- Branding and advertisement and awareness campaigns on nutritional benefits of sea foods would certainly widen the horizon of domestic fish marketing and enhance per capita fish food consumption.

- Capacity building of women SHG and retailers for value addition, novel fish food preparations and presentations would promote domestic marketing and fish food consumption.

- Government support in the forms favourable domestic fish marketing policy and investments in infrastructure development-whole sale and retail markets, storage facility and would give fillip to domestic fish marketing in India.

- Policy Analysis Matrix on issues and implications from all the model cases

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Management in seed rearing of Asian catfish, *Clarias batrachus*, in hatchery conditions

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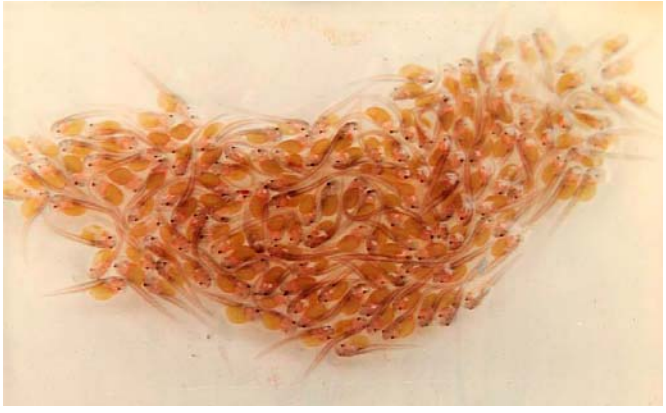
Aquaculture gained industry status in the Indian agriculture sector in the 1980s. Freshwater aquaculture has registered an annual growth rate over 6% during last decade and achieved a total production level of 2.4 million tones at present. The share of three Indian major carps is 1.8 million tonnes in the above fish production.

Catfishes are the most accepted fish variety in the Indian market for their delicacy. Now researchers in India have suggested for diversification of aquaculture considering catfish as a component for aquaculture development. Research on the production of different varieties of catfish is in progress by different institutions, among which *Clarias batrachus* is one of them. The potentiality of yielding 100 tonnes / ha has been reported in *Clarias* culture with high stocking density. Although a lot of work has been done on its artificial spawning, seed rearing and culture, the availability of quality stocking materials is still a constraint in the aquaculture sector. The culture of *C. batrachus* consists of four basic steps: Captive spawning, primary rearing phase (larvae to fry), secondary rearing phase (fry to fingerling) and final rearing phase (growing to marketable size). Usually a noticeable loss is observed during seed rearing phase



in this catfish. However, availability of desirable seed is always considered to be the most important pre-requisite for successful aquaculture of any species. Hence CIFA, a premier research institute has been involved in developing and standardising the seed rearing of *C. batrachus*. This article will communicate the management involved during seed rearing of this catfish for production of stocking material.

Larval rearing for fry production

C. batrachus larvae are very delicate and require utmost care for their growth and survival during hatchery rearing. The larval rearing phase includes stocking management, water management and feeding management.

Stocking management

The newly hatched larvae are separated from unhatched eggs and eggshells by frequent washing. The larvae measure about 5.0-5.5 mm in length. They are released in rectangular or circular tanks with a smooth bottom in the hatchery. The tanks are filled with clean water with aeration. Due to a heavy yolk sac, they do not have capacity to move, showing only tail lashing until the yolk sac is absorbed, which takes 3-4 days. During this time the larvae migrate to the side of the rearing containers and aggregate in patches. A few partially hatched eggs as well as deformed larvae are visible at the center of the containers, which are immotile. Usually they die within 5-6 days of their life so it is essential to remove them, or else the dead larvae will pollute the rearing container leading to disease in other fish larvae.

A stocking density of 2,000-3,000 larvae per m^2 should be followed for optimum growth and survival. The growth and survival range from 40-50 mg and 70-80% respectively at these density levels as observed in our study during larval rearing. Lower population compared to this may lead to under-utilisation of the rearing space. Similarly in higher stocking density (4,000-5,000/m^2), the growth and survival rate are affected due to crowding, discrimination of feeding among the larvae and stress factors, as also observed in other fishes. The larvae usually grow to 20-30 mg in weight with a survival rate of 50-60% at these densities during 14 days rearing.

Water management

Larvae being small and delicate require good aquatic environment for survival. The importance of water quality/ environment on growth and survival of aquatic organisms is well established. Hence the quality and depth of water during indoor rearing system play a major role for optimum survival of *Clarias* larvae. To optimise high larval 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 by blowers/ aerators. Accumulation of metabolites and unconsumed feed in the rearing containers pollute the environment and ultimately lead to oxygen depletion, disease incidence and mortality. Therefore, it is advisable to clean the bottom of the tank and replenish 70-80% water twice daily to maintain 10-15 cm depth. Care should be taken to give less stress to the delicate larvae while exchanging water from the tanks.

The waste from fry and decaying unconsumed feed under high density rearing produce free ammonia (NH_3), ionized ammonia (NH_4^+) and hydrogen sulphide (H_2S). Among these, free ammonia is toxic at low concentration affecting the gills and accessory respiratory organ whereas hydrogen sulphide causes stress to the fry. During high density fry rearing an increase in carbon dioxide in the environment may result to stress. CO_2, NH_3, NH_4 concentration level up to 15 ppm, 0.05 ppm, 0.25 ppm, respectively may not affect larvae of

this species but it could be dangerous if the level continues for a longer time. Aeration and frequent water exchange are required to get rid of the above problem.

Feed management

The yolksac of newly hatched larvae serves as the stored food during first three days of life. After its absorption, the hatchlings become longer with the prominent barbels, jaws, operculum and gills. The quantity of feed usually varies depending on the density of larvae reared in the container. The growth of larvae is also influenced by the quality of feed and their acceptability. The acceptability of feed depends on the feed type and their particle size, which influence the growth and survival rate during their rearing. Mixed zooplankton, *Artemia* nauplii, molluscan meat, tubifex or egg custard are considered to be the larval feed during hatchery rearing of *C. batrachus* larvae. These feed items contain 41-65% protein. Mixed zooplankton is observed to be well-accepted feed for these catfish larvae, which can be easily collected from a well prepared carp nursery ponds. Live plankton is considered to be the well accepted feed for rearing of fish larvae as observed in other fish larvae. As the plankton remain in live condition in the rearing tanks, the larvae get opportunity to feed on them as and when required. Feed containing 45% protein in the form of small ball is offered along with live plankton from 7-8 days of rearing. The supply of live plankton may be withdrawn gradually during the rearing period of 13-14 days. This mixed feeding not only enhances growth, but also ensures higher survival rate. Organisms/particles ranging from 20-30µ are ideal for the initial feeding. Size can be increased gradually to 50-60µ for a week old fry. Since there may be a differential growth in fry from the beginning, it is wise to proceed with the visual observation for selecting size of the feed. The fry develop gregarious habit within a week and being nocturnal and photonegative in nature, they normally congregate in the corners of the rearing container to avoid light during daytime. However, they get fully dispersed all over the container during night and as soon as they are exposed to light, they move to the corners of the container in groups.

Fry rearing for fingerling production

Healthy fry should be considered for stocking in nursery tank for higher growth and survival. Good fingerling production requires attention to nursery tank preparation, size of fry at stocking, feeding of fish and segregation of fingerlings.

Nursery tank preparation

Small earthen ponds may be used for this purpose. Generally, the advanced fry reared in pond condition do not show good survival due to natural mortality or predation as at this stage the fish does not have much capacity to escape from predators. Therefore, small-sized cemented tanks of 10-20 m2 are suitable for easiness in rearing and management. Also the fish at this stage do not have much capacity to search feed in the larger water body, which leads to mortality. These cisterns are provided with 2-3 cm soil base and a water level 25-30 cm. Single-super-phosphate (100 gm) and filtered cow dung (2 kg) are provided. The tanks are inoculated with plankton and the advanced fry are stocked after 6-7 days of preparation. It can be provided with floating weed like water hyacinth to give shade and shelter to the fry.

Stocking of fry

The production of fingerlings always depends on the quality and size of fry during stocking. The fry should be stocked after the development of a plankton bloom in the tanks. After initial stocking, the fry may take some time to be acclimatised to the artificial feeding. Until that time they will utilise the natural plankton as feed, which may reduce initial mortality. Overcrowding during transportation of fry may cause mortality if released in the nursery tanks immediately. So it is better to acclimatise them to indoor conditions before releasing them in the nursery tanks. The sizes of 40-50 mg fry are suitable for initial stocking. They are reared at a density of 200-300 fry/m^2. Increasing the density may affect the size during harvest, rate of survival and homogeneity in growth among the fingerlings.

Feeding of fish

Plankton in the environment is an important feed for the larvae during the first few days. Prior acclimatisation with compound feed during larval stage also helps in quick acceptance to compound feed during tank rearing. They require good quality compound feed containing at least 30% protein. The feed should be provided in crumble form for easy consumption by the larvae. They are fed @ 5% body weight in two divided meals. The ration for the fish may be increased after assessment of fish biomass by weekly sampling. The feed quantity may be increased or decreased by visual observation depending on the left out feed in the feeding tray.

Other management

As the water height during rearing is usually low, it is better to give shelter in the form of floating weed or providing pipes to protect the fish from high water temperature. The tanks should be covered with nets to prevent birds and other predators from entering. Sometimes the unconsumed feed and waste matter during intensive rearing pose problems for maintaining water quality. Monthly water exchange is essential for good growth and survival. The growth of filamentous algae cannot be ruled out in low water height of the rearing tanks. The filamentous algae developed during rearing period should be netted out. The presence of too much weed can cause oxygen depletion during the night as well as pose problem for fish to move freely in the tank.

Harvest/segregation

The fingerlings thus produced can be harvested depending on the demand. Usually the fish grow up to 1 g in size during 30 days rearing, resulting 40-50% survival rates. Sometimes long term rearing of another 3-4 months period is seen in the catfish farm to produce bigger fingerlings. Regular segregation is essential during longer rearing period, as few populations among the fish grow first. It is essential to separate them from smaller individuals to reduce the competition during feeding. Not only segregation of fingerlings plays an important role at this stage, but also regular water exchange and feeding results higher growth and survival during rearing. The fish usually grow to a size of 7-8 g during this period, which are suitable to stock in the grow-out ponds.

Conclusion

The increase in demand for stocking material has been felt for all cultivable fish. The success in *Clarias* culture also depends on the availability of seed. Hence successful rearing of catfish seed at different stages becomes important. It is felt that rearing of this catfish requires utmost care during fry and fingerling production. The growth and survival of seed during rearing depends on the careful management of rearing tanks, feeding and environment. A combined effort is highly essential for successful rearing of this catfish under hatchery conditions.

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