

Diversification options in India with Asian seabass and murrel

At AqualIndia 2020, Dr S Kandan described a nursery business for the seabass and Dr TCV Narasimha Rao, a farming model for the murrel.

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Although in fourth place in the global aquaculture sector, Dr S Kandan, Project Director at MPEDA-RGCA said that India is too centric on shrimp aquaculture. "India is lagging behind China in the seafood export race because it largely depends on shrimp and land-based aquaculture systems," adding that India lacks the technology to introduce new species and new culture systems for diversification of aquaculture. Compared to China which uses seven culture systems (indoor raceways, earthen ponds, open seas, bays, rivers, reservoirs and lakes) to farm more than 75 species, in India, culture systems are limited to brackish water and freshwater ponds and reservoirs for less than 15 species, mainly freshwater. The main reason for the wide gap in production is the under utilisation of resources available in India.

Dr TCV Narasimha Rao, Uno Feeds, who gave his experiences in developing commercial farming of the snakehead fish or the murrel as it is known in India, said that the introduction of new species have been rather slow. The farming of the Indian major carps (IMC) started in 1998, followed by the pangasius in 2007 and later came that of the pacu, murrel and more recently, the tilapia.

Asian seabass farming

During his presentation on "Seabass farming in India as an alternative to shrimp", **S Kandan** listed the merits of farming the Asian seabass *Lates calcarifer* and other marine finfish species based on the 17 years of research and introduction of farming technology. The Rajiv Gandhi Centre for Aquaculture (RGCA) which is the R&D arm of the Marine Products Export Development Authority (MPEDA) has standardised seed production and grow-out farming technology of the seabass at its hatchery facility at Thoduvaai, and aquaculture demonstration farm at Karaikal, respectively. It now produces fingerlings by bringing fry from its seabass hatchery in Thoduvaai in Tamil Nadu on the east coast to the Multispecies Aquaculture Centre (MAC) in Vallarpadam, Kerala (see issue March/April 2020). In the west coast there is no hatchery to meet the demands of surrounding farmers.

"I propose that the country should shift its focus to farming seabass to overcome the loss met by shrimp aquaculture affected by diseases. This is the best alternative species," said Kandan. "As we have determined that the seabass is the best candidate species for fresh and brackish water and mariculture farmers. RGCA can supply fry and fingerlings year-round besides that from the hatchery of ICAR - Research Institute, CIBA. A total production of 2.8 million fry/fingerlings is possible for 2019-2020 where RGCA's capacity is 3 million fry annually and 0.5 million fingerlings/year. Seabass is a species that can be bred in captivity, has a fast growth rate and a high market price."

Kandan added, "When it comes to seabass farming, small and marginal farmers can easily adopt the methods evolved by RGCA in a cost-effective manner." RGCA provides consultancy services for establishing seabass hatcheries and nurseries, training programmes on best husbandry practices as well as technical assistance for seabass grow-out. In promoting seabass farming at AqualIndia 2020, Kandan divided the production into three phases; nursery, pre-grow-out and grow-out. He discussed how the nursery phase could be a business unit.

Nursery phase

In this phase, the example given was stocking 2x2x1.3m cage with 800 fingerlings/cage or at a stocking density of 14,379 seabass fry (ranging from 1.4g - 5.0g sizes) in 20 cages. Kandan also said that the larval feed by Growel Feeds, an Indian feed miller is suitable for their use but has suggested some improvements. "We feed fingerlings with slow-sinking 0.8 and 1.0mm extruded floating pellets (Skretting) and slowly change to floating pellets with 45% - 50% crude protein (% CP) 4 times/day (UniPresident Vietnam). Cannibalism can be high resulting in low survival rates. To minimise cannibalism, grading was done periodically (once every 15 - 20 days) depending on the size variation. After 40 - 45 days, the fingerlings reach the average growth of 12.2g with 97% survival rate," said Kandan.

AqualIndia 2020, held from January 31-February 1 in Kochi, India had a session covering the diversification into finfish and into *Penaeus indicus*, a species endemic to India. ICAR-CIBA's Dr KK Vijayan proposed its selective breeding. CIBA has been researching on the indicus extensively since 2015 and its full genome has been assembled. Vijayan suggested a consortium concept for this project.



Presenters at this session and guest panelists, from left, Dr Narasimha Rao, Dr Kailasam M, Principal Scientist, CIBA, Dr S. Kandan, Dr Thomas Wilson, Aquafeed Consultant, Thailand and Dr KK Vijayan. Wilson presented on the nutrition and feeding of Asian seabass.

As RGCA encourages the take-up of this nursery phase as a business, Kandan presented the economics of nursery production in a 0.25ha pond (Table 1). The cost of production for each fingerling was INR 33.5 (USD 0.47) and the profit margin per fingerling was INR 11.5 (USD 0.16). Fingerlings can be harvested at 10g to 12.5g.

Costs of operations	INR 467,513
Pond preparation, maintenance, pond inputs, labour and packing	INR 64,500
Fry cost (14,379 fry @ INR 17 each)	INR 244,443
Feeds, additives and probiotics)	INR 158,570
Cost of sales (13,950 fingerlings sold @ INR 45)	INR 627,750
Profit	INR 160,237
Profit/kg	INR 11.49

Table 1. Economics of 0.25ha seabass nursery

Pre-grow-out in cages and a pen system

Seabass fingerlings were transferred into grow-out cages of 2x2x1.3m of different mesh sizes, according to the size of the fish. "We feed the fingerlings with floating feeds, and when the feeding behaviour was found to be very aggressive, grading was done at 20 – 30 day intervals. This avoids cannibalism and separates sizes. The sizes attained were from 100g to 300g within 125 – 145 days," said Kandan.

An alternative culture system developed by RGCA with local farmers is grow-out in pens. Within a pond, seabass fingerlings were kept in small impounded 300m² pens. In the first pen, fingerlings of between 200g and 330g were stocked. In the second pen, were fingerlings of 160g to 210g; and of 100g to 150g in the third pen. Growing seabass in the pen system evens out feeding. After 40 – 54 days of culture and reaching sizes of 190g – 450g, fish were released to the same open pond. Over the grow-out culture period 80% of the fish were of uniform sizes.

Grow-out culture

In the open pond system, there is a PVC floating frame that acts as a feeding point to avoid floating pellets from drifting towards the pond's shallow areas and remain uneaten. Feeding was done 3 times/day and sampling for growth was done every 30 – 40 days. Once the seabass reached average body weights (ABW) of 1 – 1.5kg after 160 – 190 days in the open pond, partial harvesting begins. Kandan commented, "It is important that the fish were fed using the spot feeding method. The timing of feeding is important as well." He also noted the interesting observation that the seabass is averse to different people feeding them; the same person must do the feeding every day. Through this split-up techniques of seabass culture survival rate of 90.1% was easily achieved in the grow-out phase.



In grow-out phase, 190 – 450g fish are released into the open pond system, from pens. PVC floating frames act as feeding points to avoid floating pellets from drifting towards the pond's shallow areas and remain uneaten.



Once fish reach 1 kg, partial harvest is done for marketing.

Kandan convinced the audience on the profitability of seabass farming. He showed that production could reach 15.7 tonnes over one cycle. Survival rates were high in their trials at 90%, although he did report a low of 60%. The cost of production was INR252/kg (USD3.6/kg) and the profit margin was INR149/kg (USD2.12/kg). Fish was sold at INR400/kg (USD 5.71/kg, Table 2).

Costs of operations	INR 3,970,593
Pond preparation, maintenance, chemicals and other inputs, labour and harvesting	INR 675,000
Feeds and feed additives (fish oil and probiotics)	INR 2,690,390
Seed cost (14,379 juveniles)	INR 605,203
Cost of production (kg)	INR 252.2
Cost of sales for 15.743 tonnes of fish (1.22kg)	INR 6,309,557
Profit	INR 2,338,964
Profit/kg	INR 149

Table 2. Economics of seabass farming in India

Advantages and disadvantages

The seabass is very adaptable, growing well in freshwater and brackish water environments. Therefore, Kandan suggested that shrimp farmers grow seabass in unused shrimp ponds, particularly in Andhra Pradesh. "When compared to the shrimp, the Asian seabass is less prone to diseases because the fish must be screened for diseases before they are released to the farmers." He added that there is high demand in the domestic markets for seabass, as the farm gate price is very low. Seabass readily accepts pelleted feeds.

With regards to its disadvantages, it is the unavailability of fortified feed; the minimum 2m depth of water required; shortage of hatcheries; severe cannibalism, which can be risky when ignored; long culture duration and a high investment for cages. "This calls for some support from the government. There is a mindset to change and to persuade farmers to farm seabass and other new species instead of just shrimp."

His take-home message was, "We can have seabass farming in the open sea but today, there is no open sea lease policy for cage culture. An option is pond-based cage culture that is less expensive for medium-scale entrepreneurs. However, I believe that open pond culture is the best method for marginal farmers to have good profit margins by adopting the 3-phase culture system. This alleviates risks with cannibalism and maintain an effective even feeding regime during the pre-grow-out period for a uniform growth in the grow-out phase."

Experiences in farming the murrel in India

In 2015, **TCV Narasimha Rao** began his research into the commercial farming of the murrel or snakehead *Channa striatus* with assistance from a feed premix and additive company in China. The first crop was in 2016/2017 and since then, he has increased production 100%. At this conference, Rao described his experiences and his search for the best culture model and practices for this fish.

"Consumers in South India, with higher disposable incomes, want traditional fish choices while those available now are mostly imported species or species preferred in West Bengal and Bangladesh. The murrel or snakehead fish *Channa* spp. could fulfill this gap," said Rao, adding "In Hyderabad, consumers are paying INR700 to 800/kg (USD11.4/kg) at the retail level."

As snakehead farming is extremely popular in China and Vietnam, Rao compared culture practices and whether Indian farmers should follow the same path. China is a global leader in snakehead fish production, farming a hybrid *Channa asiatica* x *Channa argus*. Vietnam farms a strain of *Channa striatus*. "However, their farmers use intensive systems; after 6-8 months, they obtain a production of 35-50 tonnes/acre (87.5-125 tonnes/ha) in China and 33 tonnes/acre (82.5 tonnes/ha) in Vietnam. In recent years, there has been a slump in farm gate prices, as low as USD1 to USD1.2/kg. But their cost of production is also low."

Moving to commercial farming

Since 2015, Rao has been farming a strain of *C. striatus* and in the last two years has produced more than 100 tonnes/year. "We had three successful crops and have published information on hatchery and farm operations to gain the interests of farmers. The focus is on *C. striatus* and we do not wish to develop an alien species." In 2019, he has supplied fingerlings to one farmer and in 2020, will begin to supply to 10 farmers.

The breeding technology is not new and fish breeds naturally in ponds. "Our challenge is to wean wild brood fish onto trash fish as it is expensive to provide live fingerlings to maintain brood fish. When brood fish are fed live tilapia/carps, egg quality and fish health are better than when fed trash fish," said Rao. Early stage rearing is in indoor tanks and grading is important as the fish is cannibalistic. Weaning fingerling to artificial feeds is easy. "After 3-4 gradings every 3 days, when the fingerlings weigh 10 to 20g, you will see that cannibalism is almost zero. At 20g, we shift them to a nursery farm where we get 80% to 90% survival." Once the fish reach 50g and above, they are put into grow-out ponds where the survival is more than 98%. Starter feeds from 0.4mm to 0.8mm are imported and Uno Feeds produce extruded floating feeds larger than 1mm.

India's freshwater fish farming is usually in massive ponds, from 10 acres (4ha) to as large as 100 acres (40ha). "But for the murrel, we have seen grow-out success in 3-4-acres (1.2-1.6ha) ponds. Ideally, 1-acre (0.4ha) ponds are better for this species. One issue is deterioration of pond bottoms especially since we are feeding high protein diets. One suggestion is to have the murrel pond next to pangasius and carp ponds and regularly exchange water between the two ponds. In Vietnam, they can have high stocking densities as the water exchange rate is high." As the fish is marketed live, there is regular harvesting. "We have been able to successfully transport live fish over 700km from the farm to Tamil Nadu with very low mortality."

The ideal culture model

As most carp farmers have small nursery ponds, Rao suggested that these nursery ponds be used to farm the murrel. Rao calls this a "modified split pond model" where small ponds are for murrel farming and water is exchanged over 2-3 hours per day with the bigger carp pond which can be 10 (4ha) to 50 (20ha) acres in size.

Recently, ponds have PE liners on the sides. Another recent model is using a large reservoir stocked with Indian major carps (IMC) and exchanging the water from this reservoir with multiple small murrel ponds. However, this model encourages the spread of diseases and biosecurity needs to be built-in.

The bio floc model was also tested in indoor ponds of 10,000 to 20,000L but so far, it has been successful only for fish up to 300g. USSEC has a raceway system for snakehead farming in China. Rao has been trying out a raceway model too. "If this works well with a large pond for IMC culture for water exchange, it will be a sustainable model. The only drawback is that murels tend to jump a lot, injuring themselves on the walls of the raceway which leads to infections."

Profitability

Results from a 1.5-acre (0.6ha) farmer's pond, where the fish were stocked at 26,000 of 40g fingerlings, showed a harvest of 20.9 tonnes of 800g fish (Table 1). The survival rate was 95% at the end of the 8-month culture period. "We only supplied fingerlings for one pond. The return of investment of 92% was attractive because the farmer was able to sell the fish at an average farm gate price of INR350/kg (USD5/kg). Of course, as more farmers produce the murrel, the farm gate price will go down," said Rao.

Stocking quantity @40g	26,000 juveniles
Harvest size (ABW)	845 g
Total production	20,930 kg
Final survival	95%
Feed usage (Uno Feeds)	31,400 kg
FCR	1.5
Unit production cost per kg	INR 182
Total production cost	INR 3,809,260
Farm-gate price per kg	INR 350
Total output value	INR 7,325,500
Total profit margin	INR 3,516,240
Return on investment (ROI)	92%

Table 3. Results from stocking in 2019 at a farm in Machillipatnam

Feeds: Getting it right

Both feeds for the murrel and seabass have high protein levels (45-48% CP) but for the murrel, Rao said that the lipid level must be lower at 7%-8% as compared to 10% to 14% in seabass. "Feeding seabass feeds to the murrel resulted in fatty liver. All the feeds are floating feeds and auto feeders are used."

Like the seabass, the lower the starch content of the feed, the better the growth rate. "Using the single screw extruder, we were able to reduce the starch content to 18-20%. If we can bring it lower, the performance would be even better and we can have more space in the formulation for more protein. Possibly with twin screw extruders, I can bring down the starch content in floating feeds up to 15%," he added.



Murrel or snakehead fish juveniles



“In Hyderabad, consumers are paying INR700 to 800/kg (USD11.4/kg) at the retail level.”
-Narasimha Rao

Disease challenges

In Vietnam, the nutritionally related poor liver condition and spinal deformities are common. The “flower head” problem has not been reported in India, possibly because of lower stocking density. Poor liver condition is managed by adding a functional liver additive and bile salts.

“Murrels are extremely sensitive to epizootic ulcerative syndrome (EUS). This has been quite serious in the last 3 years. We have managed EUS with traditional medicine which has antiseptic and antibiotic effects. The fish is also prone to intestinal worms which impact growth. We need to sample the intestines frequently for the presence of worms and apply medication,” said Rao.

A recent problem is the cotton mould disease with 95% mortality within 3-4 days. Rao believes that with a suitable stocking density, good water quality and good pond bottom, this disease can be managed. “If water temperature does not fall below 28 to 30°C, some of these serious health conditions and diseases can be prevented. I also think that growth is particularly good at a salinity of 3 to 4ppt which will protect the fish, especially from fungal infections. I believe that the maximum salinity tolerance is up to 10ppt which I will need to confirm.”

Market acceptability

There are differences between the Vietnamese and Indian strains of *C. striatus*; the former was recently introduced to India. “Because the Vietnamese strain is domesticated for many generations, we found that its immunity to diseases is slightly better and the species grows much faster. However, we need to farm both to confirm the differences. There are clear differences in skin patterns and our preliminary results show that the Vietnamese strain is less favoured by our consumers, especially those around Hyderabad.”

For the future, Rao suggested, “We could consider domesticating the endemic *Channa marulius* which grows to 2-3kg or perhaps develop its hybrid with *C. striatus*. We also should breed for disease resistance and immunity against fungal infections. There is still a high inclusion of 30% to 40% fish meal in feeds. Today, this is acceptable as the fish has a premium price. But such feeds are not sustainable. We also need to see the impact on taste and texture and what the consumer thinks with lower fish meal feeds.”

A caution is that in 3 years, with more murrel produced, prices will fall. However, retailing live murrel is easy as the fish can easily be transported live and perhaps can be the anchor fish to attract crowds and encourage the retail of other freshwater fish. “Basically, we need to drive fish consumption within India,” said Rao.



Graphic to show the modified split pond model. The smaller nursery pond is used for murrel farming and the larger pond for the rohu. Water is exchanged regularly using a pump.



Extruded 6.0mm pellets for snakehead farming, produced by Uno Feeds