INVESTMENT PROSPECTS IN THE PRODUCTION OF THE COMMON CARP (*Cyprinus carpio*) FINGERLINGS IN FRESHWATER PONDS

by

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ABSTRACT

Since the introduction of Common carp *Cyprinus carpio* in Oyo State from Israel in 1964, various local breeding methods have been employed in Carp rearing to improve the survival rate at all stages of development during breeding. The physico-chemical parameters of the ponds which were simultaneously investigated for carp rearing in this study includes temperature (t), dissolved oxygen (DO) and hydrogen-ion concentration (pH). However, high rates of water displacement in the breeding ponds were unfavourable to the development of zooplankton which play important role in the food web of *Cyprinus carpio*.

The survival rates of 15.88 - 69.50% and 19.60 - 33.83% obtained for the egg - hatchling and hatchling - fingerling stages respectively were encouraging. A breeding performance of this magnitude was found to be viable, breaking even in the fourth year. However, an increase in size of this trial project would be more profitable and increase fingerling supply as well as provide employment opportunities.

This study thereby provides some baseline information on some local techniques and progress in the propagation of *C. carpio* and scope for further improvement.

INTRODUCTION

The knowledge and techniques of artificial propagation of fish is becoming increasingly important, and is in a state of fast progress. This has resulted from the global expansion of fish farming and production intensity, which has consequently led to a higher demand for fish fry required for stocking purposes (Falaye, 1986). Of all the

fish species utilized by man, the common carp (Cyprinus carpio) has the longest history of culture. In West Africa, the common carp was introduced rather late. For instance, it was not introduced to Nigeria until 1954 when some fingerlings from Austria were stocked in ponds in Panyam Fish Farm, Jos (Olaniyan, 1961). Ten years later (in 1964), 220 fingerlings were imported from Israel for breeding in the former Western Region, part of which is now Oyo State. In spite of the successful performance of C. carpio in ponds in Nigeria, there is little information on the breeding techniques being used to propagate the species since its introduction into Nigeria. Bardach et al (1972) observed that the adaptability of carp is expressed not only in its wide distribution and long history of culture and enormous global production, but also by the wide variety of techniques employed in Carp farming.

This paper therefore, reports the practice and success of Carp breeding in Agodi fish farm, Ibadan.

MATERIALS AND METHODS

Type of Ponds

Three different types of ponds comprising of segregation, spawning and nursery ponds were used for this study. Table 1 shows size anddepth of the ponds. Water was supplied by gravity from a mini reservoir through a continuous flow to maintain adequate water level in the ponds.

Description	Type of Ponds			
	Mini Reservoir	Segregation	Spawning	Nursery
Size (Ha)	0.43	0.047	0.047	0.047
Average Depth (M)	2.4	1.30	1.32	1.30

Table 1 - Characteristics of ponds used for Cyprinus carpio breeding at Agodi, Ibadan breeding centre

Spawning trials were carried out in hapa of 0.7 x 0.35m x 0.45m dimension, between November 1978 and April 1979. Aquatic plants (Ceratophyllum sp.) were placed as breeding substrates in the hapas at about 1 kg of plant per hapa.

Brooders

The brooders were differentiated according to their sexe and stocked at a ratio of 2 males to 1 female per hapa. Each male brooder weighed 0.5 kg while each female bro weighed 1.0 kg. Brooders were introduced into the hapa 18.00 hrs and covered with a sheet of netting material. The hapa was examined for spawning success after twelve hours.

Water Quality

Physico-chemical parameters of the pond water which are critical to carp breeding and survival were monitored during the spawning trials. Daily water temperatures (°C) were measured by means of a measuring thermometer at six hour intervals between 06.00 hr, and 18.00 hrs. Dissolved oxygen (DO) levels and the hydrogen-ion concentration (pH) were determined according to Mackereth (1963) at 06.00 hr, 12.00 hr and 18.00 hr daily. Alkalinity was also assessed daily after Mackereth (op. cit).

Phyto plankton population in the rearing ponds were identified and estimated by direct count (No/litre of water samples) with the aid of a microscope.

Fecundity and Fingerlings Survival

Fecundity estimate was conducted by direct egg count; while hatchlings were estimated by number, using the method described by Bardach et. al (1972). The hatchlings were later transferred into nursery ponds where supplementary feeding was done with cooked egg yolk and chicken mash at 250 kg/ha for 15 days. Surviving fry were later transferred into rearing ponds at an average weight of 4 - 6 gm and mean length 3.5 - 5.0 cm. Hatchlings that survived to fingerling stage were estimated to compute the percentage survival at each stage of development.

Financial analysis

A financial analysis of 4 months of fingerling production (breeding cycle) in this study was projected for one year to estimate annual profit.

RESULTS

Water quality factors

The results of the examined physico-chemical parameters of pond water samples are shown in Table 2. The monthly mean water temperatures were generally high in the ponds, ranging between 26.1°C and 28.8°C. Hydrogen-ion concentration (pH) showed little diurnal variation. However, all pH values fell within bromothymol-blue range of 6.0 - 7.6. All the ponds appeared to be well oxygenated throughout the study period, but with a slight decrease of

dissolved oxygen (DO) at the peak of the dry season (Table 2). Dissolved Oxygen values range between 5.1 to 6.9 mg/l.

The phyto-plankton abundance was generally high, while the zooplankton population were found to be poor.

Fecundity and Fingerlings Survival

The egg production of Cyprinus carpio during this breeding trial is presented in Table 3. Female carp of 0.5 kg produced between 30,000 - 35,000 eggs while female of 1.0kg produced between 130,000 - 135,000 eggs during the spawning trial. The observed fecundity followed the general egg production pattern in fishing with the largest females producing the greatest number of eggs (Bardach et al, 1972).

The survival rate from egg to hatchling stage ranged between 15.88 to 69.50 per cent. Remarkably, higher survival of hatchlings were obtained in November and December than in the subsequent months of January and April, even though the fecundities recorded for the former months were much lower than the later (Table 3).

Mortality during fry rearing was slightly higher than in the egg - hatchling stage. The mean percentage survival of hatchlings to fingerlings stage was 27 per cent.

Financial analysis

Financial analysis of projected annual fingerling production is presented in Table 4. The major expenditure will be incurred in the first year during the development of the hatchery facilities. This was estimated at ₦63,445.00. Thereafter, annual cost of production ranges between ₦11,000.00 and ₦14,000.00. From an estimated 60,336 annual fingerling production, a revenue of more than ₦20,000.00 is expected over the years, assuming the present high demand for carp fingerlings in the country.

DISCUSSION

Bardach et al (1972) have described in detail the various specialised fish breeding techniques in aquaculture. In this exercise however, only Ceratophyllum sp. was used for attachment of eggs. The could have contributed to the improved survival rate of the fertilized eggs. Hora and Pillay (1962) reported the use of submerged aquatic weeds such as Ceratophyllum sp, Myriophyllum sp. and Eichohornia crassipes (water hyacinth) for attachment of carp eggs as an improvement on breeding technique in China.

Out of all environmental factors; Chaudhuri (1966) observed that light and temperature have the most pronounced influence on maturity and spawning of fish. Although light

intensity was not measured during this investigation, however, the period of study falls within the dry season (November - April) when sunshine was abundant. Therefore, it is unlikely that light was limiting to fish spawning at this time. The temperature regime of the ponds remained fairly constant (Table 2); and also unlikely to be limiting to the spawning and breeding processes.

The pond water was not only high in concentration of Dissolved Oxygen (DO_2) but of high percentage saturation values which are favourable for breeding of fish. Influx of water from rainfall and flood with increased levels of Dissolved Oxygen and pH have been shown to be important external factors responsible for stimulating spawning in fish (Khan, 1945). Prufinin (1966) reported that pH may not affect thegrowth of carp directly, but it influences the growth of food organisms in the water.

Also, the fry have to be fed before complete resorption of the yolk sac to provide energy sources while extreme temperature fluctuations should be eliminated during this critical stages (Tamas and Horvath, 1979).

The observed percentage survival rate of between 15.88 - 69.50 (egg - hatchling) and 19.60 - 33.83 (hatchling - fingerling) conforms with the findings of Le Cren (1962). Le Cren (op. cit) showed that mortality was highest during the first year of fish development. In addition, Runa (1986) observed that physical characteristics and biochemical composition of egg are other factors affecting the success of fish breeding. Although Ricker and Foerster (1948) found the survival rate of hatchery-reared Sockeye (salmon) fry to range between 3.87 and 13.13 per cent in different years; and with varying degrees of predation; modern hatchery methods tend to reduce the environmental hazards thereby increasing fish survival.

Bardach et al (1972) identified four major causes of poor survival of carp eggs. These causes are predation by parents, low fertilization rates, low temperature and fungal infection. Apart from fungal attack, none of these causes were noticed to have affected survival of carp fingerling during this study.

Financial considerations for this fingerling production trials show high profit relative to cost of production. With the high scale of capital investment in the first year of production, the venture should break-even by the 4th year (Table 4).

High profit in fingerling production is expected due to low cost of input and short production cycle of fingerlings under effective management; thus allowing about three production cycles in one year. Whereas, production of table fish requires annual high cost of input and longer production cycle (ranging between 6 - 12 months depending on fish species).

In this breeding trial , the rates of hatching, spawning and breeding success compare favourably with other breeding trials in the developing countries where little habitat manipulation have been practised. With further environmental manipulation, availability of improved fish seed, feed and effective pond management, increase in survival rate and profit can be attained by using this breeding technique.

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REFERENCES

BARDACH, J.E; RYTHER, J.H. and McLARNEY, W.O. (1972) Aquaculture, the farming and husbandry of freshwater and marine organisms - Wiley - Inter Science, New York. 868pp

CHAUDHURI, H. (1964) Introduction of exotic species of fish and their effect on the culture of indigenous species of India. Seminar on Inland Fisheries Development, Uttar Pradesh. Lucknow. 83 - 92

FALAYE, A.E. (1986) Fisheries Management under polyculture in tropical freshwater ponds. J. West. Afr. Fish. I (1):

KHAN, H. (1945) Observations on the spawning behaviour of Carp in the Punjab. Pro. Nat. Inst. Sci. India.

Le CREN, E.D. (1972) The efficiency of reporduction and recruitment in freshwater fish. Pre exploitation of Natural animal populations. Blackwell Sc. Pub., Oxford. 2: 283 - 296.

MACKERETH, F.J. (1963) Some methods of water analysis for limnologists. Sci. Publ. Freshwater Biol. Ass. 21: 13 -49

OLANIYAN, C.I.O. (1961) On the introduction of common carp, Cyprinus carpio L. into Nigeria waters and its possible effects on the hydrography of the region. Great Britain J. West. Afric. S. Ass. (i): 79 - 82

PRUGININ, Y. (1966) The culture of Carp and hybrids in Uganda. FAO Fisheries Reports No.44 (4): 223 - 229

RANA, K.J. (1986) Production and rearing of fry from mouth breeding tilapias. Aquaculture News: University of Stirling.

RICKER and FOERSTER (1948) Computation of fish production. Bull. Bingham Oceangr. Coll. 11, 4: 173 - 211

TAMAS, G. and HARVATH, L (1979) Fry and fingerling production under pond farm management conditions (Carp and other Cyprinids). EIFAC Technical Paper No.35 Suppl. 1. FAO, Rome. p.54

Table 2 - Physico-chemical characteristics of the Carp breeding ponds

Characteristics	Ponds			
	Mini Reservoir	Segregation	Spawning	Nursery
Temperature (°C)	26.1	27.0	25.2	28.8
pH	7.4	7.4	7.2	7.4
Dissolved Oxygen (mg /1)	6.4	6.6	5.6	6.4
Zooplankton (No/litre)				
Polyarthra spp.	8	-	-	NA
Cyclopoid copepod	8	-	-	NA
Brachionus angularis	-	64	8	NA
Trichocerca sp	-	48	-	NA
Keratella tropica	-	128	24	NA

Table 3 - Production data of Cyprinus carpio during the breeding trial

Month	Weight of Male	Weight of Female	Fecundity (No. of Eggs)	Hatchlings (No)	Egg-hatchling survival(%)	Fingerling (No)	Hatchling Fingerling survival (%)
November 1978	300 200	500 -	54,180	37,648	69.50	10,444	27.74
December 1978	200 300	500	29,923	10,344	34.50	3,500	33.83
January 1979	500 500	1,000	128,435	28,440	22.10	5,500	19.60
April 1979	500 500	1,000	135,000	20,652	15.88	5,696	27.58

Table 4 - Financial analysis of fingerling production based on the Carp breeding trials at the Agodi Fish Farm, Ibadan

Year	1 ₦:K	2 ₦:K	3 ₦:K	4 ₦:K	5 ₦:K
A. CAPITAL EXPENDITURE					
i) Land Development					
(a) 0.5 Ha reservoir	20,000.00	-	-	-	-
(b) 3-0.047 Nursery/ breeding pond	15,000.00	-	-	-	-
ii) Farm buildings					
(a) One farm house (Store and Office)	12,000.00	-	-	-	-
iii) Hatchery facilities	2,000.00	-	-	-	-
iv) Water Pump	1,000.00	-	-	-	-
v) Miscellaneous farm equipment	2,000.00	-	-	-	-
Total (A)	52,000.00	-	-	-	-

B. OPERATING EXPENDITURE					
i) Brood stock. 36 breeders of Carp (C. carpio) @ ₦20 each	720.00	-	-	-	-
ii) Supplementary Feed: 1 tonne @ ₦1000/ton	1,000.00	1,200.00	1,400.00	1,600.00	1,800.00
iii) Fertilizers:					
(a) Organic: 1 t (cow/chicken droppings)	100.00	100.00	100.00	100.00	100.00
(b) Inorganic: 5 bags @ ₦5 each	25.00	25.00	25.00	25.00	25.00
iv) Pesticides	100.00	100.00	100.00	100.00	100.00
Total (B)	1,945.00	1,425.00	1,625.00	1,825.00	2,025.00
C. FIXED EXPENSES					
i) Labour: Salaries -					
1 Superintendent (GL.07)	3,600.00	3,800.00	4,000.00	4,200.00	4,400.00
2 Labourers (GL.01)	3,600.00	3,800.00	4,000.00	4,200.00	4,400.00
1 Night guard (GL.01)	1,800.00	1,900.00	2,000.00	2,100.00	2,200.00
ii) Repair and Maintenance	500.00	600.00	800.00	1,000.00	1,200.00
Total (C)	9,500.00	10,100.00	10,800.00	11,500.00	12,200.00
Grand Total (A+B+C) =	63,445.00	11,525.00	12,425.00	13,325.00	14,225.00
Gross Benefit: Yield fingerlings, 75420 less 20% mortality = 60,336 @ ₦0.35*	21,118.00	24,738.00	28,961.00	33,788.00	39,218.00
Net Benefit before Tax	43,327.00	13,213.00	16,536.00	20,463.00	24,993.00

* With an annual increase at 16.7% in price of fingerlings.