FSN-FM 0013

THE COMPLEMENTARY ROLES OF CAPTURE AND CULTURE FISHERIES IN SUSTAINABLE FISHERIES RESOURCE USE

FRANCIS, AMIYE AND IBIM, TONYE

Department Of Animal Science and Fisheries, Faculty Of Agriculture, University Of Port- Harcourt, Rivers State, Nigeria

This paper was prepared for presentation at the 25th Annual International Conference and Exhibition in Administrative Staff College of Nigeria (ASCON), Topo-Badagry, Lagos, Nigeria, 25th – 29th October, 2010.

ABSTRACT

The pari parsu development and good management of both capture and culture fisheries if proactively practiced especially in coastal and marine ecosystems would, to a large extent ensure sustainability in the usage of the fisheries resource, and conservation of biodiversity. While by-catch, discards and less desirable fish can continue to be useful inputs in aquaculture, the practice of environmentally sustainable aquaculture on the other hand would lead, not only to the reduction in pressure on the wild fish stock , but also become a source of socio-economic and technological development. The risk of weakened and reduced genetic diversity in aquaculture is being offset by enrichment of genetic pool from the wild fish population. In this review, the losses and gains of capture fisheries have been highlighted in addition to the gains and negative impacts of aquaculture. The success of Capture-Based Aquaculture (CBA), enhanced fisheries, restocking and intentional introduction of fish species are all based on either branch of fisheries (capture and culture fisheries). The complementary roles both capture and culture fisheries can play to ensure optimal environmental usage and profitable use of the fisheries resource have been discussed. The strengths and weaknesses of both capture and culture fisheries can be wisely tapped for the development of both aspects of fisheries.

Keywords: Capture and culture fisheries, complementary roles.

INTRODUCTION

The depletion of wild fish stocks is globally acknowledged (Fellmann *et al*., 2003; Lackey, 2005; World Wide Fund for Nature, Eastern African Marine Ecoregion WWF EAME, 2004; FAO, 2007). Causes of fish stock depletion include overcapacity, overfishing, destructive fishing methods and practices, pollution, ecological change, environmental degradation and climate change (Speer, 1995; World Bank, 2009).

This disturbing downward trend in landed catch statistics over the years must have set the minds of many into action in order to come up with strategies, measures and approaches that should reverse the trend and ensure sustainable fishery resource exploitation. The result is the array of fisheries management measures and approaches that are gradually being implemented globally. Besides, the knowledge that about 71% of the planet earth is aquatic habitat, the home of fishes is enough reason for the emergence of many fisheries management measures and approaches backed up by many international instruments like the FAO code of Conduct for Responsible Fisheries and its guidelines such as the Precautionary approach to fisheries management. The idea behind the implementation of the contents of these guidelines the rehabilitation and build up

of depleted or collapsed fisheries, or sustainable exploitation of the current population size.

The essence of this review is to reveal the need for the *pari parsu* development of both capture and culture fisheries, knowing that an aspect alone can neither ensure food security nor the conservation and protection of the environment, its resources and services. Royce (1984) has written of the great transition from capture to culture fisheries, in this paper the focus is on the development of both arms of fisheries so that both can. enjoy equal attention for an all round profit to mankind and the environment.

CAPTURE FISHERIES: ITS GAINS AND NEGATIVE IMPACT

History and Profits of Capture Fisheries

According to Lackey (2005) capture fisheries has sustained the human society for nutrition, employment, recreation and socio-economic development as far back as 90,000 years before the present. The most commonly known way of harvesting aquatic resource, capture fisheries has been practiced since prehistoric periods. It was thought that the fisheries resources in the wild would never be exhausted but scientific research and catch statistics has proved otherwise. According to Royce (1984) the introduction of stream propulsion and otter trawling into the North Sea fisheries revealed the exhaustible state of Sea fisheries. Revelation of the fact that the aquatic marine resources were not inexhaustible led to many developments such as the North Sea convention in 1882 in the bid to find solution to the problem of over fishing and destructive fishing practices; which solution was hard to come by. Consequently, increasing public concerns about the depleting state of the fisheries resource led to the birth of fisheries science (Benson, 1970 in (Royce, 1984)), and establishment of organizations such as the American Fish Culturist's Association (now the American Fisheries Society (AFS) in 1884, the International Council for Exploration of the Sea (ICES) in 1902 and Food and Agriculture Organization (FAO) of the United Nations in 1945.

Using India as an example, its inland capture fisheries contributes about 30% of total world fish production; and is expected to continue to provide great potential for economic capture fishery, they by competing well with the fast growing aquaculture in that nation. With about 9 million people engaged in subsistence capture fishery Royce (1984) within coastal and Inland communities, production from the wild tripling between 1950 and 1970, and millions involved in recreational and industrial fisheries, its impact on the human society in terms of socio-economic and technological development has been tremendous (FAO, 1998). In Nigeria, while 80% of the fish supply is from the artisanal sector, 6% comes from aquaculture (Adewumi and Fagbenro, 2009).

Negative Impacts of Capture Fisheries

Most of the negative impacts of fishing accrue from the use of environmentally unfriendly gear such as fishing trawls that scrape off demersal fish populations thereby destroying the sea floor with its benthic communities, and a resultant distortion of the environment and food chain. Other negative effects emanate from the use of illegal mesh sizes of net that produce large quantities of by-catch and subsequent recruitment overfishing. The practice of fishing with dynamite and poisons is capable of wiping out large populations of aquatic organisms, disrupt food chains and cause failure in recruitment, or cause growth overfishing. Environmental degradation therefore, can result from environmentally unfriendly fishing methods. At fish landing sites, there could be space congestion and noise due to high traffic and the subsequent disturbance of the littoral and sub-littoral aquatic communities.

CULTURE FISHERIES: GAINS AND NEGATIVE IMPACTS

Aquaculture, the farming of the natural produce of water (fish and plants), and also known as the agriculture of the oceans, is both land and water based; being practiced in ponds, canals, rivers, streams, flood plains, swamps, reservoirs, tanks, in cages and pens within the open sea, or in the use of structures such as stakes, lines or rafts to provide attachment for sessile and benthic organisms (FAO,1998). Other aquaculture practices include restocking, enhancement, and introduction of species. With the exponential rise in world population, the increase in aquaculture to meet the demand for safe source of animal protein is equally growing. Specifically cultured organisms include algae (sea-weeds), sea urchin, crustaceans, molluscs, fin fish, frogs, and reptiles.

According to FAO (2007) aquaculture has been practiced, perhaps for millennia in Asia, and the increasing demand and consumption of its products has spread further from the coast due to sophisticated processing techniques such as freezing. A very long tradition of aquaculture has been associated with China, and they are still prominent in this sector as reflected in current production levels (FAO, 2007). For India the age long tradition of extensive pond aquaculture without fertilizing and feeding is common, so also the rice cum fish culture practice in the mountains of Northern Laos and Northern Vietnam, including the thriving pond and rice/fish culture in Java. The need to overcome the challenges faced in capture fisheries to increase production resulted in a situation where considerable attention was given to culture fisheries to the neglect of capture fisheries. Consequently, culture fisheries has undergone much development in all the water systems in Asia.

PROFITS FROM CULTURE FISHERIES

The benefits of aquaculture have ranged from being an efficient protein/food production system to providing food security, ensuring optimal use of water and land resources, to becoming an avenue of socio-economic development because of the numerous associated industries. FAO (1998) listed the gains from aquaculture to include viz; increased primary production and compensation for the low growth rate of capture fisheries, rehabilitation of coastal rural areas by re-using degraded land and the practice of enhanced fisheries (release and stocking of hatchery- reared organisms) into coastal waters. Others include the use of nutrients and organic enrichment by cultured molluscs and seaweeds, thereby eliminating eutrophication of natural aquatic ecosystems; and the enrichment of oligotrophic waters through nutrients and organic waste releases from aquaculture farms. As noted by Edwards (1999), the benefits from aquaculture as a means of sustainable livelihood to the rural poor include the provision of good quality food, especially for infants, pre-school children, pregnant, and lactating mothers; providing stable market through seed distribution networks, as well as income generation through the sale of high value fish products.. Benefits from otherwise under-utilized fisheries resources through cage and pens culture, enhanced fisheries in common property water resource, especially for the landless. Adopting rice/fish culture as an aspect of integrated pest management, ensuring food security through the availability of low-cost fish in local markets, contributing to the growing share of global fish supply for the marine sector mainly through seaweed, molluscs, and the common carp *Cyprino carpio* culture in freshwater system are all benefits from culture fisheries.

The report of FAO (2007) that 15-30% of the farmed groupers in Indonesia come from hatchery seed is proof of the gains

from aquaculture. Well-maintained aquaculture set-ups rather than increase, bring about the control of populations of pests/vectors (insects and snails) of agricultural and medical importance.

NEGATIVE IMPACTS FROM CULTURE FISHERIES

The negative impacts of aquaculture on the environment include loss of agricultural land and ground water, loss of ecologically sensitive habitats, deterioration of water quality FAO (2007), and reduction in carrying capacity of aquatic environments. Other impacts include destruction of productive ecosystems such as mud flats and mangrove vegetations to shrimp culture, especially in Asia. More problems that can emerge from the development of aquaculture to the neglect of capture fisheries include scarcity of fishmeal, fish oil and loss of biodiversity. Change in benthic communities, negative impacts from escaped farm animals; competition with and replacement of native species, outbreak of diseases associated with high stocking density, environmental pollution through fish feed and other wastes from fish farms are all adverse effects of aquaculture. It was thought that aquaculture would replace capture fisheries in terms of consumption and meeting raw material needs of industries, but aquaculture alone cannot provide the answer to the depleting issue of fish stocks in the natural environments as can be deduced from the negative impacts from its practice. Besides, aquaculture alone cannot supply all that is obtained from the natural aquatic ecosystem. As it is with other human activities, hazards and risks, which can affect human health are inherent in aquaculture practice, hence, the necessity of implementing Hazard Analysis and Critical Control Point (HACCP) plans when handling and processing fishery products. It has been noted that the three main threats to genetic diversity within species include extinction, hybridization, and loss of genetic variation within and between fish populations (FAO, 1998). Aquaculture seems to be an avenue through which these threats can become a reality within a short period of time, thus causing much distortation in nature if its development is pursued to the neglect of capture fisheries.

From the foregoing, the solution to the problem of fish stock depletion, therefore, seem to rest with restoration of lost biota and habitats through environmental friendly management and conservation approaches; and the side by side development of capture and culture fisheries.

COMPLEMENTARY ROLES OF CAPTURE AND CULTURE FISHERIES

Observations in the fisheries developmental programmes of China, the world's largest producer and exporter of fishery resources, with its well established fish seed technology, can clearly demonstrate the complementary roles of both capture and culture fisheries.

Indicators of the complementary roles of capture and culture fisheries.

FAO (1998) reported, and as well warned that both capture and culture fisheries are capable of generating positive and/or negative impacts on the coastal areas, hence the need for caution in defining policy measures for the fisheries sector, which of necessity has to be conscientiously done, taking both aspects into consideration; in addition to applying the FAO precautionary principles and other FAO Code of Conduct for Responsible Fisheries Guidelines. Areas where these complementary roles are visible include viz; the supply of fish meal and oil to industries, contribution to genetic diversity through capture fisheries, as well as the heavy dependence of aquaculture on coastal area for space and resources in some countries.

On its own, aquaculture has been a tool for alleviation of poverty in rural areas, being

a means of socio-economic development in many countries; as such, technologies for best practices need to be in place through cutting edge researches. That China with its relatively well established seed production technology and infrastructure still invests in aquaculture should awaken the consciousness of investing in both capture and culture fisheries, which of course is all in the bid to ensure sustainability and conservation of biodiversity. The insufficiency of just one arm of fisheries (capture or culture) shows in the report of FAO (1998), of the need to improve, strengthen and promote genetic conservation through introduction of aquatic organisms from other regions. By bringing the health of the ecosystem used for aquaculture into focus, the constraint to avoid exceeding its carrying capacity leads eventually to augmenting culture harvests with catch landings, the report in FAO (1998), for care in exploiting new non- aquaculture areas corroborates this reasoning.

One characteristic of renewable natural resource is the capacity for availability of surplus yields and perpetuity. This implies that if pressure on capture fisheries is reduced, biological surplus would always be available for sustainable harvest. Francis, Sikoki and Ansa (2007) recommended the practice of coastal aquaculture which should lead to a reduction in pressure on the wild fish stock as well as ensure socio-economic development through re-directing attention of some of the fisher folk to aquaculture and its several associated industries. For the purpose of reducing pressure on the wild fish population, relevant aquacultural practices include fisheries restocking and enhancement programmes, scientifically informed intentional introduction of fish species and mariculture. These aquacultural practices, however are not without grave consequences when practiced without recourse to the FAO precautionary principles for fisheries management. The bottom line in the practice of any of these forms of aquaculture especially in the marine ecosystem, is that fish from the wild will still be relevant at one point or the other in order to conserve or increase genetic diversity of the spawner population. Besides, there are some fish species that cannot be reproduced yet in captivity

For Lackey (2005) it was the limitations of aquaculture as a tool to supplement or replace wild fish population that led, by the 1900s to the establishment of harvest regulation, which on its own did not proffer the much needed solution for sustained harvests. Over the years, however, fisheries management has advanced from limiting access, technical and traditional fisheries management measures to the existence of modern management approaches such as the Ecosystem Approach to Fisheries management (EAF), co-management, community based management, participatory management *etc*. and the application of the FAO Precautionary principles, yet the implementation of these approaches are still a far cry from expectations. Noting the negative impacts of aquaculture on the environment and the use of Environmental Impact Assessment (EIA) to control them, FAO, (2007) observed that EIA, though activity and farmer oriented does not provide detailed information to mitigate against the damage done to the environment. Concerted effort towards avoiding negative impacts of aquaculture can be deduced from the development of programmes that should integrate ecosystem approach to fisheries management into aquaculture such as Ecosystem Approach to Aquaculture (EAA), Ecosystem Approach to Sustainable Aquaculture (ECASA), and the Global Partnership for Safe and Sustainable Aquaculture (FAO, 2007). The dissenting perspectives on benefits and negative impacts of both capture and culture fisheries is a good indicator of their complementary roles. Quite acceptably, according to Bene and Heck (2005),

aquaculture could be an alternative to capture fisheries in meeting the protein needs where the potential is high, the obstacle being that enormous challenges from the negative impacts must first be overcome, thus indicating the insufficiency of culture fisheries to supply man's protein needs.

According to Katavic and Tičina (2005), the production of some shellfish e.g. the Mussel *(Mytilus galloprovincialis),* the Japanese littleneck clam *(Tapes semidecussatus),* the European flat oyster *(Ostrea edulis)* and the Pacific oyster *(Crassostrea gigas)* depend on both harvesting and aquaculture.

The practice of capture based aquaculture(CBA), the collection of "seed" material from early life stages to adults from the wild and the subsequent on-growing to marketable size in captivity using aquaculture techniques (FAO, 2007) is also indicative of this complementary role. The importance of CBA is reflected in the fact that it is 20% of the total quantity of food fish production from aquaculture (FAO, 2007). The fin- and shell- fish usually produced under CBA include molluscs (mussels and oysters) and finfish (carnivorous species such as the milkfish, serranidae, tunas and eels). The trend so far as highlighted by both capture and culture fisheries, of the insufficiency of any of these types of fisheries to satisfy man`s expected needs from the fisheries resource and its environment is an indicator of their complementary roles. The dissenting perspectives on meeting the protein requirements through capture and culture fisheries points to their complementary nature

CONCLUSIONS AND RECOMMENDATIONS

The global consensus that most accessible fisheries have almost been irreparably depleted imply that capture fisheries needs to be proactively developed since the 71% of planet earth, which is the habitat of fishes, cannot be ignored. The dependence of aquaculture on capture fisheries, coupled with the demand for proper harnessing of the fisheries resource and its environment for continuity through environmental friendly approaches and principles, all make the complementary development of capture and culture fisheries imperative.

The practices and observations discussed under section 4 reveals that indeed capture and culture fisheries should be seen as the two different sides of a coin whose development should be carried out in *pari parsu*. The implication of this complementary roles of the two types of fisheries is that the development of aquaculture should not be pursued to the neglect of capture fisheries since both have their advantages and disadvantages. The strength of one makes up for the weakness observed in the other. Both fisheries, therefore are inextricably important to ensure, Lackey (2005) the "attainment and continued satisfaction of human needs for present and future generations in an environmentally non-degrading, technically appropriate, economically viable, and socially acceptable manner; such that land, water, plant, animal and genetic resources are maintained".

REFERENCES

Adewumi, A.A. and Fagbenro, O.A. (2009). Fisheries and Aquaculture Development in Nigeria: An Appraisal. Proceedings of the 24th Conference of the Fisheries Society of Nigeria (FISON) Akure 174-178.

Edwards, Peter (1999). Aquaculture and Poverty: Past, Present and Future Prospects of Impact. A Discussion Paper Prepared for the Fifth Fisheries Development Donor Consultation, Rome, Italy.

FAO (1998). Natural Resources Management and Environment Department. Integrated Coastal Area Management and Agriculture,

Forestry and Fisheries. *FAO Guidelines*. Rome.
http://www.fao.org/docrep/W8440E/W8440e00.htm
FAO (2007). Fisheries and Aquaculture Dept. The State of the World Fisheries and Aquaculture 2006: Rome.
Fellmann, Jerome D.; Getis, Arthur; Getis Judith (2003. Human Geography Landscapes of Human Activities 7th Edition McGraw Hill Public 576pp.
Francis, A., Sikoki, F.D. and Ansa, E.J. (2007). Exploitation of Fishes from the Andoni River System, Niger Delta, Nigeria and Conservation Strategies. Journal of Fisheries International 2(1):17-21.
Katavic Lvan and Tičina Vjekoslav (2005): Fishing and Farming of the Northern Bluefin Tuna *(Thunnus thynnus l..)* in the Adriatic Sea. *General Fisheries Commission for the Mediterranean* No.78, Rome. 229pp.
Lackey, Robert T. (2005). Fisheries: History, Science, Management. Pp121-129. In: (eds.) Water Encyclopedia: Surface and Agricultural water, John Wiley and Sons, Inc., Publishers, New York, 781 pp.
Royce, William F. (1984). Introduction to the Practice of Fishery Science, Academic Press Inc. London 427pp.
WWF (2004). Towards the Establishment of an Ecologically Representative Network of Marine Protected Areas in Kenya, Tanzania and Mozambigue. WWF. Dares Salaam, Tanzania. 74pp.