Breeding of carps using a low-cost, small-scale hatchery in Assam, India – A farmer proven technology

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In the last three decades the Indian fish seed production industry has recorded a remarkable growth. From earthen "pit" hatcheries used for hatching eggs there has been a tremendous development in incubation techniques. The most large-scale commercial hatcheries of today are of Chinese type wherein all activities such as raising the brood stock, breeding and spawn rearing is undertaken. The improved technologies of breeding, hatching and rearing have increased the fish seed production of the country significantly in recent times. A large number of hatcheries have been designed in India for breeding and hatching of carps eggs since the first successful induced breeding of these fish in India in 1957[1].

Rural fish seed production through small-scale hatcheries continues to be a focus of attention in many developing countries. The wider implications of the role of small-scale hatcheries to provide fish seed for farmers in rural areas and the future of public sector involvement are gaining increasing importance. In an earlier attempt we successfully introduced a small-scale hatchery using locally available cheap resources for poor farmers in rural Cambodia[2]. The hatchery comprised of a human powered bicycle pump to access a deep bore well, water jars, a breeding pool and hatching jars.

Privately operated hatcheries can be expected to play an increasing role in providing the basic input - fish seed for rural fish production. However, documentation of small-scale hatcheries in terms of their development, production methods and profitability is scanty.

A three year long participatory small-scale rural aquaculture project was undertaken between 1998-2001 with a basic objective to introduce small-scale fish culture to homestead ponds of a tribal area in Assam, India. During the second year of operation, it was realized that unless the basic input i.e. fish seeds were made locally available, aquaculture would remain a remote fantasy for these resource-poor farmers. Therefore, a low-cost carp hatchery was designed commissioned at a village, Palasaguri near Amsoi in Nagaon district with active participation of the target farmers.

A low-cost, small-scale carp hatchery developed under the study

The hatchery is a concrete structure and was designed based on the same Chinese hatchery principle with little modification to suit the local conditions. The overhead tank, breeding pool, hatchery pool and spawners tanks are integrated into one unit. It is possible for a circular tank to function also as an egg incubator, a hatching tank and a fry rearing tank[3]. The overhead tank has a

Participating farmers are engaged in fish seed production using the low-cost hatchery

Farmers working on the low-cost hatchery

capacity of about 5,200 liters. An average water flow of 9.7 liters per minutes is maintained in the hatchery although a water-flow speed of 50-60 liters per minute is generally recommended in carp hatcheries[4]. In the portable circular hatchery system a water flow of 8-10 liters per minute is maintained. In the glass jar hatchery, each with a capacity of 6.35 liters, the rate of water flow is kept around 600-800 ml/min for the eggs of Indian major carps and 800-1,000ml/min for eggs of grass and silver carps[5]. Through several trials it was observed that a 5 HP diesel pump with a delivery pipe of diameter 3 inch requires only about 10 minutes to fill the overhead tank of the hatchery developed under the present study. The diameter of the breeding cum hatching pool is 1.92 meter and in one batch about 8 kg of brood fish can be placed in it for induced breeding. A detachable circular hatching ring of 60cm diameter, made of iron is placed inside it during incubation. A nylon net/screen is fitted and stretched tightly on its outer surface. The ring is detached during the breeding operation. The mesh size of the screen used in the hatching ring is 1/80 inch, which prevents escape of eggs and spawns from the pool. The breeding cum hatching pool is provided with bottom inlets for water circulation and a circular perforated pipe fixed around the top margin of the pool for artificial rains. The unit also has three spawner tanks of 80cm in diameter and cm in height each to rear the hatchlings for a few days. About 800,000 eggs can be incubated at one time using this low-cost carp hatchery. The recommended spawning space and egg incubation density in a carp hatchery are around 3kg/cubic meter and 700,000/cubic meter respectively[6]. A convenient size of a breeding tank is around 2 meters in diameter and 1 meter deep which will hold about 1,800 liters of water[3]. Breeding and hatching operations can be carried out in about 30 batches in a breeding season lasting for about 120 days[7]. According to this observation, about one crore (10 million) eggs can be obtained in one batch (spawning pond 8 m diameter and incubation pond, 3.6m diameter).

In our trials we used the standard method of induced breeding with ovaprim hormone for seed production of various carps using the rural model carp hatchery described above. Ovaprim was injected in a single dose to both the sexes. The injected fishes were released in the spawning pool for egg laying. Later, the brood fishes were removed from the spawning pool with the help of a scoop net. The inner hatching ring was placed inside the spawning pool for incubation of fertilized eggs. A mild water flow is maintained during the period of incubation through the bottom inlets and through perforated circular water pipe fitted along the top margin of spawning pool. Breeding response was classified as complete, partial or no spawning based on the volume of residual eggs released on application of pressure on the abdomen. The fertilization rate was calculated by examining a minimum of three samples from each breeding experiment.

Outcomes

Altogether six trials of carp breeding were undertaken during June-July, 2000. Five different carp species were tried for induced breeding trial viz. *Labeo rohita*, *Cirrhinus mrigala*, *Hypophthalmichthys molitrix*, *Putius javanicus* and *Labeo calbasu*. Results of the experiments, which returned encouraging spawning results, have been summarized in the Table 1. Several dosages of ovaprim hormone were tried in this experiment. It was observed that most carp fishes responded well at a dose ranging between 0.40 to 0.60 ml per kg body weight. *Labeo calbasu* responded only partially at dose lower than 0.30ml/kg body weight. However, a dose of 0.3 ml / kg body weight of Ovaprim was sufficient for complete spawning in case of *Puntius javanicus*. Complete spawning of *Puntius javanicus* has previously been achieved with a single dose of 0.35 ml/kg ovaprim[9]. Earlier Nandeesha et al[11] recommended a dose range of 0.40 – 0.70ml/kg ovaprim for most carp species in India.

The small-scale hatcheries have several advantages. First of all they can be constructed with low investment and the return can be obtained in a short period of time. Small size enables the farmers operate the hatchery with less labor and manage it effectively. Land and other infrastructure facilities requirement are also low as it is small in size. And lastly the small-scale hatchery shall enable the seed producers to induce spawning of fish species separately for quality seed production, as the broodstock requirement is lower.

Lessons learnt

1. The low-cost, small-scale carp hatchery developed under the present study was operated successfully in the farmer's field, thus it is a farmer proven technology.
2. On an average 84% fertilization and 77.71 % hatching were recorded in the carp seed production using this hatchery.
3. The breeding pool can also be utilized as hatching pool with minor modification as suggested in this experiment to reduce the overall construction cost of a carp hatchery.

4. An average water flow of 9.7 liters/ minute was found sufficient for carp breeding in the small-scale hatchery developed under the present study.

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Table 1: Experimental results

Fish species	Fish Weight (Kg)	Hormone Dose (ml)	Spawning result	Response time	Fertilization (%)	Hatching (%)
Rohu	F 175	0.10	Complete	9.5 hours	99.0	97.0
	F 150	0.075	Complete			
	M 160	0.05				
	M 215	0.05				
Mrigal	F 250	0.12	Complete	9.5 hours	99.0	97.0
	F 260	0.13	Complete			
	M 220	0.06				
	M 250	0.06				
Mrigal	F 250	0.10	Complete	7 hours	93.0	88.0
	F 175	0.10				
	M 200	0.05				
	M 200	0.05				
Rohu	F 300	0.15	Complete			
	M 250	0.05				
	M 200	0.05				
Silver Carp	F 700	0.35	Partial	9 hours	73.0	62.00
	F 950	0.40	Complete			
	F 900	0.40	Complete			
	M 600	0.15				
	M 700	0.20				
	M 900	0.20				
Silver Carp	F 2000	0.90	Partial	11 hours	45.00	28.0
	M 1500	0.50				
	M 900	0.20				
Java Puthi	F 1000	0.30	Complete	7 hours	92.0	88.0
	M 500	0.10				
	M 500	0.10				
Calbasu	F 300	0.08	Partial	7.5 hours	87.0	84.0
	F 400	0.15	Complete			
	M 400	0.08				
	M 450	0.08				