Freshwater aquaculture Practices and prospects

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Major cultured/cultivable freshwater finfishes in India are Indian major carps (catla, rohu and mrigal), medium carps (fimbrius, gonius and gonionotus), Chinese carps (silver carp, grass carp and common carp), magur, pangas, murrel, anabas, pabda, and tilapia.

Indian major carps – Catla, rohu and mrigal



Medium carps – fimbriatus, gonius and gonionotus



Silver carp

Grass carp

Common carp

MagurPangas

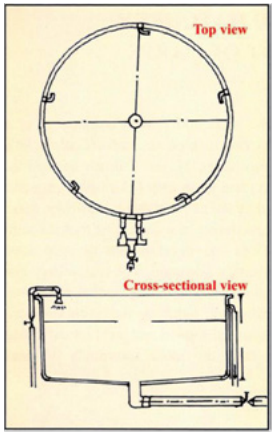
Murrel

Anabas

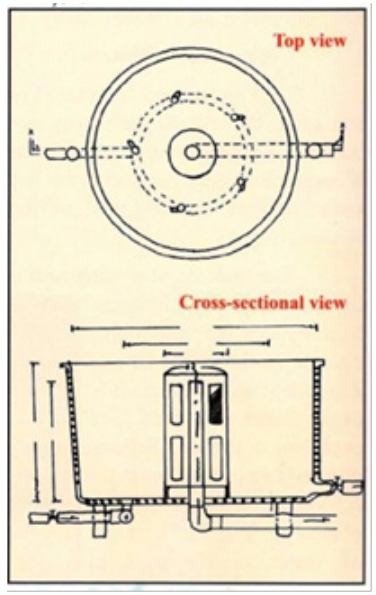
Pabda

Breeding and Hatchery Management of Carps

Until late 50s riverine seeds were the exclusive source for carp culture. Major breakthrough was made in 1957 when induced breeding technique was successfully applied to freshwater fish, leading to hatchery production of seed. To start with it was pituitary gland extract as the inducing agent; later synthetic hormones like ovaprim, ovatide, WovaFH were developed and captive breeding becomes more consistent and easier.



In a carp hatchery there is (a) Spawning tank and (b) hatching/ incubation tank. Spawning tank is circular and the size depends on the number of eggs to be produced. The bottom of the tank is sloping towards a central outlet facilitating complete drainage of eggs.



Hatching/incubation tank is circular with 3-4 m diameter. Speed of water flow inside the tank can be adjusted duck beak type water inlets (ejectors) in the bottom connected to a central water supply ring built in the bottom. Depth of water is around 1-1.5 m. A cylinder type filter with around 1-1.5 m is fitted in the centre of the tank. Shell of the cylinder is made of concrete while the superficies are covered with fine mesh of 0.3-0.4 mm diameter to prevent hatchlings from escaping.

Carps mature at about 2-4 years of age. Healthy fish of 2-4 years of age are maintained in broodstock ponds for about 3-4 months before the spawning season at a density of 1500-2000 kg/ha. They are fed with balanced diet @1-2% body weight. Around 20-25% of water in broodstock ponds is replaced with fresh water in a month. Using canvas bags mature/oozing broodfish are transferred to spawning tanks and kept in separate hapas inside the tank @male:female::3:2. Inducing hormones such as ovaprim/ Ovatide/Wova FH are administered @0.2-0.3 ml/L for males and 0.3-0.5ml/L for females by either intramuscular or intraperitoneal injections. Broodfish are kept in continuous shower post injection. The eggs are collected from the spawning tank and transferred to hatching tank. Hatching normally takes place within 14-18 h. Around 72 h after hatching the hatchlings are transferred to nursery tanks. The hatching tanks are cleaned with KMnO4 before

Training Manual- Aquaculture Worker

next operation. For long distances carp spawn can be transported in oxygen filled bags at density 25,000-50,000/bag with 6 L of water. For short distances carp spawn shall be transported in aluminium containers with good agitation of water. Table 1 depicts economics of carp spawn production in hatchery; there is potential to earn over 1 lakh rupees as net profit.

Table 1. Economics of carp spawn production in hatchery

Sl. No.	Items	Amount (in Rupees)
I.	**Expenditure**	
A.	**Fixed capital**	
1.	Breeding pool 6 m diameter (1 no), Incubation chambers (1.5 m dia, 6 nos) & egg collection chamber (2.5 X 1 X 0.75 m, 1 no) and shed	2,00,000
2.	Overhead tank (capacity 20,000 l) and accessories	1,00,000
3.	Broodstock and water Intake ponds (0.5 ha, 2 nos)	1,50,000
4.	Water pumps and accessories (Electric/diesel 5HP)	40,000
	Sub-total	**4,90,000**
B.	**Variable cost**	
1.	Prospective brood fish 1200 kg (raised from broodstock pond) @Rs 40/kg	48,000
2.	Fuel for diesel pump, electricity, etc.	20,000
3.	Disinfectant, inducing agents, etc.	15,000
4.	6 full time/part time workers @ Rs. 3000 per man-month for 3 months	54,000
5.	Miscellaneous expenditure	10,000
	Sub-total	**1,47,000**
C.	**Total Cost**	
1.	Total variable cost	1,47,000
2.	Depreciation cost on fixed capital @ 10% yearly	49,000
3.	Interest on fixed capital @12% per year	58,800
	Grand Total	**2,54,800**
II.	**Gross Income**	
1.	Sale of spent brood 1000 kg @ Rs. 55/kg	55,000
2.	Sale of spawn @ Rs 600/lakh for 50 million	3,00,000
	Total	**3,55,000**
III.	**Net Income** (Gross income - Total cost)	**1,00,200**

Fry and fingerling production

The 'nursery phase' in carp production is from 3-day old spawn to 15-20 days old fry, while the 'rearing phase' is from 20-day old fry to 2-3 months old fingerlings. It's highly recommended to use fingerling (100 mm/~10 g) to stock 'grow out' pond. Small

village ponds are ideal to use for fry rearing. Other than normal earthen ponds, cement tanks are also used for fry rearing. While the earthen ponds are 0.02-0.1 ha/1.0-1.5 m deep, cement tanks are 50-100 m2/1.0-1.2 m deep. The latter are ideal for high density rearing of fry. Aquatic weeds are undesirable in fish ponds; they absorb nutrients affecting productivity, harbor predatory/weed fishes, hinder fish movements and obstruct fishing activity. They can be removed by manual picking. Predatory and weed fishes are also undesirable since they resort to predation and competition. Examples are murrel, gobi, magur, singhi, pabda, Wallago, Puntius, Barbus, Anabas, Colisa, etc. Dewatering and sun-drying of pond are recommendedfor their eradication. Mahua oil cake shall be applied @2,500 kg/ha-mfor 3 weeks before stocking. Bleaching powder (350 kg/ha-m) and Urea (100 kg/ha-m) are also effective.

For fry production organic and inorganic fertilization are done to increase plankton in pond water. Lime is applied depending on the pH.Cowdung @5-6 t/ha or poultry droppings @2-3 t/ha are applied fortnight before stocking. This will improve natural productivity. Groundnut oilcake/mustard oilcake @750 kg, cowdung @200 kg and 50 kg single super phosphate per ha are applied in split doses, half 2-3 days prior to stocking and the rest depending on the plankton level in pond water in order to maintain desired plankton level.

Aquatic insects and their larvae are harmful to carp larvae by way of predation and competition. Examples are back swimmers, water stick insects, pond skater, water scorpion, water measurer, diving beetles, etc.Cheap vegetable oil @ 56kg/ha with 1/3 of any cheap soap is effective to control aquatic insects. Kerosene @100-200 l or diesel @75 l and liquid soap @ 560 ml or detergent powder @ 2-3 kg/ha are also effective.

For nursery rearing in earthen ponds optimum stocking density is 3-5 million spawn/ha, which are stocked during cool hours. For nursery rearing in concrete tank stocking density can be much higher, to the tune of 10-20 million spawn/ha. Either mono or multispecies can be stocked.

In nursery rearing supplementary feed in the form of finely

powdered groundnut oil cake + rice bran @ 600 g/lakh spawn is given for first 5 days and 1,200 g/lakh spawn/day for the subsequent days in 2 equal instalments, during morning and evening hours. After about 15 days of nursery growth the average size is expected to reach 25 mm which is ideal size to transfer to rearing pond. Harvesting is done by dragnet of 1/8" mesh; quantity measured by perforated cups as below:

Number of cups X average number of fry = number harvested

Expected survival in nursery rearing is between 40 and 50%. During Jun-Sep 2-3 crops of fry in earthen ponds and 4-5 crops of fry in concrete tanks can be taken. Economics of carp fry production in 1 ha pond are furnished in table 2. Assuming that 2 crops can be reared the net profit will be Rs. 124,460/-.

Table 2. Economics of carp fry production in 1 ha pond

Sl. No.	Items	Amount (in Rupees)
I.	**Expenditure**	
A.	**Variable Cost**	
1.	Pond lease value	10,000
2.	Bleaching powder (10 ppm chloride)/other toxicants	2,500
3.	Manures and fertilizers	8,000
4.	Spawn (5 million @ Rs. 6,000/million)	30,000
5.	Supplementary feed (750 kg @ Rs. 12/kg)	9,000
6.	Labours for management and harvesting (100 man-days @ Rs. 125/man-day)	12,500
7.	Miscellaneous expenditure	5,000
	Sub-total	**77,000**
B.	**Total Cost**	
1.	Variable cost	77,000
2.	Interest on variable cost (@ 12% per year for one month)	770
	Grand total	**77,770**
II.	**Gross Income**	
1.	Sale of 17.5 lakhs fry @ Rs.8,000/lakh fry (35% survival)	**1,40,000**
III.	**Net Income** (Gross Return - Total Cost)	**62,230**

Earthen ponds of size 0.5- 2.0 ha are used to stock fry to produce fingerlings. Pond is fertilized using cowdung @3-4 t/ha for 1 week prior to stocking followed by fortnightly doses of 0.5 t/ha after stocking. Urea and SSP @ 10 and 15 kg/ha, respectively

are applied as fortnightly doses. Fry of size 25 mm is stocked either as mono species or multi species. Generally polyculture is adopted in rearing ponds – Indian major carps and exotic carps at combined density of 2-3 lakhs/ha. It's advisable to provide mixture of rice bran & groundnut oil cake (1:1). Soybean flour can also be used. Feeding schedule is @8-10% first month, @6-8% second and @4-6% third month. Water depth shall be maintained as 1.5 m. Fingerlings attain 80-100 mm (8-10 g) with a survival of 70-80% in 2-3 months. They are harvested using drag nets of suitable mesh sizes. Economics of fingerling production are furnished in table 3.

Table 3. Economics of carp fingerling production

Sl. No.	Items	Amount (in Rupees)
I.	**Expenditure**	
A.	**Variable Cost**	
1.	Pond lease value	10,000
2.	Bleaching powder (10 ppm chloride)/other toxicants	2,500
3.	Manures and fertilizers	3,500
4.	Fry (3 lakhs fry @ Rs.8,000/lakh)	24,000
5.	Supplementary feed (5 tonnes @ Rs. 11,000/tonne)	55,000
6.	Wages (100 man-days @ Rs. 125/man-day for management and harvesting)	12,500
7.	Miscellaneous expenditure	3,000
	Sub-total	**1,10,500**
B.	**Total Cost**	
1.	Variable cost	1,10,500
2.	Interest on recurring expenditure 12% per year for three months	3,315
	Grand Total	**1,13,815**
II.	**Gross Income**	
1.	From sale of 1.8 lakh fingerlings @ Re 1/fingerlings	**1,80,000**
III.	**Net Income** (Gross income - Total cost)	**66,185**

For long distance transport of fingerlingsoxygen-filled polythene bags are used. Density depends on size of fingerling, duration of transport, quality of water and environment temperature. Prior to transport the fingerlings are conditioned, e.g., by stopping

feeding. It's desirable to support polythene bags by materials, such as paper cartons, to prevent damage during transportation.

Grow out culture

Usual production range in carp grow out culture is 3-5 t/ha/yr, though 6-8 t/ha/yr has been achieved by several farmers. Three critical inputs required are right kind of seed, feed and fertilizer. It's imperative to manage soil & water quality and monitor fish health. Normally grow out ponds are of 0.4-1.0 ha/2-3 m deep.

Drying of ponds is the best option, though it may not be always practical before stocking. It's essential to control aquatic weeds, predatory and weed fishes prior to stocking. Manuring with raw cowdung @3-4 t/ha, or poultry manure @1.5-2.0 t/ha is carried out. Liming is done 3-4 days before stocking - usually 200-300 kg lime for a pond with slightly acidic to neutral pH. The recommended proportion for polyculture is 30-40% surface feeders (catla, silver carp), 30-35% column feeders (rohu) and 30-40% bottom feeders (mrigal, common carp); if appropriate species of aquatic weeds are available aplenty grass carp @5-10% can also be stocked.

Stocking density depends on input use and levels of management. Stocking density is usually 80-100 mm (8-10 g) fingerlings @5000/ha after due acclimatization for a production target of 3-5 t/ha/year. If the target is 10-15 t/ha/yr fingerlings are stocked @8000-10000/ha, and @15,000-25,000/ha for production of 10-15 t/ha/yr.

Post-stocking fertilization includes providing cowdung @0.5t/ha, urea @10kg/ha and SSP @15kg/ha. Alternates are poultry litter, pig dung and duck droppings. Biofertilizer, Azollais provided @40t/ha/yr at weekly split doses can contribute to 100 kg N, 25 Kg P, 90 kg K and 1,500 kg organic matter. Biogas slurry @30-45 t/ha/yr or 80-100 L/day/ha is also recommended. It's advantageous because of lower oxygen consumption and faster rate of nutrient release. Mixture of ground nut oil cake and rice bran at 1:1 by wtis provided at 5% of the stocked biomass in first month followed by 3-2% in subsequent months.

Feed requirement/day = Estimated fish biomass in the pond x % feeding rate [biomass = average weight of fish x total number stocked x % survival].

Feed is normally given in dough form on feed trays or in gunny bags hung at uniform distance inside the pond. Feed in pellet form also given, which reduces wastage. Appropriate species of aquatic weeds are desirable for grass carp. If higher stocking density is envisaged aeration of ponds is a required using gadgets like paddle wheel, aspirator and submersible aerators. Approximately 4-6 aerators of 1 HP are required to aerate 1 ha pond. Water exchange is essential for intensive culture; no such issue with low stocking extensive culture. Skin, gill and fin of fish are carefully examined during sampling for parasites, lesion and haemorrhages. In case of Epizootic Ulcerative Symptom (EUS), CIFAX @1 L/ha-m is recommended. Lime @200 kg/ha is also effective; a second dose is preferredin case of severe infection. For other severe infections always consult the experts for proper treatment. Ivermectin is generally effective to treat parasitic infectionArgulosis.

During 10-12 months culture periodcatla attains around 1 kg and rohu 600-700 g. Multi stocking and multi harvesting is by far the best approach. Intermittent partial harvest of large fishes after 6 months of growth period would ensure continuous return, reduction of investments & risks, and congenial environment for remaining fish to grow. Catla and rohu fetch about 20% higher market price over other carp species. Silver carp is least preferred among the carps. It's advisable to transport the produce in insulated vans with ice to the distant markets of about 1000-2000 km. Live fish would fetch 30% higher price than dead (fresh) fish. Economics of grow out production of carp are provided in table 4.

Table 4. Economics of carp grow out production

Sl. No.	Items	Amount (in Rupees)
I.	**Expenditure**	
A.	**Variable Cost**	
1.	Pond lease value	20,000
2.	Bleaching powder (10 ppm chlorine)/other toxicants	5,000
3.	Fingerlings (8,000 nos)	8,000
4.	Manures, fertilizers and lime	10,000
5.	Supplementary feed (rice bran and groundnut oil cake, 8.0 tonnes @ Rs 9,000/tonne)	72,000
6.	Wages (150 man-days @ Rs.125/man-day for management and harvesting)	18,750
7.	Miscellaneous expenditure	5,000
	Sub-total	**1,38,750**
B.	**Total Cost**	
1.	Variable cost	1,38,750
2.	Interest on recurring expenditure 12% half yearly	8,325
	Grand Total	**1,47,075**
II.	**Gross Income**	
1.	From sale of 4 tonnes of fish @ Rs. 55/kg	**2,20,000**
III.	**Net Income** (Gross return - Total cost)	**72,925**

The specialized KVK of ICAR-CIFA at Bhubaneswar has been actively engaged in carp seed production on a demonstration and moderately practical scales. During 2014-16 it has used 2.4 Ha of ponds for fingerling production of catla and rohu. Many fish farmers were benefited by the quality seed produced in demonstration ponds of KVK.

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