

**TRANSFORMING AQUACULTURE FROM SUBSISTENCE TO COMMERCIAL LEVEL FOR SUSTAINABLE DEVELOPMENT IN NIGER DELTA REGION OF NIGERIA**

\*<sup>1</sup>AKINROTIMI, O. A <sup>2</sup>ABU O.M.G AND <sup>3</sup>ARANYO, A.A

<sup>1, 3</sup>African Regional Aquaculture Centre/Nigeria Institute for Oceanography and Marine Research, P. M. B. 5122, Port Harcourt, Rivers State Nigeria.

<sup>2</sup>Department of Animal Science and Fisheries, Faculty of Agriculture, University of Port Harcourt, Nigeria.

\*Corresponding author – Email ojoakinrotimi@yahoo.com

**ABSTRACT**

*Aquaculture venture in Niger Delta Region of Nigeria is an industry that encompasses fish cultivation in a controlled environment. It has evolved through numerous phases and stages with its potential yet to be fully tapped. To affirm this potential in contributing to human development, food security and improved standard of living, the aquaculture industry requires new approaches. Hence, this paper reviews the status of fish farming in Niger Delta, its subsistence state and its inability to meet the demand for fish by the populace, thus necessitating the need for transforming aquaculture from subsistence to commercial level. The components and the systems of commercial fish farming were thoroughly discussed. Also, constraints to commercial fish farming in the region were elucidated. The strategies for promoting commercial aquaculture such as, increase in awareness of aquaculture products, subsidizing of aquaculture inputs, training and manpower development, government support, formation of fish farmers cooperative societies, access to loans and credit facilities, promotion of research activities, effective fisheries policies, good institutional framework, and reducing the levels of corruption and insecurity in the region, were clearly pointed out as a veritable tools, for transforming the present state of aquaculture in Niger Delta, through planned, focused and coordinated effective management strategies, by individual farmers, government agencies and relevant institutions for sustainable development of the region in particular and the country in general.*

**Key Words:** Aquaculture, Subsistence, Commercial, Niger Delta

**INTRODUCTION**

Fish is an important source of both food and income to many people in developing countries. In Nigeria as much as 10% of the population, some 14 million people depend wholly or partly on the fish on the fisheries sector for their livelihood. Fish provides a rich source of protein for human consumption. The flesh of fish is also readily digestible and immediately utilizable by the human body, which makes it suitable and complementary for regions of the world with high carbohydrate diet, as we have in the country (FAO, 2006).

The vast production from capture fisheries which represent one of the major aspects of fish production (Table 1) seem to have reached their natural limits as a result of environmental degradation and over fishing. This consequently has led to over exploitation of many fish species from the wild sources. These fishes once considered to be vast and endless, are now being over fished and labeled as unsustainable in their present state(Eyo,2003).

**Table 1: Domestic Fish Production by Section (Tonnes)**

Year	Artisanal	Industrial	Aquaculture
1990	291,864	36,228	15,840
1992	283,943	39,365	20,041
1994	201,176	30,486	27,112
1996	180,112	26,117	49,364
1998	340,116	27,114	86,122
2000	120,121	23,121	121,112
2002	100,126	21,121	300,114

**Source: Adapted from Eyo (2003)**

In Nigeria, fish production is not only important as a source of rich protein, but also can be used to bring about institutional changes. These changes can offer access to production assets and resources which can help to empower the poor and directly promote their livelihood. According to Ugwumba and Ugwumba (2003), the demand for fish in the country has been on the rise with demand far exceeding supply.

Fish supply in Nigeria is about 600,000 metric tons while demand is put at 2.6million metric tons, (Table 2) this makes Nigeria one of the largest importers of frozen fish in the world as she imports about 2 million metric tons annually to meet the demand for fish (FMANR,2008). Fish production from aquaculture is seen as the only way of solving this problem as capture from the wild is dwindling by the day, as a result of depletion in stock, while the population is on the increase. Also, the need to solve over fishing of wild fish stocks represents the inherent requirement for aqua farming. The ability of the people to feed themselves remains an issue of paramount importance. In simple terms we must find a way to make more from what we have in our environment to solve our problems.

**Table 2: Projected per output consumption and fish demand in Nigeria (1991 – 2007)**

Year	Population (million)	Per Output consumption (kg)	Fish demand (tonnes)
1991	88.5	12.15	1,062,000
1992	90.38	12.40	1,084,540
1993	92.30	12.67	1,107,550
1994	94.25	12.93	1,131,050
1995	96.25	13.19	1,155,950
1996	98.30	13.45	1,179,560
1997	100.38	13.97	1,204,590
1998	102.51	13.97	1,230,150
1999	104.69	14.23	1,256,260
2000	106.91	14.49	1,282,910
2001	110.24	15.12	1,302,910
2002	120.74	16.24	1,381,112
2003	130.14	17.11	1,411,102
2004	138.18	17.81	1,511,112
2005	140.24	18.84	1,911,211
2006	155.26	19.26	2,111,211
2007	157.24	20.11	2,616,121

**Source: (FMANR, 2008)**

## POTENTIAL OF AQUACULTURE IN MEETING THE DEMAND FOR FISH

Aquaculture is an industry that encompasses the cultivation of fish (fin and shell fish) in a controlled systems for commercial recreation or resources management purposes with the aim of increasing production beyond natural limit (Ayinla, 2003), of the different global food production supply systems, aquaculture is generally discussed, of providing fish food at affordable prices to the poor segments of the community (Akinrotimi *et al.*, 2007). Increased production of fish from aquaculture will help combat hunger and malnutrition which remain one of the most devastating problems facing the majority of the poor in the Niger Delta region and the country as a whole. To attain its full potential in contributing to human development, food security and improved livelihood, the aquaculture industry may require new approaches. These could vary with countries and the challenge is to develop approaches that are realistic and achievable in the context of current social, economic, environmental and political situations.

## STATUS OF FISH FARMING IN NIGER DELTA

The Niger Delta region is made up of three ecological water systems, fresh water, brackish and marine waters. Each of these zones has its own indigenous cultivable fish species and suitable land topography. There is therefore a tremendous potential for aquaculture in this area (Table 3), if properly harnessed can contribute immensely to production of fish in the region. Most part of the region depends predominantly on fish for food and means of livelihood. They are primarily fishermen, who also engaged in fish related activities like fish processing, hawking, fish transportation and gear manufacture and subsistence aquaculture (Akinrotimi *et al.*, 2007b).

**Table 3: Potential Aquaculture Production in Niger Delta**

Types of Aquaculture	Production (mt/yr)
Fresh water aquaculture	500,000
Brackish water aquaculture	400,000
Marine aquaculture	300,000

Source: (Ezenwa,2006)

## IMPORTANT CULTURABLE SPECIES IN FRESH AND BRACKISH WATER ZONES

The choice of species to culture is very important for the success of any aquaculture venture. Certain criteria are developed in order to select the species, shell or fin fish that are most suitable for commercial culture in fish farms. (Tables 4,5,6). The species to be cultured must have a high market value, acceptability of artificial feed, tolerance to culture condition in pond and most importantly, regular availability of seeds.

**Table 4: Culturable Fish Species in Brackish Water Zone of Niger Delta**

Species	Market value	Availability of seed/fry	Feeding habit	Potential yield
<b>Mullets</b> <i>Liza falcipinnis</i> <i>Liza gradisquamis</i> <i>Mugil cephalus</i> <i>Mugil bananensis</i> <i>Mugil curema</i>	Good	All year round but inadequate	Phytophagous/ detritivorous	Very high yield. Performs well in poly-culture with catfish, snappers and tarpons
<b>Tarpon</b> <i>Megalops Atlanticus</i>	Low	Seasonal and inadequate	Predatory	Grows fast. Effective in the control of excess tilapia

<b>Tilapia</b> <i>Sarotherodon melanotheron</i> <i>Tilapia guineensis</i>	Good	All year round and adequate	Phytophagous / detrivorous	Hardy and wide acceptance for culture.
<b>Catfish</b> <i>Chrysichthys</i> <i>Nigrodigitatus</i>	Very good	Seasonal and inadequate	Omnivorous	Hardy. Grows very slow in culture medium.
<b>Snapper</b> <i>Lutjanus goreenisis</i> <i>Lutianus aegenis</i>	Good	Seasonal and inadequate	Predatory	Fast growth,

Source: (Ezenwa *et al.*,1990)

**Table 5: Important Cultivable Shell Fish in Brackish water zone of Niger Delta**

Species	Market value	Availability of seed/fry	Feeding habit	Potential yield
<b>Shrimp</b> <i>Peanus notialis</i> <i>Peanaeus monodon</i>	Good	All year round but inadequate	Detrivorous	Culture still experimental
<b>Oyster</b> <i>Crassostrea gassar</i>	Very good	All year round	Filter feeder	Potential culture is very high
<b>Periwinkle</b> <i>Tympanotonus fuscatus</i>	Very good	Seasonal and inadequate	Filter feeder	Potential culture is very high
<b>Whelk</b> <i>Thais coronata</i> <i>Pugillina morio</i>	Low	Seasonal and inadequate	Predatory	Culture still experimental
<b>Bloody cockle</b> <i>Anadara (Senilia) senilis</i>	Very good	Seasonal and inadequate	Filter feeder	Potential culture is very high

Source: (Deekae *et al.*,1994)

**Table 6: Important Culturable fish in fresh water zone of Niger Delta**

Species	Market value	Availability of seed/fry	Feeding habit	Potential yield
<b>Tilapia</b> <i>Oreochromis niloticus</i>	Good	All year round adequate	Phytophagous/ detrivorous	Hardy and wide acceptance for culture.
<b>Cat fishes</b> <i>Clarias gariepinus</i> <i>Heterobranchus bidorsalis</i> <i>H. longifillis</i>	Very good	All year round but inadequate	Omnivorous	Hardy with high culture potential.
<b>African bonytongue</b> <i>Heterotis niloticus</i>	Good	Seasonal and inadequate	Planktrophagous/ Benthophagous / omnivorous	(Good culture potential)

Source: (Ugwumba and Ugwuba,2003)

## SUBSISTENCE AQUACULTURE

This involves farming of fish on a small scale level in inland and coastal areas by small households using mainly extensive and semi-intensive system primarily for personal consumption and income generation (Edwards, 1999). The major systems of subsistence are small holding earthen pond culture and home stead culture. The bulk of subsistence aquaculture production is from small scale holders which are located in the rural areas and the main concern of a subsistence fish farmer is survival and improved livelihood for himself and his family (Akinrotimi *et al.*, 2009)

The emergence of new production challenges, coupled with population explosion the traditional practices and technology of fish farming are not meeting the demand for fish. And poverty in rural areas is escalating (Table 7). According to FAO (2008), large scale and medium scale commercial aquaculture production is basically difficult if not impossible in rural areas due to quantity and quality of inputs.

**Table 7: Poverty in the Niger Delta Measured by Income and Food Intake**

State	Percent Poverty Level		Food poverty levels as measured by 2,900 calories, 2004	
	1996	2004		
Akwa Ibom	72.3	39.86	31.60	68.40
Bayelsa	44.3	25.64	20.77	79.23
Cross River	61.4	52.60	42.30	57.70
Delta	61.9	41.88	35.57	64.43
Edo	53.3	41.40	35.24	64.76
Ondo	71.6	88.84	21.21	78.79
Rivers	44.3	40.65	37.56	62.44

**Source: (FOS, 2004)**

## NECESSITY FOR COMMERCIAL FISH FARMING

Analysis of the structure of Niger Delta fisheries indicate that demand for fish in Nigeria can only be met through commercial fish farming this may be due to wide acceptability of fish, which cut across cultural and religious basis. The inability of the subsistence fish farmers to meet the demand for fish has been attributed as one of the major reasons for commercial aquaculture. Another justification is the exponential growth in the Niger Delta population over the years, with the corresponding increase in demand for fish especially in homes, hotel, and restaurants. Hence the need to invest heavily in fish farming at commercial level, to satisfy the teeming masses in the region cannot overemphasize.

## COMMERCIAL FISH FARMING

Commercial fish farming entails farming of fish on a large scale. It is profit oriented in nature like every business commercial fish farming has its own associated risks not because it's based on biological processes or survival of large numbers of fish in captivity but because of its dependence on human skills, efficiency of machines and clemency of the physical forces of nature. In Niger Delta, however, slow aquaculture development and the developing status of the region are major reasons why commercial fish farming is unpopular and rarely considered (Ayanwu *et al.*, 2007), the farmers evaluate commercial decisions by weighing the risks and uncertainties of doing the business, whether to do it or not. They may also consider the prevailing environmental, political and financial circumstances.

## **COMPONENTS OF COMMERCIAL FISH FARMING**

### **Functional Hatchery**

The hatchery is a major component of a commercial fish farm, where fingerlings (fish seed) are produced in large quantities for stocking in ponds. A functional hatchery is necessary for propagation of cultivable fish species; this is a precondition for the successful operation of intensive fish culture. The hatchery includes tanks or containers where ripened fish for induced spawning are kept before and after injection, fertilized eggs obtained by stripping, must be incubated and the hatched larvae reared for 2-3 weeks in the hatchery.

### **Feed Production Unit**

Feed is a significant factor in increasing the productivity and profitability of aquaculture, feed determine the viability of fish farming as it account for at least 60-70 percent of the total cost of production. The crucial role of feed production cannot be over emphasized as demonstrated in several studies (NRC, 1983; Fasakin *et al.*, 2003; Gabriel *et al.*, 2007).

For any aquaculture venture to be profitable it must have a regular and adequate supply of balanced artificial diets for the culture fishes (Faturoti and Akinbote, 1986). As fish requires high quality nutritionally balanced diet for growth and attainment of market size within the shortest possible time. Therefore local production of fish feed is very pivotal to the development and sustainability of commercial aquaculture. A standard feed mill should have a mixer, pelleting machine, hammer mill, grinder and other minor accessories.

### **Rearing Enclosures**

The facilities for culture in commercial fish farming varied, the number of facilities in use depends on the scale of production, system of production species of fish, production function, and location, availability of land, labour and capital. The rearing facilities commonly used include earthen ponds, concrete tanks, plastic tanks, fiber glass tank and burnt clay tank.

## **SYSTEMS OF COMMERCIAL FISH FARMING**

The systems used in commercial fish farming are:

### **Integrated Fish Farming**

In Nigeria integrated fish farming has been reported in many states of the federation in which 50% of fish farmers integrate, poultry, piggery or livestock with fish production, while integrated fish cum crop production is on the rise also in several states (AIFP, 2005). According to Asala (1994), the essence of integrated system is productivity of fish as to meet the challenges of food shortage and reducing the incidence of poverty in the country.

**Fish cum poultry farming:** Poultry cum fish farming is the integration of poultry animals like chicken, duck and geese with fish farming. The most common practice in Nigeria is fish cum chicken, which is widely practiced because of its profitability. Birds raised for egg (layers) or the one that are raised for meat (broilers) can be integrated with fish farming. This will reduce the cost of inputs, such as fertilizer and feed, so as to maximize profits (Akinrotimi *et al.*, 2005). The poultry houses can be constructed inside and raised over the pond or beside the pond as the case may be.

**Fish cum pig farming:** Pig farming is widely practiced across the southern and middle belt of Nigeria, offers the farmer a husbandry which is easier than chicken farming. It has good returns. The pig is a highly prolific animal and its combination with fish not only increase economic efficiency, but also increase its ecological efficacy as wastes residues,

and left over from kitchen, aquatic plants are often used as pig food. The excreta in turn are used as organic manure in fish ponds (Ansa and Jiya, 2002).

**Fish Cum Crop Production:** This is the cultivation of agricultural crops (e.g. vegetables and arable crops like rice etc) and aquatic plants (like water spinach, water chestnut etc), with fish farming. The common practice in fish cum crop production in the country is in cultivation of fish with rice, and vegetables.

### **Water Recirculation System**

Water Recirculation System (WRS), is a type of cultivation system in which effluents or used water from fish rearing is partially or completely re-circulated to the system after water treatment and reconditioning. WRS has been in existence since the 50s, it is only recent that their potential to cultivate fish on a large scale was realized. The system allows rearing of fish at high densities with reduction in water usage. This is achieved by employing a water treatment unit which includes mechanical filtration, solid waste removal, biological filtration, water sterilization and aeration (Anyanwu and Ezenwa,2003).WRS conserve both water and land maximizes production in a relatively small area of land. For example 50 tonnes of fish can be produced – in 60cm<sup>3</sup> building annually, this is in contrast to outdoor earth ponds. WRS is particularly useful in areas where land and water are not readily available or expensive. They are very suitable in climatic conditions that hinder outdoor all year-round production e.g. winter or very dry (desert) climates or where pond culture is not feasible as a result of soil types and high water evaporation rates (Anyanwu *et al.*,2005).

Water recirculation system could be outdoor or indoor especially in the tropics but indoor system offer better environmental control for maximum fish growth and survival. The system requires continuous supply of water at a temperature and dissolved oxygen content that is optimum for growth of the cultured fish. Energy is very necessary for water re-circulation. Indoor water recirculation system may revolutionize fish production in the same way confinement system altered the poultry and pig farming industries (Gabriel *et al.*, 2009).

### **Earthen Pond Culture**

This involves raising of fish in a dug out pond, this is the oldest method of fish farming which can be practice in a selective specified area. Its major advantages include fast growth of fish, allows mineralization of uneaten food and organic materials in the pond. While the disadvantages of culturing fish in this medium include inability to sort the fish into various sizes as the fish grow, so as to reduce the incidence of cannibalism.

## **CONSTRAINTS TO COMMERCIAL FISH FARMING**

### **Insufficient Input**

The development of aquaculture at commercial level is beset with so many problems which include inadequate and insufficient input: input such as fish feed, ingredient, fish fingerlings and chemical such as hormones, anaesthetics. Also absence of effective credit and marketing facilities are major challenge (Table 8).

### **Absence of skilled manpower in aquaculture and commercial fish farming technology**

This is also a major factor limiting the development of commercial aquaculture in the region. Poor transportation strategies, lack of good fisheries infrastructure as well as lack of knowledge in modern fish handling technique have been attributed to the slow pace of commercial aquaculture in the region.

### **Inaccessibility to loans and credit facilities**

This has been identified as one of the constraints to the commercial aquaculture in Niger Delta (Table 8). This has been described to have arisen from lack of information on the part of potential investors in commercial aquaculture on the funding mechanism and the perception by banks and other lending institutions that aquaculture venture bears a high risk of failure, hence not willing to grant loans to prospective fish farmers.

### **High Interest rate on agricultural loan in commercial banks**

This has discouraged many people from investing in aquaculture at commercial level. Although in some instances when the loans are available and the interest rate are affordable, most often high collaterals are required for disbursement of such loans which the farmers, may not be able to afford.

### **Lack of good regulatory and institutional framework for aquaculture development**

There is a lack of clear cut policies, strategies and plans or guidelines piloting the affairs of aquaculture in the region. Even when such policies are formulated, the implementation level is usually low which has given room for haphazard and disjointed aquaculture programme which often are not executable.

**Table 8: Constraints to Commercial Aquaculture in Rivers State, Niger Delta, Nigeria**

<b>Constraints</b>	<b>Number of Respondents</b>	<b>Percent of Respondents</b>
Inadequate supply of fingerlings or juveniles	2	2.35
Lack of institutional framework	3	3.52
High cost of feed/feed ingredient	27	31.76
Irregular water supply	10	11.76
Insufficient funds	18	21.17
Incidence of disease and pest	2	2.35
Transportation problems	4	4.70
Unorganized market	3	3.52
Lack of good storage facility	4	4.70
Erratic power supply	10	17.4
Low technical transfer	2	2.35
<b>Total</b>	<b>85</b>	<b>100</b>

**Source: Field Survey, 2009.**

## **STRATEGIES FOR PROMOTING COMMERCIAL AQUACULTURE**

To promote commercial aquaculture venture in the region the following strategies are hereby proposed.

### **Increase Awareness of Aquaculture Products**

Awareness and appreciation of aquaculture should be created and intensified in the region in order to increase consumer demand for fish at the local and regional level, so as to encourage more production of fish which will ultimately boost fish production at commercial level. Also, awareness should be created among potential investors, donor agencies and funding institutions on the role of commercial fish farming in supporting economic growth and reducing the level of poverty (Hall, 2005).

### **Subsidy on Inputs**

The government should establish an agency positioned strategically in the region that will be responsible for procuring aquaculture inputs such as feeds, feed ingredients, fingerlings, fertilizers and hatchery materials for sale at relatively cheaper price to fish farmers (Kingdom and Alfred-Ockiya, 2009).

### **Training and Manpower Development**

Effective and efficient training in modern methods of fish farming is crucial for the establishment of fish farm on large scale. The African Regional Aquaculture Centre (ARAC) Aluu, Port Harcourt, Rivers State is located in the Niger Delta Region. The centre has an excellent human resource capacity and facilities for training in modern techniques of fish farming which will enhance commercial farming.

### **Government Support**

Government should give adequate support to fish farmers at their early stage by providing favourable and conducive business environment in terms of regulations as well as providing fiscal incentives such as tax exemptions and waivers on import duty for inputs, such as feed, feed ingredients (fishmeal), and farm equipments.

### **Formation of fish Farmers' cooperatives societies**

The farmers should organize themselves in groups popularly called Cooperative Societies; this will enhance pooling of resources together to establish fish farming at commercial level. Also, this will strengthen their influence ability and linkages with existing networks of commercial fish farmers in other regions, locally and internationally.

### **Access to Loans and Credit facilities**

Government should make it possible for the farmer to access loans easily in conjunction with financial institutions. This is because effective financial services and improving access to credit are keys to business expansion and reduction of poverty (World Bank, 1995). Hence efforts should be made by government to put in place policies that ensure low interest rates for farmers and extended payback period.

### **Promotion of Research Activities**

Government should fund and support research activities in aquaculture as a matter of priority in key areas such as modern culture techniques, genetically improvement of indigenous species, culture system, innovative seed propagation method, fin and shell fish culture, techniques of farm design, feed formulation methods and fish farm management in general. Also, effective dissemination of new research findings through extension agent should be encouraged.

### **Effective Policies and good Institutional Framework**

The government should put in place, plans, policies, strategies and institutional framework for commercial aquaculture development. This can be achieved by conveying a forum involving all stakeholders (fish farmers, researchers, financial institutions, fisheries administrator, cooperative societies and NGO's), so as to define in clear terms financial incentive and promotional instrument in fish farming at commercial level.

### **Reducing the problems of corruption and Insecurity**

The levels of corruption and the challenge of insecurity that is prevalent in the region in recent time goes beyond fisheries policy, it requires a drastic reforms in the

entire country (World Bank, 1995). According to Kingdom *et al.* (2008), government administration activities o needs to be changed from corruption tendency to an institution that will enhance rapid development and serves the interest of the masses. Hence, for any government policy, plan and support in aquaculture sub-sector to be effective the problems of corruption must be reduced to the barest minimum. The issue of security should be adequate consideration so as to create conducive environment for potential investors, as no investors will like to invest in an insecure environment.

## CONCLUSION

The need to transform aquaculture from subsistence to commercial level is very vital for the development of Niger Delta region of Nigeria in the areas of food security, improved livelihood and infrastructural objectives. To achieve this, there should be a good balance between resource utilization and development, to meet the needs of the present, while enhancing good opportunities for the future through planned, focused and coordinated effective management strategies by individual farmers co-operative societies, relevant institutions and government agencies. Hence, all the stakeholder in the region must galvanize effort in transformation of aquaculture venture from its present state to commercial level for the sustainable development of the region and the entire country.

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