Grow-out culture of the loach *Lepidocephalichthys thermalis* in modified tanks

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The ever-increasing global population necessitates access to clean water, land, and nutritious food. India, with 4% of the world's freshwater resources, finds itself in a critical situation as it is categorised as a water-stressed country. The aquaculture industry plays a significant role in meeting the nutritional demands of the expanding global population. Projections indicate that by 2050, this industry will provide nutritious food to support nine million people. However, the majority of water resources are directed towards the agricultural sector, resulting in a shared water resource scenario with aquaculture. This shared usage limits the availability of water for aquaculture.

In light of this situation, the aquaculture industry must double its production through sustainable expansion, all while minimising water and land usage to mitigate the impact on these resources. Apart from intensification, diversifying the cultivation of native species proves beneficial in efficiently utilising water resources, thereby enhancing water security. Fish species like *L. thermalis* (Indian spiny loach) hold both market value and medicinal significance in the local market. Notably, this species can survive for several hours out of water and endure adverse environmental conditions.

Considering these factors, a preliminary grow-out study was conducted at the field level to promote the future cultivation of this species. The study took place in indigenously designed poly-lined iron frame tanks.

Biology of the fish

L. thermalis is commonly known as the Indian spiny loach, common spiny loach or Ayirai meen. It is a cypriniform fish of the family Cobitidae that occurs in freshwater environments such as ponds, rivers, streams and canals in India and Sri Lanka. *L. thermalis* is an omnivorous bottom feeder.

Fabrication methods for poly-lined iron frame tanks

Tank material

Various dimensions of rust-resistant iron material were utilised to fabricate a rectangular tank for loach fish culture. The selection of iron material was specifically based on its ability to provide sufficient strength to contain the volume of water required for the tank. The tank components include an iron-meshed frame and a low-density polyethylene sheet.

Tank construction

The design for construction involved creating a rectangular tank with dimensions of 2 m^2 (1 m width x 2 m length). A 3 mm thickness of iron material was employed to construct the box frame, including corner legs. The total height of the four corner legs was 50 cm, with the box frame fixed 15 cm above the bottom. The mesh size of the iron frame was 3 cm. A low-density polyethylene sheet (200 microns) measuring 3.75 m^2 (1.5 m x 2.5 m) was laid over the iron mesh frame (Figures 1-8).

2.3 Location: The tank is portable and can be moved to any required location. However, it is essential to place it on an even surface. For optimal water quality maintenance during the grow-out phase, these tanks can be positioned indoors. It is advisable to avoid waterlogged areas to prevent rusting of the tank frames. Ensure proper fixing of the poly sheet to eliminate contact between water and the iron frame box. The tank has a capacity of 700 liters of water with 5-6 kg of riverine sand.

Grow-out culture

Pre-stocking management

Before filling the water, a thin layer of sand (up to 5 cm) should be spread over the tank bottom. The sand must be washed thoroughly, at least three times, and sun-dried. Following this, water should be filled up to a height of 25-30 cm, creating a minimum culture water volume of 400 liters. The freeboard area should be 10-20 cm. Fish can be stocked three days after water filling. Floating weeds should cover at least 20% of the water surface, and a few stones can be added as substrate to mimic the natural environment.

Stocking of fish

Typically, indigenous farmers practice a one-year grow-out period for this fish, depending on water availability. Stocking density is a crucial factor influencing growth, survival, and production. Although no stocking density study is reported for this species, based on our preliminary studies, this species can be stocked at a rate of 800 individuals/m^2 (average length: 3.5 cm, weight: 0.24 g). A total of 1,600 individuals/2 m^2 were stocked.

Food and feeding

Loach's natural feeding habitat is detritus, and they exhibit nocturnal feeding behavior. They feed on algae, detritus, insect larvae, and copepods using their specialised filter-feeding mechanism. A supplementary feed mixture of GNOC and cottonseed oil cake (60:40) can be provided at an ad-libitum level throughout the culture period. Other sinking

feeds can also be used, as the species is highly adaptable to various feeding situations. During feeding, the species comes to the surface, takes feed, and returns to the bottom immediately. At the end of the 90-day culture period, the study calculated an FCR value of 1.2.

Water quality management

Water quality is crucial for fish production. A minimum water level of 20 cm was maintained for culture. To prevent surface water from heating, the tank should be placed indoors or in a shaded area to avoid direct sunlight exposure. Floating weeds (*Azolla* and *Lemna*) can be provided, covering up to 20% of the surface area, to prevent temperature fluctuations in surface water. Floating aquatic plants and sand substrate are used to maintain a constant water temperature. During the culture period, optimal levels of dissolved oxygen (4-5 mg/L), temperature (28°C), and pH (7-7.5) were recorded.

Harvest and yield

In nature, loaches hide in the sand substrate, making harvesting possible only by completely draining the tank water. While draining, the sand substrate is collected to harvest the hiding fish, and then the sand particles are placed back in the tank. In the 90-day grow-out culture, the total harvest was 1,005 g (average length: 4.9 cm, weight: 0.67 g), contributing to a net yield of 621 g using 400 liters of water. The study found that with increasing culture duration and altering feed composition and feeding rate, a net production level of 1 kg can be easily achieved in 400 liters of water while maintaining favorable water conditions. The fish can be sold in live condition at the local market at a good price, earning a profit of Rs. 1,300 from a single tank. Increasing the number of tanks, using vertical platforms in a smaller area, may further boost the profit of this fish culture.

Conclusion

The rapidly growing aquaculture industry faces numerous challenges that are likely to impact future fish production. Simultaneously, the industry must provide solutions, employing upcoming technologies, to meet the demands of the growing population. These challenges include the need to address nutritional requirements, double farmer income, efficiently utilise water resources, and conserve and diversify aquatic species.

The Indian spiny loach, or true loach, emerges as a promising candidate for future aquaculture given its various advantages. It requires less water and land, involves lower investment with higher profitability and increased production, demands minimal cultural management, aligns with regional and local market preferences, boasts a high nutritional profile, lacks strong spines, has a shorter culture duration, and is highly suitable for vertical farming. Consequently, this single species addresses the pressing challenges faced by the aquaculture industry.

This foundational study serves as a stepping stone for farmers in our country to initiate pilot farming of this species. Moreover, it paves the way for the adoption of diverse culture practices for this fish. Additionally, the developed modified tank-based rearing system for loach proves highly beneficial for loach culture in hilly regions and is particularly suitable for areas with limitations in land and water resources.

Fig A: 1-3: Base structure fabrication; 4-6 tank bottom and side covered with iron square mesh size (3 cm); 7: tank side covered with duplex carton; 8: tank covered with polyethylene sheet; 9: substrate provided; 10: water filled; 11: stocking of loach.