

BRACKISHWATER INTEGRATED FISH FARMING SYSTEM IN POND

A Livelihood Model for Tribal Communities of Gujarat

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Introduction

India is bestowed with number of locally important cultivable brackishwater finfish species such as Asian seabass, Milkfish, Grey mullet, Pearlscale, Scat, Estuarine grouper and Cobia, suitable for Brackishwater aquaculture. Diversification assumes significant importance in coastal aquaculture in India as presently, it mostly is limited to the shrimp aquaculture alone. The tidal amplitude of Gujarat coast is higher than other parts of West coast. This natural phenomenon had created vast stretches of marshy and saline lands all along the coast. The estimated brackishwater area in Gujarat is around 3,76,000 hectare with the potential area suitable for brackishwater aquaculture being about 83,340 hectares. Navsari District of Gujarat is blessed with abundant potential brackishwater resources which can be utilized for aquaculture for livelihood of coastal communities.

Tribal communities are known to be the autochthonous folks of the land. Next to Africa, India has the second largest tribal population in the world and they are the integral segment of Indian culture and society. The country presents a diverse tribal population depicting a complex cultural mosaic. India's population includes nearly one hundred million tribal people. However, most of the areas inhabited by the tribal communities are still underdeveloped.

In order to achieve rapid development in rural and tribal areas of the country, the policies and research strategies must focus on conserving natural resources, enhancing efficient use of available resources, increasing productivity, income and profitability. On the other hand, availability of fresh water for human use is

emerging as national as well international challenge and its most efficient management as well as recycling is utmost requirement. Recycling of farm and crop residue as well as agricultural by-products need to be focused on, to minimize the production cost. Since animal waste makes good fertilizer for fish ponds, and 50-60 percent of the cost of fish farming goes for feed, integrating livestock and fish farming is an ideal model for tribal communities.

Integrated Fish Farming is one of the best examples of mixed farming. This type of farming practices involves a combination of fish polyculture, integrated with crop or livestock production. Farm waste recycling, an important component of integrated fish farming is highly advantageous to the farmers as it improves the economy of production and decrease the adverse environmental impact of farming.

Need for intervention

The integration of brackishwater aquaculture with livestock or crop farming provides quality protein food, resource utilisation, recycling of farm waste, employment generation and economic development.

It also allows us to make use of unutilized brackishwater resources for farming of salt tolerant horticultural crops on aquaculture farm dykes.

The tribal population of Navsari, Valsad and Vapi of Gujarat work mostly as agriculture or farm labour. Their daily income depends on availability of agriculture work, which in turn is monsoon dependant and therefore uncertain, affecting their livelihood. A fishery based alternative avocation, inculcating the skill of integrated fish farming in brackishwater aquaculture

ponds and providing them an opportunity to adopt it could be a source of additional/alternative livelihood option for them.

Features of innovation

The CIBA-Navsari-Gujarat Research Centre, initiated the development of different integrated culture models for the benefit of tribal communities under the Tribal Sub Plan (TSP) project of the Govt. of India. This initiative evinced keen interest among tribal community to adopt these technologies, that were customized to suit the requirements of the tribal farmers in Navsari area.

A Self Help Group (SHG) named Om Sai Self Help Group comprising of tribal men (2) and women (6) was formed to carry out a programme on integrated fish farming in brackishwater aquaculture pond with livestock culture on pond dykes at the NGRC Matwad Farm, Navsari. The model comprises nursery rearing of Asian seabass, *Lates calcarifer*; Pearl spot, *Etroplus suratensis*; Spotted Scat, *Scatophagus argus* in hapas, polyculture of Milkfish, *Chanos chanos* and Pearl spot, *Etroplus suratensis* in pond, and Surti goat farming on the pond dyke.

The materials required for nursery rearing, such as hapas, feed, hand nets, grading materials, shed facilities, etc. were provided to the SHG by NGRC of CIBA. Prior to stocking of seed, NGRC-CIBA team provided training and demonstration to the members of the SHG on pond preparation, hapa installation and cleaning, seed stocking, grading, feed preparation and feeding, water quality management, etc.

A pond of 2000m² area and water depth of 1.5-2.0m was used for the programme. Prior to seed stocking, the pond was disinfected using inorganic chemicals for removal of unwanted predatory fishes, crabs, etc. For the ease of feeding the fish, catwalks, diagonally opposite each other were erected on opposite dykes extending to the inner side of the pond. The livestock shed was built on pond dyke.

HDPE hapas of 2 x 1 x1 m, (2, 3 and 5 mm mesh) were installed in pond and hatchery produced seabass (10000 no.s; 1.5-2.0 cm), milkfish (13000 no.s; 2-3 cm), pearlspot (1450 no.s; 1-2 cm) and scat (75 no.s; 2-3 cm) fry from CIBA MES, Chennai, were provided to SHG members for stocking.



Integrated fish farming in brackishwater aquaculture pond with livestock on pond dyke

A. Nursery rearing of asian seabass *Lates calcarifer*

Asian seabass (*Lates Calcarifer*) known as Bhetki or Barramundi in India is a commercially important finfish species caught from inshore areas, estuaries, backwaters, lagoons and fresh water ponds. It is one of the fastest growing fish that can grow to an average size of 1.5kg in 10 to 12 months and fetches good price both in domestic as well as international markets. The culture of seabass involves nursery rearing in hapas, pre grow-out culture and grow-out culture in ponds and cages.



Asian seabass Lates calcarifer

For nursery rearing of seabass, seeds were stocked at the density of 300-700 no's in a (2 x 1 x 1 m) hapa. During rearing period, the seed were fed with CIBA formulated Seabass larval feed (0.2 mm-1.2 mm) @ 8-10% body weight twice a day. For small seed (1.5-4.0 cm), feed balls were kept in feeding trays, are tied inside the hapa while for fry size seed, slow sinking pellet feed was broadcast slowly in hapa. Regular grading was done by the SHG members at four-day intervals to separate the shooters and to maintain uniform size. During grading, while the SHG men removed the fish from hapas and cleaned the hapas, womenfolk carried out the grading

activity and segregated fish in to shooters, small and average ones based on their sizes.

After grading, the segregated seeds were stocked in different hapas based on their sizes. Grading assists in minimizing cannibalism and preventing survival drop. Once the nursery rearing of 75 days was completed, the seed attained the fingerlings size of 8-10 cm and 10-15g with survival of 60% (6000 no's). The harvested fingerlings were sold @ Rs. 25-45/-per piece to other local farmers and entrepreneurs for grow out culture in pond and cages.



Seabass nursery unit



Stocked seabass seed



Seabass seed grading



Harvested seabass fingerlings



Milkfish, *Chanos chanos*

B. Nursery rearing of milkfish, *Chanos chanos*

Among brackishwater finfish species, Milkfish, *Chanos chanos* is considered as one of the most potential candidate species for pond and pen culture systems, due to its fast growth rate (attains 500 g in 6 months), hardy nature, and low cost of production. Being a euryhaline and herbivorous fish, it feeds on benthic algae lab-lab, phytoplankton and detritus and it accepts low protein pelleted feed in culture systems and tolerates salinities ranging from 0 to 50 ppt. The culture of milkfish involves nursery rearing in hapas and grow-out culture in ponds in polyculture or monoculture systems.

Milkfish fry of 2-3 cm size were stocked @ 300-500 no's in a hapa. CIBA Formulated nursery feed (30-35% protein) were fed 2 times @ 8 to 10 % body weight daily. Cleaning of the debris from the hapa was done on regular basis by SHG members to prevent clogging and facilitate smooth water flow in the hapa. Sampling of fish was done at 15 day intervals to check the growth and survival of the fish stocks.

At the end of nursery rearing period of 45-60 days, the milkfish fry attained fingerlings sizes of 3-5 inch and 10-15 g with survival of 95% (12350 no's). The harvested fingerlings were sold @ Rs. 25-45/- to other local farmers in the area and around 800 No.s were stocked in IFF of brackishwater aquaculture pond for polyculture.

C. Nursery rearing of pearlspot *Etroplus suratensis*

Pearlspot *Etroplus suratensis* is a popular fish in the west coast of India, commonly called Karimeen in Malayalam and Kaalundri in Marathi. Pearlspot has



Harvested milkfish fingerlings

a market value of Rs. 250-500 per kg and is an ideal fish for polyculture, integrated fish farming and cage culture.

For nursery rearing in hapa, pearlspot fry of 1.5-2.0cm size were stocked @ 100-300 no's per hapa. CIBA formulated nursery feed (30-35% protein) were fed twice daily @ 8 to 10 % body weight. Cleaning of the debris from the hapa was done on regular basis to facilitate smooth water flow and sampling carried out at 15 day intervals to assess the growth and survival and health status of the fry.



Pearl Spot Etroplus suratensis



Harvested pearlspot fingerlings

After the nursery rearing period of 45-60 days, pearlspot fry attained fingerlings size of 3-5 inch and weight of 10-20 g at a survival rate of 96.67 % (1400 no's). Like milkfish, the harvested fingerlings were also stocked in IFF of brackishwater aquaculture pond for polyculture.

D. Nursery rearing of spotted scat *Scatophagus argus*

Spotted Scat (*Scatophagus argus*) belongs to scatophagidae family. It is an algivore fish having omnivore feeding habit and accepts commercial feed readily in captivity.



Spotted scat Scatophagus argus



Harvested spotted scat fingerlings

For nursery rearing in hapas, scat fry of 1.5-2.0 cm, were stocked @ 75 no's per hapa. As in Milkfish and Peralspot fry, CIBA formulated nursery feed (30-35% protein) was fed to the Scat also @ 8 to 10 % body weight twice daily. Cleaning of hapas was carried out regularly and sampling done every 15 days. At the end of nursery rearing of 45-60 days, the scat fry attained the fingerlings size of 3-5 inch and weight of 10-12g with survival of 96 % (72 no's). The harvested fingerlings were sold to local farmers/entrepreneurs @ Rs. 15-30/- for grow out culture in pond and cages.

E. Polyculture of pearlspot and milkfish in ponds

Polyculture is the culture of more than one species of aquatic organisms in the same production unit. Milkfish *Chanos chanos* and Pearlspot *Etroplus suratensis* are compatible herbivorous fish species registering good growth and survival and hence were used for polyculture.

Milkfish fingerlings of 3-5 inch and pearlspot fingerlings from the nursery were stocked in the 2000 m² pond at a density of 800 no's and 1350 no's respectively. Natural pond productivity was maintained by fertilization through goat droppings from goat shed. In addition, supplementary feed (20-25% crude protein) were fed to fish under polyculture @ 2-5% body weight daily. After a culture period of 120 days, harvest was done, when milkfish and pearlspot attained size of 300-500 g and 250-300g respectively with an average survival rate of 95%. The harvested milkfish and pearlspot were sold in market at rate of Rs. 100/kg and Rs. 250/kg respectively.



Harvested milkfish and pearlspot from brackishwater aquaculture integrated fish farming system

F. Surti goat farming in shed on pond dyke

Goat is considered as poor man's cow and goat's excreta is considered as a very good organic fertilizer. The Surti goat is an important breed of domestic goat in India. It is a dairy goat breed and mainly raised for milk production. The Surti goat is distributed in surrounding areas of Surat, Baroda and Nasik of Maharashtra. They are raised and maintained in small flocks ranging from 3 to 15 goats. Most of the flocks are raised on extensive grazing system. The Surti doe (female goats) are larger than the bucks (male goats). The average weight of doe is about 32 kg, while the bucks weigh about 30 kg. The SHG were provided three female (doe) surti goats (8-10 Kg) for IFF.



Surti Goat and Low cost goat rearing shed on pond dyke

For livestock culture in the Integrated Brackishwater Fish Farming system, a shed (10 X 10 ft) was constructed with the help of chain links and bamboo poles on the pond dyke. The shed was constructed in such a way that the goat waste (uneaten feed & faecal matter) falls into the pond water through the perforated base of the shed which acts as a natural fertilizer and helps to augment the natural productivity of the pond.



Goat rearing on feed and green grass grown on pond dykes

Throughout the culture, the goats were fed with green grass on pond dykes till satiation during mornings and also provided with a balanced diet of formulated feed (20-25% crude protein with mixture of maize, wheat, rice bran, wheat bran, barley, millet, soyabean, by-products of oilseeds) @ 300-500g per day per goat during evening for obtaining good growth. Changing of water and feeding time table was maintained daily by the SHG members.

The goats were grown into mature does and mated with mature bucks. On an average, live weight of 1 kg Surti goat meat costs around Rs.225 to 350 for bucks (males), and Rs. 210 to 325 for does (females).



Monitoring salinity and dissolved oxygen in the pond water



Cheque distribution to Om Sai Tribal Self-Help group of Matwad, Navsari

Water quality management

The water quality of a pond plays an important role in the success of farming operation. All through the culture duration in the IFF pond system, the water quality parameters were recorded and the value range was; Salinity: 5-35 ppt, pH: 7.5-8.5, Temperature: 28-33°C, Dissolved oxygen (DO): > 5 mg/l; Ammonia: <0.25 ppm, Nitrite: <0.05 ppm and Nitrate: < 1 ppm.

Economics

Om Sai Tribal Self-Help group of Matwad, Navsari earned total income of Rs. 5.0 lakhs from sale and production of seabass, milkfish, etroplus fingerlings and harvested fish from the 2000 m² integrated brackishwaterfish farming pond.

Advantages of brackishwater IFF system

- This system allows efficient waste utilisation from other farmed animals in the system and converting them into fish biomass.
- It reduces the additional cost for supplementary feeding as well as fertilization.

- It reduces effort and increases output with higher production and economic efficiency.
- Provides more employment/business opportunities to the farmers.
- Utilization of unutilized and untapped brackishwater and saline lands for horticultural and agricultural uses.

Conclusion

This societal aquaculture activity was a first of its kind in Navsari, Gujarat which motivated the SHGs, especially fisherwomen to participate in fish and livestock production and generate the additional income. This technology transfer on Integrated Brackishwater Fish Farming with livestock by the NGRC of CIBA has emerged as a successful participatory activity and a business model for providing employment and livelihood opportunities for the unemployed tribal and coastal fisher communities of Gujarat.

However, the revenue and income from this system depends mainly on availability of culture area, availability of seeds of various compatible species to be cultured and management of the system. It can successfully be adopted across the country all through the year.