

# Scenario of captive production of *Clarias magur* in India

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Carp are the main table fish amongst the fish-eating population of India, apart from catfish and prawns from freshwater production. Their availability in huge quantity in markets may be due to intensive research on their cultivation and its adoption by farmers for larger production. Further, the acceptable price also attracts consumers, contributing to fish as the preferred animal protein source in India.

The availability of catfish or prawns is limited as these are mainly obtained from fishing rather than aquaculture. There has been little change in this scenario in recent years as few farmers produce these fishes. However, *Clarias magur*, locally known as magur, is a well preferred medium sized catfish among Indian consumers. Researchers have intensively worked on this species under the "All India Coordinated Project on Air-breathing Fishes" during the early 1980s to popularise them among farmers. Difficulties such as shortages of effective inducing agents and the erratic response of females during induced breeding, low survival in different life stages, slow growth, and lack of effective feeds became a bottle neck for the wider adoption of this fish by farmers. Hence research institutions, fisheries departments of different states, universities and Krishi Vigyan Kendra (KVK) have undertaken research to simplify the technology and disseminate it among farmers over the last decade. This article summarises these attempts and describes the present level of its technology practiced in India.

## Induced breeding

Maintenance of healthy brood fish is a prerequisite for successful seed production in captivity. Usually, this species attains maturity in one year and both sexes can be employed for breeding on reaching 100-150 g. It is always better to rear the brood fish in earthen ponds. As the water table goes up during monsoon months, collection of the catfish for breeding attempts becomes difficult in ponds. Hence it is better to collect the broodstock from culture ponds during the pre-monsoon month and rear them at 2-3 fish/m<sup>2</sup> in cemented tanks. The tank bottom may be provided with soil of 2-3 cm thickness to prevent injury when fish move along the bottom. The tank must bear inlets and outlets at the desired level for managing water level, with a complete drainage facility. These facilities are used to manage water quality or to drain for collection of entire stock. Continuous flow of water (two litres/minute) for a few hours is necessary during sunny days to avoid excessive water temperature, reducing the chance of stress in broodstock. A mixture of fish meal, groundnut oilcake, soybean meal and rice bran with vitamin and minerals, resulting in 30% protein level at 2-3% of the body weight, is fed to the stocked fishes. The tanks are replenished with water at fortnightly intervals to maintain hygiene. Many farmers also rear fish with feeding in small ponds and collect before induced breeding without transferring to cement tanks.



Back-yard flow-through hatchery made by a farmer for small-scale seed production.

Magur usually breed during the monsoon months of June-August. The fish are taken out of the broodstock tank or pond and kept separately in plastic containers for breeding operations. Males and females can be distinguished by secondary sexual characters. The abdomen of a gravid female is round and bulging with a reddish coloured button-shaped genital papilla and the males have elongated pointed papilla. They are either bred through hormone administration or through environmental manipulation.

Females are induced to breed through commercially available synthetic hormones, i.e., Ovaprim/Ovatide/WOVA-FH @ 1.0-1.5 ml/kg body weight. However, they can also be induced using the traditional carp pituitary extract at 30-40 mg/kg of body weight. The above hormones are injected into female fish on the dorsal side of the body during evening hours in a single injection schedule. The stripped eggs are fertilised artificially with sperm suspension. However, the males do not require hormonal administration.

Unlike carps and few catfishes (*Horabagrus brachysoma*, *Pangasius pangasius*, *Pangasinodon hypophthalmus*, *Wallago attu* etc), the males of this species do not ooze sperm during stripping and thus their testes are removed and

macerated in normal saline solution (0.9% sodium chloride) to obtain the sperm suspension, which can be used within 24 hours at room temperature.

Females are stripped after a latency period of 16-17 hours and eggs are fertilised with sperm suspension. The fertilised eggs are then washed thoroughly and transferred to a flow-through hatchery. The eggs of this species are adhesive in nature and light brown eggs are considered good while opaque eggs are unfertilised. The fecundity of the species is low, at about 400-500 eggs/g of ovary weight.

The flow-through hatchery consists of a cemented platform on which plastic tubs are placed. A row of small tubs of 12 cm diameter with 6 cm height are placed under separate taps. Each plastic tub can accommodate 1,000-1,500 eggs. Water supply is provided from an overhead tank through a common pipe to all the tubs with individual control taps. Each tub has an outlet at a height of about 4-5 cm. Farmers have developed low-cost hatcheries for small-scale production using the same flow-through hatchery principle. Some farmers have also constructed rectangular cement cisterns with a drain line that may be used during continuous water flow or for complete drainage during harvest. They use these for dual activities such as egg incubation followed by seed rearing for 20-25 days.

An improvised hatchery system has also been developed at ICAR-CIFA, Bhubaneswar, for large-scale hatching, which is in use by farmers. The system consists of a circular FRP tank with inlets in the form of a duck mouth at the bottom of the tank, fixed at 45°. This system can accommodate about 50,000 fertilised eggs in a single operation with 60-80% hatching rate. The fertilised eggs are uniformly spread in the plastic tubs/circular container and a feeble current of water is provided to maintain optimum oxygen level. Some farmers also make use of the plant *Ichornia crasipe*, whose roots hold the fertilised eggs, and float them in the water tub till hatching. The hatchlings along with egg shells and broken roots are found in the bottom of the tank. It is difficult to separate them and long exposure in this environment leads to mortality of the tiny and tender hatchlings, a problem that is considered the main demerit of this system. The ideal temperature for hatching is between 27-30°C and hatching takes place within



Multiple use of cemented tank for large-scale egg incubation for hatching followed by seed rearing.

24-26 hours. The yolk sack of the newly hatched larvae is absorbed in 3-4 days. The hatchlings are transferred to circular/rectangular FRP containers for rearing.

The species can also be bred by providing a congenial environment in the paddy field. A continuous trench of 50 cm depth is dug out along the margin of the paddy fields and artificial pits are made inside it. Brood fish are released into the trench during December-January and fed with a mixture of fishmeal, groundnut oil-cake, soybean meal and rice bran at 2-3% of their body weight. During monsoon season (June-July), the trench is inundated with rain water, with further accumulation of water in the paddy field. The brood fish move in pairs and congregate in the pits to spawn there. The spent fishes go back to the trench when the water level recedes, leaving the fry behind in the pits, which are subsequently scooped out. A few farmers also allow the fry to grow further in the paddy field until the water level reaches a level suitable for fingerling production. Some researchers have also felt the limitations of successful egg laying in these types of environment.

It is possible for advanced breeding of this species prior to breeding season. The hormone treatment is given to the fish in the form of sustained hormone pellets, which are implanted



Bacterial infection in *C. magur* adult.

into the musculature. The hormone used is LHRHa @ 100 µg/ fish, which is a super-active analogue of luteinising hormone releasing hormone or 150 IU hCG/female. The pellets are made of LHRHa or hCG in cholesterol base with a binder (gelatin and acacia gum). The pellets are implanted into the fishes during preparatory period of gonadal cycle. The above treatments bring about early maturity in fish, well in advance of the monsoon, which enables them to be induced to breed as early as in April. This application is limited to research to date during seed production of this catfish.

## Larval rearing (larvae to fry)

The larvae measure around 5-5.5 mm in length with a heavy yolk sac and must be reared for at least two weeks in the indoor rearing system. There is no necessity to provide feed during the first three days as yolk sac serves as stored feed. After its absorption, the hatchlings become longer with prominent barbels, jaws, operculum and gills. The quantity of feed depends on the density of the larvae reared in the container. Identification of acceptable feed and particle size matters a lot during rearing for increasing survival rate. Researchers and seed growers usually provide mixed zooplankton, *Artemia nauplii* or tubifex as larval feed apart from molluscan meat and egg custard. The above feed items contain 41-65% protein. Farmers often mix vitamin and mineral mixture in egg-custard during its preparation before feeding.

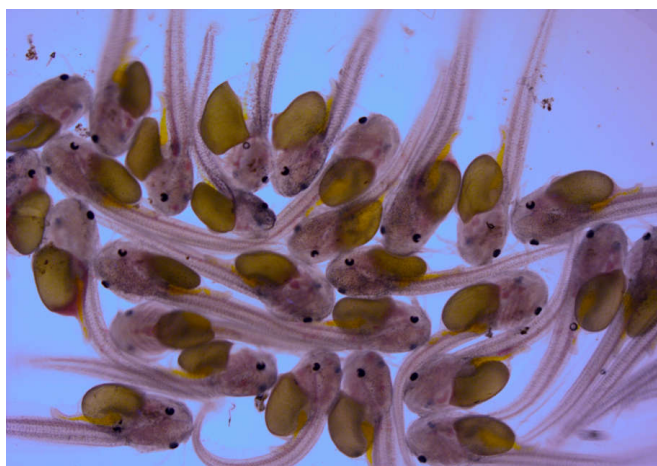
Organisms/particles ranging between 20-30 µm are ideal for initial feeding. Size can be increased gradually to 50-60 µm for 1-week old fry. The fry of magur develop a gregarious habit within a week and, being nocturnal and photo-negative in nature, they normally congregate in the corners of the rearing container to avoid light during day time. However, they fully disperse all over the container during night and as soon as they are exposed to light, they move to the corners in groups. The larval compound feed Starter-M has been developed for this species at ICAR-CIFA. Larvae of 8-10 days are fed after the gradual withdrawal of live feed. The feed is in powdered form, which is to be mixed with a little water to make it into a sticky dough. Small pieces of dough are put in several places of the rearing tanks for easy access of larvae to feed.

Since it is important to provide a congenial environment to larvae, the indoor rearing tanks are provided with continuous aeration and water exchange facilities. There is a chance of mortality and reduced growth of larvae due to poor environment as well as high stocking density during the indoor rearing phase. A stocking density of 1,000-1,500 larvae/m<sup>2</sup> is considered optimum for better growth and survival during indoor rearing.

Larvae being small and delicate require a good aquatic environment for survival and the depth of water in an indoor-rearing system plays a major role for optimum survivability. To optimise survivability, water management is an important aspect during rearing. Aerial respiration commences after 10-11 days and hence, aeration must be provided to the larval rearing tank. Accumulation of metabolites and unconsumed feed in the rearing containers pollute the environment and ultimately lead to oxygen depletion, disease and mortality. Therefore, it is advisable to replenish 70-80% of water on a daily basis to maintain 10-15 cm water depth.



*Incubation of eggs.*



*Newly hatched larvae.*



*Two-week old magur fry.*

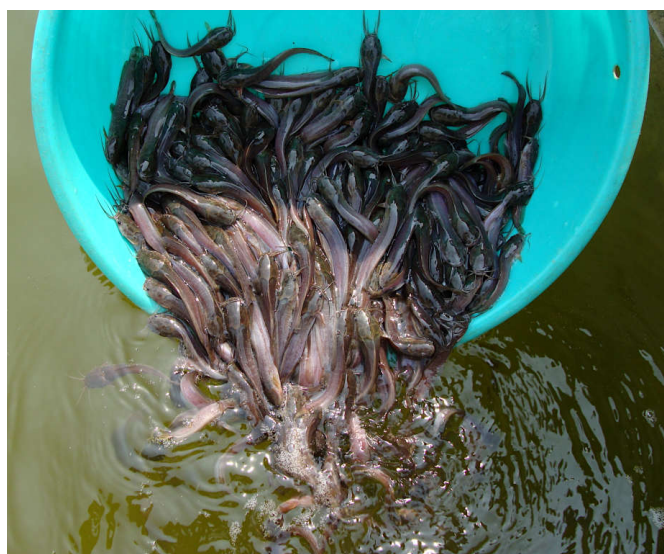
The excreta of fry and decaying unconsumed feed under high-density rearing produce free ammonia ( $\text{NH}_3$ ), ionised ammonia ( $\text{NH}_4^+$ ) and hydrogen sulphide ( $\text{H}_2\text{S}$ ). Among these, free ammonia is toxic at low concentrations affecting gills and accessory respiratory organs and hydrogen sulphide causes stress to fry. Carbon dioxide in the environment may result in stress.  $\text{CO}_2$ ,  $\text{NH}_3$ ,  $\text{NH}_4$  concentration levels up to 15 ppm, 0.05 ppm, 0.25 ppm, respectively, may not affect larvae, but may be dangerous if the level continues for a longer time. So vigorous aeration and frequent water exchange are required to get rid of this problem. Thus, the larvae grow to 30-40 mg during two weeks of rearing.

## Fingerling rearing (fry to fingerling)

The fry thus reared in indoor systems are harvested and stocked in outdoor tanks for fingerling production. Usually, private and government hatcheries sell fry from two weeks old. Some farmers also extend the rearing period for another one to two weeks in the indoor system for better growth to get a higher price. This extended rearing in the indoor system engages the rearing tanks for a longer period, which reduces the operation period leading to lower production from a hatchery. Hence many farmers sell the fry or stock them in fingerling tanks to vacate the indoor tanks for a new round of production.

Cemented rectangular tanks are used for fingerling production. The fry are stocked up to 200 individuals/m<sup>2</sup> and fed with a crumble compound feed containing 30% protein. The rearing period continues for 6-8 weeks and the fingerlings grow to about 4-5 g. Some of the fingerlings show shooting behaviour during this period. It is wise to remove shooters to reduce size disparity among the fingerlings. A drastically reduced survival is also observed if shooters are not segregated.

The growth of filamentous algae in the fingerling tanks can occur due to low water height and nutrients from unconsumed feed. Intense growth of algae may restrict the movement of fish and may change the water quality. Hence periodic cleaning through netting may be beneficial during this stage.



Releasing fingerlings for growout culture.

Some farmers also construct rectangular polythene tanks for production of fingerlings instead of cement tanks, as the polythene tanks are less expensive.

## Grow-out culture

Earthen ponds, stone pitched ponds and cemented tanks are all suitable for grow-out culture of magur, although it performs better in ponds compared to cement tanks during grow-out culture. Generally, a high density of 50,000-70,000 individuals/ha is recommended for culture of this fish. The density may be further reduced depending on the growing period of the area. Farmers usually buy seed from the seed growers. While transporting, there is a high risk of stress in the seed. The immediate release of these in pond for grow-out culture may lead to high mortality. Hence many farmers acclimatise the seed for 1 to 2 days before releasing them to culture ponds. Larger sized seeds (5-10 g) show good survival as well as growth during their culture. The fish are fed at 3-5% of their body weight with pelleted feed containing 30-32% protein, which is provided to fish in feeding baskets placed in different areas of the pond to reduce competition during feeding. Since this fish is an accessory air-breather, they normally come up to the water surface to gulping air. This kind of habit attracts predatory birds. Therefore, it is essential to cover ponds with nets to protect the fish. Magur attain a marketable size of 100-120 g during a culture period of about one year. Harvesting is done by complete dewatering and hand picking from culture ponds. A production of 2-3 tonnes can be achieved from one hectare of water.

## Health management

Sustainable aquaculture production can only occur when fish are healthy and free from disease. The prevention of disease is an essential step for the successful operation of any hatchery system. Magur larvae are very delicate and susceptible to various diseases and stress. Because of the complexity of the environment, the different life stages of this catfish are susceptible to viral, bacterial, fungal and parasitic infections. Pond waters with high levels of organic matter may contribute to disease risk during magur culture. It is essential that farmers should be vigilant for early detection of behavioural changes or clinical signs and act earliest to prevent losses. Provision of optimum rearing conditions will increase survival of magur larvae.

## Conclusion

Many farmers have taken up production of *C. magur* due to high demand for this catfish in the market. Many hatcheries have been established in the eastern states of India. Still there is a paucity of seed availability in terms of quantity as well as quality. This may be due to limitations in facilities available to farmers. Research institutions have placed emphasis in recent years on training new farmers and helping them to establish hatcheries. Seed production and culture technology of *C. magur* developed by ICAR-CIFA is in capsule form considering all the major activities for its wide adoption and successful farming. Hence, there is a greater hope for self-sufficiency in farmed production of this catfish in the near future.