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Shell Fish Farming in Nigeria: Aquaculture Potential and Investment Opportunities Projections

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Abstract: Vital aspects of the aquaculture, Investment opportunities and prospect of shrimps and Prawn farming in Nigeria were projected. This paper presented the breeding pattern, spawner availability, culture, water quality, organic feed, commercial feeds and feeding regimes and other factors needed in practical shrimps and prawns culture. The culture systems, water management, larval management, stocking density, feeding strategies were fully discussed. The investment opportunity that is available as government plans to boost production of these resources from both artisanal and aquaculture sector was documented. Management strategies needed in practical practices of shrimps and prawns culture were highlighted while effected efforts from the side of the government and international agencies were listed as the campaign on fish for all is the progress.

Key words: Aquaculture · shell fish · nutrition · investment opportunity · management strategies

INTRODUCTION

Nigeria, a country blessed with many inland water bodies whose total area is estimated as 125,470,82 km^2 and rich diversity of both fin and shell fish resources which are obtained from both coastal and inshore industrial sector and freshwater. Shrimps are exclusively inhabitat marine environment while prawns are found in freshwater body. About 48,000 metric tonnes of shell fish like white shrimp (*Nematopaleamon hastatus*), brackish water prawn (*Macrobranchium macrobranchium*), river prawn (*M. vollenhavenii*), Pink shrimps (*Penaeus notialis*), bivalve, crabs and Periwinkles have been exploited. From the coastal region of this country. Although white shrimps constituted about 50% of the estuarine catches [1]. Shrimp ground which covers about 2,500 km^2 are located off Badagry to Lagos; Lekki lagoon system and mouths of rivers in the Niger Delta region. About 2,868 metric tonnes and 15,249 metric tonnes of the shellfish resources were exploited from the inshore industrial sector in 1988 and 1999 respectively which is about 81.17% increase in the production. In 1999 government realizes ₦22, 440 while ₦22, 090,000.00 was realized in 2001 from inshore shrimping licenses which is about 98,340% investment increase and this accounted for 43.35% of revenue generated by Federal Government from fish production in year 2001 [1]. It also reported by Federal Department of Fisheries statistical unit that in year 2000 Nigeria exported shrimp worth US $46.495 million (₦5.58 billion) [1], which showed improvement in comparison to what has been happening in former years. This means there is future for investors interested in shrimps and prawn business in Nigeria.

Shrimps having 70% protein dry matter remains a good source of animal protein in mans' diet and nutrients from protein are accompanied with good health. The increasing human population, relatively cheap cost of shrimps and desire to obtain a nutritionally balanced level of protein intake remain major causes of demand outstripping supply for shrimps and prawns in Nigeria. Nigeria with projected population of 128 million and 12.5 kg per cap put consumption requires 1.6 million of both shell and fin fish in other to meet up the protein need of the populace in year 2004 [1]. The implication of this high population and fish demand is that more people will continue to have less proteins food to feed on which will lead to malnutrition pestilence, lack of resistance to diseases and reduction in labor output. Adegbola [2] also reported that about 40% of Nigerian children are undernourished, which manifested in low weight for age height and various degrees of stunning and higher susceptibility to disease infection. The immediate solution

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to this problem is found in increasing shellfish production by aquaculture sector.

Shrimp farming is gaining recognition and support from government especially in developed countries. As at 2003, Thai shrimp farming industry has grown to about 310,000 tonnes/year compared to 250,000 tonnes reported in year 2002 [3]. In a report presented by Peddie [4] Vietnam produces 158,000 tonnes of shrimps/year while India produces 127,000 tonnes of shrimps/year and Brazil with 40,000 tonnes shrimps/year. Despite these productions, export market which is dominated by United States of America that consumes about 350,000 tonnes shrimps/year is also increasing. The demand from within and outside the country is increasing geometrically and from all indications, artisanal shrimping has really been contributing immensely to shrimp production. The only hope of meeting up the consumers' shell fish demand is to inert efforts on boosting shell fish production from aquaculture sector [3]. This paper focuses on the aquaculture potentials and investment opportunity in shrimps and prawn farming in Nigerian especially on small-scale sector as the campaign on fish for all is been appraised.

CULTURE AND MANAGEMENT METHODOLOGY

Shrimp and prawn culture: From mariculture point of view tiger shrimp is best suited for culture in isolation from production and economics aspect. This shrimp is known to have a better survival rate when grown from juvenile stages to marketable size in different culture systems. Cannibalism is a great norm in post-larve when stocked without nursery rearing; the survival rate has been reported to be comparatively low [5]. The often occurrence of cannibalism cases is influenced by dense stocked density. Salinity has also been reported as a problem in *Macroborchum vollenlouenii* culture [6].

Collection of the brood stock: Mature shrimps and prawns suitable for culturing and breeding from the wild were collected with trap, line and hand-net using baits like coconut, earthworm, fish, prawn etc., can be used. The mesh size of the net determined the size of the expected catch. In most cases, traps and nets are set in the afternoon and before or at night, prawns and shrimps tend to come into shallow water to feed. When the water is clear light rays can reflect their pinkish or whitish ash colour and sometimes ovigerous females may be encountered by large quantities and they could be obtained for larviculture in order to reduce the operational cost [6].

Transportation: For safety purposes live specimens of this crustacean can be transported in any of the following for breeding purpose.

- Large tanks with aeration or continuous water circulation.
- Plastic bag with oxygen provided that the sharp of rostrum is cut off to prevent puncturing of the bag. This is appropriate for long Journey transport.
- Shallow open fish container. Water level must be deep enough to cover the specimens. With this method prawns and shrimps can be transported for 3-8 h.
- Bamboo baskets packed between layers of moistened moss or soft aquatic plants. Prawns and shrimps will survive for several hours in this method provided water is sprinkled into the basket at frequent intervals. This method remains the traditional means of transporting shrimps and prawns especially by the marketers of live specimens.

Conditions for mating, spawning and hatching: Spawning in isolation becomes necessary if there were no berried females in the natural habitat. Matured healthy males are kept separately, one in a tank while several matured females are kept in a large tank and constant screening off of newly moulted ripe females are done from the rest females to prevent it from being attacked since her new shell is still soft. Two or three hours after moulting, when the new shell is fairly hardened, she is introduced into one tanks having male contemporary.

Water quality: Proper monitoring of the physiochemical properties of water is highly essential in the culture of shellfish. Inadequate aeration (anoxia condition) in laboratory experiment or indoor culture has been reported to result into high mortality [6]. Table 1 presented some physiochemical water parameters taken from the wild and earthen culture tank.

Salinity levels of 1.7 ppt and 12 ppt have been reported for prawn hatching larval rearing respectively [7]. Lee [8] documented salinity range between 12-14 ppt while shorter juvenile growth duration was recorded by Cheach and Ang [9], when they exposed larval stage prawns to two salinities of 6 ppt and 12 ppt.

Mating: Mating takes place within a few hours, followed by egg-laying within 6-20 h. Laying of one batch of egg is complete within 20 min. A tank of about 1 m x 2 m x 0.4 m can hold about 10 specimens and a trough of 1.5 m x 3 m x 0.4 m can hold about 24 specimens. At stocking ratio of

Table 1: Some physicochemical water parameter taken from the wild and culture of prawn

Water sources/ Physicochemical parameters	Temperature (°C)	pH	Dissolved oxygen mg L^{-1}	Conductivity µohms/cm^2	Suspended solids mg L^{-1}	Turbidity FTU
Asejire dam (wild)	28.0	7.3	5.6	80.0	0.00	14.0
Kigera (Culture tank)	26.0- 28.0	7.3	6.8-7.0	170.0	73.00	215.0

Sources: Ovie [6]

one male to 4 or 5 females. When newly molted sexually-ripped females are introduced into the male tanks, they are promptly attended to by the male and both mating and egg-laying take place without trouble [7]. Group spawning of prawn and shrimp is ideal for commercial purpose.

Efficient aerators are highly essential in all spawning tanks and troughs [6]. Few days after egg-laying, the berried females should be transferred into hatching tanks and kept separately in a tank individually. The water level of the spawning tank should be about 50-60 L. During incubation period the water should be kept clean and well aerated to boost survival of the hatchlings.

Hatching: Changing of the color of the eggs from bright orange to light grey denotes the hatching of the eggs.

Rearing of young prawn and shrimps: Prawns of length 5 cm, weight 2.0 g and barely 2 months old are suitable for culturing. These prawns and shrimps thrive well in well oxygenated water within the temperature range of 26-28°C [6] (Table 1). They can be raised in pond, partitioned canals and irrigated padi-fields. Fish-ponds or any pool of not less than 400 m^2 and over 0.5 m in depth, can be used for culturing prawn and shrimps though ponds over 1,000 m^2 and 1-1.5 m depth are more suitable and economical to operate for commercial purpose.

Pond preparation and construction:

Land acquisition: It is imperative for a farmer to locate a good site for his farming business. Land availability is a key factor for planning an aquaculture venture. A land with no profitable competing value is better for pond construction especially, flooded or swampy piece of land that cannot be use for any other alternative profitable use.

The vegetation type is important. The landed property must not be filled with big trees because of the cost of removing item. The best soil type is loamy soil. Soil with a lot of rock is not good because of the cost of blasting the soil. Clayey soil tends to be acidic and the cost of liming to control the acidic content is high. Soil chemistry analysis should be carried out so as to ascertain the presence and concentration of some heavy metals that could be toxic to the shell fish [10].

Clearing: All obstacles on the sites are removed with bulldozer or tractor. Where any of these machineries is not available manual work can be adopted.

Pegging/Mapping: This is done after site clearing. This is use to size the pond. Pegs are used to determine the position of the slope, main dyke, pond depth (bottom), feeder canals and drainage canals.

Excavation and dyke building: A bulldozer is needed for this operation. Scraping of the top soil layer (10-15 cm) is done. The top soil is kept somewhere for the purpose of lining the pond, because it is rich in nutrient. A depth of 1.0 m (shallow) or 1.5 m (deepest) pond is recommended for commercial purpose.

Water inlets and outlets/drainage: Water inlets are built at the highest part of the pond to ensure easy filling and aeration while outlets are built at the lower part of the pond. PVC, Pipes, Plastic, Bamboo strokes etc., could be used as inlet while outlets can be made with concrete monk and water to be released is monitored.

Liming: This operation is carried out both in fresh and old pond before stocking. Liming is done in other to check the acidity of the soil, reduced turbidity of the water, enhances primary productivity of the pond, improve the availability of soil nutrient and relieve carbonic ions that positively influence photosynthesis. Okoye [12] and Castell *et al.* [13] highlighted on the types and quantity of lime needed in pond for aquaculture purpose.

Pond management:

Pond management before stocking: Immediately a pond is excavated, water is added to about 0.2-8.5 m levels and check for retentions, before liming could take place. This is important because if the soil has low water retaining capacity, there is high possibility of leaching of both the water and nutrients, especially in earthen pond.

Flooding from inlet system is screened filtered to check the size of the Fauna and Flora that comes in. The water must be from a good source because of pathogenic

Table 2: Pond condition (fertility) and stocking rate of prawn and shrimp

Pond conditions	Stocking rate (Prawns ha^{-1})
Rich	15,000
Medium	10,000
Poor	6,000

Source: Ling [7]

Table 3: Growth rate keys for prawns management

Tip in ponds (month)	Tip of rostrum to tip of telson (cm)	Tip of antennal scale to tip of telson (cm)	Average weight (g)
0	5.5	5.0	2.0
1	7.6	6.5	4.5
2	11.0	9.5	10.0
3	14.0	12.5	25.0
4	18.0	16.5	60.0
5	21.0	19.5	100.0
6	22.5	20.5	125.0

Source: Ling [7]

microbes that might constitute nuisance and have side effect on the productivity of the pond.

Manure application: Animal manure (such as poultry dung or any other available livestock dung) mixed with lime is to be added monthly to promote growth of natural food. About 150 kg of poultry dung mixed with 10 kg of lime will be sufficient for each hectare of pond for medium fertility. Fertilization of pond is directly done through feacal outpourings of the shrimps and prawns into the pond water. This does not require extract cost of fertilizer.

Stocking rate: Stocking rate of prawn and shrimp, depend on the readiness of the soil and conditions of water. Table 2 shows pond conditions in term of fertilization and stocking rate for prawns and shrimps. These could also be adopted for laboratory experiment and commercial purpose.

Food and feeding:

Food: Small slices of waste fish, mollusces, earthworms, offal's of animals and fish, insects, maggots, silkworm pupae, chinoromids, broken rice etc. are all suitable as food for prawn and shrimp. A combination of 75% animal proteins and 25% plant proteins is most suitable for better yield. At the larvae stage natural feed is supplemented with 35%crude protein compounded feed in the diet of three days old larvae. This 35% crude protein feed consist of egg custard, made from a mixture of whole eggs and dried milk for human babies. At the grow - out stage, shrimps and prawns required reliable, nutritionally balanced and high water stable feeds because they are slow feeders. They are fed 20-25% crude protein including both conventional and unconventional feedstuff. Adequate fertilization of the pond has been presented to contribute positively to feeding in prawns and shrimps. A detailed review on the composition, preparation and utilization of feeds for crustacean has been presented by Kazanawa [14], Cuzon *et al.* [15] and Ling [16] among other nutritionists.

Feeding rate: The ruling factors of feeding rates are sizes and number of prawns in the pond, water quality and nature of feed. 6.25 kg/of feed/hac/day has been reported as the initial feeding rate conventional feed is used in a pond stocked at $5/m^2$ and this rate can build up to about 37.5 kg/ha/day. For example average daily consumption of a pond producing 2500 kg of shell fish/hac/year has been estimated as 14-21 kg of feed/ha/day Ling [16].

Feeding regimes: In order to avoid pollution of the habitat the feed is supplied to the larvae instalmentally. In the first 5 days feeds are supplied at the regime of 3 times/day; 4 times during 5-15 days after which feed is supplied 5 times with 4 meals at the day time and one at night. Feeding regime should be monitored adequately to increase survival of the early culture stage.

The amount of feed given per day is equivalent to 30% of the body of larvae. To ensure that every larval feeds the feed should be added to the medium slowly to observe each larva picking the feed supplied because prawn and shrimp are stand feeders.

Prawn and shrimp management and care: Water inlet should be screened carefully to prevent the entry of young stages and eggs of predatory fish, toad and other aquatic predators. It helps to retain prawns in the pond.

Prompt inspection of monks and repair of linkages. *Ipomoea aquatica* should be grown in the pond to provide shade and shelter for prawns and shrimps.

Growth rate key for monitoring of cultured prawns: Growth rate is rapid in the grow-out prawns and shrimps cultured in pond with good water management and ample food supplied (Table 3).

The growth rate of young males and female is about the same. After reaching a length of about 18.0 cm and weight of 60.0 g, the growth rate of females decreases and there is a little growth beyond 22.0 cm in length and 120.0 g in weight. The males keep on growing to about 200.0 g.

Table 4: Projected inputs for pond construction/accessories for 5 years fixed assets

	Cost/year (₦)				
Fixed assets	Year 1	Year 2	Year 3	Year 4	Year 5
Land acquisition/clearing	4,000	-	-	-	-
Excavation (medium size) @ ₦5,000 per day for 7 days	35,000	5,000	5,000	5,000	5,000
Inlet and monk	15,000	-	-	-	-
Fencing and gate	20,000	-	-	-	-
Seine net	10,000	3,750	3,750	3,750	3,750
Sub-total	84,000	8,750	8,750	8,750	8,750
Variable asset					
Seed: Prawn 20,000 @ ₦5.00 per seed	100,000	100,000	100,000	100,000	100,000
Shrimp 20,000 @ ₦5.00 per seed	100,000	100,000	100,000	100,000	100,000
Compounded feed	40,000	20,000	20,000	20,000	20,000
Fertilizer (Cow or poultry dung) 2.5 tons/ha/yr	5,000	2,500	2,500	2,500	2,500
Liming (120 kg/ha/yr)	3,000	-	-	-	-
Farm technician @ ₦8500/month	102,000	102,000	102,000	102,000	102,000
Farm attendant @ ₦7,000 / month	84,000	84,000	84,000	84,000	84,000
Security man @ ₦5000 / month	60,000	60,000	60,000	60,000	60,000
Contingency 5% of capital on recurrent	24,700	23,425	23,425	23,425	23,425
Sub-total	518,700	491,125	491,125	491,125	491,125
Grand total of output	602,700	500,625	500,625	500,625	500,625

Shrimp sampling: Shrimp sampling can be carried out weekly or biweekly to determine their growth by the use of cast net. Take some samples and weigh to compare the new weight with the old weights. A progressive increase in body weight is a sign of good feeding and good health. Reduction of growth must be a concern to farmer by checking all the growth and the water quality precautions earlier mentioned in this paper.

Shrimps harvest/sales: At the end of the culturing month, the water can be drained in other to effect total cropping of the stocked shell fish, At harvest, shrimps are sorted into sizes because different shrimps commands different price. The prawn is much cheaper than shrimps. Shrimps are measured with baskets in the market or sold in kilogram me at the pond site. Where the sales of shrimps are not possible at site, harvested shrimps should be washed and stored in refrigerator or processed to avoid the quality deterioration [17].

Investment opportunity in shrimp farming: Shrimp farming is another form of aquaculture that is gaining popularity and attracting the attention of the international investment agencies, being a high foreign-exchange earner. US AID is prepared as part of the USA OAGDA initiative to assist any interested Nigerian investors to start Commercial shrimp farming in the country and FDF is well prepared as a true link.

What the country gains from shrimp farming: Revenue generated from the fisheries sub-sector presently remains the Federal Government's highest revenue generating sub-sector in the agricultural sector. With government efforts, there is appreciable increase particularly in shrimp landed by the industrial fisheries operators from 2,376 mt in 1985 to 15,249 mt in 1999.

Foreign exchange earnings from shrimps exportation has also increase from $12,966,526 in 1992 to $46,485,491.05 in 2000 [1].

Investment projections and profitability: Tables 4 and 5 reveals the capital input materials on the shrimp's pond and the succeeding year output from the culture pond. Table 6 presented the profit margin expected if shrimp farming is ventured into.

At the end of the whole exercise for 5-year period expected net profit of about 1.08 million naira is the recorded from the shrimp and prawn culture from brackish water investment.

Constrains to shrimp and prawn culture in Nigeria: The major constraints to shrimp and prawn culture in Nigeria are highlighted below.

Inadequate crustacean seeds production: Seeds such as larvae, juvenile and young developmental stages are essential in Crustacean production and their production

Table 5: Projected output on prawn and shrimp farm for succeeding 5 years

	Amount (₦ /Yr)				
Items	Year 1	Year 2	Year 3	Year 4	Year 5
Prawn at 5% less No. stocked (2,385 kg @ ₦ 170/kg of prawn)	403,750	403,750	403,750	403,750	403,750
Shrimp at 5% less No. stocked (2,090 kg @ ₦ 150 /kg of shrimp)	418,000	418,000	418,000	418,000	418,000
Total	821750	821750	821750	821750	821750
Expected net profit/year	47,850	251,325	251,325	251,325	251,325

Table 6: Projected profit margin for succeeding 5 years

	Cost/year (₦)				
Fixed assets	Year 1	Year 2	Year 3	Year 4	Year 5
Cost of output (₦)	821,570.00	821,750.00	821,750.00	821,750.00	821,750.00
Cost of input (₦)	602,700.00	500,675.00	500,675.00	500,675.00	500,675.00
Net profit /loss/year (₦/year)	219,050.00	321,075.00	321,075.00	321,075.00	321,075.00
Net profit /loss/month (₦/month)	18,254.17	26,756.25	26,756.25	26,756.25	26,756.25
Percentage net profit/loss/year (%/year)	36.34	64.13	64.13	64.13	64.13

is inadequate even to minimal value. Thus most interested farmers and stakeholders are forced to go for collection of seeds from the wild which is highly unreliable and seasonal. Consequently enough seeds may not be collected, hence negating both stocking and production.

Inadequate crustacean feeds: In feeding management of Crustacean, feeding is sequential and more technical than what it entails in fish culture although prawns perform better in well fertilized pond substituted with non-conventional feeds [18].

Water management problem: The problem of brackish water culture needs to be addressed and dully researched into as this has been a cross line encountered by most culturist. Slightly brackish salinity range 2-9 ppt has been recommended for prawn while successfully reared prawn in freshwater through all the larval stage [19].

Inadequate man power: Crustacean farming demands competency and few or none of the facilities needed for such competent training are available in the country. Very few of fish training centers give room to training farmers on shrimp and prawn culture. It is no gain saying that up till now Nigerian shrimp and prawn culture still has unqualified experts who through their incompetence introduce innocent entrepreneurs into unprofitable ventures which are often abandoned by the investors. Such practice further discourages future investors and stakeholders. Others include: limited technology, high cost of pond construction poor extension service and poaching to mention a few.

Suggestions to harness shrimp and prawn production in Nigeria:

- Training of fishery officers, interested farmers and other stakeholders.
- Adequate farm management and water quality monitoring.
- Boosting shrimp and prawn seed production.
- Adequate management of the berry females in order to reduce operational cost that will be incur on seedlings in the succeeding year.
- Adequate feed production and utilization of unconventional feed ingredients
- Research (both scientific and developmental).
- Easy access to credit facilities.
- Adequate extension service.
- Provision of security for the farm to curtail poachers.

CONCLUSIONS

Aquaculture potential of both shrimp and prawns in Nigeria is mostly unexploited and investment opportunity is with a good prospect. The culture stands as the major key to bridging the gap between shrimp demand and supply in future. Shrimps and Prawn farming is revealed in this paper as viable in that the outputs surpasses the inputs in material and considerable net profit was realized. In the quest for more sources of protein supplement for man, Shrimps and Prawn integration farm establishment and management is proposed in this paper based on available information and technologies on the symbiotic relationship between animal waste (Manure) and shrimp.

This system is recommended for big time farmers, NGO's, government agencies, retired civil and military men and women and the young graduates roaming about for white-collar jobs.

The realization of the potentials for aquaculture must take into consideration the major constraints currently facing this sector and how to alleviate it.

REFERENCES

1. Federal Department of Fisheries (FDF), 2003. Report of the Presidential Forum on aquaculture development in Nigeria.
2. Adegbola, T.A., 1999. Nigerian Children worst victims of Economic. A paper presented at an international seminar on promoting substances and small scale livestock production towards reduction of malnutrition and poverty in urban families in Nigeria; held at IITA. 3rd March, 1999
3. Shaun, M.M., 2004. White Shrimp in Asia-Fad or Future? Fish Farmer, 18: 6-7.
4. Peddie, S., 2004. Aquaculture in Zealand. Fish Farmer, 18: 5.
5. FAO., 1982. Freshwater Prawn Farming. A manual for culture of *Macrobranchium rosenbergii.* FAO Fisheries Technical paper No. 225.
6. Ovie, S.O., 1991. A review of freshwater Macrobrochium culture and some preliminary observations on the rearing of *Macrobrochium vollenhoenii* in freshwater. NIFFR Annual report 1990, pp: 59-69.
7. Ling, S.W., 1969. The general Biology of and development of *Macrobranchium rosenbergii* (de man). In proceedings of the world Scientific Conference on the Biology and Culture of Shrimps and Prawns. FAO Fisheries Reports No. 57, 3: 589-607.
8. Lee, C.L.C., 1983. Progress in development standardized system for production of Juvenile *M. rosenbergii* (De man). A paper presented in the freshwater fisheries resources station (MAROI) Bata Berendam, Malaca, Malaysia.
9. Cheach, S.W. and K.J. Ang, 1983. Juvenile production of the Malaysian giant freshwater prawn (*M. rosenbergii*-demand using modified static "green water" system. A paper presented at the international. Conf. on Dev. and Management of Tropical living aquatic, Resources Organized by the faculty of fisheries and Marine Sciences. Unite pretanian Malaysia, serdary, selangor, Malaysia. August, 2nd-5th, 1983.
10. Okoye, F.C., 1996. Fertilizer application in ponds. NIFFR extension series No. 3.
11. Adeniji, H.A., 1996. Precautions for good water quality management. NIFFR Extension guide series No. 2.
12. Okoye, F.C., 1996. Species combination and stocking density in ponds. NIFFR extension guide series No. 6.
13. Castell, J.D., J.C. Kean, D.G.C. McCann, A.D. Boghen, D.E. Conkin and L.R. d'Abramo, 1989. A standard reference diet for crustacean nutrition research. II. Selection of purified procedure for production of the rock crab *Cancer irroratus* protein ingredient. J. World Aquacul. Soc., 20: 100-106.
14. Kazanawa, A., 1993. Essential phospholipids of fish and crustacean. In: S.J. Kaushik and P. Luquet (Eds.), Fish Nutrition in Practice, Basrritz, France, June 24-27, 1991, Les Colloques, INRA.
15. Cuzon, G., J. Guillaume and C. Cahu, 1994. Composition, preparation and utilization of feeds for Crustacean. Aquaculture, 124: 253-267.
16. Ling, S.W., 1969. Methods of rearing and culturing *Macrobranchium rosenbergii* (de man). In Proceedings of the World Scientific Conference on the Biology and Culture of Shrimps and Prawns. FAO Fisheries Reports No. 57, 3: 607-620.
17. Eyo, A.A., 1996. Handling fish in land water. NIFFR extension guide senses No. 9.
18. Tacon, A.G.J., 1996. Global trends in aquaculture and aquafeed production. In (FAO, Ed.) International milling directory, 1996. Uxbridge, Turret-RAI, pp: 90-108.
19. Antetekhai, M.A. and S.O. Fagade, 1988. Induced spawning and laboratory rearing of the larval of the African River prawn *Macrobranchium vollenhovenii* (Herklots) caught at Asejire Lake. 6th Conference of Fisheries Society of Nigeria, Warri.