish and at the same time poison human beings through consumption. They also carry out fishing with tiny nets/mesh which sweeps all grade of fish whether big or small, leaving no one to reproduce more fish thereby causing fish scarcity and rendering the people impoverished.

Population pressure and environmental illiteracy among other factors have made the promotion of environmentally-friendly methods of fishing and farming difficult for adults in the target populations of Rivers State. Fishing with nets with tiny holes, chemicals, poison, explosives, bottom trawling, indiscriminate felling of the mangrove trees for firewood, and many more environmentally-unfriendly activities associated with fishing have brought about degradation of the environment and destruction of biological lives (Biodiversity). In the same vein, slash/burn practice, application of fertilizers, fungicides, pesticides, herbicides and many more environmentally-unfriendly activities associated with crop farming degrade the environment and also destroy the biodiversity.

Therefore in a bid to solve the problem of acute food shortage, man had through his agricultural activities affected the environment negatively. The fisherfolk degrade the environment by employing the use of net with tiny holes, chemicals like Gamaline 20, Dynamite and many other types of poison to kill fish of all kinds and sizes. These patterns of exploitation degrade the environment and deny the tiny fishes opportunity to get mature and to reproduce others for sustainability. There is a belief that if steps, such as encouraging environmental adult education in order to propel the desired change in individual’s orientation to the environment are taken, greater awareness will be created about environmental issues and problems. In the same vein there is need to save man from disaster through their knowledge of environmental adult education; whether individually or in groups at any level. This need is very important because since man’s economy is largely dependent on the countries’ environment and natural resources, the environment and the natural resources deserve sustainability.

Some of the reasons why the environment is negatively affected could be traced to lack of environmental awareness/knowledge, poor attitude to environmental issues, lack of appropriate skills to tackle environmental issues and also lack of participation in solving environmental problems (Apel & Camozzi, 1996). So Environmental Adult Education (EAE) is a serious necessity among the fisherfolk and crop farmers in order to bring them to the awareness of what the environment is and how man should cooperatively relate with the environment which they too are part. Some of the reasons why the environment is negatively affected could be traced to lack of environmental awareness/knowledge, poor attitude to environmental issues, lack of appropriate skills to tackle environmental issues and also lack of participation in solving environmental problems (Apel & Camozzi, 1996). So Environmental Adult Education (EAE) is

a serious necessity among the fisherfolk and crop farmers in order to bring them to the awareness of what the environment is and how man should cooperatively relate with the environment which they too are part.

Therefore, in order to curb the natural and human-made environmental issues and problems (such as drought, floods, poor sanitation, lack of clean and safe water, land degradation due to poor agricultural practices, unsustainable ways of harvesting natural resources like mining, logging and fishing, loss of biodiversity which are threatening the life support system of the environment) environmental adult education has to be adopted (Ministry of Education and Vocational Training (MoEVT), 2005; MoEVT, 2007; United Republic of Tanzania (URT, 2004). However, some efforts have been made to guide the fisherfolk and farmers back to sustainable way of carrying out their occupation hence the office of the Agricultural Development Programme (ADP) at Rumuodumanya, Port Harcourt has testified that instead of the slash and burn practice, they encourage farmers to clear the bush, gather the debris in a particular spot and burn. In this case, not all the land is set on fire but a portion; and that the ashes got from the spot also serves as pesticide/manure to some crops which are resilient to some form of weather. In a bid to reduce the incessant use of fertilizer, the organization decided to go back to intercropping which allows farmers to add some cover crops to the deep-rooted plants to enable them supply nutrients which chemical fertilizer would have supplied but in a dangerous way (Apapa, 2014). The environmental unit of “Fadama” project of the World Bank also throw more light on their effort to achieve a sustainable fishing by organising seminars, workshops to educate the fisherfolk and crop farmers on how to exploit the environment without degrading it (Oporum, 2014).

Looking critically into the objectives formulated, all efforts affect human and the environment negatively. The rather emphasis is on the exploitation to bring about adoption of new techniques, access to credit loans, and so on in order to enhance productivity in the agricultural sector (Ihimodu & Ochomma, in Tawari & Davies, 2009). These methods could only be considered as a means for the better living of the fish and not a guide against environmental degradation. Some other governmental agencies in Rivers State like the Ministry of Agriculture; Ministry of Environment have embarked on several projects but only for the boosting of agricultural production for food security. Only a little effort has been put by the “Fadama” (a Hausa name given to an agricultural programme, meaning fertile or rich land) programmes which consider environmental sustainability in its move to assist the artisanal fisherfolk in boosting their economy and means of livelihood. This invariably means that much emphasis has not been laid on environmentally-friendly methods of fishing such as the use of adequate size of fish nets/mesh, and so on which signify environmentally-friendly methods of fishing in the target areas.

These and many other activities have led to the degradation of the environment thereby making fishing activities in the state environmentally-unfriendly and unsustainable. Hence the need to carry out for the study on how to effect change in man for a sustainable and environmentally-friendly fishing among the artisanal fisherfolk. They (fisherfolk), therefore need EAE so as to live and maintain a sustainable environment which will also help them to improve in their socio-economic activities. A sustainable environment will encourage a sustainable economy (that is to say they will be able to move from primary production or transform their basic production to secondary level for effective socio-economic development in a convenient environment).

Despite all the little efforts put in by the bodies mentioned above and some communities, to minimise the wrong methods used by the fisherfolk and crop farmers in the target areas, experience revealed that the problem still persist. It is therefore pertinent to note that Environmental Adult Education (EAE) programmes such as environmental education, environmental basic literacy, seminars, workshops, talks and many more would help in solving these problems because no normal human being would ever want to hurt himself. The power of illiteracy/ignorance should never be underrated; it is indeed very dangerous. It is on this note that

this study is carried out to identify and recommend the desirable EAE programmes for the promotion of Environmentally-friendly methods of fishing in the target population of Rivers State of Nigeria.

It is clear therefore that the fisherfolk in the target areas degrade the environment and this shows that they need environmental adult education that would enable them become aware of issues that affect them and the environment. Environmental adult education is that education that would effect changes in the attitudes of the fisherfolk and crop farmers towards the environment and also educate them on sustainable/friendly methods of fishing. Considering this fact, there is therefore a need to investigate how environmental adult education when adopted would help to re-orientate the fisherfolk towards the promotion of environmentally-friendly methods of fishing.

## **Concept of Fishing and Environmentally-friendly Methods of Fishing**

### **Artisanal Fishing**

The small-scale (artisanal) fishery is the main economic sector in the coastal area and the main source of income for its habitants. The participants are fishermen who catch fish, fisher-women (fish mummies) who smoke and market them, river boatmen who transport them, secondary and tertiary fish dealers, and a variety of suppliers, servicemen, and money lenders, whose business is associated with or totally dependent on the fishery. The artisanal marine fishermen of the Niger Delta of which Rivers State fisherfolk belong are among the bravest, most skilful, and professional in the world (Ben-Yami, (n.d).

They operate mostly from open surf-beaten beaches. Their canoes sometimes capsizes in surf which they must cross on the way to and from their fishing grounds. Loss of catches, equipment, and human life is a frequent occurrence. Most artisanal fishermen and fisher-women manifest fiercely independent attitudes with respect to outside ideas, and as a rule are communicative, surprisingly well informed, and, overall, a people who know their business. Conservatism recorded among the fishermen is a myth stemming mainly from unsuccessful development attempts to introduce inappropriate technologies and institutions. They are quick to adopt technologies and social schemes whenever they perceive a clear benefit from them. For instance, they were quick to adopt synthetic fishing nets, twines, ropes, and outboard motors when they found that these innovations improved their earnings and reduced physical effort entailed in paddling their canoes and mending their fast deteriorating cotton nets (Ben-Yami,n.d)

<http://www.fao.org/docrep/004/Y1290E/y1290e0e.htm> 23/05/2013).

Over 80% of fish production in Nigeria is from the artisanal fishery sector and these small-scale fishermen are scattered in the remote villages along the coastline and the extensive brackish water system. They toil around and settle in the remote villages around the rivers, streams, lakes and flood plains (Aina, 1992). Since early time, man has caught fish for food and today the introduction of highly efficient fishing techniques has led to over exploitation of some of the commercial fish stock. Nigeria's domestic fish production hovers around 400,000 metric tons (MT). This is far less than what is required to support the annual fish consumption of her populace estimated at 120 million. For instance in 1997, the fish damage figure was 1.27 million MT.

In order to fill the demand-production gap, Nigeria expended over 200 million US dollars annually on the importation of frozen fish to augment the under production (Dublin-Green & Tobor, cited in Olawusi-Peters& Others, 2014). Also, Nigerian waters are over exploited, thus reducing the volume of fish catch and enhancing the catch of undersized fish; the waters are polluted by oil and run-off of chemicals and fertilizers, the nutrient enhancement leads to alga blooms and mats of water hyacinth impedes navigation, thereby minimizing social and economic activities in the riverine areas.

In addition, the supposed fishery stakeholders, namely, the government, the fishermen-fishers (artisanal and trawling) and fish farmers, fish traders (Processors and Marketers) and consumers

have either directly or remotely jeopardised the objective of sustainable fishery resources by their actions and counter-actions in the past. In order to achieve sustainable fishery development, management strategies need to be enhanced beyond the present level. Survey of resources should regularly be carried out. This will provide ready information on the state and identity of stock, which is used for quick intervention in cases of excessive drop in yield. There is a need for extensive and quantitative study of the artisanal fishery for further development. This is as a result of overexploitation of stock occasioned by excessive fishing and the use of small size net, which results in mortality of young fishes which ought to grow and replenish the stock.

In addition, shellfish remain an understudied, yet critically imperilled fauna. Although knowledge of the shellfish diversity in Nigeria is poor, it is known that Nigeria hosts more than 250 species of endemic coastal water shell fish comprising of shrimps, prawns, crabs, snails, periwinkles, bivalves etc. (Bello-Olusoji, 1997.2004). These species are greatly threatened by habitat fragmentation and degradation, as well as pesticides used in nearby plantation areas (Olawusi-Peters and Bello-Olusoji, 2014).

Fisheries management includes different management measures. Among these are technical regulations on fishing gears in order to obtain the overall goal of high sustainable yield in fisheries. These are regulations e.g., on mesh size to improve the selective properties of a fishing gear so that bycatches of juvenile fish are reduced-in order to safeguard recruitment to the larger size groups of a fish stock including the spawning stock.

Recently, there has been a growing focus on “ecosystem effects of fisheries”, addressing the impact of fishing operations not only on the target species, but also on bycatch of or other effects on non-commercial species or habitats. Energy efficiency, reduced pollution and improved quality of the catch are also important aspect related to fishing gears and fishing operations (Asmund, 2013).

From a situation where the development of fishing gears and methods only focussed on the highest possible catching efficiency for the target species, now fisheries research, fisheries management and the fishing industry are challenged to develop gear, methods and regulations that meet the different considerations mentioned above. This is part of an emerging ecosystem approach to fisheries management.

### **Challenges Faced by the Fisheries Industries in Nigeria**

- a) **Unforceable Policy/Changes in Policy-Making Institutions:** Asmund, (2013) stated that policy-making, therefore, tends to alienate not only the local people but also institutional structures for fisheries research. This makes enforcement of fisheries laws and regulations difficult if not impossible. An example is the “3” mesh size that was recommended by National Institute for Fresh water Fisheries Research (NIFFR) and entrenched in the fisheries decree of 1992. A good number of fisherfolk still contravene this by using lower mesh sizes as they had little or no input into the contents of the fisheries laws and regulation.
- b) **Funding:** Inadequate and untimely release of funds is a major problem confronting fisheries research and capacity to contribute to the livelihoods of the fisher-folk. In most cases, release is less than 1% of the request and also often less than 50% of the final allocation. If and when releases are made, bureaucratic procedures often delay receipts. These processes are unduly long and affect adversely, efforts at carrying out village level field research aimed primarily at the local artisanal fisher-folk (Asmund, 2013).
- c) **Inadequate Personnel:** Due to government’s negligence and poor attitude about agriculture, it has become difficult for even distribution of personnel to local villages for research and impact on the livelihood of the fisherfolk. Adeshinwa and Bolorunduro (2007) in their study identified that awareness and adoption levels of improved fisheries technologies were generally low among all the respondents. This invariably means that inadequate personnel have affected the respondents’ awareness and adoption level of environmentally-friendly

methods of fishing since they cannot become aware or adopt any knowledge without being related with.

- d) **Lack of Viable Co-operatives and Weak Government/Village Level Institutions:** Viable cooperatives and village level institutional structures are veritable platforms for linkage of research provider with research end-user such as the rural fishing communities. The absence or weaknesses of these structures have made the dissemination, application and adoption of results difficult. There is need therefore, to strengthen these local level structures to make them more functional in terms of interaction between fisheries research providers and the fisher-folk and also to enable the latter optimise research results.
- e) **Illiteracy in Rural Fishing Communities:** Like poverty, illiteracy is an all-prevailing phenomenon in rural fishing villages and has negative impact on the flow of information. In almost all cases studies have to rely on interpreters to convey information on fisheries results to local fishermen. Okwu, Yahaya, and Obinne; (2011) in their study on Analysis of Artisanal Fisherfolk Information need and Accessibility in Benue State, Nigeria, identified that the artisanal fisherfolk were mostly married male adults with low level of formal education, low income and low use of modern technologies. The study also revealed that there was a significant relationship between access to needed information and the output of the artisanal fisherfolk at 1% level of significance. There is therefore need to pursue literacy skills among fishermen to raise their level of awareness and to enable them participate actively and adequately in matters affecting their general well-being. This will also increase their advocacy and lobbying capacities.
- f) **Inadequate Number of Extension Agents:** In addition to inadequate funding, inadequate number of extension experts in NIFFR is one of the factors responsible for the low level of interaction between the institute and artisanal fisher-folk. The contribution of NIFFR to the livelihood of artisanal fisherfolk would be enhanced if adequate field extension experts are available for village level research and development. The study carried out by Okwu, Yahaya, and Obinne; (2011) also revealed that age, education and household size had significant effect on fisherfolk access to information. They discovered that the important areas of information need of the fisherfolk were sources of micro credit; modern fish capture methods and aqua culture. It was therefore recommended that adequate fisheries extension service should be provided in the fishing communities. This is to ascertain the need and importance of extension officers' regular visit to the fishing communities. Example is the Rivers State Ministry of Agriculture where Agricultural Extension has become a thing of the past due to the state's negligence to agricultural issues; if not the services from the office of the ADP.
- g) **Conflicting Government Policies:** The frequent conflicting policies of government separating research from development have not helped demand-driven research aimed primarily at enhancing the livelihood needs of research target beneficiaries. In the absence of a strong central coordinating unit, government policies should encourage a dual role of Research and Development for fisheries research providers (SFLP/DFID, FAO,2002).

### **Effects of Fishing and Fishing Methods on the Ecosystem**

For a proper evaluation of the effect of fishing on the ecosystem according to Olawusi and Others,(2014), to identify the fishing methods that can be regarded as ecosystem-friendly or otherwise environmental-friendly, the methods have to be x-rayed one after another thus:

#### **Gillnet**

Gillnet are considered to be very size selective, with catches of fish sizes that correspond well to the chosen mesh size. However due to entangling a small proportion of larger and smaller fish may be taken. The species selectivity of gillnets is not particularly good and as different fish species grow to different sizes, there is always a possibility of catching juveniles of a large species when using small mesh gillnets for a smaller target species. Another negative impact of

gillnets is the bycatch of sea birds, marine mammals and turtles. Little is talked about by-mortality of fish after escapement from gillnets. Ghost fishing is one of the most criticized aspects of gillnet fishing. Gillnets that are operated with soak times of several days tend to produce catches of inferior quality, as fish caught early in the fishing period may die and start to deteriorate long before the nets are retrieved (Eyo and Ahmed, n.d).

**Trammel Nets:** Trammel nets have very poor size selective properties and they will also catch a greater variety of species. There is no problem of ghost fishing since there is no risk of gear loss due to the fact that they are generally operated in shallow water.

### **Handlining and Trolling**

Handlining and trolling are not particularly size selective and not very species selective too. They are commonly used in specific seasons or at specific grounds to catch only one or a few species. Handlining and trolling are generally regarded.

### **Longlining**

Here, different species make use of different bait; so the species selectivity of longlines can clearly be affected by the type of bait used, as different species have been shown to have different bait preferences. The size selective properties can partly be regulated by the hook and bait size as many studies according to Asmund (2013) have shown a correlation between the size of hook and bait and the size of the fish caught. It is attractive and catches large fish. It causes bycatches, especially of different seabirds. By-mortality, ghost fishing, and energy efficiency is high.

### **Pots**

In pot fishing, there is no problem of by-mortality. It has only a negligible effect on bottom habitats but has a certain risk of ghost fishing, as lost pots may continue to fish long after they are lost. It has high energy efficiency and good to superior catch quality, as the catch normally remains alive and in good condition.

### **Traps**

Due to the construction of the mesh, they allow for easy release and high survival of unwanted catch organisms. The actual selectivity properties may be good, the by-mortality is low, they have little adverse impact on bottom habitats, they do not create ghost fishing problems and the energy efficiency and catch quality of trap fishing is high (Olaniyan, 2015).

### **Spears and harpoons**

The capture of fish and other animals by spears and harpoons is probably one of the most environmentally-friendly fishing methods. By their nature, the fisher can be very selective regarding the size and species of prey. Apart from some by-mortality of animals that escaped and, when used in reef areas and the damage of coral, there are no substantive adverse effects related to ghost fishing or habitat destruction and the energy efficiency and catch quality is high.

The knowledge of fishing practices makes it very easy for one to discover their effect on the ecosystem. The following are carefully outlined according to Olaniyan, (2015), Olaronke-Peters, and Bello-Olusoji, (2014); and Asmund, (2013):

1. The removal of the organisms caught in the fishery, destruction of the bottom habitats like corals, ghost fishing, pollution etc.
2. The selectivity of fishing methods and fishing gears bring about incidences of bycatch (a situation where anything beyond the species and sizes of the targeted marine organisms are caught); discards (a situation where marine organisms are caught either intentionally or otherwise and thereafter thrown back in to the water dead or alive); by-mortality (a situation where mortality of marine organisms are caused from injuries they encounter with the fishing gear during the fishing process); ghost fishing (a situation where marine organisms are



captured by lost or abandoned fishing gear); habitat effects (this is a situation where the use of dragged demersal gear like beam trawls, otter trawls and dredges destroy the bottom habitats which takes too long a time to recover); Catch quality (the quality of fish is made poor when the gear is left to soak for too long time and the catch is allowed to die in the nets and either rotting or becoming damaged by scavengers or is reined by squeezing in the trawl bag or becomes of inferior quality because of too long storage on deck before it is processed);

3. The use of energy, particularly fossil fuel, is also an ecosystem related aspect of fisheries. The energy efficiency (i.e. fuel consumption per unit of landed catch varies considerably with different fishing gears and methods, from negligible use of fuel to more than 1 litre of fuel per kilogramme of landed catch.
4. Fisheries can contribute to air pollution through emission of combustion gases. The relative pollution effect from different fisheries is closely related to their energy efficiency. Pollution of water from fisheries is mainly by loss of fishing gear or by deliberately discarding old gear and equipment as well as oil products and chemicals at sea (Asmund, 2013).

### **Environmentally-Friendly Methods of Fishing**

Environmentally-friendly methods of fishing can be defined as the methods which allow man to earn his living and also allow other living organisms to survive in order to continue to perform their own duties toward man and the entire ecosystem without degrading the environment. COM., 2004; said it is also known as fishermen friendly because it helps to maintain the necessary environmental balance for stable and predictable economic activity.

Eyo & Ahmed (n.d); and Olaniyan, (2015) supported COM, (2004) to say that fisherfolk need healthy fish stocks in a balanced environment and any fishing done in an environment contrary to this is regarded as unfriendly and unsustainable even to the economy. This is so because it will not contribute to the promotion of the sustainable economic and social condition of the fishing sector. Environmentally-friendly fishing helps to maintain the necessary environmental balance for stable and predictable economic activity. This is why it is known as fishermen-friendly. COM, (2004) identifies within an integrated management approach, three main objectives related to conservation and the development of environmentally-friendly fishing such as:

1. **To reduce Fishing Efforts to Sustainable Levels and Keep it there:** Reduction of the fishing pressure to sustainable levels will stop the rate of fish mortality (the state where fishes of all ages are killed) which has recently been so high that the stocks are under threat of collapse.
2. **To Optimise Catches of Target Species and Minimise Unwanted Catches:** By this objective, fishing operations shall be made as selective as possible so that only the target specimens of the right species and sizes with minimum impact on other species or juvenile fish of the target will be caught.
3. **To Minimise the Impact of Fishing on Habitats:** These objective demands that fishing gears should be specified and areas of operation restricted to avoid the instance where some types of fishing gears damage or even destroy sensitive marine habitats.

### **Ways to Reduce Fishing effort to Sustainable Levels**

The Council also examined briefly the methods of achieving each of the objectives thus (Asmund, 2013):

- i. By establishing a recovery plan for the endangered stock, so that the areas be allowed to recover from the over exploitation for a period of time.
- ii. By enacting some community laws that will monitor any one or group of persons who will in any way violet the recovery plan.

### **Ways to optimise the catches of target species and minimise unwanted catches**

- i. By adopting fishing gears which are selective and can only catch such fish that it is meant to catch; by this the juvenile fish will remain to grow into maturity thereby giving way for optimal catches. This will also reduce the rate of discards in fishing in community waters.
- ii. By reducing fishing effort in order to rebuild the abundance of adult fish and contribute to the reduction of juvenile catches.
- iii. By increasing mesh sizes as this will limit the rate of fish discards.

Summarily, Olaniyan (2015) and Olaronke-Peters (2014) confirmed with Asmund, (2013) that environmentally-friendly methods of fishing entails making fishing more species-and-size-selective without compromising catches of target species by gear specifications such as the use of square-meshed panels or other devices which permit non-target species to escape from the net; closed areas and seasons to protect spawning grounds or nursery areas; bans on the use of certain fishing gears, or restrictions on the size composition and species composition of landings. From the foregoing of the plans, it is clear that the priority is on unwanted catches which are considered non-sustainable and may endanger the species concerned and a lower priority to be placed on by-catches because they are insignificant both in biological and economic terms. Evidence identify that the limitation of drift-net can prevent the incidence of by-catches and that unwanted catches are caused by some lost gears referred to as “ghost nets”. Unwanted catches and discards are regarded as waste of resources; therefore, effort should be made to report for the removal of every lost gear from the sea bed to avoid this waste which also stands against the sustainability of the environment and the fishing activity.

### **Ways to Reduce the Impact of Fishing on the Habitat**

Habitat is the place where an organism lives (Encarta Dictionary). It is a place which is suitable to its way of life. Example in this case could be especially sensitive habitats within the community waters like reefs (cold-water coral reefs, stone reefs) which are often highly productive and are host to very many different fauna and flora. Fishing on reefs may alter the physical structure to the extent that the unique biological status of the habitat of the fish is threatened. Sikoki, (2013) confirms that environmentally-friendly methods of fishing will promote protection of living aquatic resources and their environment. Therefore for effective reduction of the impact of fishing on sensitive habitats, it may be necessary to close the area to some types of fisheries and gear specifications would also help in well identified cases (COM, 2004).

### **Ways to Balance Environmental and Economic Sustainability**

It is glary and also possible to note that the application of environmentally-friendly methods of fishing may not be easy as the fishermen would need to invest in some new equipment's or get involve in some losses of revenue due to some reduction and regulation or laws binding them on some fishing methods. That notwithstanding, the fishermen need to understand that there is future and long-term benefit despite the short-term losses.

### **Environmentally-Unfriendly Method of Fishing**

Due to the environmentally-unfriendly methods of fishing in our rivers and creeks by the artisanal fisherfolk, the tiny fish which would have grown to maturity and reproduce younger ones (fry) are killed through the use of tiny-sized nets, mesh and traps and even chemicals. Moreover, in a situation where fishes of all sizes are cleared and when selected, larger ones are picked and tiny ones are thrown away or back into the river dead, they can only get rotten and waste away instead of a situation where they could be selected and thrown back into the river alive to enable them get mature and produce more fishes.

By the above techniques, a lot of species of fish have been endangered in the rivers and creeks. This has also caused the scarcity of fishes thereby rendering the people poor. Such destructive

fishing practices devastate the marine environment. Unfriendly and destructive practices such as bottom trawling; by-catch; the use of poison and explosives; ghost fishing and many others have been universally recognised dangerous, degrading and devastating and as such, should be banned and offenders punished (Olaniyan, 2015). To be convinced of the devastating effects of these practices, it is better to have a brief review of how they are carried out:

**Bottom Trawling:** This is an industrial method which uses enormous nets weighed down with heavy ballast which are dragged along the sea floor, racking up or crushing everything in their way; from fish to ancient coral. With this method, many species, including those at risk of extinction, are accidentally caught and then thrown back onto the sea, often already dead. These unfortunate losses known as discards can count up to 80% or even 90% of the total catch. Large areas of the seabed, the habitat where fish find food and shelter, are crushed and flattened. This method leaves scars on the seabed and its damage on the ecosystem can be permanent. It churns up sediment, creates turbid water and makes it inhospitable to life. This type of fishing obliterates the natural environmental features where marine animals would normally live, rest and hide. This practice is accused of having contributed heavily to overfishing and it is a striking illustration of the lack of global fisheries management (Olaniyan, 2015).

**By Catch:** By catch refers to all the forms of marine life caught unintentionally while catching other fish. By-catch can include the wrong size of the target species, other species that are not eaten or for which there is no market and banned or endangered species such as certain birds, turtles and marine mammals. Some fish are discarded for many reasons one of which is; the sizes of fish caught are not wanted or even needed. The great proportion of this by-catch; about millions of tons each year is thrown back into the sea dead or wounded.

Recently a WWF report estimates that by-catch represents 10% of global marine catches and that in many cases the fish discarded are juveniles. It is easy to identify what consequences such devastation has on the ability of a species to reproduce and regenerate stocks. By-catch also represents a monstrous waste of food, for both human and marine predators.

### **Poison and Explosives**

The use of poison to kill or stun fish is very common, in both fresh and salt water including coastal lagoons and coral reefs. In many places the use of poison to catch fish is a traditional technique but negative effects have multiplied since plant-based substances were replaced by chemical poisons. These kill all the organisms in the ecosystem, including the corals forming the reef. The use of chemicals for killing fish in the river or creek is a very dangerous style or technique and this has serious negative effect on both human and non-human components of the ecosystem (Eyo & Ahmed n.d).

The use of explosive for blast fishing has also been around for centuries and is on the increase. Explosion can produce very large craters, devastating between 10-20 square metres of the sea floor. They kill not only the target fish, but all the other surrounding fauna and flora. In coral reefs, reconstruction of the damaged habitat can take decades. This method of fishing is hazardous to human and non-human as some could cause amputation of man's vital part like the arm. Another harm caused by explosion is the indiscriminate killing of fish and other aquatic living organisms.

### **Ghost Fishing**

Ghost fishing is the result of nets and other fishing materials that are accidentally or intentionally abandoned in the sea. These nets continue to senselessly trap fish and shellfish and even large marine mammals which die of exhaustion or suffocation after struggling to get to the surface to breathe. The problem of abandoned or lost equipment has been amplified by increased fishing activity and the introduction of nets and line made from long-lasting synthetic material.

### **Oil and Gas Pollution**

Another aspect is the pollution caused by the explosion of oil and gas into the water body

causing the scarcity of these natural resources. This has led to a condition where some species of fish, periwinkle, oyster and many more species of shellfishes can no more be accessed; and if scarcely found, they are rather tiny in size or incapacitated in one form or another. It could be said that the exploration of oil and gas in the area has caused the scarcity of fish in the water thereby making the fisher folk to adopt any type of strategy and technique to kill fish without minding the harm they cause to themselves or the environment (Olaniyan, 2015).

### **Methods of Fish Preservation (Fish-Smoking)**

Another area of environmentally-unfriendly impact is the method of fish preservation which is smoking. In most cases, this is the major method of preservation since there may not be available electricity to encourage refrigeration except for the little quantity harvested close to the urban settlements; which might be frozen or some ice block being place on the fish to preserve them for some time. This may not last longer and cannot be used in the fishing settlements far away from the urban areas (Ephraim, 2015).

This activity (Fish smoking methods) could be unfriendly because of the destruction of the mangrove forest (which houses different kinds of fauna and flora meant to maintain the equilibrium in the ecosystem and saves lives of both human and animals) for firewood used for the smoking of the fishes. Due to this activity (indiscriminate felling of mangrove trees for firewood) has rendered several species of fauna homeless and had also led to their extinction. It also endangers the lives of the fisher-families as there could be cases of fire-outbreak where the smoking is usually done in the living room or environment. The health of the fish-mammies is also at risk because they inhale all the smoke from the fire. Their eyes which are affected could cause eye diseases like cataracts to mention but a few (Tawari and Davies, 2009).

### **Methods of Waste Disposal**

Another aspect according to Ben-Yami, (n.d) is the method of waste disposal of the remains from the fish. For instance, when the fishes are prepared for consumption or for proper preservation, the waste is always disposed around the living environment. This pollutes the environment and attracts flies, rodents and reptiles which are not healthy to humans. They also dispose their human waste into the water ways (even though they may not be the only culprit of this offence) which goes along to pollute the water bodies, the aquatic organisms and makes it difficult for them to access good drinking water. The method of the fisherfolk human waste disposal can also be regarded as unfriendly in a situation whereby the fish eat their excreta. In such a case, fish are contaminated and their consumption becomes dangerous to health. In the same way the water becomes contaminated when chemicals are used to kill fishes. The pollution causes serious danger to man's health conditions.

### **Health and Welfare of the Fisherfolk**

Apart from the case of pollution, the living condition of the fisherfolk who scarcely enjoy balanced diet as they depend solely on their produce can be regarded as unfriendly and also a problem. This can be seen in a situation whereby the population of residents in one hut can give rise to over crowdedness and diseases that are associated with it such as communicable diseases.

Furthermore, Asmund, (2013) observed that, due to the proximity of the fishing settlements from the urban areas, it becomes difficult for them to access fresh vegetables, fruits and other food items that might supply other food nutrients apart from those fishes may supply to their body. They do not also have enough time to take care of their health hence they continue fishing in order to be able to feed their families at the detriment of their health. In this case, they rather patronize quack-health practitioners when their health conditions become worse.

This action could also be caused when their catch is low, they will only get the little to eat and sell the rest to augment for other areas of livelihood with the hope that they can still go a fishing the next day. This situation is more serious and dangerous if the tide or season is not in their favour. Hunger may creep into the family and they may even lack what to mend their gears with.

This is the condition or situation where the female folks (customers) who buy their fish take advantage of them to lend them some money to survive with or buy their gears and thereafter exploit them through their catches when the condition improves. Dangerous to lives of fisherfolk is accident, a situation where the canoe or boat capsizes and there are loss of lives and properties (Ben-Yami n.d.). Fishing is a dangerous and delicate occupation hence proper care must be taken to save and maintain lives.

More to think of is the heat and smoke which emanates from the fish fire which releases excessive smoke (carbon monoxide) into the atmosphere (one of the causes of climate change which turns around to affect them in the form of flood). This smoke in a way damages the eyes of the Fish Mammies. The children, who sleep where their mothers are, suffer the heat since the fish smoking is done in the living environment. (Ben-Yami, n.d.) cited an instance when a healthier and efficient smoke houses were rejected by the fish mammies with the claim that they must smoke the fish in their living houses so that they may at the same time look after their children.

**Potentials of Environmentally-Friendly Methods of Fishing.** It is very necessary to let the fisherfolk understand what they and their unborn generations stand to gain so as to encourage them to move in line with the directions of environmentally-friendly methods of fishing thus:

- i. They will benefit directly from increased fish production, improved income, food security and improved management of their businesses.
- ii. They will participate in decisions affecting the sustainable exploitation of fish, and the entire marine resources.
- iii. Some will be able to buy fishing gears on cash bases and the non-fishers will benefit from employment opportunities. This is because there will be increased demand for processing, marketing and support services such as boat repairs and maintenance, fish-related small-scale enterprises and labourers at the landing sites as well as fish processing plants.
- iv. They will have improved access to fishing input and increased income through better training, regular input supply, better processing of their products and improved access to markets.

It is very necessary for us to encourage environmentally friendly-methods of fishing, mostly now that we are consciously moving beyond oil and gas into agriculture for the survival of Nigerian citizens if not we would not be running away from pollution which oil has over times caused or exposed us to. This was adopted during the Nigerian Guild of Editors Annual Conference, 2013 held in Asaba, Delta State Capital on 22/08/2013; with the Theme- “Nigeria Beyond Oil Initiative”. If Nigeria must invest in agriculture as it was clamoured in that conference among other occasions, it must be environmentally-friendly agriculture which would help man run away from pollution which oil and gas has exposed man to (Senator Ayim Pius Ayim (SGF), Dr Ngozi Iwuala, World Bank Director, Delta State Governor, and Dr. Emmanuel Oduaga).

## **Conclusion**

This study was based on widely adopted theoretical frameworks for message development which is theory of behaviour change which have been repeatedly corroborated by research and stand today among the most successful and intuitively appealing theoretical frameworks for social intervention programmes not only on environmental adult education where they are used extensively but in many other fields like agriculture. Essential concepts in the field of EAE which are Awareness, Knowledge, Attitudes, Skills, Participation and Actions were reviewed.

Issues on fishing in Rivers State were diagnosed, the methods the fisherfolk have been using, what better methods that could be used which would be environmentally-friendly and what programmes could be used to pass the message were all discussed. The necessity of EAE that could promote environmentally-friendly methods of fishing among the fisherfolk were also discussed.

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