COMMERCIAL MARICULTURE OF Oreochromis niloticus USING NET CAGES

by

A.S. FINEMAN-KALIO

Rivers State University of Science
& Technology, Faculty of Agriculture,
P. M. B. 5080, Port Harcourt,
Nigeria

ABSTRACT

The culture of tilapia has a long history in Africa. Fossil remains of members of the genus have been found which are about 18 million years old (Fryer and Iles, 1972). Oreochromis niloticus was the subject of detailed observations in Egypt of 5,000 years ago. A bas relief of 2,500B.C. depicts tilapia being reared in ponds in Egypt.

However, despite this long history the prolific nature of this fish results in very high populations in pond culture systems. Consequently small size fish are harvested. Several methods have thus been tried to control the excessive reproduction of tilapia in captivity with only partial success. This paper reports how large size tilapia especially O. niloticus averaging at least 150g per piece can be commercially produced using floating net cages in the marine environment.

INTRODUCTION

Oreochromis niloticus live in a relatively stable physical environment to which they have long made necessary adaptations. Balarin (1979) reported that O. niloticus spawns at salinities of 17ppt to 29ppt. However, Fineman-Kalio (1984) observed that O. niloticus was unable to spawn at high salinities of 30ppt to 50ppt in brackishwater ponds. He further reported production figures averaging 2.5 tons/ha with sizes of 125g-140g per piece after 120 days of culture with supplemental feeding. Corre (1981) reported spawning of O. niloticus at salinity of 14ppt 45 days after stocking while Biona (1981) observed nest building of O. niloticus during the 45th day of culture at salinities ranging from 18-28ppt but no actual spawning was reported. Also Chervinski and Yashov (1971) stated that tilapia species when exposed to high salinities are unable to reach sexual maturity due to a stop in their gonadosomatic index. These findings show that one effective method of controlling

reproduction of O. niloticus is to transfer it from freshwater to saline water. The resultant effect being growth to large size because energy hitherto expended for reproduction is utilised for growth.

Thus this paper will describe the various processes to achieve a successful transfer from freshwater to saline water and further show the possibilities of utilising floating net cages in the marine environment for intensive commercial culture of the fish.

MATERIALS AND METHOD

Procurement of fingerlings:

The procurement of freshwater O. niloticus fingerlings is possible within the country as there are several tilapia hatcheries in various parts of this country viz: Kainji Lake Research Institute, New Bussa, Kwara State; Sydenham Nigeria Ltd., Ibadan; Ijoma Fisheries Ltd., Ibadan, Oyo State etc.

Acclimatization of fingerlings:

The acclimatization of fingerlings from freshwater to seawater is possible using wooden tanks of dimensions 90 x 80 x 40 cm filled to a depth of 25cm and using the formula proposed by Corre (1981):

$$S_f V_f \doteq S_1 V_1 + S_2 V_2$$

where

S_f = salinity of the final mixture

V_f = volume of the final mixture

S_1 = salinity of the water to be used

V_1 = volume of water to be used

S_2 = salinity of the water in the tank

V_2 = volume of the water in the tank.

Each of the tanks should be stocked with 500 fingerlings during the acclimatization process. The salinity should be adjusted at 5ppt per day, 2ppt in the morning and 3ppt in the afternoon at 9a.m and 3p.m respectively. This will ensure a gradual transfer and ensure a 100% survival. When fish have been acclimatized to a salinity of 30-35 ppt they should be allowed to remain in this medium for at least on week before transfer to the net cages in the sea. In order to raise salinity in the hatchery the ordinary salt purchased from the local market could be used to raise salinity where actual seawater is not available. Fish should be fed a 30% protein supplemental feed at 5% body

weight during the period of acclimatization.

Cages:

At the end of the acclimatization period fish fingerlings should be transported in oxygenated plastic bags to net cages (4 x 3 x 2.75)m i.e. 33m^3 in size. Cages should be floated in units of four, referred to as one module. For a commercial venture such as proposed 50 modules will be required.

Net Material and mesh size:

The net cage made of polyethylene netting is preferable although galvanized wire mesh could also be used to keep the fish in the floating cages. However, galvanized wire needs frequent replacement besides it is bulky. Each module should be floated by 8 tar-coated metal drums. The mesh size should be 0.64cm (fish below 5cm), 1.27cm (fish between 15-20cm) and 2.5 to 3.8cm (fish above 21cm). The expected life span of the fish cage is 3 years using net material.

Project Site:

Cages should be installed in sites where salinity is at least 30ppt with dissolved oxygen at 3 cc/litre minimum. The velocity of the water current should be about 20-50cm/sec. with wave height averaging 1 meter. Water temperature should be in the range of 27-32°C. A minimum depth of 4 meters is required for an ideal site.

Stocking density:

A stocking density of 350 fingerlings/m^3 is proposed for this intensive culture system. Elsewhere in the Philippines stocking densities of 250-1,000/m^3 have been tried with good results (Guerrero, 1979). At the proposed stocking density each cage will contain 12,705 fingerlings which includes a 10% increase to offset loss due to mortality during culture. Each fingerling should weigh about 5g before stocking to ensure good survival.

Management:

Personnel

The project will require 1 manager with a achelor's degree in Fisheries to manage the business, 2 university diploma holders, one in Fisheries and the other in Marketing and 2 casual labourers for routine jobs.

Supplementary feeding:

A 30% protein supplemental feed is recommended for this venture. The feed should be formulated with locally available feed ingredients such as brewery waste, Ox blood, soyabean cake, beans, garri, fish meal, fish offals from canneries, palm oil, vitamin-mineral mix etc. Production of fish feed could be through the establishment of a private feed meal or by arrangement with existing livestock fed mills within the country or in consultation with fish nutritionists in research institutes and universities e.g. Kainji Lake Research Institute (KLRI), Kwara State; Institute of Oceanography and Marine Research (NIOMR), Lagos; Department of Fisheries, Rivers State University of Science & Technology, Port-Harcourt.

Cropping:

Two crops will be made each year with a one month between for preparation before stocking viz; net mending, repair of floats, procurement and acclimatization of fingerlings, purchase of feeds etc.

Investment potentials:

Table 1 shows a simple cost and returns analysis of the commercial mariculture of freshwater O. niloticus in net cages. A profit margin of ₦438,474.30 will be realised after all taxes have been deducted during the first crop, with an initial investment of ₦924,100. An ROI of 48% during the first cropping is good indicator that the project will be viable if embarked upon. There is no doubt the profit margin will be on the increase during the second and succeeding croppings when there will be no additional cost of construction of net cages. The coast of the Delta special area is some 258km long and there are approximately 8,300 square kilometers of coastal waters within the given limits which are open to exploitation (Scott, 1966). In this area are enclosed numerous saline bays such as Forcados, Ramos, Dodo, Penington, Kulama, Sombrero, New Calabar, Bonny which are all potential sites suitable for installation of net cages for the commercial cage culture of freshwater O. niloticus.

DISCUSSION

Tilapia is known all over the world as one of the promising candidates for aquaculture. Its high fecundity and prolific reproduction ensures a dependable supply of fish seed for a continuous cultivation. However, it is fast becoming a menace in ponds owing to its tendency to overpopulate the ponds, resulting into staunted growth due to depletion of food. Several methods still being tried to control or minimise its prolific reproduction with the aim of increasing its individual target size include monosex culture through manual sexing and sex reversal by use of hormones (Guerrero, 1979) and use of predators (Fortes, 1980). Under the Nigerian context, the

aforementioned methods are not only laborious but also require some special technology that require importation of some raw material, from outisde the country. The proposed control by salinity is very simple, promising and inexpensive. The response to artificial feeding by O. niloticus is an added advantage that makes possible the attainment of the proposed minimum size of 150g in 150 days.

A production of 1.7325 tons per 33m³ cage is expected in this proposal. A production of 1.32 tons was reported for cages of similar size after only two months of culture in Lake Laguna, Philippines (Guerrero, 1978). Infact it is possible for fish to attain sizes of 200g during 150 days of culture with inhibited reproduction.

CONCLUSION

The culture of freshwater O. niloticus in saline waters using net cages has great promise in controlling reproduction of this fish, which is a factor limiting growth to large size. The high fish production using floating net cages will go a long way in narrowing the gap between supply and demand of fish in Nigeria currently having an estimated deficit of well over 1.65 million metric tonnes annually.

REFERENCES

Balarin, J.D., AND J.P. HALTON (1979) Salinity In: Tilapia A guide to their biology and culture in Africa. Unit of Aquatic Pathobiology. University of Stirling, Stirling. U.K. 18-19pp.

BIONA, H.D. (1981) The effect of stocking densities on the growth and survival and reproduction of intensively fed Nile tilapia in brackishwater ponds. M.Sc. thesis, UP-SEAFDEC graduate study program. UPVCF. Iloilo City, Philippines.

CHERVINSKI, J. AND A. YASHOV. (1971) Preliminary experiments on the growth of tilapia aurea in seawater ponds. BAMIDGEH 23 (4): 125 - 129pp.

CORRE, V.L. (1981) Culture of Nile tilapia in brackishwater fishponds using feeds containing various levels of protein, M.Sc. thesis. University of the Philippines, College of Fisheries, Iloilo City.

FINEMAN-KALIO, A.S. (1984) Effects of supplemental feeds containing different protein: energy ratios on the growth and survival of Oreochromis niloticus in brackishwater ponds. M.Sc. thesis, University of the Philippines, College of Fisheries, Iloilo City, Philippines.

FORTES, R.D. (1980) Tarpon as predator to control Java tilapia young in brackishwater ponds. Fish Resources Journal of the Philippines. 5(2): 2-35pp.

FRYER, A., AND T.D. ILES (1972) The Cichlid fishes of the great lakes of Africa: Their biology and evolution. T.F.H. Publications, New Jersey.

GUERRERO, R.D. (1978) Studies on the feeding of Oreochromis niloticus in floating cages. Provisional Report No. 2, Aquaculture. International Foundation of Science. Stockholm, Sweden. 55-69pp.

GUERRERO, R.D. (1979) Use of hormonal steroids for artificial sex reversal of Tilapia. Proc. Indian National Sci. Acad. B45(5): 512-514pp.

SCOTT, J.S. (1966) The brackishwater zone - Potentials for development In Report on the fisheries of the Niger Delta Special Area. Niger Delta Development Board 43-58pp.

Table 1 - Simple Cost And Returns Analysis For One Crop During First Year Of Production

Item No.	Description	Material Cost	Labour Cost	Others	Total Cost
1.	Construction of 200 units of (4 x 3 x 2.75)m rectangular net cages	87,500.00	10,000.00	2,500.00	100,000.00
2.	O. niloticus fingerlings 2,541,000 @ 20k per fingerling				508,200.00
3.	Fish feed for 5 months 592 tons @ ₦500/ton at 5% fish biomass				296,000.00
4.	Personnel:				
	1 Farm Manager				6,000.00
	2 Fisheries Assistants				6,000.00
	2 Casual Labourers				2,400.00
5.	Miscellaneous - Security, Maintenance etc.				5,500.00
	Total Production Cost				924,100.00
6.	Revenue				
	Sale of large tilapia 150g/PC i.e. 1.7325 ton/cage for 200 cages 346.50 tonnes @ ₦5/kg				1,732,500.00
	Gross Profit				926,600.00
	Less Interest on Loan @ 14%				129,374.00
	Net Profit before Tax				797,226.00
	Less Company Tax @ 45%				358,751.70
	Net Profit				438,474.30
7.	Return on Investment				47.74%