Success in hatchery development of seabass and its potential for commercial cage culture in India

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Introduction

Brackishwater fish farming is considered as one of the potential areas not only as a source for fish production but also ensures the food security, livelihood for coastal community, business opportunity for entrepreneurs and also can earn foreign exchange. Coastal aquaculture has grown tremendously in early 1990s with farming of single species, the tiger shrimp *Penaeus monodon.* However, the shrimp farming faced severe set back due to outbreak of viral diseases coupled with social and other environmental issues. To overcome these issues, it is important to introduce some of the remedial measures in order to revive the aquaculture industry to achieve the sustainable production and one such measure clearly visible is the diversification of brackishwater aquaculture with fish species. It is evident that crop rotation can also decrease the risk of disease outbreak in the pond system. In the recent years, reduction in large scale practices of shrimp farming can be seen in most of the countries, which is not only due to viral disease outbreak but also due to other reasons such as non availability quality and disease free shrimp seed, low in market price, increasing production cost *etc.*, Due to these factors, most of the established shrimp farms have been kept idle without any farming practice. Besides, a rich resource of inland coastal water bodies, which is suitable for fish farming under cages or pens can be also explored to increase the fish production in all maritime states of India.

Culture potential

Among the brackishwater finfish species, the Asian seabass, *Lates calcarifer* is considered as one of the most important candidate species suitable for farming in ponds and cages in fresh, brackish and marine water ecosystem. Asian Seabass popularly known as Bhetki in India is an important brackishwater finfish of the family Centropomidae. The demand for seabass both in domestic market and international market is increasing every year because of its white tender meat.

Development of hatchery technology

Successful seed production in the hatchery depends upon the availability of healthy matured fishes. For selecting potential breeders, viable broodstock under captive conditions has to be developed. Since seabass attains maturity after 2 years of age, one has to wait more than 2 years. To save time, adult fishes could be procured from the commercial catches, transported carefully to the hatchery holding facilities and maintained. Healthy broodstock fishes after observing as protocols can be transferred to broodstock holding facilities like RCC tanks (preferably large tanks of 50 – 100 tonne capacity) or cages or ponds for further maintenance and development providing required feed, quality water and healthy diet for maturation and spawning.

Water Quality Management

Broodstock fishes maintained in captive condition should be provided with environmental quality prevailing in the sea for maturation and spawning. The desirable range of some of the water quality parameters in a broodstock tank are

Temperature	-	28 – 32°C
Salinity	-	28 – 33 ppt
pH	-	7.0 to 8.2
Dissolved oxygen	-	more than 5 ppm
Ammonia	-	less than 0.1 ppm
Nitrite-N	-	less than 0.01 ppm

Feeding and health management

Brood fishes can be fed with trash fishes such as Tilapia or Sardines at the rate 5% body weight daily. The unfed feed can be removed carefully to avoid the contamination. Fishes have to be examined monthly basis to check the parasitic infection if any. External parasites such as *Caligus spp.* and monogenic trematode, *Diplectenum latesi,* can be effectively treated either with 100 ppm formalin for one hr or 1 ppm dichlorvos for one hour.

Maturation

Seabass is a protandrous hermaphrodite fish. They are males during early stage of its life cycle and become females in later period. Reproductive system is very much complicated in hermaphrodite fishes since they go through different phases of hormone secretion which is responsible for gonadal development. Maturation process can be induced/ accelerated either by simulating the environmental conditions prevailing in sea or through the administration of the hormones responsible for maturation and spawning. Seabass spends most of its growing phase in confined waters in the coastal and inland areas and migrates to sea for maturation and spawning.

Induced spawning and selection of spawners

Spawning is a "process of release of sexual gametes". Since sexes are separate in the fish, both male and female matured fishes have to be selected for spawning. The fertilization is external.

Matured female fishes will have ova with diameter more than 450 ←. Males will ooze milt if the abdomen is gently pressed. The gonadal condition is assessed by ovarian biopsy. Brood fishes selected for induction of spawning should be active, free from disease, wounds or injuries. Female fishes will be around 4 – 7 kg and males will be 2.0 – 3.0 kg. Since seabass spawning is found to have lunar periodicity, days of new moon or full moon or one or two days prior or after these days are preferred for inducing the spawning.

Induced spawning by hormone injection

The commonly used hormones in the finfish hatcheries for induced spawning are:

LHRH-a	-	Luteinizing Hormone Releasing Hormone analogue (Available with SIGMA CHEMICALS – USA – ARGENT CHEMICALS)
HCG	-	Human Chorionic Gonadotropins. (Available in Pharmacy – medical shops)
Ovaprim	-	A Glaxo Product

But in the case of seabass LHRH-a hormone is found to be effective with assured result though other hormones can also be used singly or in combination.

Hormone dose

After selecting the gravid fishes the requirement of hormone to be injected is assessed. The dosage level has been standardized as LHRHa at the rate 60 – 70 ←g/kg body weight for females and 30 – 35 ←g/kg body weight for males. The hormone in the vial (normally 1 mg) is dissolved in distilled water of known volume (5 ml). Care should be taken that hormone is thoroughly dissolved. The weight of the brood fishes is assessed and the required hormone is taken from the vials using a syringe. The fish is held firmly. After removing one or two scale just below the dorsal fin – above the pectoral region the syringe needle is inserted into the muscular region and the hormone is administered intramuscularly gently. Since the spawning normally occurs in the late evening hours, when the temperature is cool, hormone is injected normally in the early hours of the day between 0700 – 0800 hours.

Spawning tanks

Spawning tanks size depends upon the size of the fish selected. Normally 10 – 20 tonne capacity tanks with provision for water inlet, drainage, overflow provision and aeration is used.

Sex ratio

Female seabass are generally larger (more than 4 kg.) and the males are smaller (in the size of 2.0 – 3.0 kg). To ensure proper fertilization normally two males are introduced for one female in the spawning tank.

Spawning

Fishes injected with LHRH-a hormone response for spawning after 30 – 36 hours of injection. Prior to spawning gradual swelling of the abdomen will be seen indicating the ovulation process. Spawning normally occurs late in the evening hours 1900 – 2000 hours. At the time of spawning the fishes will be moving very fast and in the water surface a milky white substance will be seen. Prior to spawning activity the males and the female will be moving together exhibiting courtship.

Spawning activity in seabass coincides with lunar periodicity. During full moon or new moon days, the activity is found to be in peak. Hence, induced spawning is done during new moon/full moon Seabass has high fecundity. It is a protracted intermittent spawner (releasing eggs batch by batch). In one spawning the fish may release 1.0 – 3.0 million eggs. The process of spawning will follow during subsequent day also. If the condition is good, both female and male respond simultaneously resulting spontaneous natural spawning and fertilization is effected.

Fertilization

Fertilization is external. In natural spawning of seabass in good maturity condition, fertilization will be 70 – 90%. The size of the fertilized eggs will be around 0.75 – 0.80 mm. The fertilized eggs will be floating on the surface and will be transparent. The unfertilized eggs will be opaque and slowly sink to bottom. Due to water hardening sometime, even the unfertilized eggs, for short duration will be on the sub-surface but will sink subsequently. The fertilized eggs can be collected by any one of the following methods.

Overflow method

After spawning and fertilization, the water level in the spawning tanks can be increased and allowed to overflow through overflow outlet. The eggs will be pushed by the water flow. Below the overflow pipe a trough covered with bolting cloth of mesh size 150 – 200 ←m is kept. The water with the egg is allowed to pass through. The eggs are collected in the next bolting cloth washed and transferred to the incubation tanks.

Scooping/ seine net collection method

Since fertilized eggs will be floating on the surface, a bolting net cloth of 150 – 200 ←m mesh size can be used for collecting the eggs from the surface. The cloth is stretched as net and towed along the water surface. The collected eggs after washing are transferred to the incubation tanks.

Siphoning method

The water in the spawning tank is siphoned into small tank covering with collection net cloth through which the water will be allowed to pass through. The eggs collected in the net cloth are transferred periodically to incubation tanks.

Incubation and hatching

The eggs collected from the spawning tank are washed to remove the debris that would have adhered to and transferred to the hatching tanks for incubation and hatching. The hatching incubation tanks can be 200 – 250 L capacity cylindro-conical tanks. Eggs are kept at density of 100 - 200 nos/litre. Continuous aeration is provided. Temperature of 27 – 28°C is desirable. The eggs will hatch out in 17 – 18 hours after fertilization undergoing developmental stages are given in the following Table:

Embryonic development Stages	Duration
One Cell stage	30 minutes
Two Cell stage	40 minutes
Four Cell stage	45 minutes
Eight Cell stage	60 minutes
Thirty two Cell stage	2 hrs
Sixty four Cell stage	2 hrs 30 minutes
128 Cell stage	3 hrs
Blastula stage	5 hrs 30 minutes
Gastrula stage	6 hrs 30 minutes
Neurula stage	8 hrs
Early embryo	11 hrs
Heart functional and tail movement	15 hrs
Hatching	17 – 18 hrs

The larvae are scooped gently using scoop net and transferred into buckets of known volume. After taking random sample counting depending upon the number required to be kept in the rearing tanks, larvae will be transferred to rearing tanks.

Larval Stocking Density

Freshly hatched healthy larvae (Hatchlings) from the incubation tanks are transferred carefully to the rearing tanks. Larvae are stocked initially at the rate 40 – 50 nos/litre. Depending upon the age and size, the larval density is reduced to 20 – 25 nos/l on 10th day and later and after 15 days, the density is maintained around 10 – 15 nos/l.

Feeding the Larvae & Live Feed production

The following live feeds are very important for feeding the larvae

Algae Green unicellular algae like *Chlorella* sp., *Tetraselmis* sp., *Nannochlorpsis* or *Isochrysis* sp. are needed for feeding the live feed zooplankton.

Rotifer Rotifer (*Brachionus plicatilis*) or *B. rotundiformis* is the most preferred diet for the fish larvae in their early stages.

Artemia Brine shrimp, *Artemia* in nauplii stage are required for feeding the larvae from 9th day. *Artemia* with its natural nutrient profile required for larval development of fish is used in all the hatcheries. .

Whatever good the culture system may be in many cases, Rotifer or *Artemia* nauplii produced in the hatchery may not be having all the nutrients required for the larvae, (especially the unsaturated fatty acids), the cultured Rotifer/*Artemia* are enriched with nutrient rich media and then fed to the larvae.

Water Change

Water quality in the rearing tanks is very important for better survival and growth of the larvae. Water provided to the larval rearing tanks should be free from flagellates, ciliates and other unwanted pathogenic organisms. Water should be filtered through biological filters, pressure sand filters. UV radiation treatment is also given, to get rid of the pathogenic organisms. If chlorine treated water is drawn, residual chlorine should be removed, since, fish larvae are highly sensitive to chlorine and water should be used only after de chlorination.

In the larval rearing tanks, the larvae stocked as well the live feed supplied for the larvae will excrete nitrogenous metabolites and other debris also will accumulate. They have to be removed carefully. The debris and bottom sediment are removed by siphoning using siphon tubes. The bottom debris is slowly siphoned out along with water into a trough with filter net. To maintain water quality in the larval rearing tanks, 30 – 40% water change is done daily. The salinity should be maintained around 30 ppt. And the desirable range of temperature is 27 – 29°C. The water level reduced (30 – 40%) in the rearing tank is leveled up with filtered quality seawater and green water after taking cell count of the algae in the rearing tank.

Algal water is added daily up to 15th day. After bottom cleaning and water reduction, while water change is done, algal water is also added depending upon the concentration, (around 20 thousand cells/ ml in the rearing tank Algal water added should not be contaminated since in the open culture there is chance of contamination by flagellates, ciliates and filamentous algae which will be toxic to the fish larvae. Apart from being a source of feed for the rotifers in the tank, the algae also help in the conversion of harmful excretory products like ammonia and other metabolites in the rearing container into less harmful nutrients.

Feeding

Rotifer (*Brachionus plicatilis*) is given as feed to the larvae from 3rd day. Rotifer is maintained in the larval rearing tanks at concentration at the rate 5 nos./ml initially. From 4th day to 15th day the rotifer concentration is increased to 10 – 20 nos./ml gradually. Every day after water exchange, the food concentration in the tank should be assessed and fresh rotifers should be added to the required concentration. In the early stages (3 – 5 days) the larvae may not be in a position to ingest the large sized rotifers. Hence after collecting the rotifers from the tanks small sized rotifer less than 1500 ←m should be sieved using suitable mesh size bolting cloth nets. . From 6th day assorted size rotifer can be given as feed. *Artemia nauplii* are given as feed along with rotifers and green water from 9th day. By this time the larvae will be around 4 mm TL in size. Larvae can be feed exclusively with *Artemia* from 16th day to 24th day. The density of the brine shrimp nauplii in the rearing medium is maintained at the rate 2000 nos./l initially and gradually increased to 6000/l as the rearing days progress. The daily ration of *Artemia* nauplii feeding is adjusted after assessing the unfed *Artemia* in the rearing tank at the time of water exchange and the larval density.

Feed density/quantity to be given to seabass

By 21st day the larvae will be around 10 – 11 mm TL in size after completing larval development stages. From 25th day the larvae can be fed with *Artemia* sub adult (biomass) along with cooked minced fish/shrimp meat. The fry can also he weaned slowly to artificial feed.

Under circumstances, when the rotifers could not be fed with marine *Chlorella* adequately, the nutritional quality of such rotifers may be poor. In such case, the rotifers can be enriched with special enrichment media. Enrichment is done by keeping the rotifers in emulsified enrichment medium like SELCO DHA or cod-liver oil for 18 - 24 hours. By this process, the animals will ingest the enrichment media which is rich in Poly unsaturated Fatty Acids (PUFA), required for larval growth. The animals are washed and fed to the larvae. In this way Rotifers *Artemia* nauplii/ *Artemia* biomass can also be enriched and fed. *Moina*, a cladoceran can also be fed to the seabass larvae after 21 days.

Grading

Seabass while growing exhibits differential growth rate, hierarchy, resulting different size groups in the same rearing tank. The large one's shooters dominate others for food and space and also prey on them. Seabass larvae are highly cannibalistic and it is more pronounced in early stages. In the rearing tanks, when the larval concentration is more and congregation takes place for food and feeding, the larger ones are tempted to feed on the smaller ones. To avoid this problem, regular grading has to be done. The large sized larvae, ("Shooters") have to be removed. Uniform sized larvae should be kept in the rearing tanks for better survival and growth. Grading should be done once in three days from 15th day or whenever different size larvae are seen in the tanks. Grading can be done using a series of fish graders with different pore size of 2 mm, 4 mm, 6 mm, 8 mm, 10 mm. When the larvae are allowed to pass through the graders, different size will be retained according to pore size of the sieves. Grading may cause injuries leading to mortality. Hence proper care should be taken in handling the larvae. Prophylactic treatment with 5 ppm Acriflavin can be given. By adopting these practices survival rate up to 48% has been achieved with average survival rate of around 15 % in 25 days in larval rearing phase. After rearing the larvae in the hatchery for 25 – 30 days the fry can be transferred to nurseries for further growing.

Nursery rearing

Nursery Rearing in Hatcheries

Seabass fry of 25 – 30 days old in the size of 1.0 – 1.5 cm can be stocked in the nursery tanks of 5 – 10 tonn capacity circular or rectangular (RCC or FRP) tanks. Outdoor tanks are preferable. The tanks should have water inlet and outlet provision. Flow through provision is desirable. *In situ* biological filter outside the rearing tanks would help in the maintenance of water quality. The water level in the rearing tanks should be 70 – 80 cms. Good aeration facility should be provided in the nursery tanks. After filling with water 30 – 40 cm and fertilized with ammonium sulphate, urea and superphosphate at the rate 50, 5 and 5 gm (10: 1 : 1 ratio) per 10 tonne of water respectively. The natural algal growth would appear within 2-4 days. In these tanks freshly hatched *Artemia* nauplli at the rate 500 – 1000 l are stocked after leveling the water to 70 – 80 cm. The nauplii stocked are allowed to grow into biomass feeding with rice bran. When sufficient *Artemia* biomass is seen, seabass fry are stocked at the rate 800 – 1000 nos/m^3. The pre-adult *Artemia* would form good food for seabass fry. The fry would not suffer for want of food in the transitional nursery phase in the tank since the larvae are habituated to feed on *Artemia* in the larval rearing phase. Along with '*Artemia* biomass' available as feed inside the tank supplementary feed mainly minced fish/shrimp meat is passes through a mesh net to make each particle of size of around 3 – 5 mm and cladocerans like *Moina* sp can also be given. The fish/ shrimp meat feeding has to be done daily 3 – 4 times. Feeding rate is 100% of the body weight in the first week of rearing. This is gradually reduced to 80%, 60%, 40% and 20% during 2nd, 3rd, 4th and 5th week respectively. Regular water change to an extent of 70% is to be done daily. The left over feed and the metabolites have to be removed daily and aeration should be provided. In a rearing period of 4-5 weeks in the nursery rearing, the seed will be in the size of 1.5 to 3.0 g/ 4-6 cm with survival rate of 60-70%. Adopting this technique at a stocking density at the rate 1000 nos/m^3 in the hatchery, survival rate up to 80% has been achieved. For the better survival during early growth phase, regular Grading should be done. Vessels/trough placed with different mesh sized nets can be used for grading. When the seed are left into the containers the seeds will be sieved in different grades according to the mesh size and seed size. Care should be taken that the fry are not injured while handling. If the number is less it could be manually done.

Status of seabass farming

Amongst the cultivable fishes in India, Seabass fetches higher price in domestic market varying between Rs.100-250 per kg depending upon the size, the availability and season. It is extensively cultured, in South East Asian Countries like Thailand, Malaysia, Singapore and Australia. Culture of seabass is relatively easy and dependable with fewer risks. Based on case studies, in Thailand it has been estimated that the production of seabass culture was 20.5

kg/m^3. The price of seabass is US$2.27 per kg. The total income from the cage is US $ 46.49 per m^2. The rearing cost is US $ 24.15. The net return is US $ 22.34 per m^3. In the culture operation the fixed cost in cage culture is only 5.9%. The variable costs such as feed, seed, labour etc cost 94.1%. The feed alone costs 63%, followed by the seed cost. Seabass, the value added finfish can be considered as a complementary to shrimp for the sustainability of brackishwater aquaculture.

Traditional Culture

Seabass is cultured in the ponds traditionally as an extensive type culture throughout the areas in the Indo-pacific region where seabass is distributed. In low lying excavated ponds, whenever the seabass juveniles are available in the wild seed collection centers (For eg. April June in West Bengal, May-August in Andhra Pradesh, Sept-Nov. in Tamil Nadu, May to July in Kerala and June-July in Maharashtra. Juveniles of assorted size seabass are collected and introduced into the traditional ponds which will be already with some species of fish, shrimps and prawns. These ponds will have the water source from adjoining brackishwater or freshwater canals, or from monsoon flood. The juvenile seabass introduced in the pond will prey upon the available fish or shrimp juveniles as much as available and grow. Since, seabass by nature is a species with differential growth are introduced into the pond at times of food scarce, the larger may resort to feed upon the smaller ones reducing the number. Seabass are allowed to grow for 6-7 months of culture period till such time water level is available in these ponds and then harvested. At the time of harvesting there will be large fish of 4 to 5 kgs as well as very small fishes. In this manner production up to 2 ton/ha/7-8 months have been obtained depending upon the number and size of the fishes entered/introduced into the pond and the feed available in the pond.

However, this practice is highly unorganized and without any guarantee on production or return for the Aquaculturists. With the advances in the technology in the production of seed under captivity assuring the supply of uniform sized seed for stocking and quality feed for feeding, the seabass culture is done in South East Asian Countries and Australia in more organized manner. The major problem in the development of seabass aquaculture in India is the availability of seed in adequate quantity and the time of need and quality feed for nursery rearing and grow out culture. The former has been overcome and the technology package for the seed production of seabass under controlled conditions is available. The suitable feed for the culture of seabass is being developed. The seed production technology developed by CIBA has already been commercialized and the feed technology will be ready shortly for commercialisation. These technological improvements in the seabass culture have motivated the farmers to select seabass as a candidate species for aquaculture. Farmers have been adopting improved farming practices in seabass culture.

Improved Seabass Culture Methods

The traditional culture method is improved with stocking of uniform sized seed at specific density and fed with low cost trash fishes/formulated feed of required quantity. Water quality is maintained with exchange periodically. Fishes are allowed to grow to marketable size, harvested and marketed for high unit price. Seabass culture can be done in more organized manner as a small-scale/large scale aquaculture in brackishwater and freshwater ponds in cages.

Polyculture

This is an improvement over the traditional method, where the feed, the live fishes, shrimps are deliberately allowed in to the seabass culture ponds to serve as facilitating feed for the seabass in the pond. In the traditional method there is no control over the quantity and quality of the feed entering the ponds which may or may not be adequate. At times of scarcity for feed, the seabass may resort to cannibalism resulting in low survival and production though few fishes will be large size. Under polyculture method, the feed in the form of forage fishes are produced in the culture ponds itself and made available to the seabass fish to prey upon as and when it requires.

Grow out culture of seabass in cages

Fish culture in cages has been identified as one of the eco-friendly at the same time intensive culture practice for increasing in fish production. Cages can be installed in open sea or in coastal area. The former is yet to be developed in many countries where seabass is cultured but coastal cage culture is an established household activity in the South East Asian countries. There are abundant potential as in India also for cage culture in the lagoons, protected coastal areas, estuaries and Creeks. Since, cage culture of seabass has been proved to be a technically feasible and viable proposition this can be taken up in a large scale in suitable areas.

Cage culture system allows high stocking density, assures high survival rate. It is natural and eco-friendly and can be adapted to any scale. Feeding can be controlled and cages can be easily managed. Harvesting is not expensive. Water depth and water current alone the criteria. Even in areas, where the topography of the bottom is unsuitable for pond construction, cage can be installed. Diseases can be easily monitored. Fishes in the cages can be harvested as per the requirement of the consumers, which will fetch high unit price. Above all, cage culture has got low capital input and operating costs are minimal. Cages can be relocated whenever necessary to avoid any unfavorable condition.

Design of Cages

Grow out cages of 20 or 50 m^2 are preferable for easy management and maintenance. Cages are fabricated with polyethylene netting with mesh size ranging from 2 to 8 cm depending upon juvenile fish propose to stocked in the cages. There are two types of cages:

Floating cages: The net cages are attached to wooden frames kept afloat using plastic drums. Anchors or Concrete weight blocks as anchors can be attached to the corners of the net cage at the bottom. These types of cages can be installed in areas with water depth more than 4 meters with feeble water current.

Stationary cages: These are fixed enclosures, which can be installed, in shallow water areas in lagoons, brackishwater lakes having water depth of 2-4 meters. The cage net is fastened to wooden poles erected in the water system at the four corners.

Stocking Density

In the cages, fishes can be stocked at the rate 25-30nos/m^3 initially when they are in the size of 10-15 gm. As they grow, after 2-3 months culture, when they are around 100-150 g stocking density has to be reduced to 10-12 nos/m^3 for space. Cage culture is normally done in two phase – till they attain 100-150 gms size in 2-3 months and afterwards till they attain 600-800 in 5 months.

Feeding in Cage

Fishes in the cage can be fed with either extruded pellets or with low cost fishes as per the availability and cost. Floating pellets have advantages of procurement, storage and feeding. Since, a lot of low cost fishes are landed in the commercial landings in the coastal areas which are fetching around Rs.3-5/kg only used as feed for seabass culture. Low cost fishes like Tilapia available in the freshwater and brackishwater also serve as feed for seabass in ponds and in many cage culture operations. The rate of feeding can be maintained around 20% initially and reduced 10% and 5% gradually in the case of trash fish feeding and in the pellet feeding, the feeding rate can be around 5% initially and gradually reduced to 2-3% at later stage.

In the feeding of low cost fish FCR works out around 6 or 7 (*i.e.* 7 kg of cheaper fishes has to be given for one kg of seabass). In the case pelleted feeding FCR is claimed to be around 1 to 1.2 in Australia. However, the cost effectiveness of the pellet feeding for seabass in grow out culture has to be tested.

Cage Management

Since cages are inside the water and exposed to water current, the debris materials drifted may adhere to the cages and clog the mesh restricting the water exchange. The fouling organism will also attach and clog the meshes. Other animals like Crab may damage the nets. The cages should be regularly checked for clogs and leaks. Damaged nets should be repaired or replaced. The clogging will reduce water exchange, and lead to accumulation of waste products depleting the oxygen causing stress to the fishes, affecting feeding and growth. If the damage is not repaired immediately, the fishes will escape from the cages.

Production

Under cage culture, since seabass can be intensively stocked and properly managed, the production will be high. Frequently culling and maintenance of uniform sized fishes in to the cages will ensure uniform growth and high production. Production of 6-8 kg/m^2 is possible in the cages, under normal maintenance and production as high as 20-25 kg/m^2 is obtained in intensive cage management in the culture of seabass.

Integration of cage culture of seabass with shrimp culture

If seabass can be weaned to feed on floating pellets, because of their addictive nature to selective feed, they will not resort to prey upon shrimp as normally experienced in shrimp culture ponds. If the water depth can be maintained around 1.5-2.0 m, in a pond, cages can be installed in the shrimp culture pond itself and seabass seed weaned to feed on floating pellets can be stocked in the cages and reared. In this way, seabass culture will be a complimentary to shrimp culture.

Conclusion

Cage farming in India can be taken up in pilot scale by utilizing different ecosystem. Cost effectiveness of seabass cage farming with formulated feed in high density in the marine water ecosystem has to be evaluated. The production of value added species like seabass will be increased by using marine and freshwater reservoir cage system. There is need of creation of infrastructure facilities to carry out the nursery rearing and cage farming of the seabass. The safety and security of the stock has to be assured since the fisheries in marine water are prone to poaching. The value and importance of the cage farming has to be taken as massive awareness programme in the surrounding areas. The programme can be initiated as a community programme through fishermen/women co-operatives.

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