

## EXPERIMENTAL CAGE CULTURE OF NILE TILAPIA (*Oreochromis niloticus*), AND RED TILAPIA (*Oreochromis sp.*) IN SRI LANKA

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### Abstract

Cage culture is used widely in fish seed production in most parts of the world. In Sri Lanka, rural community is increasingly getting involved in cage culture of Red tilapia (RT) and Nile tilapia (NT) in perennial reservoirs. Ministry of Fisheries encourages community to produce their requirements through this process as it helps to stock seasonal tanks and perennial reservoirs in the dry zone of Sri Lanka.

These trials were carried out in Kiri-Ibbanwewa, a perennial reservoir in Moneragala district in the dry zone of Sri Lanka with the community participation. Two trials were conducted, one using RT and the other using NT. Twelve (12) cages (15 m<sup>3</sup>) were used for rearing each species. The stocking density was 150 fry m<sup>-3</sup> and the feed types were Rb (Rice bran), Cf (Commercial feed) and Mf (Farmer made aqua-feed). Natural feed as the supplementary feed (Nf) was also tested. All 3 feed types and Nf were tested in triplicate. The fishing community was engaged in cage preparation, cage setting, cage cleaning, feed preparation and feeding through Farmer Field School Approach (working with people in the field to knowledge them) under the guidance of Research Officer.

It is necessary to determine the suitable rearing period for RT and NT in cage culture. As such, attempt was made to find out the high growth and high survival in the feed types of Rb, Cf and Mf. Similarly, this was determined in Nf.

The mean initial length and weight of NT and RT were 2.3±0.21 cm (for Rb only); 2.3±0.51 cm, 0.16±0.04 g (for Rb only); 0.24± 0.17 g and 2.34±0.51 cm; 0.2483±0.03 g, respectively. The amount of feed was provided daily as 2 portions based on the 10% of the fish body weight. The amount of feed was determined, after the sampling in respective cages bi-weekly throughout the rearing period. Rearing period was 40 and 51 days for NT and RT, respectively.

The final mean length (ML<sub>final</sub>) of NT and RT in Rb, Cf, Mf and Nf were 5.45± 0.97; 5.92± 1.11; 5.57± 0.61; 5.05 ±0.87 cm and 4.32±0.54, 8.05±0.66, 7.714±0.65, 6.13±0.99 cm respectively while the final mean weight (MW<sub>final</sub>) of NT and RT in Rb, Cf, Mf and Nf were 1.02±0.68, 2, 6±0.96, 2.57±1.14 and 2.69±1.07 g and 1.08 ± 0.52, 3.61 ± 0.10, 3.41 ± 0.61 and 2.91 ± 0.48 g, respectively. The % survival in Rb, Cf, Mf and Nf of NT and RT were 92, 40, 26, 30 and 82, 38, 29 and 31, respectively. The ADG (Average Daily Growth) of RT and NT in Rb, Cf, Mf and Nf were 2.5±0.22, 8.4±0.37, 7.9±2.17 and 7.28±1.75 g and 2.25±0.81,

6.60±2.76, 5.26±2.73 and 4.81±1.51 g, respectively. The SGR-L (Specific Growth Rate in Length) of RT and NT in Rb, Cf, Mf and Nf were 2.73±0.0079, 3.18±0.1274, 2.61±0.6566, 2.49±0.2856 cm and 2.06±0.05, 1.72±0.09, 1.60±0.12, and 1.49±0.25 cm, respectively. The SGR-W (Specific Growth Rate in Weight) of RT and NT in Rb, Cf, Mf and Nf were 5.2713±0.1926, 6.691±0.1039, 6.5084±0.6425, 6.1182±0.5924 g and 4.02±0.6261, 5.21±0.78, 4.75±0.97 and 4.67±0.56, g, respectively.

Tilapia species NT and RT could be reared in cages successfully with community participation. Rb could be provided as an agricultural by-products of supplementary feed for seed rearing of RT and NT. Though Rb is more suitable it has a high demand locally for poultry feed production. It is suggested that Rb could be used as an ingredient in Mf as a smaller quantity to be reduced the cost of fish feed. The rearing period should be over 50 days.

## **Introduction**

Cage culture is commonly practiced worldwide in both freshwater and marine environments, including the open ocean, estuaries, lakes, reservoirs, ponds and rivers (Beveridge, 1987). It also used satisfactory in seed rearing of Common Labeo (*Labeo dussumeiri*), Rohu (*Labeo rohita*), Common carp (*Cyprinus carpio*) and tilapias (*Oreochromis niloticus*) in Sri Lanka (Ariyaratne, 2001). The perennial reservoirs have been used to install cages (De Silva, 2001). Cage culture in perennial tanks helps to reduce mortality of fry during transportation. Further, this helps for those who do not have land for pond culture. The cages have been used to replace ground nurseries for rearing fry in India (Jana *et al.*, 2004). Cage culture can be used to produce fingerlings by the fishers to stock in perennial reservoirs and culture based fisheries in seasonal (De Silva, 2001). Further, it is a simple methodology that could be applied by the fishers themselves.

There is an urgent need to prepare a low-cost farmer made aqua-feed for the seed rearing of tilapia. Pond culture for seed rearing needed 30 – 40 days (Ariyaratne, 2000). Then it is necessary to check the growth of fish in cages within the period. There is a current need to select a suitable, low cost agricultural by-product or mixture of the by-products as supplementary feed and test the efficiency of the production of tilapia seed with available natural foods in the reservoir.

## **Materials and method**

These trials were carried out in Kiri-Ibbanwewa, a perennial reservoir in Monaragala District in dry zone of Sri Lanka.

Three different types of feed, i.e. Rb (rice bran), Cf (commercial feed), Mf (man made aqua-feed) and Nf (natural food in the reservoir as supplementary feed) were used in triplicate. Cages were selected randomly for 3 feed types and Nf. The feed ingredients for Mf were Rb, Fm (locally prepared) and boiled cassava tubers. Rb and Fm were in powdered form and boiled cassava tubers mix as binder, to prepare Mf.

The size of cage was 15m<sup>3</sup> (2m x 4m x 2.5m). Cages were made with HDPE (High Density Poly Ethylene) webbing material with thickness 0.5-1.5mm and mesh size 4mm knotless. Cages were settled in one floating bamboo frame. Eight floating cages were set up at once using bamboo (*Bambusa spinosa*), coir, kuralon and nylon ropes and plastic barrels, etc.

The used stocking density for Nile tilapia (NT) and Red tilapia (RT) were 150fry m<sup>-3</sup>. Fish fry were obtained from a Government fish breeding station in Udawalawa. The fry were stocked in the morning around 0900 hrs. The rearing period for NT and RT were 40 days and 51 days, respectively.

The fry were fed twice a day at a rate of 10% of body weight with the respective feed types. The amount of feed in respective feed types were mixed with hot water and prepared as dough. The feed dough was provided to the fish using feeding tray hung in side the cages 40 cm below the water surface. The amount of feed in respective feed types were determined through the sampling that was carried out biweekly throughout the culture period.

The fishing community was engaged in cage preparation, cage setting, cage cleaning, feed preparation and feeding under the guidance of Research Officer provide through Farmer Field School Approach (working with people in the field to knowledge them). The women fishers mainly engaged in preparation of fishmeal, and preparation of feed. Cage cleaning was done throughout the rearing period when the algae flame were deposited in the cages.

#### ***Preparation of fishmeal***

Small indigenous fish species which are not presently exploited by the commercial fishery were caught using small mesh (18-38 mm) gillnets, drags nets and fyke nets. The women fishers caught these species which comprised *Amblypharygodon melettinus*, (green carplet), *Esomus danrica thermoicos* (Flying barb), *Puntius filamentosus*, (Filamented barb) (mostly juvenile), *Rasbora danicinius* (Striped rasboro), *Danio malabaricus* (Giant danio), *Glossogobius giuris*, (Bar eyed goby), *Hyporamphus gaimardi* and Attyid shrimps.

These fish were mixed with powdered salt (250g salt/kg fish) and spread on thin metal sheet and sun dried for 3 days. The dried fish were wrapped in paper and hung in a fireplace for further 5-7 days, and then were powdered using mortar and pestle and were sieved with a mesh of 2mm.

#### ***Data analyses***

Specific growth rate in length (SGR-L), Specific growth rate in weight (SGR-W) and Average growth per day (ADG) were calculated according to the following equations (De Silva and Anderson (1987).

$$\text{SGR-L} = \frac{\text{LNG Final length} - \text{Ln Initial length}}{\text{Experimental duration}} \times 100$$

$$\text{SGR-W} = \frac{\text{LNG Final weight} - \text{Ln Initial weight}}{\text{Experimental duration}} \times 100$$

$$\text{ADG} = \frac{\text{Final weight} - \text{Initial weight}}{\text{Experimental duration}} \times 100$$

The growth (% ADG, SGR-W, SGR-L) and % Survival were determined at the end of the rearing period.

## Results and discussion

Table 1. Specific growth rate in length (SGR-L±sd), Specific growth rate in weight (SGR-W±sd), Average daily growth (ADG±sd) and % survival of Red tilapia (RT) and Nile tilapia (NT) fry in cage culture trials when fed with different types of feed.

Trial No.	Tilapia Species	Culture method	Stocking density	Feed type	SGR-L	SGR-W	ADG	% Survival
1	Red tilapia	Cage	150 fry m <sup>-3</sup>	Rb	2.729 ±0.0079	5.2713 ±0.1926	2.50 ±0.2192	82
				Cf	3.1849 ±0.1274	6.691 ±0.1039	8.40 ±0.3751	38
				Mf	2.6160 ±0.6566	6.5084 ±0.6425	7.90 ±2.1673	29
				Nf	2.4978 ±0.2856	6.1182 ±0.5924	7.28 ±1.7489	31
2	Nile tilapia	Cage	150 fry m <sup>-3</sup>	Rb	2.0617 ±0.0462	4.0205 ±0.6261	2.15 ±0.8067	92
				Cf	1.7255 ±0.0944	5.206 ±0.7853	4.72 ±2.7626	40
				Mf	1.6056 ±0.1249	4.756 ±0.9690	4.66 ±2.7286	26
				Nf	1.4917 ±0.2499	4.6695 ±0.5669	4.81 ±1.5073	30

The fry of NT and RT could be reared successfully in the cages in perennial reservoirs in Sri Lanka. The community could be engaged in this activity since no advanced technology is required for the rural fishing. The 50 days of rearing period was better than the 40 days of rearing period because the fish grew more in 50 days rearing in cage culture.

Rb could be recommended as supplementary feed for seed rearing of RT and NT as they showed high % survival of 82 and 92 respectively (Table 1). However, the amount of Rb should be reduced by preparing a suitable aqua-feed as the high demand for Rb as an ingredient in poultry feed.

The % survival of NT and RT in NF (natural food in reservoir as supplementary feed) have shown considerably higher values in both trials, than the other feed types except Rb. Accordingly, when the selection of perennial reservoirs for extensive cage culture of Tilapia varieties (NT and RT) the amount of available natural food could be considered.

Coche (1982) has explained, when natural food is insufficient but still an important part of the diet, supplementary feeding is practiced with relatively low cost, locally available agricultural by-product i.e. Rb has shown good results in %survival, SGR-L, SGR-W and ADG too. It is a good sign in development of Rural Aquaculture as most of the rural areas with plenty of seasonal tanks are in agricultural areas in dry zone.

The % survival of both RT and NT fry, fed with Rb was significantly higher than when fed with other feed types (Mf and Cf). Therefore, it appears that there is no need to feed fry of NT and RT with Mf or Cf. However, the Rb is not cheap in the agricultural areas. It costs Rs.7 –8/kg, as it is used in the preparation of poultry feed. Then the reduction of the amount of Rb is very important. It could be done through the preparation of aqua-feed. So, attempt should be made to prepare a suitable low cost aqua feed for cage rearing fish. It would be help to develop cage culture and finally the Rural Aquaculture in dry zone of Sri Lanka.

The Nf (natural food as supplementary feed) showed a considerable SGR-L, SGR-W and ADG in RT and NT seed rearing. It has shown, the fish in Nf has utilized more natural food, as they have no other food. The nutritionally complete natural food may have contributed to the high growth of fish in Nf. Coche (1982) has explained that in some cases, natural food (plankton, aufwuchs or benthos) may be sufficient and no supplementary feeding is required. Accordingly the extensive seed rearing of cages could be recommended. The community who involved in cage culture practices should clean the mesh of the net cages to exchange water for entry of natural foods. The Researchers and Extension staff could select the reservoirs with plenty of natural foods to promote cage culture extensively.

Mf has not shown high % survival in NT or RT seed rearing comparing with Rb (Table 1). Accordingly, it is an evident for the less importance of Mf in seed rearing of RT and NT. According to Ariyaratne (2001), the % survival of seed rearing with Mf could be improved by the gaining experience of the community. Therefore, the low % survival of NT and RT in Mf feed type could be increased.

Though, Rb is suitable for seed rearing of NT and RT, the demand for Rb is very high in the rural areas as it used to produce other poultry feeds. Rb is not cheap and cost Rs.7–8/kg in the area. The reduction of Rb through the preparation of farmer-made aquafeed is essential to develop the process. Rb and Fm (1:1) were used as ingredients and boiled cassava in farmer made aqua-feed (Mf) preparation. The Fm component was prepared using minor cyprinids in the reservoir and it was time consuming and there were problems in drying. The prepared aqua-feed couldn't be kept for more than 1 day. Although, these constraints could be avoided by considering the price of Rb.

The % ADG was lower in feed type Rb in both RT and NT seed rearing trials than the other used feed types i.e. Cf, Mf (Table 1). The Nf (natural food as supplementary feed) also recorded higher % ADG than Rb. It may be due to the high % survival of the fish in Rb feed type. The amount of feed utilized more fish as the number of fish was high in this feed type. If the amount of utilizing feed (Rb) is increased, the % ADG could be increased by the Rb feed type. The amount of utilizing feed could be increased in 2 ways.

- (i) The feed amount should be provided in the calm climatic conditions in reservoir. Then the wastages could be reduced. Fish would eat more food in this situation.
- (ii) The feed amount could be provided at higher frequency.

The production cost for the cages in Sri Lanka (seed rearing) has increased due to the cost of cage materials and cost of feed. Therefore, it is a current need to provide cage material at subsidized rates and produce a low cost fish feed for the sustaining the procedure.

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