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## Culture Possibilities of *Penaeus monodon* in Nigeria

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### ABSTRACT

The Black Tiger shrimp, *Penaeus monodon* is a new entrant in the Gulf of Guinea along the West African coast. The species though not native to the region has been well established. In Nigerian coastal waters for example, fishing trawlers and local fishermen catch berried females all year round and thus can serve as sources of broodstock supply for aquaculture purposes. Preliminary studies by Nigerian Institute for Oceanography and Marine Research on shrimp broodstock availability, collection, breeding, post larvae production and grow-out indicated that there are great potentials for commercial culture of the species in the country. However major challenges included scarcity of post larvae for stocking, power outages, lack of technical know-how and negative environmental impacts. The prospects and challenges of shrimp farming in Nigeria are highlighted.

**Key words:** Prospects, challenges, culture, *Penaeus monodon*

### INTRODUCTION

Shrimp is an important seafood commodity representing a global industry with a market valued at over US \$ 20 billion annually accounting for 19% of international trade (Islam *et al.*, 2003). Captured shrimps accounted for 3,120,556 tonnes in 2008 declining from 3,307,856 tonnes in 2003 while shrimp culture has increased at the rate of 10% per annum over the last 10 decades increasing from 2,049,011 tonnes, in 2003 to 3,399, 103 tonnes in 2008 (FAO, 2009).

There has been tremendous development of shrimp and prawn culture globally (Rahman *et al.*, 2002; Alam, 2007). It is undertaken in many tropical and sub-tropical regions of the world including Europe, Asia, America, Australia and some parts of Africa (Boonyaratpalin and New, 1982; Fast, 1991). Farmed shrimp is becoming more valued in the world seafood market due to growing concern of seafood safety and traceability (FAO, 2003). The most widely cultured shrimp species is the Black Tiger shrimp *Penaeus monodon* accounting for 58% of global shrimp production (Chen, 1990; Rosenberry, 1998). *P. monodon* is the largest shrimp species globally and has the fastest growth rate among all penaeid species (Chemonics, 2002; ASEAN, 2003; Ravichandran and Pillai, 2004). Similarly the Giant prawn *Macrobrachium rosenbergii* is the most widely cultured prawn (Soundarapandian *et al.*, 2008; El-Sherif *et al.*, 2009).

Nigeria is a maritime state with enormous water resources including fresh, brackish and marine waters. Members of the penaeid family especially *P. monodon* which is widely cultured occur in the

coastal waters (Dublin-Green and Tobor, 1992; Ebonwu *et al.*, 2007a; Adetayo, 2008). *P. monodon* although not indigenous to West African region but accidentally introduced has become well established in the coastal waters of Nigeria as fishing trawlers and local fishermen catch berried females all-year round (Ayinla *et al.*, 2009a). The availability of broodstock of the species offer great potentials for culture possibilities and the development of a viable shrimp aquaculture industry in the country. This study highlights the prospects and challenges of shrimp farming in Nigeria.

## PROSPECTS FOR SHRIMP CULTURE DEVELOPMENT

Nigeria is a maritime state with fisheries especially shrimping playing an important role in the economy through provision of food, employment, income and foreign exchange. The declining shrimp catches from the marine waters has caused many fishing companies to fold up due to scarcity of raw materials. Diversification of shrimp production through aquaculture is the next viable option. There are bright prospects and great potentials for shrimp culture development in Nigeria due to the nation's favourable conditions which include among others:

**Climate:** The climate is tropical which will ensure all-year round production. The rainfall, solar radiation, wind, air and water temperatures are very suitable for shrimp culture especially in the coastal areas.

**Water resources:** The country is endowed with enormous water resources which include a long coastline of 853 km, a continental shelf of 37,934 km<sup>2</sup>, an Exclusive Economic Zone (EEZ) of 210,900 km<sup>2</sup> and inland water surface area of 14 million hectares.

**Land resources:** Nigeria has a land mass of 923,768 km<sup>2</sup> with many suitable coastal sites for the establishment of shrimp farms. Extensive areas of flat land behind mangrove areas can be found in the Niger Delta, as well as more open coastal flats where ponds might be constructed. However, detailed feasibility studies of these potential sites are essential before making decisions on suitability of the different areas.

**Shrimp resources:** The shrimp industry in Nigeria is capture based with 176 shrimp vessels registered in 2006 (FDF, 2007). Shrimping in Nigeria dates back to about 1950 when the exploitation was handled mainly by foreign fishing vessels. By 1961 and later, there was a commercial stock of shrimp in the Nigerian territorial waters to sustain a shrimp trawling industry. The targeted shrimps include: the Tiger shrimp *P. monodon*, the pink shrimp, *P. notialis*, *P. kerathurus*, *Parapenaeus longirostris*, *Nematopalaemon hastatus* and the brown shrimp *Parapenaeopsis atlantica*.

The Tiger shrimp *P. monodon* (Fig. 1) although indigenous to the Indo-Pacific region is a new entrant to the Atlantic Ocean in the Gulf of Guinea area. Shrimp aquaculture technology is available in many countries with good market potentials. The availability of good quality broodstock in the country will serve as local supply for the culture industry.

The pink shrimp *P. notialis* (Fig. 2) another shrimp resource is native to the West African region. The culture technology is not yet well developed but juveniles are common in the estuaries (Ebonwu *et al.*, 2007b). The species do not grow as fast or as large as *P. monodon*.



Fig. 1: *Penaeus monodon*



Fig. 2: *Penaeus notialis*

**Manpower:** Nigeria has a population of 140 million (2006 census) with a growth rate of 3.2%. About 8.23 and 18.27 million people are involved in primary and secondary employment in the fisheries sector, respectively. Hence, human capital is adequate but there is dearth of skilled manpower which can be resolved through organization of shrimp culture training workshops.

**Institutional arrangement:** The fisheries sector in Nigeria is regulated by the Federal Ministry of Agriculture through the Federal Department of Fisheries which issue policy guidelines and development programmes. Two Fisheries Research Institutes (Nigerian Institute for Oceanography and Marine Research and Nigerian Institute for Freshwater Fisheries Research) are charged with the responsibilities of development of marine and freshwater fisheries, respectively. They have well trained scientists in their mandate areas.

The 36 States of the Federation also have State Fisheries Department and together with the Fisheries Components of the Agriculture Development Projects over-see fisheries and aquaculture developments in their states. The Fisheries Society of Nigeria (FISON) is the apex organization for

all operators in the fish industry. These institutions over the years have contributed to the development of fisheries and aquaculture through technical assistance and other ways.

**Market:** Shrimp is the largest internationally traded aquatic commodity and hence shrimp culture is growing substantially all over the world to meet the global demand and aurgument supplies from the wild. Nigeria has a well organized shrimp industry which is capture-based. There is proven capacity to process and export shrimp and the country already have an established position in the international shrimp market place. Hence, export market will not be much of a problem for farmed shrimps.

Shrimp export is of central importance to the fisheries sector in Nigeria. It grew from next to nothing in the early 1970s to contribute about US\$53,380,00 of total exports in value in 2005. No other primary commodity enjoyed such spectacular growth in post-independence Nigeria. Despite this tremendous contribution, shrimp production in Nigeria has been characterized by fluctuating annual yields and total production levels for the last ten years in terms of export and value. Hence, the country will benefit from the development of sustainable shrimp farming methods.

**Viable aquaculture industry:** Nigeria is a leader in catfish aquaculture production in sub-Saharan Africa and has operated intensive catfish recirculation aquaculture system for over a decade. Hence, the technology for shrimp culture will be easily adopted by the fish farmers once it is developed.

**Preliminary shrimp culture trials:** Nigerian Institute for Oceanography and Marine Research (NIOMR) has commenced research studies aimed at the development of shrimp culture in the country (Ayinla *et al.*, 2009b). Results of studies by Deekae and Ayinla (1995) on culture trials of *P. notialis* in brackish water ponds showed that the shrimp attained an average weight of 18.59 g from an initial average weight of 1.16 g after four months of culture.

In 2008, a functional shrimp hatchery and micro-algae culture unit were established for the propagation and culture of *P. monodon*. Broodstock of the species were collected from three Nigerian Fishing Companies namely Karflex Fisheries Nigeria Limited, Honeywell Fisheries and ORC Nigeria Limited. The body weight ranged from 64.17 to 371.0 g, total length, 24.0-34.0 cm and carapace length, 8.0-24.5 cm. Abdominal length ranged from 10.3-16.0 cm and telson length from 3.0-5.7 cm. The stage of ovarian development ranged between 0 and 3.5 while the percentage of sperm carried by the females ranged from 0 to 100%. The broodstock were stocked in the maturation tanks in the shrimp hatchery and fed on squid to enhance gonadal development and maturation.

Spawning of the species was successfully carried out using berried females with ovaries in Stages II to IV. Each selected shrimp breeder was stocked singly in 0.5 m<sup>3</sup> plastic tank filled with 35 ppt filtered sea water and aerated mildly. Fourteen breeding trials were carried out with only six being successful. Eggs obtained from the six successful spawning trials hatched and later developed into nauplii, zoea, mysis and post larval stages in the nursery tanks. The shrimp larvae were fed with live micro-algae *Chaetoceros* spp. and *Skeletonema* spp., as first food and later with *Artemia* and imported mixed algal flake. Successful hatchery production of shrimp post larvae will ensure regular stocking of ponds leading to the development of shrimp farming in Nigeria.

Growth studies of *P. monodon* in concrete tank by Ayinla *et al.* (2010) showed that the shrimps were able to attain a mean body weight of 19.538±2.293 g at harvest from an initial mean weight

of  $1.763 \pm 0.647$  g at stocking after a culture period of 157 days. The body weight at harvest ranged from 17.30-24.70 cm while the total length ranged from 13.5-16.2 cm. The daily growth rate was  $0.113 \text{ g day}^{-1}$  while survival rate was 90%. A yield of  $3539 \text{ kg ha}^{-1}$  was achieved at harvest (by extrapolation).

## MAJOR CHALLENGES

The major challenges that may limit shrimp culture development in Nigeria include:

**Scarcity of post larvae for stocking:** Despite the relative abundance of *P. monodon* in Nigerian coastal waters, the culture of the species is yet not fully developed due to scarcity of post larvae for stocking grow-out ponds. There is only one shrimp hatchery in Nigeria established by NIOMR which is of small capacity and research-based. There is need for investors to key into commercial hatchery production of shrimp post larvae. Also a regular and reliable means of live shrimp broodstock collection and supply as well as mass culture of marine micro-algae (*Chaetoceros* spp. and *Skeletonema* spp.) must be addressed.

**Power outages:** Erratic power supply and high fuel costs can affect smooth shrimp production operations. The development and use of other alternative energy sources like wind and solar will compliment electricity supply from the national grid.

**Low technical know-how:** The technology for shrimp propagation and culture although low in Nigeria, is available in other parts of the world especially Asian countries. NIOMR has trained 8 of her aquaculture scientists on shrimp culture technology in Thailand and China and over 60 people including extension workers and investors have been inducted with the technology. Many Nigerian farmers and investors have shown interest in shrimp culture. There is need to build up capacity in shrimp culture.

**Environmental impacts:** Environmental issues like oil spillage, protection of mangrove, swamp areas, coastal waters, biodiversity, soil/water conservation and effluent/sediment management are major concerns of environmentalists. There is the general perception that shrimp culture has negative environmental impacts on the ecosystem. There are also objections by some environmental protection pressure groups whose concerns centre on mangrove and estuary destruction which are critical habitats for many marine lives. Presently, FAO has put in place regulations and effective management strategies for sustainable responsible aquaculture in the Code of Conduct for responsible aquaculture and sustainable ways of shrimp production. These are mandatory for farmers to comply with.

The Best Aquaculture Practices (BAPs), Global Aquaculture Alliance guidelines (GAA) and Best Management Practices (BMPs) are stringent measures aimed at mitigation and reduction of negative impacts of aquaculture production on the environment. All stakeholders must be carried along in the developmental phases of shrimp culture in Nigeria and detailed EIAs must be carried out before establishment of shrimp farms. Farmers must meet standards and investors to be made aware of such standards and to comply. Nigeria has a National Aquaculture Strategy plan which serves as a guideline for farmers and investors in the industry.

**Social unrest:** The coastal communities especially the Niger Delta areas where the potentials for shrimp culture development are great are passing through some unrest due to youth militancy. A

lot of programmes have been put in place to curtail their activities through gainful employment and re-orientation. The development of shrimp culture in these areas will help to curb youth unrest through their active participation and the high economic benefit if the industry is sustainably developed.

**Disease outbreak:** Disease out-breaks have seriously affected shrimp culture in many countries causing economic adversities. In Nigeria, there is no known serious shrimp disease and NIOMR has established a fish and shrimp disease laboratory centre to cater for such outbreaks. There is need for food safety through microbial sanitation, drug and chemical management and disease prevention. Accurate good record keeping for traceability must be adopted.

**Grow-out:** Grow-out possibility of post larvae in small concrete ponds 12×6×1 m is not viable, hence NIOMR has acquired from Lagos State a suitable site at Yovoyan, Badagry for bigger ponds.

**Shrimp feeds:** Development of good quality local feeds for *P. monodon* broodstock and post larvae is vital for a viable shrimp culture industry. Presently, there are fish feed mills in the country but no shrimp feed is locally produced.

## CONCLUSION

Culture of *P. monodon* in Nigeria has great potentials in ensuring food security, employment generation and foreign exchange earnings. However the major challenges highlighted must be addressed and adequate care taken to ensure that shrimp culture development is well planned in order to maximize potential economic benefits and minimize negative environmental impacts.

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