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An Insight to Common Carp Breeding and Culture– A Farmer Advisory

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INTRODUCTION

Aquaculture – a key food production sector – is anticipated to produce and supply the world's cheapest protein food – fish – in the upcoming days. Almost 622 fish species are produced through various aquaculture practices which makes the aquaculture as most diverse animal meat production sector. As per the latest report (FAO, 2022), aquaculture is produced around 82.1 mmt fish in which 62.48% (51.3 mmt) is contributed by inland aquaculture from various developing countries. Presently, inland aquaculture – rearing of fish in fresh and slightly salt-alkaline waters – is dominated by the production of finfishes. Among the various farmed finfish throughout the world, only 20 species are considered as most important and share 83.6% of the total finfish being produced. Cyprinids – topmost cultivated finfish – are the highly demanded and farmed fish due to their greater market value (Dawood and Koshio, 2016). In the top ten farmed fish, six species, namely grass carp, silver carp, common carp, bighead carp, catla and *Carassius sp.*, are from cyprinids.

The common carp (*Cyprinus carpio*) is a member of the family Cyprinidae and the order Cypriniforms, which include 220 genera, seven subfamilies, and around 20,000 known species, which was first described by Linnaeus in 1758 (Howes, 1991). The most prevalent cyprinid species is, common carp, which contributes significantly to inland fish production (Basavaraju and Reddy, 2013). In the earlier days, availability of the carp's seeds was the major hurdle for the expansion of carp culture, however, the success of induced breeding completely changed the carp culture during late 70's. Along with Indian major carps, common carp is also becoming an interest of fish farmer for doing aquaculture. In general, Indian major carp breeding was carried out during monsoon season, whereas common carp breeding was done throughout the year. Even consumers are preferred to buy a smaller size common carp, which made the farmers to stock common carp in poly culture along with other Indian major carps.

Status of Common carp

Common carp, originated from Europe and Asia, has been brought to every continent for economic and recreational purposes, except Antarctica (Panek, 1987). At present, carps are the largest group of species, produced in terms of volume and they are least traded at international markets. However, on the other side, they significantly contribute for the nutritional balance of millions of people in developing countries. In 2023, around 25 metric tonnes carps were produced, of which at least 16 metric tonnes came from China, and at least 3 million from several other nations. Among the carps, common carp is the third most farmed fish species in aquaculture, with an output of 4.24 million metric tonnes in 2019 (FAO, 2022). Common carp production plays a major role in Central and Eastern Europe, as it has a Europe heritage.

In India, culture of IMC (catla, rohu, mrigal) and exotic carps (silver carp, grass carp, common carp) have contributed for more than 70% of total inland fish production in recent years. India now produces more fish from aquaculture compared to any other country in the world, mostly as a result of the increase in IMC production, which increased from 830 tonnes in 1950 to 4.947 million tonnes in 2019. Freshwater culture accounts for 88% of India's total aquaculture production, with IMC share of 57.3 percent (FAO, 2022). To India, common carp was brought from Thailand to mix-up in composite fish farming to enhance the fish output in ponds, tanks, lakes, and reservoirs. Initially, German strain of common carp was introduced to India in 1939 and later, in 1957, Indian and Bangkok strains were developed and they were successfully used for further production augmentation. Presently, India producing 6.2 metric tonnes of carps with its available freshwater resources.

Breeding of Common carp

i. **Natural breeding**: In general, major carps breeds naturally in open water bodies such as rivers. In case of common carp, they bred in smaller ponds when they provided with substratum. Moreover, in captive conditions they can be bred without using hormones by making the environment conducive for the breeding i.e. running water system with lower temperature. They need some grass mat or weeds or any other substrate to attach their eggs. Then the eggs can be either collected and loaded in the hatchery or left as such in pond for hatching.

ii. **Induced breeding**: In this technique, the breeders use hormones to stimulate the brooders to release their eggs and milts artificially. In general, pituitary gland extract and commercial inducing agents like ovatide and ovaprim were used as inducing agent to breed the fish. This technique is also called as hypophysation.

Common carp Breeding

Regardless of size, common carp attains sexual maturity at the age of six months. In tropical seasons, common carp reproduces throughout the year, with two peak breeding seasons: January to March and July to August. Common carp do not breed much in the winter, however, they breed a lot during the monsoon season.

Common carp Brooder

Broodstock or brood fish – fish with matured gonads and used for breeding and seed production in aquaculture – plays an important role in maximizing the survival and quality of seed produced.

In general, male and female were stocked and reared in a same pond and after attaining maturity the brooders were segregated and used for breeding. The male and female brooders were easily identified with their external appearances.

Male	Female
The male pectoral fin is rough	The female pectoral fin is soft
The vent of the male is like a deep and pit	The vent of the females is like a small tube
The male belly is flat	The female's belly is soft and bulging
	
Male (bottom) and female (top) common carp brooders	Male (left) and female (right)

Brooder hapa preparation

Breeding hapa with common carp brooders

Development and maintenance of broodstock

In general, the brood stock were raised and maintained in either rearing or brood stock holding ponds. The proper management of broodstock with favourable environmental parameters improves the gonadal development and boost their fertility. It further helps to regulate the time of maturation and spawning, as well as to enhance the quantity and quality of eggs produced. Prior to breeding, the male and female brood fish were separated for at least one month. While separation, fish won't be able to reproduce in the pond. Generally, in fertilized ponds, mature males and females are stocked individually at a rate of 1,500 – 2,000 kg/ha. Brooders were fed with protein rich commercial pellet feed at the rate 2-5% of their body weight daily. Regularly check the brood stock to make sure the eggs are growing normally and there is no sickness.

Natural breeding in hapa

Choose the brooder fish with completely developed gonads. When the slightest pressure was applied to their belly, they should release either milt or ova freely. Males should weigh around 1 Kg while the female in the range of 1.0-1.5 Kg is highly preferred. One female and two males are placed in a breeding hapa. When combined, the two males should weigh equal to or slightly more than the single female. The hapa's dimensions should be 2 m x 1 m x 1 m for ease of breeding.

In general, common carp eggs are sticky, and they require some substrates for attachment. Therefore, to attach their eggs aquatic weeds, such as Hydrilla, Najas, and Eichhornia, are placed inside the breeding hapa. Firstly, aquatic weeds, preferably Eichhornia, need to be cleaned with water and rinsed in a potassium permanganate ($KMnO_4$) solution to avoid cross contamination. Then add a greater number of weeds (more than the female brood fish weight) and spread them all along the hapa. In place of aquatic weeds, plastic strands also can be placed at the bottom for common carp breeding. In the evening, brood fish are placed inside the breeding hapa to mate. The hapa was placed near the inlet of pond to create a natural water flow for inducing the brooders to breed. After releasing in hapa, the brooders were left undisturbed and they spawn within 6-8 hours. Next day morning, small, orange-colored, shiny eggs were seen all along the hairy roots of Eichhornia and the brooders were removed immediately. A typical female brood fish weighing one kilogram will lay around 1.5 lakh eggs.

Induced breeding in Cement cisterns

Generally, induced breeding of common carp was done in Chinese circular hatchery system. The hatchery system consists of water storage tank, breeding pool, incubation pool and seed collection tank. Initially, the common carp brooders collected from brooder ponds, were segregated sex-wise. Then the selected brooders can be induced with OVA-FH. Both male and female brooders were injected at 0.2mL/Kg body weight. Followed by the injection, brooders were released in the breeding pool with the sex ratio of 2:1 (male: female). Then the breeding pool was covered with floating aquatic plants (Eichhornia) in surface of the water to provide the substratum for common carp adhesive eggs. In the mean-time, water was released from the taps placed on the tank wall to create a natural environment condition for breeding. After 6-8 hours of spawning, the brooders release their eggs and it will be attached on the hairy roots of floating plants (Eichhornia). The spent male and female were disinfected with potassium permanganate and returned to their

brooder pond for the future usage. After a fortnight interval, the male matures rather fast and may be utilized once more.

Hatching of common carp eggs

In both systems, natural and induced breeding, immediately after release of eggs, brooders will be removed. In general, fertilized eggs take 40-72 hours to hatch in any systems. In natural breeding system, weeds with the attached fertilized eggs will be distributed to 3-4 hapas for ease of hatching. In each hapa, around 50,000 numbers of eggs were loaded to avoid crowding stress for hatchlings. Till hatching, water flow is maintained with the help of inlet regulatory valve in the pond. After hatching, weeds need to be removed carefully from the hapa. The hatchlings are left in same hapa for three to four days, or until the yolk sac has been absorbed.

In the case of induced breeding, fertilized eggs were loaded in the incubation pool which consists of two chambers (outer and inner). The bottom of the outer chamber is provided with 4-5 water inlets to create water flow. A nylon screen covers the circular wall that divides the inner and outer chambers. The nylon screen allows the water to flow from the outer chamber to the inner chamber and prevents the escape of hatchlings. After 2-3 days, the seeds were collected in seed collection tank. Then the seeds are stocked in nursery pond for further sizing.

Generally, in colder conditions the eggs take more time to hatch whereas it hatches faster in warmer temperature. There will be a yolk sac in these hatchlings. After 3-4 days, they will be collected from incubation pool and transferred to hapa or directly stocked in nursery pond for sizing.

Colour of the eggs	**Condition of the eggs**
Shiny and translucent	Good condition and ready to hatch
White	Unfertilized eggs

Common carp eggs attached in Eichhornia plant

One week old common carp fry

Common carp fry rearing

The seeds are moved to a nursery pond where they will develop into fry. The seeds are fed with mustered oil cake and rice bran. After stocking, fed the fry with finely powdered mixture of mustered oil cake and rice bran in a 1:1 ratio. Feeding is carried out twice a day, in the morning

and the evening. In a period of 14–15 days, fry stage develops in to a length of 2-3 cm which either sold for rearing purpose or stocked in grow-out ponds.

Polyculture based grow-out culture of common carp

Initially, to promote the live feed production, grow-out pond is fertilized. Once the water turns into greener, fry can be stocked. The seeds are stocked at the rate of 5000-8000 nos. per hectare, size ranging between 3-4 cm. Stocking might consist of three, four, or six species, depending on the state of the market and the availability of seed (Hlaváč et al., 2014).

Six carp species (Chinese, common, and Indian major) are cultivated in semi-extensive based polyculture systems. Rohu (25–30%), catla (10–15%), mrigal (15–20%), silver carp (20–30%), grass carp (5–10%), and common carp (10–20%) are the combination of species that followed in polyculture practices.

Culture is carried out for minimum of 12 months. During this period, common carp reaches 800 gm to 1 kg, and ready for marketing. However, under proper management practices catla, rohu, grass carp, common carp can attain a marketable size of 1 Kg in 6-8 months.

Water quality

In water, fish carry out all their biological processes. Fish carry out their physiological activities such as respiration, feeding, growth, waste excretion, maintaining a salt balance, and reproduction, in water, therefore, a thorough understanding of the physico and chemical requirements of fish culture water is essential for the successful operation of aquaculture. Common carp can tolerate and grown in the following water quality conditions;

Sl. No	Water quality parameter	Range
1.	Dissolved oxygen (mg/l)	4-5
2.	Temperature (°C)	20-30
3.	Salinity (ppt)	Less than 0.5
4.	pH	6.5-9
5.	Alkalinity (mg/l)	20-150
6.	Hardness (mg/l)	20-200
7.	Ammonia (mg/l)	Less than 0.05
8.	Nitrite (mg/l)	Less than 0.1

Feed management

The use of both natural fish food and supplemental or balanced feeds is a practice that enhances fish nutrition and the quality of the pond environment when it comes to common carp pond farming. Stocked fishes were feed with 4:1 ratio of rice bran and oilcakes. Feeding the fish at a rate of 5-6% of their body weight for 500 gm size of fish, the rate should drop to 3.5% of their body weight for 500-1000 gm size fish. The following feeding schedule can be practiced in common carp culture to obtain better production;

Sl. No	Stage of fish	Crude protein (%)	Feeding intensity (in times)	Feeding ration (in % body weight)
1.	Brooders	30-33	Two times	3-5
2.	Fingerlings	38-40	Two times	6-8
3.	Fry in nursery rearing	50-55	Four times	8-10

Challenges in common carp farming

- A greater degree of inbreeding in the subsequent generation leads to the production of genetically poor-quality seed.
- The emergence of Koi Herpes Virus (KHV) is threatening the common carp farming.
- Non-availability of species-specific supplementary feed.

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