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High-Density Farming of Striped Snakehead *Channa Striata* (Bloch, 1793) in Artificial Tanks

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ABSTRACT

The study was conducted to evaluate the growth performance of Channa striata during high-density farming in artificial tanks. The fish reached an average weight of 420.28± 30.5 g and a length of 35.07± 5.5 cm in 250 days when fed with a formulated diet. The total production was 235.5 kg from an area of 12.6 m^2 during 250 days. The feed conversion ratio was 1.8, and the average production cost per kg was Rs.312/Kg. Though the ammonia level was as high as 9.6-11 mg/l, a higher survival percentage of 97 was recorded. The ability of *Channa striata* to overcome high ammonia levels and lower oxygen levels makes it compatible with high-density farming. It can also be farmed in artificial tanks. This fish can accept formulated feed during all stages of growth. Among the various issues reported by the farmers, marketability was the primary issue.

Key Words: Artificial tanks, Channa striata, Formulated feed, Growth performance, High-density farming, Water quality.

INTRODUCTION

Channa striata is a benthopelagic fish species commonly found in wetlands, freshwater ponds, lakes, reservoirs, canals, swamps, *etc*. It is endemic to India and Southeast Asian countries. *Channa striata* is a nutritious fish since its flesh is abundant with bioactive albumin, amino acids (glycine, lysine, arginine), and fatty acid (arachidonic acid 20:4n-6) (Kumar *et al,* 2022; Vikas *et al,* 2014; Vikas, 2023). The flesh of *Channa striata* possesses wound-healing ability, involves antinociception, gastroprotection, and disease resistance, and acts as an excellent antioxidant agent (Musa *et al,* 2022). Nutritional superiority and fleshy meat having less intramuscular spines enhance consumer demand.

Channa striata can survive in harsh environments with low dissolved oxygen and ammonia high due to air-breathing ability (Chitra *et al,* 2020). They do air-breathing with the support of the supra branchial organ above the gills (Kumar 2020). There is increased demand for farm-produced *Channa striata* as availability from natural grounds became less due to overfishing, destruction of natural breeding grounds by reclamation of wetlands and other natural water bodies, etc. (Chitra *et al,* 2020). Since the tropical climatic conditions are ideal for *Channa striata* farming, there is a massive scope for its culture. High fat and protein are required in their feed since they are typically carnivores and hunt small fishes, insects, tadpoles, frogs, and crustaceans. The non-availability of pellet-weaned seed is a limitation in promoting *Channa striata* farming. The present study aims to evaluate the growth performance of *Channa striata* in artificial tanks when fed with a formulated diet.

MATERIALS AND METHODS

A high-density polyethylene (HDPE) lined tank of 4 m diameter supported by a galvanized iron (GI) frame was used for the study. A water depth of 0.3 m to 1.2 m was maintained during the culture. A continuous water-circulating multi-stage filtration unit continuously removed suspended particles and dissolved ammonia. The slurry and wastewater were sucked from the tank bottom and charged at the rate of 16000 L per hour into the first stage filter- containing nylon nets packed to 200 kg/m^3

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density. The second stage filter, containing ten units of biological sponge, each 600mm×400mm×60 mm in size, separates solid waste while acting as a natural filter to remove ammonia. The third and final stage filtering tank was also a biological filtration unit that contains 8 kg moving bed bioreactor media (K1 media) that provides the most active surface for bacteria to colonize, ensuring aerobic respiration by delivering vigorous aeration in the final stage of filtration to aid faster growth of aerobic bacteria. Water pH was tested using a universal indicator solution (Merck, India) and maintained at an optimum level between 7.0 and 7.5 by adding CaMgCO3 powder.

Eight hundred numbers of healthy striped murrel seeds, each of size 70 mm, were brought from M/s Rosen Fisheries, Fish hatchery, Ernakulam, during July 2022, acclimatized and stocked in the tank and provided gentle aeration using a high-blow air pump of capacity.

120 L/min. Floating formulated feed was administered daily until satiation at 6.00 am, 5.00 pm and 11.00 pm, as detailed in Table 1.

The formulated feed used in the study was procured from M/s Uno feeds Komarada, Bhimavaram– 534 201, W.G. Dt. Andhra Pradesh, India. Standard methods analyzed .This feed for crude protein, crude lipid, moisture, and ash (AOAC, 2000). Moisture was determined by oven-drying at 105°C until constant weight. Crude protein (N×6.25) was determined by the Kjeldahl method after acid digestion using a semi-automated Kjeldahl System (FOSS Kjeltec). Crude lipid was determined by the ether-extraction method using a Soxhlet System (FOSS Soxtec). Ash content was determined by incinerating the sample in a muffle furnace at 550 °C for 24 h. The proximate analysis is provided in Table 2.

Water samples from the culture tank and also source water were collected on the 30th, 120th and 210th day of culture and tested pH, salinity, alkalinity, carbonate, bicarbonate, hydroxide, calcium, magnesium, total hardness, ammonia, nitrite, and sulfide by following the standard procedure (Boyd *et al,*1985).Fishes were collected using a hand net, and length and weight were recorded regularly. The survival percentage was calculated using the following formula:

Survival percentage = (Number of fish at the end of the experiment ÷Number of fish at the beginning of the experiment) × 100.

The feedback of farmers on high-density farming of *Chana striata* was collected using a structured questionnaire. The main points sought were the acceptability of the technology, production ease, water requirement, feed cost, marketability, ecological issues, environmental issues, and replicability. Kirkpatrick's (Kirkpatrick *et al,* 2016) training evaluation was adapted and applied to analyze the farmers' feedback.

RESULTS AND DISCUSSION

The water quality of the culture tank was significantly different from that of the source water. The source water pH was lower, ranging from 4.2 during the rainy season to 5.3 and 5.1 in the consecutive post-monsoon periods, whereas pH varied from 5.9 to 6.6 in the culture tank (Table 3). Salinity was zero throughout the culture since there was no addition of salts. The alkalinity of source water was less during the rainy season (20 mg/l) and slowly increased to 25 mg/l after 150th d and 40 mg/l at the 250th d of culture. The alkalinity was high in the culture tank (120 mg/l) on the 50th day of culture and, after that, reduced to 45 mg/l and 75 mg/l. Carbonate and hydroxide content were zero both in the source and culture water. Calcium content was eight mg/l during the initial phase of the culture, which increased to 10 mg/l during the culture in both cases. Magnesium was 72 mg/l at the initial period and decreased gradually at 150thand 250thd of culture (50 mg/l, 55 mg/l, and 15 mg/l in source and culture water, respectively). Total hardness was high at 80 mg/l on the 50thd of culture and reduced to 65 mg/l and 25 mg/l at a later stage of culture. Ammonia was nil in the source water but increased drastically to 11 mg/l, 10.6 mg/l, and 9.6 mg/l during culture. This shows that *Channa striata* can withstand high ammonia levels and attain satisfactory growth. Nitrite level was high during the 150th d(2.3 mg/l) and the 250th d of culture (0.49 mg/l). Sulfide was nil in source and culture water throughout the culture period.

Table 1. Specification of the feed.

Day	Size (mm)	Quantity of feed offered percentage of body weight
1 to 30	0.6	10.0
31 to 60	1.0	7.0
61 to 90	2.0	5.0
91 to 120	3.0	3.0
121 to 150	4.0	2.0
151 to 300	6.0	1.5

Table 2. Proximate composition of the feed.

Pellet size, (mm)	Moisture (%)	Crude protein, (%)	Crude fat (%)	Crude fiber (%)	Crude ash (%)	Acid insoluble ash (%)	Carbohydrate (%)
10	5.81	33.05	4.49	2.31	12.46	6.37	41.88
7.0	5.92	31.05	4.45	2.52	12.24	6.42	43.81
4.0	3.87	34.12	6.22	2.23	12.33	5.61	39.27
2.0	5.45	33.57	5.44	2.47	12.52	5.31	40.56
1.5	5.69	34.79	6.06	2.45	10.50	4.65	40.51
0.8	5.45	31.10	3.53	2.53	10.46	4.60	46.94

Table 3. Water quality data.

Sr. No.	Water quality Parameter	Unit	Days of culture					
			50		150		250	
			Source	Tank	Source	Tank	Source	Tank
1	pH		4.2	6.6	5.3	6.0	5.1	5.9
2	Salinity	ppt	0	0	0	0	0	0
3	Alkalinity	mg/l	20	120	25	45	40	75
4	Carbonate	mg/l	0	0	0	0	0	0
5	Bicarbonate	mg/l	20	120	25	45	40	75
6	Hydroxide	mg/l	0	0	0	0	0	0
7	Calcium	mg/l	8	8	10	10	10	10
8	Magnesium	mg/l	72	72	50	55	15	15
9	Total	mg/l	80	80	60	65	25	25
10	Ammonia	mg/l	BDL	11.0	BDL	10.6	BDL	9.6
11	Nitrite	mg/l	BDL	BDL	BDL	2.3	BDL	0.49
12	Sulfide	mg/l	BDL	BDL	BDL	BDL	BDL	BDL

Table 4. The growth rate of *Striped murrel.*

Day	Length (cm)	Weight(g)
1	5± 2.0	0.2±0.02
50	7.4± 2.3	20± 1.4
75	15± 3.2	40.66± 3.5
125	19.1± 3.6	110± 8.2
175	30.65 ± 4.5	285.3± 15.5
250	35.07± 5.5	420.28± 30.5

Table 5. Cost economics

Sr. No.	Particular		Amount (Rs)
Capital cost			
1.	Tank and aeration system		50000.00
A. Annual fixed cost			
	a.	Depreciation on capital cost, @20%	10000.0
	b.	Insurance premium @ 2% of the capital cost	1000.00
	c.	Interest on capital cost @8%	4000.00
	Total		15000.00
2	Electricity charges, 8 months@ Rs.200/-		1600.00
3	Feed, 423.9 kg @ Rs115/- per kg		48749.00
	Total		58349.00
	Total Operational cost (A+B)		73349.00
C. Gross benefit			
1	Receipt, 235.5 kg @ Rs.350/- per kg		82425.00
2	Gross income		24076.00
3	Net income		9076.00
3	BC Ratio		1.1

The fish were harvested towards the end of 250 days of rearing. The survival percentage was 97. The fish reached an average weight of 420.28± 30.5 gm from the initial seed weight of 0.2±0.02 gm within 250 days. Similarly, length also increased from 5± 2 cm to 35.07± 5.5 cm. The growth data is given in Table 4.

The total production reported in our culture system was 235.5 kg within 250 days of culture from a tank area of 12.56 m2, i.e., 18.75 kg/ m^2. The average production earlier reported by Rahman *et al*. (2012) from 40 m^2 (1 percent) of natural production system was only 6.06 kg (0.1515 kg/m^2). The significantly higher production observed in the present study indicates the improved efficiency of the aquaculture system and the feed used for this species.

The average production cost was Rs.312/ Kg. The FCR realized from the culture was 1.8. The wholesale market price realized was Rs.350/ kg. The BC ratio was 1.1 (Table 5).

Table 6. Water budget.

Month	Water depth, m	Volume of water, m^3	Water exchange interval, days	Percent water exchanged at a time	Quantity of water exchanged at a time, m^3	Monthly water exchange, m^3
1	0.3	3.768	10	30	1.13	3.39
2	0.3	3.768	8	40	1.51	5.65
3	0.5	6.28	7	50	3.14	13.46
4	0.5	6.28	6	60	3.77	18.84
5	0.8	10.048	5	70	7.03	42.20
6	0.8	10.048	4	80	8.04	60.29
7	1.2	15.072	3	90	13.56	135.65
8	3	90	1.2	15.072	13.56	135.65
TOTAL						415.13

Table 7. Farmers' feedback.

Feedback	Level of Agreement					
	Very high	High	Medium	Low	Very low	Rank
Marketing issues	8	2				1
Water requirement	9	1				2
Feed cost	10					3
Environmental issues		3	5	2		4
Acceptability of the technology	8	2				5
Drudgery				2	8	6
Adoption		1	1	8		7
Ecological issues			2	5	3	8

The water budget is detailed in Table 6. The total water for a single culture was 415.1 m3, and the water required to produce 1 kg of fish was 1.8 m3. Verdegem (2009) reported a water requirement of 5.2 m3 per kg of fish produced in inland conditions. This indicates that the freshwater required in natural inland aquaculture is higher than that required for artificial tank systems.

Feedback from farmers is presented in Table 7. Marketability was reported as the primary issue among various issues, followed by high water requirements. The issue of feed cost was ranked 3rd,and all the farmers reported feed cost as very high.

CONCLUSION

Though the ammonia level was 9.6-11 mg/l, the *Channa striata* performed well, with a survival percentage 97. The ability of *Channa striata* to withstand high ammonia levels and low dissolved oxygen levels makes it compatible with high-density farming in tanks. During all stages of growth, this fish can take formulated feed of appropriate sizes. After the culture period, the fish reached an average weight of 420.28± 30.5 g and a length of 35.07± 5.5 cm. The total production was 235.5 kg during 250 days from an area of 12.56 m^2. The average production cost per kg was Rs.312/-, and the FCR was 1.8. The benefit-cost. The ratio

was 1.1. The water required to produce 1 kg of fish was 1.8 m^3. Among various issues reported by the farmers, marketability was the primary issue. Channa striata is an ideal candidate for high-density farming in artificial freshwater tanks.

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