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Innovative Approaches and Success Stories of Brackishwater Aquaculture Farmers

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Preface

Brackishwater aquaculture in the form of trap and hold the tide fed stock has been practiced since time immemorial by the coastal communities as a livelihood activity. Scientific advancements in seed production and feed processing technologies of penaeid shrimps, entrepreneurial aptitude of farmers and promotional policies by the Governments have transformed it as a commercial farming enterprise. Today, brackishwater aquaculture is the vanguard of seafood exports contributing about Rs.30,000 crores to national income and providing employment to one million people and contributing significantly for the village economy and societal development. India is blessed with 1.2 million ha of potential brackishwater area and about 8 million ha of inland saline soils in the landlocked states which are suitable for saline water aquaculture. Unlike freshwaters, brackishwater can only be used for fish production. With hardly 15% of potential being tapped for farming so far, it offers tremendous scope for enhancing aquaculture production fulfilling the national vision of 'blue economy'.

Presently, brackishwater aquaculture is synonymous with farming Pacific white shrimp (*Penaeus vannamei*) in about two

lakh ha with a production of six lakh tonnes. However, shrimp farming also beset with bottlenecks in terms of quality seed, emerging and existing diseases, pond management issues, low profit margin with increasing production costs and fluctuation in market prices. ICAR-CIBA being the nodal research organization has been extending technology backstopping which include, developing indigenous technologies and products to bring down the cost of production and sustainability of the of the major farmed shrimp the vannamei, and also promoting native white shrimp (*Penaeus indicus*). CIBA has been contributing in important aquaculture areas such as production of quality seed and feed, disease surveillance of shrimp farms and health management, indigenous diagnostic kits, cost effective soil and water quality kits, soil and water health cards, shrimp immunostimulants, probiotics for efficient management of shrimp ponds and advisory back up through mobile application '*Vanami Shrimpapp*' on 24 x7 basis. Similarly in the species diversification front, CIBA has successfully brought new finfish species such as seabass, milkfish and pearlspot for brackishwater farming through development of captive broodstock, hatchery and feed technologies. However, availability of stockable size fish fingerlings is a critical factor in the promotion of fin-fish farming and CIBA has been successful in mobilising fishers to take up fin fish nursery rearing for supply of fingerlings for farming, as livelihood support model.

ICAR-CIBA has been working with farmers and fisher groups on 'institute-farmer partnership mode' in evolving innovative farming approaches, farming strategies and alternative viable production systems to promote sustainable brackishwater aquaculture with a slogan **``brackishwater aquaculture for food, employment and prosperity"**, a successful farmer partnership model in aquaculture. In this direction, this book on 'Innovative approaches and success stories of brackishwater aquaculture farmers' is brought out with 30 chapters and released on the occasion of World Brackishwater Aquaculture Conference - 2019 at CIBA, Chennai. I am sure this book would be useful to the aqua farmers and fisherfolks and extension workers of the coastal states in contributing towards the sustainable development of brackishwater aquaculture sector in the country.

(K.K.VIJAYAN)
DIRECTOR

Homestead modular hatchery of brackishwater catfish, *Mystus gulio* for eastern India – an innovative model

- Rabiul Islam Sekh

Mr. Rabiul Islam Sekh is a young innovative farmer from Baliara, Mousuni, West Bengal. He has adopted Homestead Modular Hatchery Technology of Brackishwater Catfish, Mystus gulio locally known as "nona tengra", which is an important small indigenous fish species (SIS) of the Sundarban delta and achieved success.

Brief profile of farmer

Mr. Rabiul Islam Sekh is a 31 year young progressive farmer from Baliara, Mousuni, West Bengal. He has a vast experience in paddy-cum-fish farming and owns a farm area of 1.2 ha, which is used for paddy cultivation and farming of brackishwater fishes. Apart from his interest in fish farming, he is also a good Bengali writer. He adopted homestead modular hatchery technology of brackishwater catfish, *Mystus gulio* from Kakdwip Research Centre of ICAR-CIBA and has achieved great success.

Need of the intervention

Mystus gulio (Ham.) is a commercially important brackishwater catfish locally known as "nona tengra", which is an important small indigenous fish species (SIS) of the Sundarban delta. The optimum salinity for farming of this species is 5-12 ppt, where it attains a maximum size of 30 cm (250 g) in a year; however, they can also grow in 1-2 ppt of salinity. It is an important candidate species for aquaculture diversification because of its hardy nature, delicious taste, excellent nutritional value and high market demand in Eastern India. To meet the high seed demand and also to reduce dependency from wild seed collection, Kakdwip Research Centre of ICAR-Central Institute of Brackishwater Aquaculture has developed a cost-effective and farmer-friendly homestead modular hatchery technology for this species.

Feature of innovation

The farmer established a backyard hatchery with the technical support from ICAR-CIBA having the following features

- Water intake system: From brackishwater canal through filter bag (2 HP pump).
- Broodstock holding pond: Earthen pond


Hormone administration


Larval rearing tub and tank

having size of 250-1000 m^2. ICAR-CIBA has supplied the mature brooders.

- Breeding tanks: Two cement tanks each having capacity of 500 L were (water depth 0.75 m) constructed.
- Flow-through system: Water flow-through system was established in breeding tanks using 0.5 HP pump.
- Incubation and larval rearing unit: Twelve plastic tubs having capacity of 100 L was used for egg incubation and hatching.
- *Artemia* hatching unit: *Artemia* hatching was carried out in 1L water bottle.
- Pond nursery: Small pond 250-500 m^2 was used as nursery pond.

Hatchery operation and seed production

- Selection of mature and healthy broodstock of male and female.
- Maturity assessment through ovarian biopsy of female and through eye observation of male genital papillae.
- Preparation of hormone dose and intramuscular injection to males and females
- Observation of spawning after 12-15 h of injection
- Egg collection with egg collector and incubation for 16-18 h
- Hatching and larval rearing for 7 days in small plastic tubs
- Nursery rearing for 30 days in pond system

Total seed produced from one operation (10 females and 20 males) was 28,000 fingerlings. The farmer sold the 2- inch size seed at the rate of Rs. 2 per piece.

Advantages of innovation and scope of upscaling

- Relative cost of construction and operation of homestead modular hatchery of *M. gulio* is low.
- Breeding in small cement tank with little water flow is possible, which is an innovative idea.
- Use of egg collector (made up of nylon fibre) is an innovative idea to increase fertilization and survival of eggs.
- Incubation in small plastic pool is cost effective to improve survival of larvae.
- Nursery rearing in small shallow pond and hapa is an ideal practice.


35 days old fry


Mystus gulio adult

Economic viability

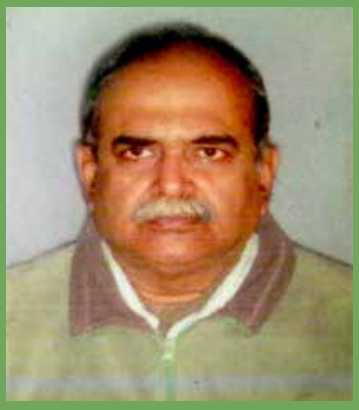
Total operation cost for one breeding cycle for 10 sets of females was Rs. 15,320/- only. Gross return from sale of 28,000 fry (30 days old@Rs1/-) was Rs. 28,000/-, and net return was Rs. 12,680/-. Benefit cost ratio was 1.80.

Contact details

Rabiul Islam Sekh; Village and post: Baliara, Gram Panchyat: Mousuni, PS: Fraserganj (Coastal), Block: Namkhana; Dist.: South 24 Parganas, West Bengal – 743357, Mob. No: 9733508341
Scientist Mentor : Dr. Prem Kumar, KRC of CIBA

Low input based farming of milkfish and its popularization as Deccan Hilsa in Sundarban- an innovative approach

- Amalesh Chatterjee



Mr.Amalesh Chatterjee, an engineer by profession, is a progressive aqua entrepreneur from Khamargachhi, Hooghly, West Bengal. He in association with ICAR-CIBA developed and demonstrated the low input based farming of milkfish and its popularization as Deccan Hilsa in Sundarban region of West Bengal.

Profile of the farmer

Mr. Amalesh Chatterjeeis a well-qualified engineer and progressive aqua entrepreneur from Khamargachhi, Hooghly, West Bengal. He has vast experience in all spheres of aquaculture systems for over 30 years. He has a brackishwater farm of 7.5 ha in South 24 Parganas and a freshwater farm of 1.2 ha with a hatchery in Hooghly. He has strong linkages with state and central govt. organizations and is involved at the field level demonstrations of different fish species. He is a recipient of several awards from various organizations as a progressive fish farmer. Mr. Chatterjee in association with ICAR-CIBA has done the low input based farming of milkfish and its popularization as Deccan Hilsa in Sundarban.

Need for the innovation

Milkfish *(Chanos chanos)* is an important candidate species suitable for brackishwater aquaculture. Milkfish, being a herbivore, can grow rapidly in natural water bodies by feeding on benthic algae, *lab-lab*, phytoplankton and detritus matter. It can tolerate a wide range of salinity. West Bengal vested with enormous resources of brackishwater almost over 2.1 lakh ha provides tremendous opportunity to undertake milkfish farming in its bheries and other coastal water bodies. Milkfish is having tiny bones and its appearance resembles to the prized fish Hilsa and therefore, can be considered as *'Deccan Hilsa'*, an alternative to costly hilsa, affordable to ordinary consumers. In order to promote milkfish farming and its popularization, ICAR-CIBA has developed seed production technology by achieving the first breakthrough on captive breeding in June 2015. There was a need to develop low input based milkfish farming protocol which could be easily adopted by farmers. In this context, trials were undertaken with a progressive farmer to test and

A haul of harvested milkfish

develop the economically viable milkfish farming using hatchery produced seeds in an innovative approach.

Feature of the innovation

CIBA hatchery produced 20-day old milkfish fry were reared in net cages for 30 days. Later, fingerlings (4-5 g) were stocked in a 1 ha brackishwater pond (0-10 ppt) with stocking density of 10000/ ha. Fish were fed with floating pellets @ 6-2% bodyweight. Fertilization was done fortnightly and white nylon net (15% of pond surface area) was fixed vertically in water surface to grow periphyton. In 6 months, average body weight of fish was 400 g with survival of 77% and productivity of 3.5 ton/ ha.

Harvested milkfish

Harvested milkfish ready for marketing

Advantages/ attributes of the innovation

- Being herbivorous, milkfish could be easily farmed with low-input based system which can be adopted by small and marginal farmers.
- Periphyton grown on substrate reduces feed amount and thus production cost.
- Unutilized/ abandoned shrimp ponds could be used for fish farming.
- As the fish resembles hilsa, the delicacy of eastern India, it could be popularized as “Deccan hilsa”.
- Although, this fish is a native species, it is unknown in eastern India. Therefore, it needs proper marketing strategy and support.

Mr. A. Chatterjee (in middle) with other officials

Economic viability of the innovation

The productivity was 3.5 ton/ha with production cost of Rs. 110/kg. From 1 ha pond, in 6 months, an income of Rs. 2.2 lakh can be realised with benefit cost ratio of 1.55 (Rs. 6.2 lakh return/ Rs.4 lakh production cost). Fish can be sold at Rs.180-200/ kg.

Contact details

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Pond based aqua-agri integration for the socio-economic transformation of farm families in the Sundarban region of West Bengal

- Debakinandan Patra

Mr. Debakinandan Patra is a marginal farmer of Madanganj village, Namkhana block of the Sundarban. He has pioneered the aqua-agri integrated model developed by Kakdwip Research Centre of CIBA for the livelihood security of coastal families of Sundarban region of West Bengal.

Profile of the farmer

Mr. Debakinandan Patra is a small farmer of Madanganj village, Namkhana block of Sundarban. He has 3 decades of experience in aqua-agri farming. His land is low lying and during dry months, he does not have irrigation facility. He used to cultivate only paddy in kharif season (June -September) and khesari *(Lathyrus sativus)* with some vegetables in winter season (Nov - February). His agriculture produce and fish produced were used for domestic consumption and anything surplus, was sold. He is having brackishwater ponds and land shaping units of 0.4 ha each.

Need for the intervention

The agriculture in coastal Sundarban is predominantly rain-fed in nature and is characterized by excess rainfall during the rainy season followed by acute water scarcity in the post-monsoon period posing a severe threat to improved agricultural production as well as productivity of the regions. Sundarban receives high rainfall about 1800 mm during July-September only and most of the water is wasted as run-off into rivers and sea. As ground water is saline, digging of deep tube wells for irrigation is prohibited by law as it would increase salinity in the area. The adjoining low lying area was raised (including dyke of pond) with excavated soil for growing vegetables, oilseeds and other horticultural crops round the year.

Feature of the innovation

The technology of land shaping was introduced where about 1/5th of low lying area is dug into water harvesting structure (pond) of 9 feet depth and rest adjoining low land raised up to 1.5 feet with the excavated soil. Pond embankment is 5 feet wide and 4 feet height.


Lanshaping unit


Harvested fish

During rainy season, when the pond is filled with water, he is practising nursery raising of carp seeds. After pond preparation, he is releasing 10 lakh IMC spawns during July and he is selling 5 lakh fry to local villagers as seed demand is there during rainy season. He is earning Rs. 1 lakh from seed sale annually.

He is also stocking IMC @ 1.25 no./ m^2 in the developed pond during August and after 6 months, 500 kg fish was produced with an income of Rs. 60,000/ per year. He is producing ladies finger, ridge gourd, bottle gourd during rainy season and tomato, brinjal, bitter gourd, cucumber, mastard, sunflower and green leafy vegetables during rabi season in the pond embankment and raised land.

Table: Income from farm land before and after aqua-agri integration (Model: 0.4 ha)

BEFORE INTEGRATION		AFTER INTEGRATION	
KHARIF SEASON	**NET INCOME**	**KHARIF SEASON**	**NET INCOME**
Indigenous paddy (0.4 ha land)	Rs. 5000	HYV paddy (0.26 ha land)	Rs. 4200
		Okra (0.02 ha) land embankment)	Rs. 2500
		Ridge gourd (0.01 ha pond embankment)	Rs. 3200
		Bottle gourd (Aerial cultivation)	Rs. 3600
Rabi season		Rabi season	
Khesari and vegetables	Rs. 5000	Tomato (0.13 ha land)	Rs. 16000
		Mustard (0.06 ha land)	Rs. 4000
		Sunflower (0.06ha land)	Rs. 5000
		Bitter gourd (0.01 ha pond embankment)	Rs. 4000
		Bottle gourd (Aerial cultivation)	Rs. 4000
		Other vegetables (0.03 ha)	Rs. 3500
		Year round	
Fish	Rs. 5000	Fish sale	Rs. 120000
		Total	**Rs. 170000**

Advantages/ attributes of the innovation

- With this model, both fish and agricultural crops can be produced round the year in Sundarban of West Bengal.
- Creation of freshwater ponds helps in irrigation during rabi season.
- Low lying area is made upland with the excavated soil which prevents land logging during rainy season and helps in crop production and reduces salinity build up.
- This land shaping model has been accepted by State Govt. as a major livelihood model in remote Sundarban

Aerial cultivation

Bitter gourd cultivation on pond dyke

Economic viability of the innovation

He solved the irrigation and water scarcity problem for his cultivation after land shaping and using the pond water crop fields. This small piece of land is now giving him a net income of Rs.1.2 lakh per annum from fish and 0.5 lakh from agriculture. Now, his livelihood is secure and he is a happy and progressive model farmer in the village.

From a 0.4 ha model, a farmer can earn a net income of Rs. 1.7 lakh with operational expenditure of Rs.70,000 with a benefit cost ratio of 3.42.

Contact details

Mr. Debakinandan Patra, Vill+P.O.- Madanganj, P.S.- Namkhana,
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Scientist Mentor : Tapas Kumar Ghoshal, KRC of CIBA

Biofloc based shrimp nursery rearing the means for sustainable shrimp farming – a success story

- Aditya Pradhan

Shri. Aditya Pradhan an innovative aquafarmer from Balasore district of Odisha has about 30 years of experience in brackishwater aquaculture. He established an eco-friendly biofloc based nursery rearing for Pacific white shrimp *P. vannamei* with the support of ICAR-CIBA and popularising this on-farm nursery model in Odisha.

Farmer Profile

Shri. Aditya Pradhan an aquafarmer from Balasore district of Odisha has about 25 ha farm and is farming for the last 30 years.

Need for the intervention

Pacific white shrimp (*Penaeus vannamei),* an exotic species has become the major shrimp species farmed in India. Rapid expansion of this species without proper scientific management practices resulted in occurrence of many emerging diseases like Running Mortality Syndrome (RMS), Early Mortality Syndrome (EMS), Enterocytozoon hepatopenaei (EHP), Slow Growth Syndrome, besides the other prevalent diseases like WSSV and IHHNV. He felt that vannamei farming efficiency would certainly increase if one or two stage nursery is introduced in its production cycle. In shrimp culture, the nursery rearing is an intermediate phase between early post larval and juvenile stages. Nursery rearing has several benefits in shrimp production cycle like higher stocking density, improving the survival, enhanced feeding efficiency, growth of shrimp and reduction in the period of grow-out farming and production cost.

Features of the innovation

He approached the ICAR-Central Institute of Brackishwater Aquaculture, Chennai for the technical assistance and established an eco-friendly biofloc based nursery rearing technology for Pacific white shrimp. ICAR-CIBA gave the necessary guidance with standard operating protocols (SOP) for nursery rearing which includes

- Nursery design and construction,
- Bio-security(taking the emerging diseases into account)
- Suitable species and appropriate stocking (SD depending on system),
- Biofloc generation and maintenance

- Carbon sources addition strategies
- Culture management practices
- Feed management and water quality management (zero/minimal water exchange)
- Sludge management etc.,

Concrete based cement elliptical tanks of 350 Cubic meter capacity were constructed near the farm. The inlet and outlet of the nursery was designed and biosecurity fences were raised. He stocked 3000 to 3500 PLs/ m^3 in his nursery of 300 cu m of water. The nursery phase was taken up for 3 to 4 weeks as per the SOP provided by CIBA.

Advantages/Attributes of the innovation

The nursery system has increased the survival, enhanced growth and health performance, uniformity of size, reduction in the farm grow-out period, and reduction of cannibalism. Among other advantages, improved health and immunity were achieved through the continuous consumption of bio-floc which in turn positively influenced the grow-out performance. It has been established that bio-floc technology reduced the occurrence of acute hepato pancreatic necrosis disease (AHPND, and IMNV) in *P. vannamei* may be due to the antagonism which occurs between dense heterotrophic bacteria and *Vibrio parahaemolyticus.*

Biofloc technology of nursery rearing is an innovative eco-based technology that helps in sustainable production through the conversion of waste to microbial floc as natural food within the culture system and ensures sustainable income.

Economic viability of the innovation

A successful production of juveniles weighing 7–10g was attained with 98% survival and this subsequently reduced the culture period in the grow-out phase by 20-30 days subsequently lowered 20-30% production cost. Nursery grown seed was sold at Re. 0.80 to 1.0./piece A nursery tank (100 ton) with central drainage, aeration system and lab facility will cost 4 lakh rupees. With 5 cycles for annum, a net profit of 3 lakhs can be generated with minimum rate of return of 60%.

Contact details

Shri. Aditya Pradhan, Balasore, Odisha
Scientist Mentor : Akshaya Panigrahi & S.K. Otta, CIBA

Indian White Shrimp (*Penaeus indicus*) farming technology as an alternative to exotic white shrimp (*P. vannamei*) - A success story

- Anjan Dandapat

Sri.Anjan Dandapat is an innovative shrimp farmer and pioneer established shrimp farm in Northern Balasore, Odisha which is increasing in its scale and operation. He is farmer opinion leader, mentor and entrepreneur. He diversified his farming with Asian seabass with the support of ICAR-CIBA. He was awarded as best farmer from NFDB, DADF, Govt. of India for his efforts in di-versification of brackishwater aquaculture.

Brief profile of the farmer

Sri Anjan Dandapat is engaged in shrimp farming since last 20 years. He is the pioneer in establishing a farm in Northern Balasore, Odisha. Initially he farmed Tiger shrimp (*Penaeus monodon*) the native shrimp species and ruling variety since the inception of commercial shrimp aquaculture since the late eighties. He diversified his farming with Asian seabass with the support of ICAR-CIBA. He was given the best farmer award from NFDB, DADF, Govt of India.

Need for the intervention

His farming was seriously affected by White Spot Disease (WDS) which warped the sector in Odisha since 1995 with repeated crop failures and incurred huge economic loss to the shrimp farmers. He was looking for an alternative and subsequently adopted Pacific white shrimp farming and produced up to 14 tonnes per ha but that did not last long. The idea he had that vannamei shrimp is genetically improved and is of SPF variety and disease cannot easily afflict its farming is not correct. While pursuing vannamei shrimp farming, he found that it is equally susceptible to existing diseases like WSSV and IHHNV and almost every year there are few new emerging diseases like EHP, white fecal, red virus etc. and RMS, DMS, EMS (in other countries). Therefore he was looking for an alternative to vannamei shrimp. He came to know that ICAR-Central Institute of Brackishwater Aquaculture has taken up breeding and farming of Indian White shrimp (*Penaeus indicus*) through culture demonstration. He desired farming of Indian white shrimp with the technical support of CIBA.

Features of innovation

Scientists of ICAR-CIBA collected Indian white shrimp broodstocks from the east, south-east


and west coast regions for stock assessment and ensured quality broodstock for seed production. Disease-free *P. indicus* seeds produced from sourced broodstock which were tested and confirmed to be free from specific pathogens relevant to India (WSSV, EHP and MBV) were supplied to him. Package of practices for farming was provided both for low input based sustainable farming with low density and high input based sustainably intensive high density based farming and fine-tuned. ICAR- CIBA produced *P.indicus* shrimp seeds were stocked @ 10 PL/ sq m and @ 45 PL per sq.m depending on the pond conditions. The shrimps were fed with CIBA formulated shrimp feed 'indicus *plus*' with 35% protein. Zero water exchange system and pond management practices were adopted. The observations of the farmer are:

- The productivity was 2.0 -3.2 tonnes/ha in low density and 4.5-6.5 tonnes/ha in higher density farming
- *P.indicus* shrimp showed equal growth rate (similar to vannamei) up to 18 to 20 g and though after 20 g the growth slowed down
- These native species of shrimp are relatively disease free *vis-à-vis P. vannamei* shrimp with regard to white fecal and other diseases.
- *P. indicus* was less sensitive to low oxygen (hypoxic) condition and hence the aeration expenses were low
- This species could be cultured in relatively low salinity also (<5ppt) though the growth was affected
- A very high survival of above 90% could be achieved in this variety if disease free healthy seeds can be stocked.
- The performance of Indian white shrimp is on par with the exotic SPF vannamei shrimp and holds a great potential as an alternate species of shrimp for aquaculture in India.

Economics

At the end of 125 days culture duration, a final body weight of up to 28g ABW was recorded in low input based farming with lower stocking density, whereas 18-23 g ABW was recorded in the high input based intensive farming (HISF) with higher stocking density in 110-125 days. The rate of return with a profitability of Rs 2.5 to 3.5 lakhs per ha per crop in low input based extensive farming and Rs 4.0 to Rs 6 lakh in high density based farming was achieved.

Contact details

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Scientist Mentor : Akshaya Panigrahi, CIBA

Aquamimicry an innovative approach for shrimp farming

- M.Ganesh Babu

Mr. M.Ganesh Babu, an innovative farmer and entrepreneur. He has adopted and popularised the biomimicry concept in shrimp aquaculture in Andhra Pradesh. He is giving training to fellow farmers on innovative farming practices and an advocate for scientific shrimp farming.

Brief profile of farmer

Ganesh Mokkapati belongs to farming family from Vijayawada, Krishna District, Andhra Pradesh. Though graduated in electronics, he was into distribution business and has a great passion for aquaculture. He started learning aquaculture in 2014 from his uncle who is an aqua farmer at Gudur and used to do extensive culture in traditional way under Kandaleru creek. He always wanted his product to be chemical free and sustainable. Came to know from internet that Thai farmers are doing intensive culture in a very sustainable manner, went to Thailand in 2015 and attended a workshop on Aquamimicry and constantly in touch with Mr.Veerasun of Thai organic shrimp. Under his guidance he adopted aquamimicry approach and best management practices.

Need for the intervention

The innovator adopted shrimp culture with a stocking density of 25 PLs/sq.m. The shrimps grow well till 50 to 60 days of culture, afterwards pathogenic *Vibrios* which are the major menace in the pond bottom and pond water used to get polluted because of fecal matter and uneaten feed. He had to harvest before the targeted body weight and the culture was not sustainable. Promoting microalgae growth can help maintain water quality, but this can sometimes be hard to manage, and these systems are prone to fluctuations in pH and dissolved oxygen that can stress the animals. Biofloc technology was introduced to tackle some of these issues and has been met with success around the world. However, the operating costs were significantly higher to maintain bioflocs in constant suspension. A potentially more balanced approach between using both microalgae and biofloc in aquaculture is known as Aquamimicry.

Description of innovation

Aquamimicry is combination of aquatic biology and technology, developing the natural environment into culture pond without any usage of harmful chemicals. Aquamimicry is the one of the sustainable technology in shrimp farming that provide natural diets like copepods for the post larvae prior to stocking, pond water stability, enhances good survival rate, good profitable and sustainable. For more understanding, the system has been divided into 5 easy steps viz., pond design, soil analysis and treatment, developing natural food chain, water management and sludge removal and animal health and balanced ecosystem.

Pond - design

In traditional extensive farming pond bottom and soil used to get polluted after 50 to 60 DOCs because of fecal matter and uneaten feed slowly leading to vibrio and other problems. In order to avoid these problems we need to adopt “shrimp toilets” and need to remove the sludge from the pond. This will help you in reducing the organic loads and eradicates toxic gases. Pond carrying capacity will increase and allows farmer to go for high stocking densities. A simple change in pond design will enable high sustainability for farmers. Long arm aerators in Plus (+) shape design are recommended. Aeration with blowers would keep the pond bottom in aerobic conditions.

Soil analysis and treatment

As the age of the ponds increase the organic waste accumalation in the pond soil also increases. Hence the quality of pond water and soil decreases

by 45 to 50 Doc. In order to avoid these conditions befor starting of a new cycle need to analyse soil pH, ammoniacal and nitrate forms of nitrogen. Need to remove all the organic waste physically from the ponds and treat the soil with good soil probiotics. As the organic loads decreases the pond bearing capacity increase and can easily go for higher densities. It shoul be ensused that soil pH shoud remain neutral before starting a new cycle.

Developing natural food chain

Once the pond design, soil rejuvenation and water treatment is done, need to develop good natural food chain in the pond. In the natural habitat the post larvae will have algae,copepods as its feed, hence need to develop good amount of copepods in the pond. Fermented rice bran will help in developing good amount of zooplankton. Chain dragging is a good practice to avoid biofilm in the pond bottom. These copepods and other zooplankton will colonise in the rice bran, consume it, breed and develop its number. It is essential to regularly monitor the quantity of the zooplankton with the help of the plankton net and to start the commercial feed when the density of the copepod decrease to 0.5 ml on the plankton net. Because of this natural feed shrimp will gain good immunity and resistance.


Water management & sludge removal

Pond water when treated with good probiotics and fermented rice bran, the colour will be in golden brown. pH will remain stable through out the cycle. No disturbances in molting cycles and growth rate will be faster. Need to maintain turbidity level between 30 to 45 cm on Secchi Disk. Applying 5 to 10 ppm of fermented rice bran enhances the development of zooplankton and maintains the pH level constant. Timely removal of sludge will keep the pond bottom clean and there won't be any toxic gases like ammonia and nitrite or nitrate in the system.

Animal feed & growth

Proper pond preperation enhanced the growth of natural food chain in the system and good amount of zooplankton like copepods, rotifers etc. were developed. Once the natural food chain is ready, shrimp seeds were stocked. Liquid fermented rice bran need to be applied to maintain consistant zooplankton growth. Alternate natural feed like fermented soya with fish sauce for two meals and commercial pellet for two meals can also be applied. This could make crop more sustainable for farmer. Problems like white fecal matter, *Vibrio* loads etc. were less and can easily go for higher density stockings.

Advantages and degree of complex

- More sustainable than conventional method.
- pH of the water remains constant during both day and night.
- Pond water remains golden brown.
- Enhanced zooplankton growth.
- Maintains DO level more than 5 ppm in both day and night.
- Low ammonia, nitrite, and H2S levels.
- Shrimp develops good immunity and remains in good health.
- Easily adaptable with simple changes to our conventional farming.

The success of this approach includes decreasing the feed conversion ratio, minimizing water exchanges and eliminating disease. A variety of factors are believed to contribute, such as a better overall nutrition of the animal, reducing stress associated with fluctuating water quality, and minimizing environmental conditions favorable to pathogens. Two major drawbacks to the aquamimicry approach include the potential difficulty of applying this concept to indoor conditions, as well as the use of relatively large treatment ponds. As with any new

aquaculture technology, farmers interested in this new protocol should first perform trial runs to determine whether this can be successfully applied to their particular circumstances.

Adoptability of the innovation

The initial idea towards the development of this protocol occurred in Thailand during the disease outbreaks in the 1990s. Few farmers in India decided to first try this concept in their worst performing ponds and sometimes seen as a last chance attempt before switching to fish farming or getting out of the aquaculture industry altogether. However, within the first cycle, pond production costs were reduced by half, and the practice significantly expanded to more ponds. As with any farm, there are some variations to the protocol depending on available resources and the farmer's experience. ICAR-CIBA helped the farmer from the beginning in testing the samples, monitoring the water quality during culture period including the estimation of greenhouse gases, ensuring that the Aquamimicry farming is environmentally sustainable.

Economic viability

With a stocking density of 40 nos./m^2, the production obtained was 5.53 tons with a survival rate of 94 %. The cost of production is Rs.199/kg, whereas the farm gate price was Rs.330/kg.

Contact details

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Scientist Mentor : M. Muralidhar & J. Ashok Kumar, CIBA

Integrated polyfarming of fishes for the landless poor – an innovative model from Nagayalenka, Andhra Pradesh

- T.Raghu Sekhar

Mr.T.Raghu Sekhar hails from Nagayalanka (Mandal), in Krishna District of Andhra Pradesh. He has been working for landless tribal community and farm innovator. He has been experimenting farming of finfishes, mud crabs in cage and pens in the brackishwaters. His innovations are published in popular Telugu magazines, Telugu and English Newspapers. He is the icon for openwater cage culture in AP. He received M S Swaminathan Jamsetji TATA National Virtual Academy Fellow-ship and Innovative farmer award from Govt. of Andhra Pradesh and ICAR-CIBA, Chennai.

Brief profile of the farmer

Mr.T.Raghu Sekhar who hails from Nagayalanka (Mandal), in Krishna District of Andhra Pradesh is a farm innovator who has been experimenting farming of diversified species like Mud crab (*Scylla spp.*) and fin fishes, such as, Pearlspot (*Etroplus suratensis*, Mullet (*Mugil spp.)* and Asian seabass (*Lates calcarifer*) while most of the farmers farm high valued species like the Pacific white shrimp (*Penaeus vannamei*). He has been sharing his expertise periodically with Polytechnic fisheries students on cage culture demonstration, pond culture techniques and fish feed management.

Need for the intervention

The landless poor especially tribal people were economically and socially marginalised and their standard of living was below the poverty line. As a community worker,he wanted to help them in improving their plight. However, lack of physical asset like land for taking up farming and related activities posed a challenge. His inquisitiveness and efforts paved the way for utilizing the common property resources like open waters for fish culture and allied activities was a shot in the arm.

Features of innovations

Cage farming of fishes

The innovator has been involving the tribal people living in the coastal block of Nagayalanka in open water fish farming and mud crab fattening and helping them to earn their livelihood through such activity. He has adopted innovative system of cage culture in the open waters and has been successful in getting good production. Nursery reared 1000 *L. calcarifer* juveniles were stocked in open water cages. Conventional trash fish was provided. After 7 months, he obtained a survival of 80% and around one kg size fishes were harvested and the profit earned from each cage was Rs.

40,000/-. Earlier, 200 farmers have benefited from his training and have established culture farms on their own. He has innovatively used low-cost materials for preparing the cages. The conventional HDPE cage of 6 m diameter costs Rs. 2.5-3 lakhs whereas the cage he fabricated costed only Rs. 70,000/-. This has reduced the cost to nearly one-third. The innovated cage made with the low-cost material is suitable for backwater fish farming as well as in freshwater reservoirs. He has shown that the fish culture system is economically viable.

Polyfarming of mullets with pellet feed

He has demonstrated a two stage rearing (nursery and grow-out) of two mullet species, *Mugil cephalus* and *Liza parsia* in a farmer's pond. In the nursery phase, wild grey mullet (1.65±0.2 g) and gold spot mullet (1.03±0.1 g) fry numbering 450 and 4000, respectively were stocked in pen enclosures. After 30 days of nursery rearing, they were released into the same pond and reared for 7 months using dry pelleted feed produced in the ICAR-CIBA feed mill. Feed was formulated using

locally available ingredients containing 33.4% crude protein and 5.7% ether extract. The fishes were fed with crumbles (0.8 mm) and pellets (2 and 3 mm) in the nursery and grow-out phases, respectively.

Dr. Ramasankar Naik, IAS Commissioner of Fisheries (AP) holding harvested seabass from cage with Farmer.

Economics

The production of both the mullet species together at harvest was 1262 kg ha^{-1} (*L. parsia* 851; *M. cephalus*, 411 kg ha^{-1}). The benefit-cost ratio of mullet poly culture is 1.78.

Contact details

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Sustainable shrimp farming through adoption of cost effective indigenous shrimp feed processing technology

- M.Karuna Raju

Shri.M.Karuna Raju a farmer entrepreneur established Feed Mill M/s. Sai Aqua Feeds with the support of ICAR-CIBA at Adavi village, Bapatla, Guntur district, Andhra Pradesh. He produces feed using locally available ingredients in the concept of "Make in India" and supplies shrimp feeds at a relatively less cost to fellow shrimp farmers in the region.

Brief profile of the farmer

Shri.M.Karuna Raju is an entrepreneur who owns Sai Aqua Feeds located at Adavi village, Bapatla, Guntur district, Bapatla, Andhra Pradesh. He has about 20 years' experience in shrimp farming and owns about 150 acres of shrimp ponds. His main aim is to produce quality shrimp with a nominal margin using the locally available resource in a sustainable manner, and to help the neighbouring farmers. Considering the contribution of feed to the cost of production, he desired to produce his own feed. Bapatla being a town surrounded by villages with a diverse range of agriculture activities all around the year, he felt that the required feed ingredients could be sourced locally and it was an opportunity for him.

Need for the innovation

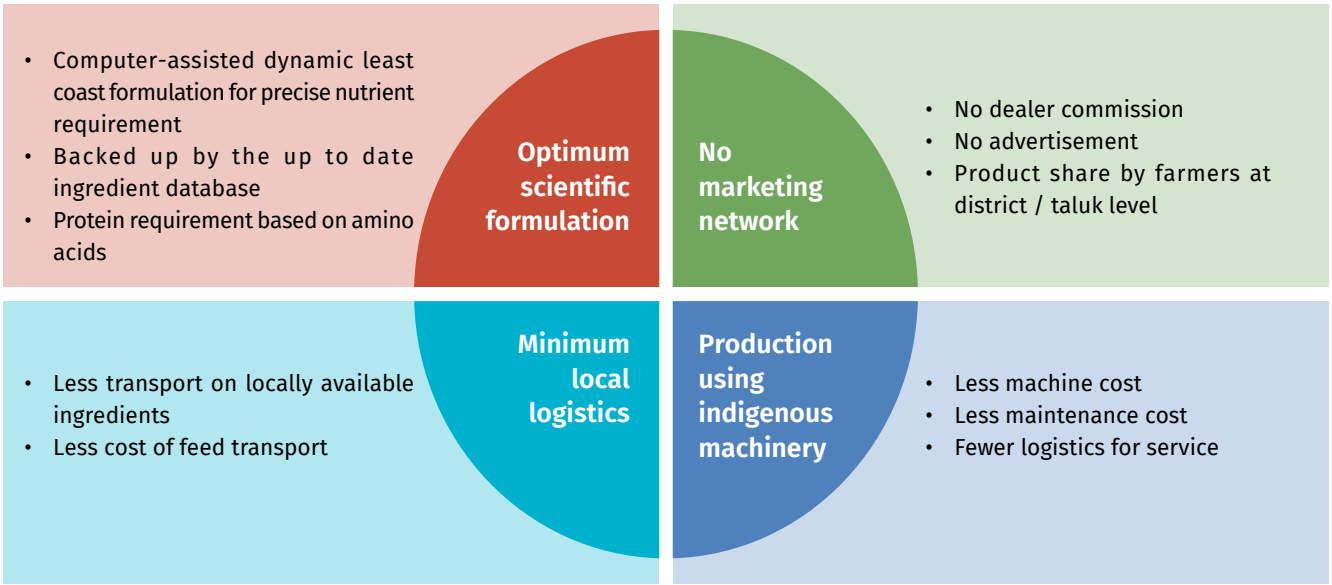
The aquaculture sector of India witnessed a boom with the introduction of White leg shrimp *(Penaeus vannamei)* since 2009-10. Increased production of farmed vannamei shrimp led to a significant boost in shrimp production and India has become the leading shrimp producing nation in the Asian region with a production of 0.6 million metric tonnes in 2017-18, and contributed about 60% seafood exports of the country in terms of value. This increase in production created a multi fold demand for shrimp feed, which often ranges from 50 to 60% of the total cost of production and directly determines the profitability to the farmer. Feed being a critical input in shrimp farming, not only determines the growth performance of the shrimp, but also is a key factor related to cost of shrimp production and sustainability. Feed also plays a critical role in maintaining the ambient water quality of the rearing system. This sharp growth of demand for shrimp feed in India has lured many multinational companies. Currently,

major share of Indian shrimp feed business is held by multinational corporate companies or their joint ventures, where an upward trend in price was noticed during the last few years due to monopoly. While farmers are already facing several challenges due to emerging diseases, water management issues, increasing energy cost, lack of man power etc. Increasing feed cost was a severe blow for medium and small-scale farmers. Currently, the cost of producing one kilogram of 50 count (20g) shrimp ranges between Rs.230-250. Bapatla region houses large number of shrimp farms and opportunities to market shrimp feed to nearby areas was abundant. The entrepreneur felt that any intervention which reduces the feed cost without compromising the quality will be the only option to bring down the cost of production. He approached CIBA for the technology and signed a MoU for the transfer of Vanami^{Plus} feed technology on a non-exclusive basis with a payment of one-time fee.

Features of the innovation

ICAR-CIBA's focussed research on nutrient requirements of shrimp for more than a decade, expertise in scientific feed formulation, database on price and seasonality of locally available ingredients led to a cost-effective shrimp feed using indigenous feed processing technology. The feed was tested in varying systems during different phases of development. Initially, feeds were tested in clear water system without influence of natural feeds. Thereafter, the feeds were tested in microcosm of shrimp rearing facility, which was a simulated pond environment with good control over production parameters. In the final phase, feeds were tested in farmers' pond with sufficient replications and compared against commercial feed brands.

ELEMENTS BRINGS THE COST EFFECTIVENESS OF THE INDIGENOUS SHRIMP FEED




Nutrient composition of the formulated shrimp feed

This indigenous feed manufacturing technology was branded as Vanami ^{Plus}, the nutrient composition of the feed is given in the Table.

Nutrient	g/kg
Crude Protein	320 – 360
Crude Fat	60 – 62
Total Ash	110 – 126
Moisture	90 – 110
Crude fibre	22 -26
Nitrogen free extract	300 – 330

Advantage of the indigenous technology adoption and brief economics

While the cost of the commercial feed available to the farmer was about Rs. 80 to 85 per kg, the cost of indigenous shrimp feed was only Rs. 55 to 60 per kg. The indigenous shrimp feed had good attractability, palatability and performed at par with the top performing commercial brands in terms of growth, survival and feed utilization, as revealed by the farmers. It was demonstrated that, while cost of feed to produce 1 kg of shrimp can be restricted to Rs. 91 to 98 by using indigenous shrimp feed, it was as high as Rs.140 with branded commercial feeds. The feed showed impressive performance and the farmers could reduce the cost of production of shrimp (*P. vannamei*) from Rs.230- 240 per kg to 170-180 per kg. Thus, this indigenous shrimp feed processing technology played a crucial role in improving the profitability of small and medium shrimp farmers.

Brief economics of feed mill operation

- Production per annum : 5000 to 8000 tons
- Fixed costs: 2.5 Crores
- Gross return: 25%

Contact details

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Scientist Mentor : K. Ambasankar, CIBA

Community based seabass nursery rearing to supply fingerlings for grow out farming – Garaladibba model, Andhra Pradesh

- M.Rajesh

Shri. M.Rajesh is a pioneer in pond based nursery rearing of seabass. He and his fellow fishers of Garaladibba village in Machilipattinam Mandal of Krishna district, Andhra Pradesh made the Garaladibba model of seabass nursery rearing. They are supplying oxygen backed live fish fingerlings for farming both in east and west coasts of the country.

Brief profile about the farmer or group

Garaladibba in Machilipattinam Mandal of Krishna district, Andhra Pradesh is a small fishing hamlet, which became the hot spot for supplying seabass juveniles across the country. The village has a total population of around 700 , majority them being fisher folk. About 300 members are involved in the seabass nursery at present. Shri. M.Rajesh is a one of the fisher folk engaged in fishing activities and aquaculture in his small land holding tide fed pond of around 3 acres using wild seed collected from creek and seasonal culture of shrimp in small scale.

Need for the innovation

Garaladibba is bestowed with brackishwater creeks around the village periphery with the brackishwater fish seed availability at different seasons. Few of the families were engaged in nursery rearing of Asian seabass and extensive culture of brackishwater species in small scale. Fisher folk used to collect wild fish seed such as Asian seabass, milkfish and mullet seasonally, and sell in nearby areas apart from stocking in their own ponds. Asian seabass seed were collected in wild and stocked in their tide fed pond and reared up to 2-3 inch size. The fingerlings were sold to farmers from Bhimavaram and Gudivada area for culture in freshwater fish ponds to weed out excess Tilapia in carp farming ponds.. This was a small trade until 2001. During 2002, some of the farmers procured hatchery produced seabass fry from ICAR-CIBA, Chennai and supplied to the other farmers for fingerling production. Since, the activity of seabass fingerling production earned them a reasonably good income within 45-60 days, the nursery rearing activity attracted more families in the Garaladibba village to venture in this activity.

In 2009, ICAR CIBA took up a demonstration programme on hapa based nursery rearing and grow-out culture of seabass under the NFDB funding support at Gilahaladindhi village near to Garaladibba with farmer participation. CIBA also conducted two farmers interaction meets and seabass harvest mela functions during demonstration period and invited the aqua farmers and fisher folk in and around Machilipattinam area to create awareness on seabass farming practices. A total of 200 aquafarmers who attended the interaction meeting understood the availability of hatchery produced seabass seed from CIBA for taking up seabass nursery and farming practices. Later on, more number of farmers adopted seabass nursery rearing technology in large scale basis and started supplying the fingerlings to the grow out culture aqua farmers throughout coastal areas. Presently, about 500 acres of tide fed ponds in 6 villages around Garaladibba are practicing nursery rearing of Asian seabass and supply live seabass fingerlings to various parts of the country. .

Features of the innovation

Traditionally, the fishers carried out nursery rearing with seed collected from wild which was not of uniform size, not of adequate quantity, not consistent in availability every year and restricted to certain seasons. With supply of hatchery produced uniform sized seed available in adequate quantity from CIBA and RGCA hatcheries, farmers had assured seed availability from hatchery and accordingly they prepared their ponds in advance for stocking and adopted improved farming practices. Due to intervention of CIBA, in the recent years, farmers procured seabass seeds of 1.0 cm size @ Rs.2/- per seed from hatchery and stocked in their pond @ 25000 nos/acre. The seeds were fed with naturally collected zooplankton on a daily basis, such as Acetes, crustacean larval forms etc. which were abundantly available in their ecosystem.. The zooplankton were collected either manually or by directly pumping the natural creek water in to the pond as per requirement. Seabass fry feed on naturally available zooplankton and attain 2-3 inch size in 45-60 days culture period. The survival ranged from 45-70%. Fingerlings of 2 to 3 inch size are sold @ Rs. 20/ piece.

Advantages/Attributes of the innovation

In the early 2000, only few farmers were involved in nursery rearing with wild seed. Subsequently, with the availability of hatchery produced seed from CIBA and RGCA, substantial number of farmers also ventured in to seabass nursery rearing. After CIBA's intervention through NFDB demonstration programme in Machilipattinam area, the farming area of seabass nursery rearing increased from 10 acres to 500 acres in and around Garaladibba village. Even though, about 60-70 million seabass fry requirement is expected annually, a total of 5 million hatchery produced seabass fry were supplied to the farmers every year from these two hatcheries. The demand for the seabass seed

is increasing every year. Due to the increased demand for seabass seed from the farmers, CIBA has signed a MoU with two private entrepreneurs to establish seabass hatchery in Andhra Pradesh and Tamil Nadu. Besides, Govt. of Andhra Pradesh and Govt. of Maharashtra are in the process of establishing seabass hatchery to meet the seed requirement of the farmers. Therefore, the scope for upscaling the fingerlings production activity is very high, once the hatchery produced seeds are supplied from these upcoming hatcheries. Adoption of seabass fingerling production activities in more areas have led to an increased production of seabass fingerlings in these areas. The fingerlings produced in Machilipattinam area were sold to farmers in Kerala, Karnataka, Goa, Maharashtra and Tamil Nadu for culture in cages and ponds. This process has generated employment opportunity for local youths since it involves the participation of seed growers, traders, seed transportation vehicle owners and labour for loading and unloading of fish seed. They get revenue through the sales of seabass fingerlings. The continuous availability of stockable size seabass fingerlings from Machilipattinam area has resulted in an increase in the grow out culture of seabass in ponds and cages in the coastal states. It has generated direct and indirect employment to about 5000 people.

Economic viability of the innovation

Sl.No.	Items	Amount Rs. Lakhs
I	**Expenditure**	
A	**Fixed cost**	
1	Pond lease cost (1.5 acre)/annum	0.30
2	Water pump (5 Hp -one)	0.50
3	Miscellaneous	0.20
	Sub-total	1.0
B	**Variable cost**	
1	Fry (40000 seed @ Rs 2.0/piece)	0.80
2	Seed transportation cost	0.15

Sl.No.	Items	Amount Rs. Lakhs
3	Wages (2 labourers @Rs.5000/month)	1.20
4	Nets/Graders	0.10
5	Fuel/Electricity	0.20
6	Miscellaneous (fertilizers etc.,)	0.10
	Sub-total	2.55
C	**Total Cost (For 5 crops/annum)**	
1	Variable cost for one crop 2.55 lakhs. For 5 crops 12.75 lakhs	12.75
2	Depreciation on fixed cost 20% per year	0.20
3	Interest on fixed capital @ 12% per year	0.12
4	Interest on variable capital @ 12% per year	0.30
	Grand Total	**13.37**
II	**Gross income**	
	Sale of 2-3 inch fingerlings (1.00 lakh 60% SR @ Rs.20/pc)	20.00
III	**Net income (Gross income-Total cost 2000000-1337000=6,63,000)/annum**	6.63

Contact details

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Cage aquaculture of Asian seabass in brackishwaters for the livelihood security and doubling the income of coastal fishers – A success story

- APJ Abdul Kalam Fisher Youth Group

Shri. M. Paramanandam is a retired school teacher heils from the fishermen village Kottaikadu, Kancheepuram District. He realised that coastal fisher youth were leaving fishing due to low catch and inadequate income. He felt that aquaculture in the natural brackishwaters might give them an oppurtunity. He then approached CIBA for help and started the cage farming in open brackishwater.

Profile of fishers

The livelihood of coastal fishers whose livelihood hinges on the fishing potential of open brackishwaters like estuaries, lagoons, creeks etc. is vulnerable due to depleting fishery resources. Hardly 3-4 months in a year is the fishing season which is also turning to be erratic. The younger generation though well-versed in fishing, are neither adequately qualified nor equipped to do other jobs. These youth were found shifting to other forms of employment to earn wages in an effort to sustain their families.

Need for intervention

Brackishwaters can be used only for fish production and is unfit for any other productive purpose like irrigation, drinking or construction. Crafting suitable rearing system with right fish species and feed could turn this unutilized resource to a highly productive aquaculture system which is highly profitable and sustainable. Cage aquaculture is an apt system to utilize the open brackishwaters having suitable depth and optimum water quality by crafting location-specific cage systems. Cage confines the fish in a mesh enclosure where the initial investments and inputs in terms of land, water, electricity and manpower requirement are very low vis-à-vis land based aquaculture. Brackishwater bodies being a common property resource, a group-based aquaculture activity could be a sustainable one. The fisher youths whose livelihood depends on the Buckingham canal brackishwaters, spanning along the Idaikazhinadu village cluster in Kanchipuram district of Tamil Nadu fits perfectly for this avocation.

Features of the innovation

A team of scientists from the ICAR-Central

Institute of Brackishwater Aquaculture, Chennai and National Institute of Ocean Technology (NIOT), Chennai initially inspected the site and evaluated the water quality parameters. The team found that the resource was suitable for cage farming as there was an open bar mouth for most part of the year ensuring continuous water movement which takes care the water quality free from turbidity, pollution, water depth, salinity and other the essential parameters to take up cage aquaculture in the brackishwaters. The fisher youth were mobilised to form a society named Dr.A.P.J.Abdulkalam Fish Producers Self-Help Group. The scientific team in consultation with the fishers decided to demonstrate a three-tier model of cage farming comprising nursery rearing in net cages, pre-grow-out in circular cages and grow-out in rectangular cages. The team initially trained the fisher youths on the nursery rearing of Asian Seabass (*Lates calcarifer*) fish in small net-cages (hapas), subsequently imparted skill development on cage designing, fabrication, installation, and farming of fishes in cages as a part of Attracting and Retaining Youth in Agriculture (ARYA) initiative at the village itself. The cages had customized dimensions based on the prevailing hydrodynamic and local conditions in the identified areas.

Hatchery produced Asian Seabass fry of 2 cm size were stocked in small net cages, grown to an average size of 7 cm with a mean survival of 40% in 50-60 days. Subsequently the fingerlings were reared in pre-grow out cages for 90-100 days after which the juvenile fishes of 100-125 g size were transferred to grow out cages. The survival in pre-grow out phases was 80-90%. The fishes were provided with CIBA Seebass^{Plus} feed @ 8-10%, 4-6% and 2-4% of body weight respectively in nursery, pre-grow out and grow out phases. In 270 days of grow-out culture, the fishes attained a marketable size of 900g to 1.2 kg. The fishers were linked with Tamil Nadu Fisheries Development Corporation, a government owned agency for procurement and marketing of quality fishes to consumers. Seabass fishes of 1kg size were sold @ Rs.380 at the cage site itself and quality of the cage reared fishes was premium. The economics revealed that all the three phases are economically viable. Subsequently, for the second crop, ICAR-CIBA only facilitated them to procure quality seeds and feed to continue the cage farming and the group has harvested two cycles of crop and the third cycle of three-tier cage farming is in progress. Upon seeing this successful initiative, two more fisher groups approached CIBA for taking up this technology. CIBA facilitated by getting them trained by the previous group and linked them with seed and input sources.

Advantages and economic viability

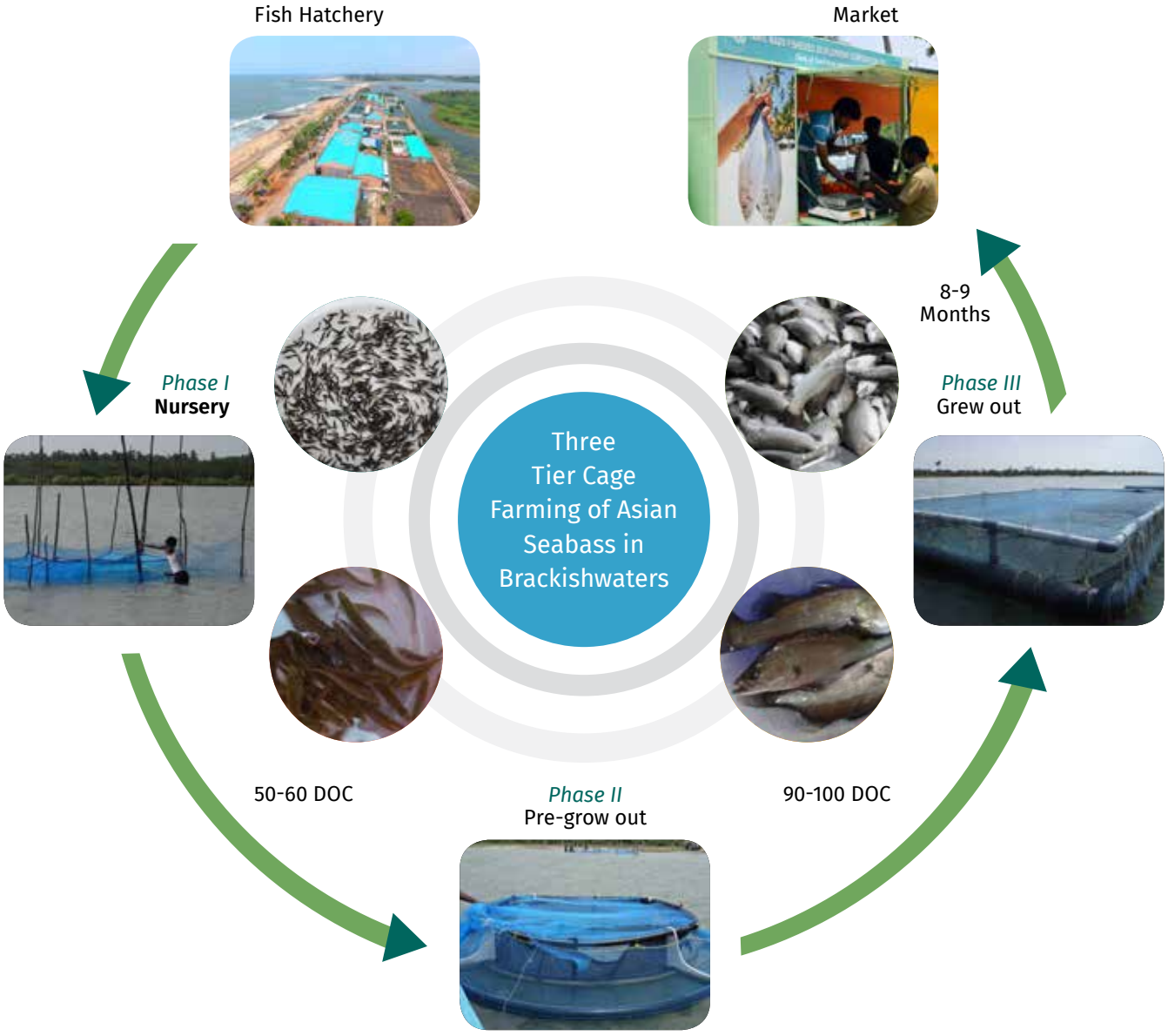
Cage farming in brackishwaters is an economically viable model for providing livelihood security to coastal fishers and provides an additional monthly income of Rs.8000, Rs.4900 and Rs.8500 per head respectively in nursery rearing, pre-grow

out and grow out farming for putting in just about a 2-3 of hours in a day. Subsequently the group divided the phases among themselves so that each sub group can takeup nursery, pre-grow out and grow out phases respectively as this could provide interim returns and they need not necessarily wait for the cycle to be complete. The Govt. of India's slogan of doubling of the farmer's income has been successfully achieved. Fisher women could be involved in nursery rearing in net cages to

Economics of three-tier system of cage farming in open brackishwaters

Particulars	Nursery (in Rs)	Pre-grow out (in Rs)	Grow out (in Rs)
Total fixed cost per crop including depreciation, interest, insurance	Rs.14,000	Rs.16,200	Rs.20,700
Operational Expenses including seed, feed, miscellaneous charges cost including logistics	Rs.58,000	Rs.55,000	Rs.1,35,000
Total expenditure	Rs. 72,000	Rs. 71,200	Rs. 1,55,700
Net income per crop	Rs.48,000	Rs.29,600	Rs.2,04,300
Benefit Cost Ratio	1.6	1.4	2.3
Monthly income for the group in Rs.	Rs.24,000	Rs.9867	Rs.34,050
Monthly income per person for spending 2 hrs daily	Rs.6000	Rs.4933	Rs.8512

produce fingerlings from the fish fry in just 50-60 days, which is in huge demand and could be a path-breaking activity. The impact of this technology is that, presently 100 cage farming units are bring established to provide livelihood security of coastal fisher families in Sindhudurg district of Maharashtra by the Mangrove Foundation, Govt. of Maharastra, in partnership with ICAR-CIBA.



Contact details

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Scientist Mentor : M.Kumaran & PR.Anand, CIBA

Livelihood security through brackishwater aquaculture technologies by Irular tribal Women Self-Help Group – A success story

- Marikolunthu women SHG

Smt. M. Usha is the leader of Marikolunthu women SHG in Kulathumedu which is a tribal hamlet situated adjacent to the backwaters of Pulicate Lake in Tiruvallur district of Tamil Nadu. She mobilized Irular tribal women for taking up mud crab fattening and seabass culture in community ponds as an alternative livelihood for them. Smt. Usha received the "ICAR-IARI Innovative Farmers Award"- 2016 from Hon'ble Shri. Radha Mohan Singh, Union Minister for Agriculture & Farmers' Welfare, Govt of India. This award facilitated her to qualify as a Balwadi [Nursery school teacher] teacher in a State Govt. School.

Brief Profile about the farmer or farmer group

Smt. Usha is the leader of Marikolunthu women SHG in Kulathumedu which is a tribal hamlet situated adjacent to the backwaters of Pulicat Lake in Tiruvallur district of Tamil Nadu. Their socio-economic condition was poor. Fishing and mud crab collection was their livelihood but their access to fishery resources was limited. Their craft and gear were primitive and hence their income was low. Hence, they could not earn enough to sustain their living from these avocations. Their exposure to welfare schemes of the Governments was poor and they were compelled to search for other livelihood options.

Need for the intervention

The village had embankments which could be shaped as pond bunds for utilizing them for polyculture of fishes which could provide them an additional source of income. Further, the tribal women were also willing to work as a group. Capacity development and handholding them for taking up brackishwater aquaculture was an alternative livelihood option for them. Seabass nursery rearing in small net cages (hapas) and mud crab fattening were taken up with ICAR-CIBA support by the Marikolunthu women SHG in the tide-fed and community brackishwater ponds of the village.

Features of the innovation

Crab fattening (in tide-fed pond) was carried out. Water crabs 200-300 g were stocked @1 to 3/m^3. In 25-30 days of duration about 250 – 270 kg of hardened crab were harvested. Crabs were fed with trash fish @ 5 to 10% of body weight. The harvested crabs were sold in the local markets at Pulicat and in Chennai Chindadripet market. An income range of Rs. 75,000 - 1,00,000 was realized from a single cycle.


Tribal families of Kulathumedu village, Pulicat, Tiruvalur dt. TN.

Seabass nursery rearing in hapas was also undertaken. A total of 10,000 seabass fry (average size of 2 cm) were stocked in hapas @ 500 nos/ hapa (2m^2). CIBA formulated farm made nursery feed was fed to the fishes. After 50-60 days of rearing, a total of 4000 nos of seabass fry with the size range of 8 to 10 cm was harvested and sold. The survival was 40%. A corpus amount of Rs. 1,94,194/- was earned in three cycles of nursery rearing. WSHGs members pooled their individual share and reinvested in other income generating avenues like textile business, poultry farming, snack preparation vegetable sale and crab fattening in tide fed ponds.

Advantages and impact

Aquaculture in community ponds provided them income which is saved in their group bank account. They used it for internal lending among the group members and subsequently led to the micro-credit system among the tribal families. Social taboos like women should not appear in front of men while they return from fishing and women should not go out of the village to participate in meetings and programmes were overcome through these interventions. The leader of the SHG Smt. Usha learnt the skill of Seabass fish nursery rearing and she became the trainer for other such groups. Observing the interest of these Irular tribal WSHGs, the Govt. of Tamil Nadu adopted this women group and provided subsidised credit of Rs. 3 lakhs to continue the aquaculture activities by the group. This tribal WSHG was awarded as the "Best WSHG of Tiruvallur District". Smt. Usha received the "ICAR-IARI Innovative Farmers Award"- 2016 from Hon'ble Shri. Radha Mohan Singh, Union Minister for Agriculture & Farmers' Welfare, Govt of India. This award facilitated her to qualify as a Balwadi [Nursery school teacher] teacher in a State Govt. School.


Tribal families of Kulathumedu village, Pulicat, Tiruvalur dt. TN.

Smt. Usha receiving the award from Hon'ble Union Minister for Agriculture and Farmers' Welfare of India Shri. Radha Mohan Singh and the Hon'ble Minister of State for Agriculture and Food Processing Industries of India Dr. Sanjeev Kumar Balyan.

Contact details

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Entrepreneurship development through aquaculture – A success story in Tamil Nadu

- J.Sivagnanam

Mr.J.Sivagnanam is a progressive aquaculture farmer hails from Kattur village, Ponneri taluk in Tiruvallur district of Tamil Nadu. He took up aqua-culture with the support of ICAR-CIBA. He has brought in about 200 new farmers in to aquaculture with about 1000 ha area and about 10000 tonnes of shrimp. He is an entrepreneur , mentor and farm opinion leader. He is farmer faculty at Tamil Nadu Fisheries University and decorated with many awards by national institutions like ICAR and MPEDA.

Brief profile of the farmer

Mr.J.Sivagnanam is a progressive aquaculture farmer hailing from Kattur village, Ponneri taluk in Tiruvallur district of Tamil Nadu. He received education up to school but could not continue his studies due to family circumstances. He lives in a joint family. Basically he is an agricultural farmer with four acres of farm land. The ground water in his village was saline hence using tank irrigation he was raising one crop of paddy in his land during the Samba season (September-January). Though he got paddy for his home consumption, the production was stagnant and he could not get any income from agriculture. He understood that by doing paddy crop alone he cannot get enough returns and improve his standard of living providing good education for his children. He was desperately looking for an avenue. During that time, the Central Institute of Brackishwater Aquaculture (CIBA) was implementing the Institute Village Linkage Programme (IVLP) in his native village during 2000-2004 and he was one of the beneficiary farmers for agriculture development. During this programme, his interactions with CIBA scientists and progressive aqua farmers at CIBA's facilitation had brought him to aquaculture. In the year 2000, he had started aquaculture by farming Indian Major Carps (catla, rohu and mrigal) in one pond and subsequently shifted to farming of freshwater Giant prawn (*Macrobrachium rosenbergii*). Later, he shifted to low saline culture of Pacific white shrimp in 2011.

Need for the innovations

He experienced low seed survival in low saline waters in his farm. Because of the high demand for the seed in peak seasons, the farmers had no say in the seed quality and were at the mercy of hatchery operators. This had led to poor seed quality resulting in size variations and poor survival in grow out ponds. He decided to go for nursery

rearing as a strategy to solve this critical problem. As most of the farmers do, he also followed zero water exchange and carried out topping of water to manage high algal bloom. The pond water is rich in nutrients as he had applied required minerals and other water probiotics during the culture. He thought that instead of letting out the quality rearing medium (the water) to the canal after harvest, it is wise to use the same water for another culture.

Innovation features

He converted 25 cents of his land in to a nursery pond. He prepared the pond similar to that of grow out culture. He purchased *P.vannamei* seed from his regular seed supplier. He felt that the salinity acclimatization of the seed to the pond water salinity was rapid and because of that the survival was very poor. Hence, to ensure procurement of quality seed, he adopted another strategy. He used to pack 100 seeds alone from the larval tank identified for him and stocked the seed in a happa in the culture pond. He checked the survival after 24 hours. If the survival was more than 90% only then would hetake the seed for stocking. Otherwise he rejected of the seed from that tank. After ensuring the quality of the seed, he stocked SPF *P.vannamei* post larvae (PL) 10-12 size seed @ 500/m^2 in his nursery pond. The seeds were fed @ 1kg of crumble feed per 1 lakh PL from the day of stocking onwards. He had increased daily feeding ration @ 200 g per lakh seed. He supplied feed no.1 (crumble) for the initial period of 10 days, a combination of feed no.1 and 2 (starter-1) during 10-20 days and feed no.2 alone after 20 days. He provided aeration for 4 hours in the forenoon and 8 hours from 10 P.M to 6.00 A.M. A growth rate of 2 to 2.5 g was achieved in 25-30 days of nursery rearing. He carefully monitored the water quality for DO, pH and bottom metabolites (ammonia, nitrite, H2S). After 30 days, he shifted the seed from the nursery to grow out pond using drag or scoop net after weighing a lot at random.

Recycling of pond water: He harvested the shrimps using drag net, and pumped only 25% of the pond water to the other pond and retained the remaining water in the same pond. He topped up the 25% of water from the source water. He applied one dose of water sanitizer and provided limited aeration. The pond water quality was very good and by recycling the same water it was sufficient to apply only 25% of the minerals and other water quality enhancers. Similarly, he had used the same water for three crops in a year and after the third crop he drained all the ponds for one month before starting the next crop.

Advantages and economics

He had demonstrated that nursery rearing enhanced the seed survival up to 95%. Since the

nursery was located at farm itself, the seed was well acclimatized; because of this, the seed subsequently adapted well to the pond conditions. The nursery seed was healthy and the growth was good. The 2 g size seed stocked in the main pond grew to 20 g size in about 60-70 days and including nursery, the culture duration was 90-100 days only. By adopting nursery rearing, he was able to practice three cultures in a year with a production of 8.5-9.0 t/ha. He popularised this concept among the shrimp farmers in the nearby areas and presently about 30 *P.vannamei* shrimp farmers follow nursery rearing in Tiruvallur and Kanchipuram districts. He confidently said that adoption of nursery rearing ensured better survival, cost-effective as seed can be procured in a lean period, survival and growth were very good in main pond and culture duration was shortened.

Similarly, recycling of pond water ensured quality rearing medium for the shrimp, minimised the input and energy (aeration) costs considerably and prevented the eutrophication of natural water bodies.

Entrepreneurship development

Mr.Sivaganam's shrimp farm is a good example of family farming owned and operated by his family. His farming members were actively carrying out day to day farming activities. His children were also doing farming activities whenever they are at home. He is a proud father as his son is a Marine Engineer working as Vice-Captain in a shipping company and his daughter has studied Architecture Engineering, both children are well settled. His assets have grown manifold. His standard of living has improved considerably. All this has been possible only by adopting aquaculture, his inquisitiveness and hard work. He is a farm opinion leader and a mentor. He is an entrepreneur and an example for the rural entrepreneurship development through aquaculture. He is a 'successful model' for the budding and potential farmers. Many institutions dealing with fisheries and aquaculture have been using his farm and his services for promoting aquaculture in other areas.

Contact details

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Family Farming in brackishwater aquaculture for livelihood support of communities near Adyar creek and estuary – a novel initiative

- T. Kennit Raj

Thiru. T. Kennit Raj is the member of Srinivasapuram Fisher Panchayat adjacent to Adayar creek, Chennai. He is instrumental in mobilising the fisher women of the village to form a group to revive aquaculture in the restored Adayar creek with the help of ICAR-CIBA.

Profile of the farmer or farmer group

Fishers from Srinivasapuram, Mullikuppam and Mullimanagar villages adjacent to the Adyar Creek, were unaware of utilising the restored Adayar Creek for fish farming which would provide them an income. CIBA mobilised the fishermen from the villages and subsequently facilitated them to form a group to take up pen and cage farming in the in Adyar creek water bodies. This group was led by Mr.Ravi and Mr. Suresh, the key informants and active members in the fishermen co-operative society and gram panchayat of the village. These fishermen group were engaged in economic activities connected with fisheries. Poverty, unemployment and engagement in unproductive activities are reported.

Need for the intervention

Adyar creek is one of the primary and vibrant estuarine ecosystems of Chennai. In 1950s Department of Fisheries, Govt. of Tamil Nadu was involved in setting up fish and shrimp farms adjacent to the creek. However, in later years with the urbanisation of Chennai, Adyar estuary lost its pristine condition. In order to restore the ecology of Adyar estuary, Govt. of Tamil Nadu has taken up eco-restoration activities of the creek under the Chennai Rivers Restoration Trust (CRRT), witnessing the rebirth of Adyar creek. In this backdrop, in 2015, ICAR-Central Institute of Brackishwater Aquaculture, has taken up research cum demonstration work involving local fishers for the development of brackishwater aquaculture in the Adyar creek water bodies.

Features of the innovation

Considering the potential, ICAR-CIBA , explored the possibility of farming suitable brackishwater shellfish and finfish, using appropriate rearing system such as pen and cage units. Based on

the soil and water quality, social conditions and feasibility of suitable brackishwater species, two pen (100 sq m) structures 1500 meter away from the Adyar Creek mouth, were installed and Milkfish and Mud Crab farming were taken up. The adopted fisher folks (5 families; 2 nos. from each family) were trained in cage and pen installation, cage and pen maintenance, feeding to animals, handling of crabs, and sampling etc. During the farming period, they faced the problem of water exchange in the creek, due to the poor water flow into the creek where fish and crab culture units were maintained. The sandbar formation prevents exchange of water between the sea and Adyar creek, leading to the deterioration of the water quality in the creek ultimately leading to the mortality of the farmed fishes after attaining an average weight of 52.5 g and 168-627 g of fish and crab respectively. In spite of these adversities, the beneficiaries in the villages realized Rs 18,785/- worth fish and crab through partial harvest.

Economics of intervention

At micro level, the community has benefitted in terms of additional employment and income to a group of 10 fishermen. More than monetary gains, the community was made aware of productive capacity of the rejuvenated system due to the concerted efforts of Tamil Nadu State Government through CRRT. Fishermen could benefit economically and nutritionally, and the fishing and city community will also benefit by cleaner and better ecosystem.

Advantages and sustainability

Brackishwater aquaculture Initiatives by ICAR-CIBA in the Adyar estuary with the participation of nearby fishermen communities has revealed the potential of the estuary as a food production system, with scope for generating employment and income generation. This initiative becomes a model for resource use plan for aquaculture development such water bodies. Therefore, the partnership of strong expert and technological support available with ICAR-CIBA and trained fishermen group at the grass root level will provide synergy and create a platform for the future sustainability of the farming system in Adyar creek water bodies.

Contact details

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Application of indigenous organic solutions to manage white fecal and EHP diseases in Shrimp farming in high saline waters - An innovative approach

- M. Selvakumar

Thiru. M. Selvakumar a post graduate in marine biology and aquaculture began his carrier as mar-keting technician in a major feed company, later started his own farming and guiding small scale aqua farmers in the Ramanathapuram district of Tamil Nadu a relatively neglected district in terms of limited access to diagnostics and distant from main aquaculture hubs like Chennai, Nellore etc. He has been a farmer entrepreneur, mentor and consultant for new farmers and potential entrepre-neurs.

Profile of the farmer

Mr. M. Selvakumar is a shrimp farming consultant and a farmer in Ramanad. He has been helping the farmers in technology application. He has been modifying or reinventing the farming practices suiting to the high saline and draught condition of the region. He is a mentor and entreprenuer.

Need for Intervention

Fishing and aquaculture is the major employment opportunity for the people of Ramanathapuram district due to less rainfall and limited agriculture and other industries. It has roughly 200 Km coastal line with many islands and coral reef. However, the sea water quality is always highly nutrient because of coral reefs and because of this, the quality of shrimps produced from here is superior and fetches premium price. However, due to low rainfall the brackishwaters turn highly saline which in turn leads to high pH in shrimp gut, low survival, susceptible to diseases like WFS, WSSV, EHP and high cost of production. Therefore, a low cost approach to the address these issues was the need of the hour.

Intervention and features

Being a technician, his strong conviction was that keeping the gut of the shrimp healthy by applying organic pre & probiotics which produces organic acids in the gut minimises the gut pH to an extremely low level that reduces the virulence of the harmful protozoans and repair the shrimp gut. He articulated that high salinity enhances the pH of the shrimp gut and the incidences of WFS and EHP which were very high in his region. He applied the organic paste containing Garlic or tamarind compound @ 2-3 gm per kg of feed mixed thoroughly and provided to the shrimp as first meal of the day. The hungry shrimp consumed the feed and this helped in minimization of

white fecal and slow growth by 50%.He was of the view that this intervention strengthened the digestive immune system. He recommended that this intervention need to be adopted from the beginning to minimise survival.

Advantages

- This intervention was able to minimise the incidence of WFS and EHP by 50%.
- The innovation is purely indigenous and easy to prepare and use.
- The results are visible and help in enhancing the flora and fauna of the pond.
- Cost effective and no side effects.

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In-pond hapa nursery rearing of seabass - an innovative and profitable enterprise for aqua farmers

- K. Ilanchelian

Thiru K. Ilanchelian, an enterprising aquaculture farmer with post graduate degree in ma-rine science from Sirkazhi taluk, Nagapatinam District, Tamil Nadu. He has evolved an in-pond hapa nursery rearing of seabass fish. He is an inspiration for other brackishwater farmers, mainly searching for an alternative species to culture other than shrimp. The farming model standardized by him “Mangrove Integrated Tide-Fed Aquaculture System" was recognised and awarded as the innovative farming model by Dr. Jayalalithaa Fisheries University, Nagapattinam Tamil Nadu.

Brief profile about the farmer

Mr. K. Ilanchelian, an enterprising aquaculture farmer with post graduate degree in marine science from Sirkazhi taluk, Nagapatinam District, Tamil Nadu. He has attended a ten days training program on Asian sea bass culture and hatchery management at CIBA, during 2009 and he also received training on the mud crab (mangrove crab) culture and hatchery management, organized by Krishi Vigyan Kendra (KVK) in CMFRI Cochin during 2010.

Need for the intervention

Shrimp farming is the face of brackishwater aquaculture in India. Due to the increased cost of production and constant losses due to the disease outbreak in shrimp aquaculture, small and medium farmers cannot cope up with the losses and are looking for an alternate species for aquaculture. Incidentally, ICAR - CIBA has made extensive research efforts in promoting diversified species in brackishwater aquaculture. Seabass culture is one of the ideal alternative for shrimp aquaculture. The major constraint for grow out aquaculture for seabass is the availability of fingerlings for grow out stocking of 8-10 cm size and cost effective feed. The innovator with a passion for innovative models in aquaculture developed suitable pond design for culture of diversified species with commercial viability (especially sea bass and mud crab). In this endeavor he joined hands with CIBA for two years, demonstrating culture of Asian sea bass in pond condition and the project was also financially supported by NFDB and this has given required impetus for the propagation of seabass culture in India in general and Tamil Nadu in particular.

Features of Intervention

To address the vital missing link of availability of stockable seabass juveniles/ fingerlings, he has undertaken scientific nursery rearing with CIBA developed nursery feed (Seebass Nursery^{plus}). The


main difficulty encountered during the nursery phase was the differential growth, cannibalism and reduced survival. To overcome this, he had improvised the grading mechanism using an innovative grader so that uniform sized fishes were kept together in each hapa. This activity, coupled with better feed management and use of efficient indigenous feed, resulted in uniform fingerling production with higher survival. About 8000 nos of hatchery produced seabass seeds with an average length of 3-4cm were stocked @500 nos per hapa (size 2 x 1 x1 m). The fry were fed nursery feed CIBA *seebass*^{plus} up to 80 grams per feeding in hapa based system. Unlike shrimp feeding, the feeding strategy adopted here was little different and innovative. As advised by CIBA scientists the feeding was carried out by 3 times a day and at each time the fish were fed to satiation by standing on the catwalk and the feed given slowly till satiety. The feeding was done for about 30 to 45 minutes per feeding which ensured that all the fish are fed to satiety and this resulted uniform growth of fish, reducing the differential growth. This feeding strategy along with un-stressful grading using mechanical graders resulted in uniform size of the fish with better growth and FCR along with higher survival. By this innovative intervention he was able to successfully complete the nursery phase with 87% survival. The fishes could grow to a size of 80-120 gram within 4 month of culture period.

Economics of the intervention

Input cost Seed 8000 Nos (@ Rs.20/ seed	160,000
Happa (12@ 2000/happa)	24,000
Feed @ 100/kg	83,800
Electricity/Diseal fuel cost pumping and lighting	27,500
Labour 1per×10000×4month	40,000
Total Expenditure	335,300
Survival 87.6 % (7177 Nos @80/piece)	538275
Profit (in Rs.)	202975
Income per month (in Rs.)	50,744
Benefit cost ratio	1.6



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Collective compliance of BMPs for sustainable shrimp farming through group approach – Success story

- M.K. Sethuraman

Shri. M.K. Sethuraman is an innovative aquaculturist. He is the president of Pamini river shrimp farmers association. His novel collective disease management and compensation for farmers are really awesome. He is a supporter of native shrimps. A community leader keeping his association vibrant and successful

Profile of the farmer group

Pamini river Shrimp Farmers Association in Tiruvarur district in Tamil Nadu is a self-initiated shrimp farmers' association started mainly to prevent and manage the disease outbreaks collectively by enforcing collective compliance of better management practices. The cluster started with just five farms (35ponds) in 2003, has grown to 50 farms (320 ponds) now. One season of shrimp culture (February - July) was practised in this cluster. The association oversaw the farm operations in this cluster beginning from pond preparation, stocking, farm management, harvesting and marketing to prevent the vertical and horizontal transmission of diseases, optimum utilisation of resources and ensure better price for the shrimps produced.

Need for the intervention

Shrimp diseases are major threat to shrimp farming. Adoption of Better Management Practices (BMPs) and biosecurity measures are the appropriate option to prevent and minimise the disease occurrences in shrimp farming. Further, since all the farmers are dependent on the same water source and disease pathogens are contagious due to poor farm management even by one or two farmers. Therefore, compulsory adoption of BMPs by all the farms in the cluster is essential to ensure disease free farming.

Features of innovation

- Collective complaince including the following common crop calendar for the entire cluster which was written document signed by all the farmers.
- Association monitored the farming operations in the cluster by appointing a technical person who facilitated proper pond preparation, initial water intake, double filtration and chlorination in the ponds.
- Seed procurement team was constituted for

seed procurement from one reputed hatchery and the team monitored the complete seed production process. Seed selection included screening of mother brooders, nauplii, early and later stages of post larvae (PL 5 and PL 15 – 20), the time of purchase in more than one diagnostic laboratories. Seeds were procured collectively or individually from the same hatchery.

- Association decided that the stocking was done in a period of 20 days
- It was mandatory that every pond was bird fenced and non-compliance attracted penalty of Rs.3000 per pond. It was reported that bird fencing had reduced the disease spread by 30-40%. Every farm had a reservoir wherein the source water was disinfected and used for water exchange. Every farm had a paid consultant who visited the farm once a week to monitor and advice.
- Feed rationing and scheduling based initially on feed off-take from the check tray up to 60 days and then based on check tray and weekly sampling till harvesting and Soil and water quality management through application of probiotics, adequate aeration and continuous monitoring of animal behaviour.

Collective disease management

In spite of all precautions, if an outbreak of the disease occurred it was immediately informed to the association. The association convened an emergency meeting and decided the course of action. There were two courses of actions, (i) either premature harvest was resorted to or (ii) the pond was bleached. Depending on the DOC (Day of Culture), nature and magnitude of problem, appropriate decision was taken. Disease affected ponds were bleached if the culture was in less than 60 DOC. Bleaching of ponds was continued to certain number of ponds to carry forward the culture in the other ponds to the

maximum possible period. During such occasions the association assured the affected farmers' in-writing that they would be compensated. The cost of bleaching was borne by the association.

Compensation to sacrificed farms

The association invited quotations from shrimp buyers for negotiating the best price for the shrimp produced in the cluster. However, the price was not binding on the members. Irrespective of the buyer, a stamped agreement (legally enforceable) was signed and given to the association by the farmers and the chosen buyers. This agreement stated that a given amount of the sale price per kg of shrimp sold was to be deducted at the buyer's end and handed over to the association to compensate the affected farmers and for maintaining the common facilities. It was the responsibility of the buyer to ensure this payment to the association. The same procedure was adopted to collect the common fund for the association to take up collective works even in normal culture seasons. This amount was deposited in the bank as a joint account operated by three executive members to ensure its safety and make certain that the agreed compensation was paid to the farmers who lost their crop due to the disease.

Advantages and impact

Collective seed procurement reduced the seed cost due to the nature of bulk order procurement and the low incidental and transport expenses. The Association was authorised to negotiate with hatcheries and shrimp buyers for quality seed and price respectively. Public institutions and private input traders considered the association as the representative of the farming community. It had closer interactions with the neighbouring farmers and shared information for mutual benefit. Since most of the farmers belonged to the same or nearby villages, cordial relations were maintained with everybody. The associations helped the village in developing and maintaining infrastructures, like roads, school buildings, temple renovation etc., for the benefit of the villages and fishers. Moreover, local villagers and fishers were given employment in shrimp farms. The group maintained close rapport and linkage with government departments and facilitated through the Department of Fisheries for availing farming approval from the Coastal Aquaculture Authority (CAA) which is mandatory for setting up aquaculture farms.

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Shrimp farming through adoption of BMPs and bio-security – the means for sustainability

- P.Elancheran

Dr.P.Elancheran is a well experienced shrimp farmer cum farm opinion leader has a doctorate in Fishery Science. Started his carrier as Senior Aquaculture Officer subsequently become an Assistant Manager, Deputy Manager, farm manager, Technical manager and then farming consultant since 2007 and he is also operating a hatchery. He has tried domestic marketing of processed fish and shrimps but discontinued due to practical difficulties. He has expertise in eco-friendly and sustainable shrimp farming. He writes scientific articles in magazines on various issues affecting shrimp farming. He has his own column in the aquaculture magazine Aquaculture Spectrum.

Brief profile of the Farmer innovator

Dr.P.Elancheran is a well experienced shrimp farmer cum farm opinion leader who has a doctorate in Fishery Science. He started his career as a Senior Aquaculture Officer subsequently becoming an Assistant Manager, Deputy Manager, farm manager, Technical manager and then farming consultant since 2007 and he is also operating a hatchery. He has tried domestic marketing of processed fish and shrimps but discontinued due to practical difficulties. He has expertise in eco- friendly and sustainable shrimp farming. He writes scientific articles in magazines on various issues affecting shrimp farming. He has his own column in the aquaculture magazine, Aquaculture Spectrum.

Need for the intervention

Shrimp farming is severely constrained by diseases especially white spot viral disease both in tiger shrimp and Pacific white shrimp leading to large scale mortality and failure of crops. Further, shrimp farms were affected with white muscle, slow growth, running mortality in vannamei farming, white gut, white fecal matter and EHP infections leading to chaos in farming.

Risk factors for the diseases

- Un healthy seeds and inferior brood stock
- Poor pond preparations
- Large ponds higher stockings
- Unwarranted chemicals and antibiotics
- Lot of probiotics
- Continuous stocking
- Climatic fluctuation and stress
- Inconsistent bloom in 30 days
- Lower ph 7.4-7.6
- Low alkalinity in young ponds
- Over feeding and over stocking
- Too much aeration or less aeration

- Low depth ponds
- Turbidity in first month

Market crash, very low selling price, repetitive crop failures with < 10 gm shrimps brought huge losses to shrimp farming. White gut, loose shell and white muscle were observed in many ponds. This problem kept increasing batch after batch especially from seeds sourced from inferior quality hatcheries. Many farms experienced slow growth for the past 4 years. The weight ranged from 2-3 gm in 60 days of culture and could not even reach 10 gm in 100 days of farming. No farmer could grow up to 40 and 30 Count Shrimp, maximum harvest took place between 10-15 gm sizes only. Farmers ended up in very high FCR even for 50 C (20 gm) size it was 2.0 and for 40 C and 30 C it ranged from 2.5 to 3.0 in many ponds. Many farms were kept idle and more and more ponds were getting affected even in 15-20 days of culture. Therefore strict adoption of farm specific package of practices and biosecurity measures appear to be the only way to save shrimp farming and its sustainability.

Features of the innovation

Strict compliance of Better Management Practices inclusive of the following

- No compromise in pond preparation, which includes proper gap between the crops, (minimum 3 weeks) and if the previous crop failed (2 months gap), and if 2 previous crops failed continuously, resort to a crop holiday.
- Sufficient gap will increase the soil reconditioning and in such ponds there is no Running Mortality Syndrome (RMS)
- If the slow growth continues, a 2 inch sludge can be scrapped out and taken away from the pond bund
- At least once in summer bund repairing and compacting has to be done to avoid seepage and cross contamination
- Maintaining proper slope and erecting central drain for proper pond management enhances the performance
- No compromise in Biosecurity crab fencing and bird fencing has to be properly maintained
- Very strict filtration of source water with minimum 3 sets of filters such as 80p, 60p and 40p mesh sizes
- Eco friendly bloom development is very important for successful crop
- Green water technology and stable bloom in the first month will safe guard the shrimp from stress factors and pathogens
- Routine dolomite application initially will give better bloom with less pH variation
- Application of cow dung and organic juices will increase the zooplankton in ponds
- Start applying probiotics just after dechlorination, otherwise vibrio may grow faster than any other good bacteria
- Probiotics once in 3-4 days is more efficient in controlling vibrio
- Less quantity and more frequency of probiotics will always give better results
- Very good seed selection with proper testing, selecting bigger PLs for better performance.
- Traditional seed testing procedures such as Salinity stress test, formalin stress test will provide better quality seeds
- Screen the seeds for MBV, IHHNV, EHP and

WSSV by PCR before buying

- Feed probiotics from day 1 onwards, Vitamin C 5 gm /kg feed in 1 meal and very good gut probiotic 5 gm/kg feed in 1 meal is very important
- This will give better immunity and protectagainst all vibrio infections
- Higher protein feed in the first month will give better growth and survival
- Right feeding from the beginning with proper feed management is very important in controlling the cost of production
- Experienced and Skilled Supervision are the key factors for very good production
- Periodical pond bottom treatment will prevent the shrimp from getting EHP and white gut infections
- Sludge management is very important, periodical chain dragging, bottom water exchange, routine usage of central drain systems are advised
- Now optimum density is 1-1.2 lakhs of seed per Acre for sustainability
- Strictly maintaining the density between 25-30 SD with adequate facility farms and in case of limited facility farms the SD should be maintained below 15 for sustainability

Advantages of the BMPs

- No diseases outbreak such as WSSV and vibrio infection in first 2 months and hence the breakeven point is reached safely
- With proper gap between the crop, soil reconditioning is allowed and thus next crop performance has been enhanced
- Because of very good and strict filtration, the chances of contamination is blocked and the

quantity of bleaching is also reduced

- Very good and systematic bloom development will help in establishing proper stabilized bloom and there would not be any bloom crash in the first month
- Strict Biosecurity measures will ensure the long life of ponds to minimum 3-4 month
- Testing of seeds for important pathogens will ensure no vertical contamination
- Stocking bigger post larvae will give better growth in the first month and very good survival
- Feed mixing from day 1 onwards, keep shrimp stress-free and healthy, will also ensure uniform growth and better survival in the long run
- Less quantity and frequent probiotic application will keep vibrio under control and a decent bloom to safe guard the pond from diseases out break.
- Right feed and Right feeding management by an experienced skilled supervisor will help in maintaining very good FCR, better water quality and thus less input cost
- Sustainable way of farming with less density will give better size in shorter period with good survival and reduced production cost.



Economics and profitability in shrimp farming

No	Description	Quantity	Rate in Rs.	Amount in Rs.
1	Pond preparation Clean, plough etc			10000
2	Lime, fertiliser			15000
3	Seed cost	1,00,000	60 p	60000
4	Feed @1.8 FCR @25 gm	3600	80 Rs	288000
5	Probiotics, chemicals			40000
6	Power cost@40 Rs/kg			80000
7	Salaries &Misc			50000
8	Water testing exp			2000
9	Harvesting exp			15000
	Total expenses	(2000 kg)	280	5,60,000
	Profitability of shrimp farming			
	➢ Pond area : 1.0 acre			
	➢ Seed qty @25pc SD/m^2 : 1,00,000 no			
	➢ @80 % survival : 80,000 no			
	➢ Harvest @25 gm size : 2000 kg			
	➢ @1.8 FCR Feed Qt : 3600 kg			
	➢ 2000 kg@ 350Rs rate : 7,00,000			
	➢ Production cost (280Rs) : 5,60,000			
	➢ Profit : 1,40,000			

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The experiences in farmer-institute partnership for fine tuning the farming of pacific white shrimp with cost effective feed Vanami plus

- C.K.Sudhakaran

Mr.C.K.Sudhakaran is an innovative and assertive farmer from Kodungallur, Thrissur, Kerala. He is pioneer in brackishwater aquaculture especially diversification with mud crabs and fin fishes farming. He evaluated the relative performance of Vanami ^{Plus} feed of CIBA vis-à-vis commercial feeds. His interest in scientific farming got him the best crab farmer award from MPEDA during 2014. He is a mentor and aquapreneur and an advocate for sustainability of shrimp farming.

Brief profile about the farmer

Mr.C.K.Sudhakaran belongs to Narayana Mangalam village in Thrissur district of Kerala. He was fascinated by shrimp farming and made his foray into farming during 1999 by stocking *Penaeus monodon* (Tiger shrimp) in his 5 acre pond in Kodungallur, Thrissur, Kerala. By following scientific methods for shrimp farming, he gradually procured more culture area and expanded his shrimp farming. He was able to get a production of 1 ton/acre by stocking shrimps @ 20 nos/m^2. After farming tiger shrimp successfully for about 9 years, during 2008 he started finfish (Milk fish, Grey mullet and Pearl spot) and mud crab farming also in his farm by understanding the importance of species diversification in aquaculture. He has started *Penaeus vannamei* farming during the year 2014.

Need for the intervention

Over the years he had expanded his farming area to 5 hectares. When he started *Penaeus vannamei* farming with stocking density of 40-50 nos/m^2, he started thinking of reducing the production cost. He understood that major cost of the production was due to feed and the cost of feed available in the market was too high. Hence, he was in search of a quality cost effective feed for his crop and subsequently contacted ICAR-CIBA for support. With his keen interest in using advanced and cost effective technologies, he decided to adopt the cost effective indigenous feed Vanami ^{plus} in his farm. He was convinced by the experiments and demonstration trials conducted by ICAR-CIBA for Vanami ^{plus}.

Features of the intervention - Vanami ^{plus}

- Scientifically formulated quality feed for *Penaeus vannamei* with 35% protein and 6% fat content.
- The production cost is about Rs 55-65.

- Increases the profit margin for farmers by 15-20 %.
- Tested and evaluated extensively in farmers ponds.
- FCR of 1.2-1.5
- Eco-friendly feed with better soil and water quality.

The production cost is comparatively much lesser than the other commercially available shrimp feed in the market.

Advantages of the innovation and economic viability

He started using Vanami *plus* feed in one of his ponds whereas in other ponds he used the commercial shrimp feed. He observed that the shrimp fed with Vanami *plus* performed at par with those fed with commercial shrimp feed, and by using Vanami *plus* he could reduce the production cost from Rs 250 to 180 per Kg of shrimp. Thereafter from the next crop he used using Vanami *plus* for his entire farm. He had stocked shrimps in various stocking densities for his different crops from 20 nos/m^2 to 60 nos/m^2 using Vanami *plus* with FCR of 1.2-1.4. With 50 nos/m^2 stocking density, he could harvest 4.8 tonnes/0.3 ha with a productivity of 16 tonnes/ha.

Armed with his experience in ICAR-CIBA, he was helping other small shrimp farmers in his locality by giving them scientific advice on responsible shrimp farming. Moreover, he has conducted culture demonstration of *Penaeus indicus* under NFDB project with ICAR-CIBA's technical and scientific support. This progressive aquafarmer, is truly an ambassador for the technologies developed by ICAR-CIBA for small and medium shrimp farmers in the country.

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Milkfish farming and its on-farm domestic marketing-an innovative model for Kerala

- Tennyson

Mr. Tennyson is an advocate by profession a progressive brackishwater aquaculture farmer from Kollam, Kerala. He owned Pullichira Aqua Farm in Kollam and farming shrimps and fish on crop rotation mode successfully to keep the pond environment clean and amenable for successful shrimp and fish culture sustainably. He made a success story of milkfish monoculture and on-farm marketing of live fish in Kollam.

Brief profile of the farmer

Mr. Tennyson a progressive brackishwater aquaculture farmer from Kollam owns Pullichira Aqua Farm in Kollam. He has been farming shrimps and fish on a rotation basis successfully to keep the pond environment clean and amenable for successful shrimp and fish culture sustainably. He made a success story of milkfish monoculture and on farm marketing.

Need for the intervention

Milkfish farming is becoming popular in Kerala after the success of CIBA in induced breeding technology and hatchery production of milkfish seed. The state of Kerala possesses abundant resources of brackishwater with salinities ranging from 2 to 20 ppt. Finfish farming is an alternate technology option (crop rotation) for shrimp farming, with crop duration of 180 days for doubling farmers income through production of high-value finfishes along with increase in pond productivity, employment generation and societal development. ICAR-CIBA Chennai achieved a major breakthrough in artificially breeding the milkfish (*Chanos chanos*), locally known as 'PaalKendai' or 'Poomeen' in captivity for the first time in the country. Milkfish has the ability to grow in brackishwater, seawater and freshwater ponds and lakes. This fish consumes low protein pellet feed and grows up to 500 g size in 6 months. Availability of seed is a boon for small and marginal farmers who can grow the fish at a low cost. Milkfish fetches Rs. 120-150/kg in the local markets of Kerala. hence, the farmer decided to adopt an on-farm marketing of fish which could fetch him higher profit.

Features of innovation

The farmer successfully demonstrated milkfish or Poomeen, *Chanos chanos* grow out farming


Demand based partial harvestingusing cast net at Pullichira Aqua Farm, Kottiyam, Kollam

initiative on farmer partnership farming mode. Hatchery produced milkfish seeds were stocked @3000 nos in one acre pond, and farmed on a zero water exchange system. Salinity during the culture period ranged between 5-15 ppt. Milkfish fingerlings were fed with low cost commercial floating feeds which costs about Rs 25-30/Kg. At the end of 180 days of culture period, a body weight in the range of 250 to 450 g was recorded. The production obtained was up to 1.5 to 2 tons/ha. Cost of production for milkfish was around Rs. 90- 100/kg and the average market price was Rs. 200/kg making the culture economically viable.

For any business venture to become successful, an efficient marketing strategy is vital along with other technical aspects of the same. There is no exception for the importance of marketing strategy in the case of aquaculture practices too. Here is an example for how an effective marketing strategy improved the income of an aquaculturist in Kerala. The farmer had focused on milkfish grow out culture and the sale of the same. The normal price of the species ranged from Rs.120 -150/-, which was considered as normal and less profit. The farmer tried for a 'demand based harvesting technique', which focused on partial harvesting based on demand on farm gate in addition to final harvesting. This practice had an added advantage of allowing the smaller sized fishes to reach a marketable size and prevent overcrowding of the stock.

Advantages and economics

The farmer studied the market demand and whenever it rose for a particular quantity for the fish, the farmer harvested from the farm, the required quantity, for both wholesale and retail customers. In this way, he reaped much higher profit. As the fishes were caught live and sold, the farm gate price for the fishes caught in this pattern was in the range of Rs 220/- for whole sale and Rs. 350/- for retail customers, which was a higher amount compared to the bulk harvest caught fishes. This practice of demand based harvesting can be recommended to other fishermen, as it is found to be profitable for the farmers.


Dr. K. K. Vijayan, Director, ICAR-CIBA inaugurating the Harvest mela cum farmers interaction meet at Pullichira Aqua Farm, Kottiyam, Kollam, kerala

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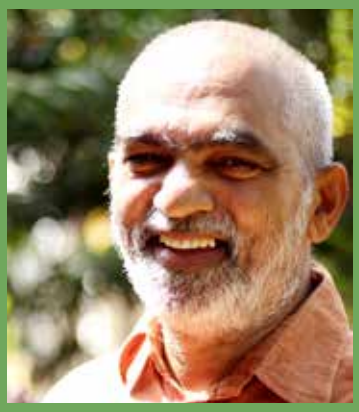
Better fit brackishwater aquaculture models for Kerala: A farmer's perspective

- T. Purushothaman



T. Purushothaman, a farmer innovator, entrepreneur and mentor from Payyanur, Kerala. He has been closely associated with shrimp/brackishwater farmers of Kerala as an office bearer of farmers' association for the last two decades. He has prepared the roadmap for fisheries and aquaculture development for the God's own country Kerala. He has successfully organised several seminars for the benefit of farmers in Kerala.

Brief profile of the farmer

Mr.T. Purushothaman is a shrimp farmer from Kerala who has been farming shrimp for the past twenty five years. He harvested extremely good crops initially, subsequently his farm was affected by WSSV, and he lost crops for the next two years. After that he strictly followed all the suggested best management practices, and for the last twenty years, he has been successful although the profit margin varies among the years. He realised that his success is owing to the uncompromised scientific method of farming. He has been using a closed system of farming to prevent the horizontal transmission of pathogens. His experience is that if farmers are following the scientific method of farming and best management practices using probiotics, they can be successful in shrimp farming. During the monsoon season, he planted vegetable crops on the bunds of shrimp farms. It provides him an additional income. With this background, he provides an over view of brackishwater of aquaculture in Kerala and its way forward through a farmer's perspective.

Need for intervention in Kerala

According to the official statistics, aquaculture production in Kerala is about 24,000 tonnes, and it is said to be showing a declining trend. The production during the last four years is:

Year	Production (mt)
2014-15	57000
2015-16	36000
2016-17	28000
2017-18	24000

In this production, maximum contribution is from bivalves (green mussel, brown mussel and oysters), which is about 3000 tonnes followed by shrimp (2000 tonnes), and brackishwater finfishes comprise 500 tonnes. The remaining production

comes from freshwater fishes. When compared to the potential of brackishwater aquaculture in Kerala, the present scenario is far below than the optimum production. According to the available official statistics, Kerala has 65000 ha of brackishwater area, however, this area cannot entirely be converted into scientific farming. A closed system of farming is essential for exclusion of pathogens from the system and disease management. The traditional farms such as *Pokkali* and *kaippad* area could be used for farming of other suitable species for farming. At least 5000 ha of area could be used for scientific shrimp farming, and remaining area which is undrainable and where removal of predatory organisms become impossible, could be used for modified culture practices. Some portion of this area can be converted for nursery rearing, and when they reach certain age and size, the seeds can be released into the pond. This nursery rearing would increase the survival in these types of ponds. This area can also be used for pen culture. Currently, scientific shrimp farming is being carried out only in 500 ha. Apart from pen culture, cultivation of brackishwater finfishes is almost nil.

Features of innovation -Sustainable Brackishwater Aquaculture

Shrimp farming and aqua-agri integration

The brackishwater area available to use for scientific shrimp farming is 5000 ha, although a total area of 65000 ha has been identified for brackishwater aquaculture. If we can use this area for scientific shrimp farming that follow the principles of biosecurity and better management practices with 4 aerators (2 hp) per ha, a minimum production of 4.5 mt/ ha can easily be obtained. During the post monsoon period, when salinity increases (January to April), Indian white shrimp *P. indicus* can be farmed at a stocking density of 20 PL/m^2. shrimp grows to 12-14 g within this period and minimum production of 2 mt/ha could be achieved. Indian white shrimp is a delicacy

and it can be marketed with a brand name which would fetch a premium price both in domestic and export market. During monsoon (June to October), salinity reduces in the aquaculture ponds during which period, tiger shrimp (*P. monodon*) could be cultivated at a stocking density of 10 PL/m2. Within 130 to 150 days, this shrimp will grow up to 34-40g.. The production from this ponds would be around 2.5 to 3 mt per ha. Pacific white shrimp (*P.vannamei*) can also be cultivated during this period. Thus if we are able to convert 5000 ha area to scientific shrimp farming, about 22,500 mt shrimp can be produced annually. Besides, the bunds of shrimp farms can be used for horticulture during the monsoon season and it would provide 1.5 mt vegetables per ha. Therefore, 7500 mt of vegetables can also be produced from 5000 ha of brackishwater area, in addition to shrimp. The remaining 60000 ha of brackishwater area available for shrimp farming could be converted to modified traditional shrimp culture, and that would provide an additional 30000 mt of shrimp.

Mussel farming

In Kerala mussel farming (green mussel: *Perna virdis*) is mainly focused in northern districts, Kasaragod and Kannur, although limited mussel farming is found in Kozhikode and Malappuram Districts. Most farms, about 80%, are concentrated in three villages in Kasaragod: Valiyaparamba, Thrikkaripur and Cherukunnu. Cultivation of mussel in the same area for a long period at density more than acceptable limits adversely affects the growth rate of mussel. Further, frequent disease outbreak and unpredictable changes in the climate may have a negative effect on the growth and sustainability of mussel farming in this area. The failure of mussel

farming in Kasaragod district could be attributed to the mushrooming of mussel farms, which is far higher than an ecosystem can sustainably support. If farmers diversify the species and system of culture to cage and pen culture, the density of farms in this ecosystem could be brought to an optimum level. Simultaneously, strategies have to be made to expand the area of mussel farming in neighbouring districts. Thus, within five years, mussel farming can be expanded to 100000 units (each unit is 25 m^2) with a production of 7500 mt, and it would provide an annual revenue of Rs. 75 crore.

Cage Aquaculture

In the brackishwater area of Kerala, at least 50000 cages (2 m x 2m x 1.5 m = 6 m^3) can be installed and used for aquaculture of high valued

fishes such as seabass, grey mullet, red snapper, pompano and pearl spot. If we can solve the major issues in cultivation of these species, such as seed and feed, the cage culture in Kerala could revolutionize the aquaculture scenario. These 50000 cages would provide 6000 tonnes of fishes (1 m^3= 25 kg; 50000 cages=50000 x 6 m^3=300000 m3; 30000 m^3 x 20 kg). The revenue generated from 1 kg fish would be Rs 350, and from 6000 mt, a total of Rs. 210 crores could be obtained.

Pen culture

Brackishwater area having a minimum of 1.5 m depth during low tide can be used for the pen culture. At least 5000 pens with a total area of 100 ha can be brought under pen culture during a period of 5 years. From these 5000 pens, each with an area of 200 m^2, 5000 mt of fishes could be produced. From this form of culture, Rs 175 crores could be generated (Rs 350 for 1 kg fish, and minimum of 25000 labour days could be newly) created.

Mangrove based aquaculture or aqua silviculture

According to official statistics, a total of 2000 ha of mangrove area is available in Kerala. Of this, 100 ha of land can be converted for mangrove integrated mud crab culture, without destruction of mangroves ecosystem. The pens are built in such a way that mangroves are retained as such, and 1200 crab juveniles are stocked per hectare. Mud crab uses the indigenous biota for forage and 500 kg of crab of size above 750 g can be produced. Thus about 500 mt of crabs with a revenue of Rs. 50 crores can be obtained. This form of aquaculture creates 100,000 man days of work.

Aquaculture planning

In order to attain this production and development in Kerala, a comprehensive master plan has to be developed considering the aquaculture potential and specific socio-political scenario of the state. If we can achieve this, 'Kerala model aquaculture' can be achieved within a five year period. For this, proper planning, human resource development and technology transfer should be done. In order to develop a sustainable shrimp culture, specific pathogen free shrimp seed should available at a reasonable rate. In order to develop the aquaculture of high valued brackishwater finfishes such as sea bass, grey mullet, red snapper and pompano, seed, feed and other axillary products should be available easily to the farmers. For this, scientific community and other government developmental agencies should work together. The farming community of Kerala also should change their attitude towards the farming of high valued crops. Most failures in brackishwater farming are due to lack of proper scientific management, and farmers should follow the farming methods that are in harmony with the coastal ecology. The carrying capacity of the ecosystem that supports the aquaculture ponds should always be considered while planning to start aquaculture. Intensive aquaculture without proper management of discharge would destruct the fragile balance in the ecosystem.

Market and price of aquaculture produces

The market value of aquaculture produces is declining over the years for example: the price of tiger shrimp (30 count) was Rs 485 per kg in 2008, which has reduced to Rs 480 per kg in 2018. However, the cost of production escalated thrice

during this period. This scenario is not encouraging and shrimp farming became unprofitable.

Institutional support-Bank loan

Bank loan is essential for the development of aquaculture, however, the approach of nationalized banks and other financial institutions for providing loans to aquafarmers is not encouraging. During the recent floods in Kerala, the state Government announced moratorium for bank loans, however, aquafarmers never benefited.. It may possibly be because those who obtained bank loans for aquaculture was meagre. This situation has to be changed, and those who want to start aquaculture and does not have sufficient capital should get loan with proper mortgaging. The initiation should come from the side of the Government.

Insurance

In the aquaculture sector, proper insurance is not available presently, and insurance companies are reluctant to provide this facility. During the floods, the most affected sector was aquaculture, still aquafarmers have not received any insurance security whereas other agriculture related sectors received the insurance security. Therefore, many farmers are reluctant to take up aquaculture. Government should take proper steps in this regard to attract farmers to venture into this sector with confidence.

Conclusion

Potential for brackishwater aquaculture in Kerala is extremely high, however, entry of

new farmers and entrepreneurs to this sector is minimal. In order to educate the new farmers and entrepreneurs, Government and scientific community should develop proper strategies. Aquaculture should expand to new areas, and steps for increasing the productivity should be developed. The exploitation of feed companies and other sectors should be properly addressed by appropriate social interventions. It is true that, Government alone cannot address this issue; in this regard a co-operative society (Aquaculture Development Cooperative Society, ADCOS) presently limited to five northern districts of Kerala, has been formulated and has started functioning. This can be expanded to other districts of Kerala. This society can provide high quality seed, feed and other ancillary products to farmers at a reasonable cost. Further, society can help farmers to market their produce. Certainly this initiation will be a land mark in the development of aquaculture in Kerala.

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Organic Shrimp Aquaculture with CIBA Organic Feed Technology – A success story

- Anil Sasidaran

Mr. Anil Sasidaran is a post graduate in fisheries and pioneer in organic aquaculture. He has developed standards and acquired organic certification for shrimp. He demonstrated organic shrimp farming in partnership with ICAR-CIBA. He is an entrepreneur, mentor and trend setter for the new genera-tion farmers in India.

Brief profile of the entrepreneur

Jass Ventures Pvt. Ltd. is a start-up company formed by three youngsters who studied marine biology and coastal aquaculture. It is inolved in Manufacture of grain mill products, starches and starch products, and prepared animal feeds. Mr. Derry Feriad, Joe Antony, Anil Sasidharan and Rajeev Kumar are the directors. The firm has gained immense expertise in supplying & trading of Organic aqua feeds, fish feed, shrimp feed etc. The supplier company is located in Kochi, Kerala and is one of the leading sellers of organic aqua feeds, fish feed, shrimp feed in bulk from us for the best quality products and service.

Need for the intervention

The preference and demand for organic seafood has been growing among the middle classes of emerging economies, including Southeast Asia. The seafood farmed in the organic aquaculture systems, which is based on minimal use of off-farm inputs and promotes the harmony between species and ecosystem, fetches a premium price in the market. The growth rate of organic aquaculture is estimated to be 20-30% per annum. The most challenging issue in the organic aquaculture is the availability of certified organic feed, in the market. Development of organic aquaculture feed, and establishment of feed mill, also on the certified scale, are challenging and requiring high level of commitment and co-operation among different sectors. Further, sourcing of the feed ingredients which satisfy the requirements of organic label is a daunting task. Formulated feed does not comply with organic standards unless you can identify the species and exact origin of the fish meal, squid meal, krill meal and even the soya protein that's in it. Organic shrimp feed has to be made from traceable raw materials like non-genetically-modified plant

ingredients and certified fishmeal checked by IFFO (an international, nonprofit organization that represents and promotes fishmeal, fish oil and marine ingredients worldwide) or the Marine Stewardship Council. Fish processing wastes can also be used in organic shrimp feeds, but must be certified first.

Features of innovation

Organic feed development and production started with identifying the organic feed ingredients and getting tested it in in vivo in yard experiments and in field conditions. CIBA helped them developing an organic feed on a collaborative mode by signing a MoU. The organic feed has been produced at the CIBA feed mill, which is certified for processing and production of organic shrimp feed by the certifying body, INDOCERT, Kerala in 2013. This is the only certified feed mill for producing organic shrimp feed in India. They sourced different organically certified feed ingredients including fishmeal and developed a process for organic feed manufacturing and produces organic shrimp feed for first time in India. The organic feed produced was tested extensively in yard experiments and optimised for its performance. Further, the feed was tested in pond trials in Kerala in many farmers' farms. The organic shrimp feed comprising of different grades, viz., Pre-starter, Starter, Grower and Finisher, were tested by us with 25 farmers having the total farm area of about 50 hectares. The organic shrimp produced using organic feed was sold in the international market for a premium price.

Elements of the technology:

- Sourcing of organic certified feed ingredients including the fish meal
- Formulation the feed following the organic principles mainly, the use of organic feed ingredients and strictly adhering to the limits in certain ingredients especially, fishmeal.
- Auditing the feed processing and strictly adhere to the organic guidelines.




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Biofloc based Shrimp Farming – Innovative model for the state of Karnataka, India

- Sunny Joseph Dsouza

Mr. Sunny Joseph Dsouza, innovative farmers from Mangalore, Karnataka. He established the First private Aqua Laboratory named "Microls Aqua Lab" in Bhimavaram which was well known and serving the aqua farmers even today. He has adopted bio-floc based shrimp farming and harvested a production of 43 tonnes per ha. He is a mentor, entrepreneur and farm opinion leader in the Mangalore region.

Brief profile of the farmer

Sunny Joseph Dsouza after his graduation in 1989, worked with Microl Remedies dealing with Iodophor Sanitizer, a popular Brand "STERIDOL", which is a very popular brand in sanitizers even today. While he was working in Aqua industry in 1991-92 he came across severe disease problems and introduction of sanitizers have then helped the aqua industry to give a solution benefiting the farmers. Based on this experience, he established the first private Aqua Laboratory named "Microls Aqua Lab" in Bhimavara, Andhra Pradesh. Subsequently he came back to his home town Mangalore and continued family organic farming and visited many SAARC countries to promote organic farming in association with CARITAS India an NGO as a resource person. However, the zeal in shrimp farming in him kept helping people and learning new technologies through online published articles continued.

Innovation features

The farmer came through a blog article written by Prof.Yoram Avnimelech's after which he made a small trial in his backyard which encouraged him. He started biofloc based shrimp farming in a leased 1.4 ha farm in Padupanambur village in Mangalore. He adopted bio-floc technology and he obtained a production of 43 tonnes per ha. He took support from the Fisheries College, Mangalore in analysing water and checking the pathology in vannamei shrimp like PCR, Vibrio load, Ca, Mg in pond water on regular basis. For the first time in India, he followed root aeration in farming using diffused aeration replacing traditional Paddle Wheel Aerators. The results are tremendous and this has saved nearly 65-70% power. He harvested 1070 kg of Shrimp with 1 HP of power. Initially he used membrane diffusers which are very costly and later replaced with aero tubes which are much cheaper (almost 75%)

compared to membrane diffusers with better efficient aeration.

Economics

He started on one acre with 4 tanks of 1000 sq ft each based on funding from friends and relatives. The total cost was Rs. 42 lakhs including working capital and 1st crop itself he harvested 11 tonnes of shrimp which was sold @ Rs. 450/ 40 count and recovered all the investment and slowly expanded phase by phase enabling them to purchase and establish a 8.5 acres new farm in Thalassery, Kerala.

Contact details

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Shrimp seed production and diversification for Sustainable brackishwater aquaculture in the West Coast – Success story

- Vasudeva Byndoor

Mr. Vasudeva Byndoor is a fisheries graduate having experience in both the private and government sector. He graduated with B. F. Sc. degree from College of Fisheries, Mangalore in the year 1979 and since then have been working in the fisheries sector as production manager in seafood Industry, fisheries department, and later started own farming. He pioneered cage farming of seabass fish in deepened shrimp ponds and proved that this system is techno-economically viable.

Brief profile of the farmer

Mr. Vasudeva Byndoor is a fisheries professional having experience in both the private and government sector. He is a fisheries graduate of College of Fisheries, Mangalore and has been working in the fisheries sector as production manager in seafood Industry, fisheries department, Government (about ten years) and later started own farming. Subsequently, he established a shrimp hatchery and diversified into other aquaculture related activities. This experience has given him in-depth knowledge of administration, industry requirement, and farmers' concerns related to Agricultural development, specifically fisheries development.

Need for the innovation

Shrimp seed is the main critical input. Quality shrimp seed could minimise the production related risks by 50%. However, the farmers from the west coast have to depend on the hatcheries in the east coast as there were no hatcheries in the region. He had to depend on the middle men to procure seeds from the east coast and in that process the quality of shrimp seed supplied to the west coast was poor and the cost was also high. Therefore, he decided to establish a shrimp hatchery in the west coast. Similarly he understood that dependence on a single species for farming would be a risk and felt that brackishwater aquaculture needs diversification.

Features of innovation

He established Anugraha Aquatech Tiger Prawn seed Hatchery at Head Bunder in Vannalli Village, Kumta Taluk of Uttara Kannada District in Karnataka. He has a farm located at Alvekodi Kalbag Village, Kumta Taluk on 10 acres. His farm gets water from a small creek and in the recent years, this creek has become a dumping place for chicken and mutton wastes from Kumta area besides Municipality sewage drain, hence is highly polluted. It was very difficult for him to carry out the culture beyond 40-50 days. He developed raw water treatment before use in

farming. The creek water was pumped to one pond for settlement and another pond was used for treatment to improve water quality. This practise reduced the incidence of WSSV and EHP diseases. He adopted nursery rearing of seeds which had reduced farming period and increased the scope of assured production. He screened each input starting from source water and seed for pathogens which had significantly reduced disease occurrence.

He, aided by MPEDA, farmed seabass and had a successful harvest and this has initiated the spread of Asian Seabass farming in the region. He deepened his shrimp pond approximately 2 meter depth to install cages for seabass farming. Cages of 1.3 m height were erected in the pond with ground clearance of 30 cm and a water depth of 1.6 m was maintained. All the basic requisites for cage farming like cat-walk, cage with different net sizes, crab fence etc. Seeds (fry stage, 2-3 cm) were obtained from RGCA, MPEDA Thirumullaivasal, Tamil Nadu. Nursery rearing was carried out in tanks of 10 tonne capacity. Daily thrice, feeding was done with slow sinking and floating feed. Grading was done to minimise cannibalism using adjustable mechanical grader once in every 7-10 days. Post grading a salinity shock was given to control parasite infestation. Nursery rearing was carried-out for three months until they reached 10-12 cm and 30- 45g.

Grow-out farming was done in cages installed in the pond with a stocking density of 75 to 130 no/m^3 or 3.7 -3.9 kg/m^3. The fishes were weaned from slow sinking feed to floating feed and feeding was done twice a day, after sunrise and before sunset. Feeding was done carefully without much disturbance as it was observed that the fish did not consume feed when disturbed. Sufficient aeration was provided by paddle wheel aerators (1.0 HP capacity). In the early stage of culture period, mesh size being small, caused frequent clogging. The cage net was regularly cleaned (once in a week or 10 days) using a jet stream of water from 1.5 HP pump. Filamentous algae used to be common problem for clogging, which was controlled by introducing pearlspot @100-300/ cage. During culture, three sizes of the seabass were observed during each grading, out of which 60 % were good growing seeds. The remaining 40% were slow-growing and not viable for culture. This caused huge production and economic loss for the farmer and a mechanism was required to improve the size variation in seeds in early stages or identify better performing seeds at the early stage of larval rearing and use for culture. Availability of hatchery reared seeds round the year and good quality feed at fair price will aid in sustaining Asian Seabass farming.

Advantages and economics

Grow-out farming was practiced for 220 days and the young seabass seeds stocked weighing 30-45g grew upto 931.6g with an average weight of 438g. Out of 3,869 seeds stocked, 3509 were harvested, realising a total 4690 kg of seabass with more than 90% survival. A food conversion ratio of 1.8-2.0 was obtained. Planned marketing could fetch @ 250/ kg.

Contact details

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Diversification of brackishwater aquaculture with finfishes – Innovative model for the state of Karnataka

- Sanju Fernandes

Mr. Sanju Fernandes is a passionate young farmer hailing from Kasarkoda village in Uttarakannada district of Karnataka. He is the champion of diversified brackishwater aquaculture with seabass and milk fish. He popularised nursery rearing and farming of finfishes in the state of Karnataka.

Brief background

Mr. Sanju Fernandes has been practising brackishwater aquaculture since 2014 and has a 0.2 Ha tide fed pond. He started farming of Asian seabass under the intervention of ICAR-CIBA and was able to earn more than Rs.1 lakh from this pond with a production of more than 500 kg.. After the success of Asian seabass farming he expanded the farming area upto 8 acres (on lease basis) for Milkfish farming.

Need for the Intervention

The farmer practised the traditional tide fed farming which was a polyculture of shrimps and finfishes by auto stocking of seeds during high tide and cultured for 6 – 8 months. This traditional system had low productivity and uncertainty in production. He faced a lot of problems in farming due to lack of technical inputs and was looking for an alternative. He learnt about importance of Asian seabass and milkfish farming and their market demand. He sought the help of ICAR-CIBA for the hatchery produced seeds of Asian seabass and Milkfish. This made a way to adoption of Asian seabass and milkfish farming technology.

Features of Innovation

CIBA supplied Asian seabass seed which he reared in his nursery and the juveniles (average total length 13 cm & 15 g weight) were stocked in the 0.18 ha pond, and reared for 11 months, fed with trash fish (Sardine and Tilapia) @ 5 % body weight twice a day. Fishes attained a body weight ranging from 980 – 1050 g with an average total production of 512 kg/0.18 ha. He sold the farmed fish in the Goa market (on Christmas eve) @450 Rs/kg. He along with his brother jointly were involved in Milkfish farming and had taken 8000 fry from CIBA for nursery rearing. The fingerlings



Sanju Fernandes and his brothers involved in Asian seabass farming

were stocked in 1.5 ha pond and a production of 1.5-1.8 tons/ha was realised. This has resulted in creating an awareness and considerable interest among youths and farmers to take up Asian seabass farming in Karnataka.

Advantage/ attributes of the Innovation

Asian seabass farming technology was easily adopted by the farmer because of its faster growth rate, wider acceptability and premium price in the domestic market providing profitable venture option to the farming entrepreneurs.

The complete technology package of Asian seabass is readily available in terms of hatchery produced seeds to feed (from nursery to growout feed).

Economic viability

Economics of Asian seabass farming	Cost (Rs)
Asian seabass fingerling cost for 600 no's @ 25 Rs/Piece (15 g, 13 cm)	15,000
Transportation cost	10,000
Feed cost :- trash fish (Sardines/ Tilapia)@ 35 Rs/Kg (1686.95 kg)	59,043
Miscellaneous(Pond preparation, liming, Harvesting)	15,000
Total (A)	**99,043**
Total Production from 512 kg /0.18 ha * Market Price (450 Rs/kg) as on December 2017 (Christmas eve) In Goa Market (512 *450)	2,30,400
Total (B) gross income	**2,30,400**
Net income (A-B)	**1,31,357**

Contact details

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Entrepreneurship development through Aquaculture – A success story from Goa

- Rajesh Chandra Singh

Mr. Rajesh Chandra Singh, a fisheries Graduate and an entrepreneur promoting sustainable ecosystem based shrimp farming in the state of Goa. He is a pioneer in aquaculture and the face of shrimp farming in Goa and Konkan region.

Brief profile of the farmer

Shri. Rajesh C. Singh is a fisheries graduate from Govind Ballabh Pant University of Agriculture & Technology, Uttarakand. After his graduation he worked for the water base limited as an officer trainee in farms and after 5 years of experience he started his own business in name of shrimp aqua needs.

Need of the intervention

As a fisheries graduate he wanted to help farmers and decided to have own farming and business in the sector for his livelihood and career.

Features of intervention

The entrepreneur had the business of aquaculture inputs distribution in Goa and Maharashtra and farming shrimps. He has a group of 82 farmers most of them were small farmers with a farm size of few acres. Small farmers do farming on their own and they could not afford employing technicians. He provided them free technical support and also financial support by supplying inputs on credit. He promoted the concept of work together towards sustainable aquaculture and help small farmers to increase their income. He encouraged them to do partnership farming and provided finance and technical support. Presently most of the farmers under his management were farming pacific white shrimp and were relatively sustainable.

Economics and impact

The technical advice and sourcing of quality inputs provided the farmers confidence on shrimp farming and they were successful in their farming. Presently he is covering whole of goa and south Maharashtra, complete Konkan belt up to Alibag.

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Nursery Rearing of Seabass by the Mangrove Coastal Community for the Livelihood Security in Maharashtra – A success story

- Jai Ganesh SHG

The mangrove fisher community with the support of ICAR-CIBA and Mangrove Cell has taken up the three tier system cage farming of Asian Seabass fish in the Sindhudurg district of Maharastra. The partnership model involving research institution, mangrove foundation and fisher community has emerged as successful participatory model for providing employment and livelihood opportunities for the unemployed coastal fisher communities.

Brief background

Sindhudurg accounts for 3% of Maharashtra's total mangrove cover but houses more of its coastal biodiversity that any other district in the state. The coastal community of this region mainly depends on marine fisheries and agriculture for their livelihood. However, due to depletion of natural fish stocks from unsustainable fishing by trawlers, an expanding tourism sector, and pollution from fishing vessels and other maritime traffic affecting the livelihood security of coastal community. Similarly deforestation of mangroves timber for boat fabrication, fuel-wood, human settlements, illegal aqua cultural activities have also impacted on the nursery and breeding grounds of Marine Fishes, mammals, birds, etc. Hence for mangrove protection and regeneration through coastal livelihood and ecotourism activities the Mangrove Foundation, Mumbai have formed several conservation and livelihood scheme programmes for selected coastal villages of Maharashtra. Under this schemes different SHG were formed in the selected villages.

Need for Intervention

The fishers of Nivati village, Taluk-Vengurla in Sindhudurg worked as labourers for unsustainable Purse Siene and Trawler Boat fishing while most of women work as an agriculture labour. Their daily income and livelihood depend on the availability of fish catch and agriculture work. Similarly fishing ban period during monsoon also affected their livelihood. Provision of fishery based alternative avocation could provide them the livelihood. Inculcating the skill of fish nursery rearing and providing them an opportunity to adopt it could be a source of alternative livelihood for them. Therefore, a SHG named Jai Ganesh Self Help Group comprising of men and women's were formed for seabass nursery rearing. The theme of the work is

Jai Ganesh SHG, Nivati Farmers Installing Bamboo poles and fixing Happas for Seabass Nursery Rearing

Seabass Stocking Acimilization and Seed

Jai Ganesh SHG, Nivati Farmers Installing Bamboo poles and fixing Happas for Seabass Nursery Rearing

Shri. Vasudevan, APCFF, Mangrove Foundation, Mumbai & Mr. Pankaj Patil, OIC, CIBA –NGRC handing Cheque of Rs. 1, 07,880/- to Jai Ganesh SHG towards sale of Fingerlings

to create a satellite hub of seabass culture unit in Sindhudurg through production of seabass seeds, stockable fingerlings and table size fish with SHG's active participation.

Features of innovation

ICAR-CIBA and Mangrove Cell of Maharashtra government have initiated the CIBA's three tier model of seabass farming which includes hapa based nursery rearing, cage based pre-grow out and grow out culture in and around the mangrove coastal waters in Sindhudurg district of Maharashtra with the participation of Ganesh Self Help Group. Nursery rearing of Asian seabass seed in hapas was taken up. CIBA team provided training and demonstration to SHG's on pond preparation, happa installation and cleaning, seed stocking, grading, feeding and water quality management. Happas (2 x 1 x1 m, 2 mm mesh size) were installed in a pond with water depth of 1.5 m and salinity 25 ppt. A total of 7500 seabass seeds (1.8-2.0 cm) were stocked at a density of 750 per happa-1. The fry were fed with CIBA formulated Seabass larval feed (0.2 mm-1.2 mm) @ 8-10% body weight two times a day. Regular grading was done at the interval of four days to separate the shooters and to maintain uniform size. During grading work, men farmers do removal of fishes from happas for grading and cleaning of happas while women farmers do the work of grading. The grading results in non-occurrence of cannibalism and improved survival rate. After the nursery rearing of 75 days, the seed reached to the fingerlings size of 8-10 cm and 10-12 g with survival of 71.9% (5394 fingerlings). The harvested fingerlings were sold @ Rs. 20 per fingerling to another SHG Vithal Rakhumai, Nivati for pre-grow out culture in happas.

Economics and impact

Jai Ganesh SHG earned Rs.1,07,880/- from the sale of fingerlings as an additional income and this activity provided them the livelihood. In Sindhudurg, Maharashtra this was the first kind of the activity which motivated the SHG's especially fisherwomen to participate in seabass seed production and generate the additional income. This "Technology Transfer Mode" of CIBA has emerged as successful participatory model for providing employment and livelihood opportunities for the unemployed coastal fisher communities of Maharashtra.

Contact details

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Automated shrimp aquaculture farm management – A success story

- Suresh Bhai J. Patel

Suresh Bhai J. Patel is an innovative shrimp farmer hailing from Navasari district of Gujarat. He is an innovator and entrepreneur and established a business company M/s. Hariom Aquaculture Pvt. Ltd., in Navasari, Gujarat. He applied artificial intelligence concept for optimization of farming operations and efficiency to reduce the production cost and increase the profitability in shrimp farming.

Brief profile of the farmer

Suresh Bhai J. Patel is an innovative shrimp farmer hailing from Navsari, District of Gujarat. He has started shrimp farming with four earthen ponds in 1993. Today, he has established a business company M/s. Hariom Aquaculture Pvt. Ltd., in Navsari.

Need for the innovation

Aquaculture is a fast growing sector in India. Application of technology can bring efficiency in shrimp farming and save labour and cost. He understood that human error can create havoc in shrimp farming. Therefore, application of artificial intelligence could enhance the optimization of operations and would enhance efficiency thereby reduce the production cost and increase the profitability.

Innovation features

He adopted artificial intelligence concept in his shrimp farm to increase production. He has installed automation in feeding, aeration, water quality measurement, harvesting, security, etc. using artificial intelligence. Automatic feeder saved the labour needs simultaneously reducing the cost of production. He installed the automatic time set aerator operation through which labour requirement was reduced, simultaneously the human error in starting aerator timely is also reduced which sometimes led to severe problem due to low dissolved oxygen in shrimp ponds. Further, he made automatic water quality measurement devices in shrimp ponds which measure all crucial water parameters in 24 hrs. These devices can be accessed anywhere though IP sets. It also sends the message when the parameters go below or above its range required. He has modified a vehicle into an insulated one for transportation of harvested shrimps which helps him in getting better prices than those from

a chilled once. He has installed CCTV cameras in his shrimp farms making the monitoring of farms easy and reduce dependence on labour for more security. He compared the production performances of earthen and lined ponds. The results show that lined ponds were efficient. He stocked 6 lakhs PLs and 3 lakh PLs of post larvae of *P vannamei* in Lined and earthen ponds of size 1 ha and reared for 4 months. Partial harvesting was done twice during the culture period in both lined and earthen ponds. The production parameters are given in the Table.

Variables	Lined pond	Earthen pond
Stocking per pond	60 no /m^2	30 no/m^2
1st Partial Harvest	16.5 - 18.3 g (2.3 - 2.5 tons)	19.5 – 22 g (1.6 – 1.8 tons)
2 nd Partial Harvest	20 – 22.5 g (2.0-2.45 tons)	25 – 27.2 g (1.7-2.0 tons)
Final Harvest	30 – 33 g (9.7 - 12 tons)	33 – 35.8 (3.11 - 3.8 tons)
Culture period	120 -134 days	125-136 days
Cost of production	220 – 240 Rs/kg	180 - 200 Rs/Kg
Survival	95.99-98 %	92.0
FCR	1.2-1.5	1.4-1.6
Total production/Ha	14.0-16.95 tons	6.41-7.6 tons

Advantages

Automation saved the requirement of labour and also the cost of parameters testing from outer agency. Through automation he followed all the biosecurity measures to prevent the entry of diseases causing agents which leads to crop failure. All this is possible because of the adoption of new technologies and artificial intelligence in his farm.

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Crab fattening in vertical tier model using Recirculatory Aquaculture System: Innovative model for state of Gujarat

- Himansu Patel

Mr.Himansu Patel is an innovator and entrepreneur practicing out of the box ideas in the aquaculture of mud crabs. His vertical tier model of crab fattening is a novel one which occupies less space and offers an efficient food production system that could be emulated by others in cities.

Brief background

Himanshu patel is an innovative farmer in Ecchapur village of Surat, Gujarat. After graduation in mechanical engineering, he involved in mechanical fabrication and estate business. In 2017, he ventured in to shrimp farming and farming of Pacific White shrimp (*Penaeaus vannamei)* in 12 ha area. He started crab fattening in vertical layers adopting in recirculatory aquaculture system in 1000 sq. ft area.

Need for the innovation

Aquaculture in India focused mainly on farming of shrimps in the coastal areas. Shrimp farming is often prone to various diseases like WSSV, EHP, EMS etc and incurring huge economic losses. On the other hand, finfish culture is constrained with low economic returns as well as marketing issues in Gujarat. Therefore, the farmer innovator tried crab farming adopting novel recirculation system.

Features of innovation

The farmer innovator installed 1000 boxes (1ft x 1ft x 0.5 ft) in a battery of 5 rows of 200 boxes each connected to a re-circulatory system. The whole assembly was imported from China. The creek water was brought to the facility. Water crabs (100-150g size) were procured from Maharashtra area and reared to around 1 kg marketable size for a period of 6 months. Trash fish was used as a feed. Average production of 800 to 850 kg of fully grown crabs achieved using the recirculatory system. Subsequently, the original recirculatory system was modified based on the needs and his experience. He used 6000-7000 litres of seawater during each cycle. He has standardised the water quality management in RAS. Feed and feeding

Vertical battery of crab culture boxes

Live Crab in box

Sand filter

also was standardised. The farmer felt that bright opportunities and returns are possible in crab business (Current per kg price Rs. 1200 to 1400 kg) and presently he scaled up his units to nearly 2000 boxes.

Lessons Learned

Pre moult death in crab lets need to be solved with research intervention and complete dependence for trash fish need to be changed to make the system economically viable and sustainable. Vertical crab farming technology could be easily adopted by the farmer because of wider acceptability and premium price of crabs in the domestic market provide profitable venture option to the farming entrepreneurs.

UV filter

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Doubling the farmers income through use of indigenous feed, Vanami Plus in the inland saline regions of North India

- Vinod Poonia

Mr. Vinod Poonia is a pioneering farmer who initiated shrimp farming in the inland saline soils of Haryana state. He has established an indigenous shrimp feed mill using the locally available ingredients and ensured the availability of cost effective feeds to shrimp farmers in North India. He commissioned a new feed mill Dr Attar Aqua feed, Bhiwani, Haryana by adopting VanamiPlus feed technology of CIBA.

Brief profile of the farmer

The inland saline soils of North India, particularly in the states of Haryana, Punjab and Rajasthan possess ground water salinity ranging from 3 to 20 ppt. The use of saline water for agriculture led to yield loss and crop failure. This necessitated the farmers to look for an alternative farming in these inland saline areas. The average income from agriculture in these areas was around Rs. 30,000 per acre and agriculture has become unviable for the small and medium farmers. After the successful demonstration of shrimp farming in inland saline areas and proactive approach by CIBA, many farmers evinced keen interest to take up shrimp farming mainly due to shorter crop duration of 100 to 120 days with a ready market and better profit margin.

Mr. Vinod Poonia is a pioneering farmer who initiated shrimp farming in Haryana. During the initial phase, shrimp farming showed a rapid growth due to better profit margin. However, over the years, the cost of production increased considerably due to the unprecedented increase in input cost particularly the feed. This increased cost of production led to severe dent in the profit margin of shrimp farmers.

Need for innovation approach

The increased area under shrimp farming resulted in increased demand for shrimp feed, which often ranges from 50 to 60 % of the total cost of production and directly determines the profitability of farming. Feed being a critical input in shrimp farming, not only determines the growth performance of the shrimp, but also is a key factor related to cost of shrimp production and sustainability. Feed also play a critical role in maintaining the ambient water quality of the rearing system. Here, it is pertinent to note that the two critical inputs required for shrimp farming viz., seed and feed were sourced from south India. The cost of shrimp feed available to the farmers in these region was a whopping Rs.75 to 85 per kg whereas the realistic price of shrimp




feed should be around Rs. 60 per kg. This drove Mr. Poonia to look for an innovative solution of making available the cost-effective feeds to shrimp farmers of North India.

Futures of the innovation

During 2017, he came across the information that a training to be conducted at ICAR-Central Institute of Brackishwater Aquaculture in Aquaculture nutrition and feed processing technology. He along with his friend Mr. Gurdiyal Singh participated in the training program and at the end of the program, they were confident to decide in having a small feed mill to prepare the feed for their own use. Mr. Vinod Poonia's Dr Attar Aqua feed commissioned a new feed mill at Bhiwani, Haryana by adopting Vanami ^{Plus} feed technology of CIBA, through an MoU. It is a first of its kind in Northern India, which will be a great advantage for shrimp farmers in inland saline regions of Punjab, Haryana and Rajasthan, where the feed is brought from the southern states.

The ingredients are sourced from the local areas and with the indigenous feed technology from CIBA, and an installed production capacity of 750 kg/hour, this mill can produce 8-10 ton of feed per day. The unique aspect of this venture is 'Factory to Farm', concept wherein the farmer can take fresh feed directly from the feed mill to their farm, bypassing the agents, also savings on dealer margin. This would increase the profit margin of farmers by 20%.

Advantage of the indigenous technology adoption for farmers of North India

Through this venture, the cost of indigenous shrimp feed was only Rs. 60 to 65 per kg for the farmers of Punjab, Haryana and Rajasthan. Since the establishment of feed mill, within 4 months about 50 farmers have used this feed and the results revealed that the indigenous shrimp feed has good attractability, palatability and performed at par/better with the top performing commercial brands in terms of growth, survival, and feed utilization. The FCR realised by the farmers ranged from 1.1-1.5. The cost of production reduced by Rs. 25 to 40 per kilogram of shrimp thereby saving of Rs.50,000 to Rs. 90,0000 per acre through the use of Vanami^{Plus} feed produced by Dr. Attar Aqua Feeds. Thus, it is playing a crucial role in improving the profitability of small and medium shrimp farmers in the states of Haryana, Punjab and Rajasthan.

Brief economics of feed mill operation

- Production per annum : 800 to 1000 tons
- Fixed costs: 60 Lakhss
- Gross return: 35%

Contact details

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Shrimp farming in inland low saline shrimp farming in South Western Punjab – a success story

- Manish Goyal & Vineet Verma

Mr. Manish Goyal and Mr.Vineet Verma, young engineering graduates from Bathinda, Punjab who took shrimp farming in to the western Punjab region and proved that shrimp aquaculture is viable in the inland saline soils of Punjab and shown that shrimp farming would triple the income of farmers.

Brief profile of the farmer

Mr. Manish Goyal and Mr. Vineet Verma, two young engineering graduates from Bathinda, Punjab have been taking care of their family business of corrugated box manufacturing and fuel business over the years apart from minor agriculture activities. The young entrepreneurs realised that diversification is an essential part of business and spreading out to new fields would help in mitigating risk arising from losses incurred from a business. By this time in 2017, shrimp farming had become a major economic activity in Haryana and its effects were being felt in parts of Punjab. Mr. Goyal and Mr. Verma were convinced that shrimp farming using saline groundwater in Punjab would be an alternate business opportunity and a way to make more revenue per unit area when compared to traditional agriculture. They had interacted with farmers across the state of Haryana and were confronted with several issues such as high price of shrimp feed in Northern India, lack of mechanism for seed quality testing and lack of technical support for farming. Subsequently they approached the ICAR- Central Institute of Brackishwater Aquaculture for training and input support in shrimp farming, in the early part of 2017, and were subsequently trained at CIBA, under the ARYA program on “Innovative and evolving brackishwater crustacean aquaculture” during February, 2017. The entrepreneurs established their company M/S. Blancas Aqua, Gurthari road, Sangat Kalan, Bathinda for farming shrimp in Punjab.

Need for the innovation

South Western Punjab possesses abundant resources of inland saline groundwater, similar to brackishwater with salinity ranging from 3 ppt to 15 ppt. The districts of Bathinda, Muktsar, Fazilka

and parts of Mansa have regions with underlying low saline ground water. Hence the agricultural productivity in this region is very low compared to rest of the regions in Punjab owing to poor soil fertility, insufficient irrigation network and the absence of a major river system flowing through the region. Farmers in this region earn an income of Rs. 30,000 - Rs. 50,000 per acre from agriculture, based on market prices, rain and type of crop cultivated. Inland shrimp farming using the low saline water is an alternative farming technology option, with crop duration of 90 - 120 days for doubling farmers' income through production of high value shrimp along with employment generation and societal development.

Features of innovation

The farmers with the support of ICAR-CIBA took up Pacific white shrimp (*Penaeus vannamei*) farming using inland low saline water at Sangat Kalan Village, Bathinda, Punjab on a partnership farming mode. They stocked PL 13 size shrimp seed in two ponds measured 4000 m^2 (1 acre) sourced from a Coastal Aquaculture Authority (CAA) certified hatchery in Tamil Nadu. Stocking density adopted was 30 PL/m2. The shrimp seed were subjected to PCR screening and stress tests at CIBA laboratory in Chennai prior to packing and transportation. The salinity and pH during the culture varied from 4.5 ppt to 5.0 ppt and 8.1 to 8.9, respectively. Management of mineral supplementation viz., potassium, magnesium and other trace elements were monitored based on ionic profile of the farm with the help of CIBA on a weekly basis. Mineral supplementation was a critical abiotic factor as the ionic profile of inland saline groundwater varies significantly from that of seawater or brackishwater. CIBA supported the farmers with quality shrimp seed and CIBA's cost effective shrimp feed Vanamiplus (at Rs. 60/kg). The CIBA vannamei feed Vanami^{plus} was used. The feed was specially formulated to fulfil the mineral requirement of shrimp reared in inland saline water available in this region of Punjab.

High alkalinity of saline groundwater (> 350 ppm) is one of the major bottlenecks for shrimp farming in Punjab. The farm saline water had high alkalinity (370 ppm). Thirty days in to the culture, the farmers observed running mortality in both ponds and several shrimp sampled had sluggish activity. The ponds were then subjected to a series of treatments involving fermented mixtures, sugar and yeast consecutively until running mortality was ceased. The alkalinity was effectively brought down to 290 ppm and subsequent rains brought down alkalinity values to 240 ppm. The issue of running mortality which occured due to high alkalinity of the rearing medium was controlled and no mortality was further observed in the ponds. The shrimp attained a marketable size with an average body weight (ABW) of 20 g in a crop period of just 3 months and 26.31 g in 4 months, which falls in 36-40 count grade for shrimp. The survival and feed conversion ratio (FCR) observed during the trial were 79.18 % and 1.2 respectively. At the end of 120 days of culture (DOC), a production of 2.5 tonnes/acre was obtained resulting in a productivity of 6.25 tonnes/ha.

Advantages and economics

The harvested shrimp fetched a farm gate

price of Rs. 320/kg resulting in a total revenue of Rs. 16 lakhs against an operating cost of Rs. 12 lakhs, thus yielding an operating net profit of Rs. 4 lakhs i.e., 2 lakhs/acre/crop. The cost effective feed of CIBA, Vanamiplus which was competitively priced at Rs. 60/kg as compared to commercial vannamei shrimp feed (Rs. 74 - 88/kg) resulted in an additional 25 % reduction in the production cost on feed, thereby increasing the profit to the farmer. This is a success story in South Western Punjab, where farmers earning a maximum income of Rs 50,000/acre, has proved that aquaculture can triple their income with Rs. 2.0 lakh/acre in a 4-month crop period. However, the development and expansion of shrimp farming in inland saline areas need to be on a sustainable mode, maintaining a balance of freshwater resource and possible

issues of salinization in the neighbouring areas of the farming, through scientific planning. Mr. Goyal and Mr. Verma have presently doubled the water spread area under culture from a 2 acres in 2017 to 4 acres in 2018 and continue successful shrimp aquaculture in the region along with technical support from ICAR-CIBA, Chennai.

Contact details

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