Special Publication - 87

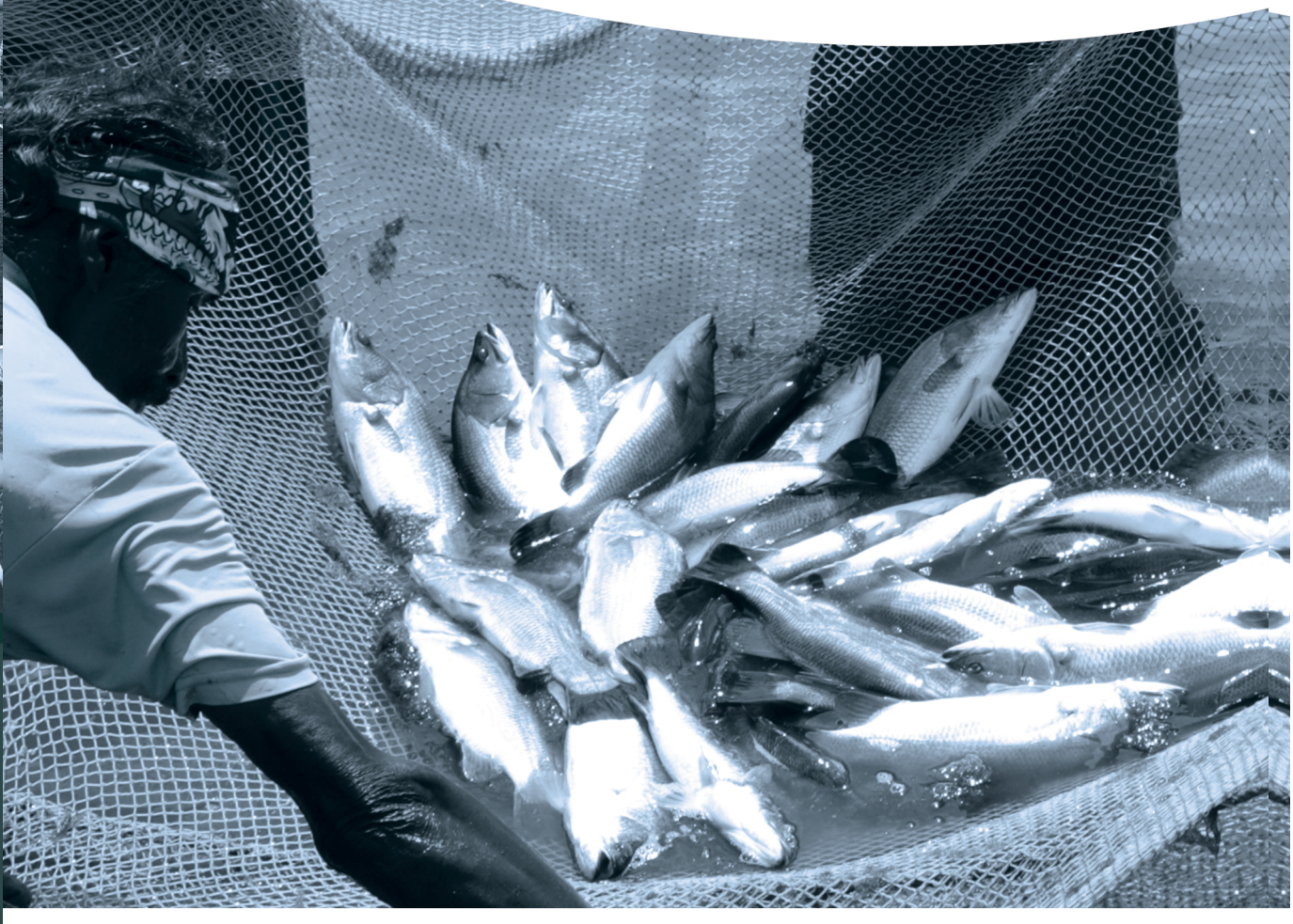


FREQUENTLY ASKED QUESTIONS ON

ASIAN SEABASS

(Lates calcarifer)

SEED PRODUCTION AND FARMING



ICAR - Central Institute of Brackishwater Aquaculture
(Indian Council of Agricultural Research)
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Title : Frequently Asked Questions on Asian seabass *(Lates calcarifer)* Seed Production and Farming

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Foreword

Fisheries and aquaculture are considered as one of the fastest-growing food-producing sectors in the world. In India, it also plays an essential role in the economic development front because of its contribution to food and nutritional security, national income, employment opportunities, and generating livelihood options. It is the primary source of animal protein for billions of people worldwide. Aquaculture supplies dietary essentials for human consumption and provides excellent opportunities for employment and income generation, especially in economically backward rural areas. Presently, India ranks second in aquaculture and third in fisheries production, contributing 1.07% to the national GDP and 5.30% to the agriculture GDP.

In a pioneering attempt way back in 1997, ICAR-CIBA made a breakthrough in breeding Asian seabass. Later the technology was fine-tuned and scaled up for mass production of seabass seeds. The institute has conducted several capacity-building programmes, workshops, seminars, farmers' interaction meetings in the last two decades to promote seabass farming in this country. CIBA has conducted field-level demonstrations of seabass farming in using diversified rearing systems in various coastal states with farmers' participation. We also offer technical support to the farming community and stakeholders across India. ICAR-CIBA has also been working with the farmers to promote community-based finfish nursery rearing and supply of fry and fingerlings to grow-out farmers in the nearby region. Seabass farming is getting popular and getting attention on a national level among the aqua farmers. In this scenario, it is essential to provide up-to-date technical know-how to them to have successful farming and good returns.

In this backdrop, this publication titled "Frequently Asked Questions on Asian seabass Seed Production and Farming" is conceived to provide as much as information in a simplified way on breeding, seed production, seabass nursery rearing, grow-out farming, feeds and feed management, water and soil quality, health management, harvest, marketing etc. We hope this will serve as technical support for the farmers and stakeholders. Authors deserve appreciation for their meticulous efforts in bringing out this farmer-friendly publication.

DIRECTOR

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CHAPTER – 1

ASIAN SEABASS (*LATES CALCARIFER*) - AN INTRODUCTION

1. What are the vernacular names of seabass?

Hindi	—	Bhetki
Bengali	—	Bhetki
Tamil	—	Koduva
Malayalam	—	Kalanji/Narimeen
Marathi	—	Jitade
Kannada	—	Kurudae meenu
Telugu	—	Pandu Kapppu
Australia	—	Barramundi



Asian seabass

2. Mention the habitat and distribution of seabass?

Seabass is considered as a euryhaline and catadromous species, it inhabits in freshwater, brackish and marine habitats including streams, lakes, estuaries and, coastal waters. Adults migrate to the sea for gonadal maturation and subsequent spawning. It is distributed throughout the Indo-Pacific region. Its range of distribution includes the areas from India, Australia, Malaysia, Singapore, Vietnam, Thailand and South East Asian countries.

3. Countries where seabass is widely farmed?

The countries that are popular for culture of seabass are Australia, Taiwan, Thailand, Singapore, Indonesia, Philippines, and Malaysia. In Australia, seabass is locally called as Barramundi and considered as an important food fish. In

India, seabass is being farmed by stocking hatchery produced seed and also seed sourced from the wild.



Asian seabass broodstock (male)

4. Highlight the feeding habits of seabass?

Seabass is carnivorous in nature. In the wild, they consume zooplanktons in their very early stages and when they grow to 10-20 cm length; they prey upon small fishes and shrimps. However, when this fish is farmed in the ponds and cages, it can be adapted to consume formulated feed. ICAR-CIBA has developed a series of formulated feeds (Seebass^{Plus}) for seabass nursery rearing, pre-grow out and grow-out culture stages.

5. What characteristics make Asian seabass fish a candidate species for farming in India?

Seabass is a high-value marine fish and has stable demand and high degree of consumer preference in domestic and international markets. Seabass is a euryhaline species capable of withstanding wide range of salinity from 0-40 ppt

and makes the species in wide range culture environments from freshwaters to seawater. It can be farmed in ponds and cages from freshwater to seawater environments. The fish can grow to 1.0 kg size in 6-8 months by consuming pellet feed. Availability of hatchery produced seed and formulated pellet feed ensures the year-round supply and thus enables easy adoption of seabass farming by farmers. It can also be farmed in net cages, floating cages and Recirculatory Aquaculture System (RAS).



Farmed seabass harvested from pond

6. How to select a suitable site for seabass farming?

Asian seabass can be farmed both in earthen ponds and cages. In the case of pond culture, the nature of soil, alkaline and acidic contents of the soil, availability of water, human resources, access to seed, feed, and market are the factors to be considered while selecting the site. Also, the site should have proper drainage facility and should be above the ground level to avoid unexpected flooding. Dry/ clay soil is more suitable for earthen pond based farming. The water pH range of 7.5-8.5 of the soil is appropriate for its growth. The site should be free from pollution and flooding.



Seabass farmed in brackishwater pond in a short grow-out farming cycle as option for crop rotation in shrimp farming

7. Mention the different phases of seabass farming

There are four different phases in seabass farming. i.e. hatchery phase (fry production), nursery rearing phase (fingerling production), pre-grow out phase (advanced fingerling production), and grow-out culture phase (marketable size production).

8. How are the ponds prepared for seabass farming?

Nursery rearing ponds: The pond should be smaller with a desirable size of 250-500 m^2. The fry size seed of 1.0 to 1.5 cm can be stocked in these ponds @ 40-50 nos/m^2 and farmed to the size of 7.0-8.0 cm in 60-75 days and then shifted to pre-grow out ponds. Four cycles of nursery rearing can be done in a year.

Pre–grow out ponds: Pre–grow out culture ponds of 500-1000 m^2 size can be used to produce advanced fingerlings. The fish can attain 12-16 cm in size in 60-75 days culture period and then the seed can be shifted to the grow-out pond.

Grow-out ponds: An earthen pond in the size of (0.5 to 1.0 ha) can be preferred. The pond depth should be around 1.5 m and preferably can be in rectangular shape for easy drainage and harvest.

CHAPTER – 2

SEED (FRY) PRODUCTION IN THE HATCHERY

9. How to identify the sex in seabass?

There is no sexual dimorphism in seabass. However, small size fishes with a size range from (2-3.5kg) can be males which can be confirmed by observing oozing milt when gentle pressure is applied on the abdomen. In the case of matured females, the fish can be noticed with an enlarged V- shaped belly and genital opening can be seen.



Analysis of maturation stage in captive broodstock maintained in CIBA fish hatchery

10. What is the size of broodstock fishes?

Seabass is protandrous hermaphrodite fish, which act as males during early stage (2-3 kg) and later, they turn into females (more than 4 kg) in size.

11. How is seabass fry produced in the hatchery?

After obtaining the fertilized eggs from the hatchery, they are stocked in the incubation tanks for hatching. After hatching the larvae are stocked in the larval rearing tanks @ 8-10 nos/l. Live feeds such as rotifers and Artemia nauplii are supplied on the second and ninth day of post hatch (dph) respectively. From 17th dph artificial feed is supplied to the larvae and the larvae are completely weaned from the artificial diet by 30-35th dph. The fry attains 1.5-2.0 cm size by this period and they are ready for nursery rearing.

12. What is the rearing duration of fry in the hatchery?

In the seabass hatchery the fertilized eggs hatch out in 17-18 hours after spawning. They are reared in tanks and fed with small rotifers, Artemia nauplii, and formulated diets. After 30-35 days of rearing they attain to the fry size of about 1.5-2.0 cm. These fry size seeds can be collected carefully and stocked for nursery rearing.

13. What are the feeds given to seabass larvae in the hatchery?

Rotifer, *Brachionus plicatilis* can be supplied as first feed to seabass larvae from 2nd day (dph) and continued up to 15th dph. Meanwhile, Artemia nauplii can also be included as feed from 9th dph along with rotifer. From 15 to 30 dph, Artemia nauplii can be supplied along with artificial feed from 17 dph. The fry can be completely weaned from the artificial diet between 30-35th dph.

Live feeds used in seabass seed production



Rotifer


Microalgae

14. How to stock seabass seeds in the ponds?

The seeds procured from hatchery have to be packed with water of similar salinity to that of stocking pond. Before stocking the seeds in the ponds or cages, they have to be acclimatized to the rearing conditions of nursery or grow-out system to avoid sudden stress. Acclimatization of seeds according to the pond condition can be done by mixing the pond water in a gradual manner for 5-10 minutes and thereafter, the seeds can be slowly released into the pond.

15. How to procure and transport the seabass seeds from hatchery to farm?

Before the procurement of seabass seeds from the hatchery, information such as number of seeds required, pond water salinity, mode of transportation and transportation hours have to be informed by the farmers to the hatchery personnel in order to maintain the seed in required salinity and to decide the seed packing density. Seabass seeds can be packed in the hatchery and then transported to the farm using oxygen inflated bags or in closed tanks with continuous oxygen supply and reduced water temperature. The transport density of fish seeds depends on weight, size, distance and salinity in which seed is packed and also transport duration. Normally, 400-500 nos. of fry size seed (1.0-1.5 cm) can be packed in 5 l of water for transport of 18-24 hours duration.

16. Explain the seed transportation methods for fry, fingerlings, and advanced fingerling?

Seed transportation is an important activity in seabass farming, where the seed has to be procured in good quality and needs to be transported without stress from the hatchery to the farm site. It is always easy to transport the small size (fry size up to 2.5 cm) seeds in oxygenated polythene bags filled with 5-6 l of seawater/freshwater. The fingerlings and advanced fingerlings (5 cm and above) can be transported in open containers (tanks) provided with oxygen bubbling. Water temperature can be reduced by keeping the ice cubes as per requirement. Even though the seabass seed can be transported to any destination, it is suggested to produce fingerling size seed near the grow-out culture site to avoid transportation cost since fingerling seed transportation by the tanker would involve high cost.



Live transportation of seabass seeds

17. How much would it cost to establish a new seabass fish hatchery?

Approximately an amount of 3-5 crores will be required to establish a new seabass fish hatchery in the coastal area. In this hatchery facility, 5 million fry can be produced per annum. CIBA offers technical support to establish seabass hatchery in a Public – Private Partnership (PPP) or 3P mode on consultancy basis. Those who are interested to establish seabass fish hatchery can contact the Director, ICAR-CIBA, Chennai, for guidance and consultancy.

CHAPTER – 3

SEABASS NURSERY REARING

18. What is nursery rearing?

The fry size seabass seed (1.0 – 2.5 cm) obtained from hatcheries can be raised into fingerling size (7.5 to 10 cm) in hapa/ tank/ pond system for a period of 60-75 days by supplying suitable artificial/ live feeds. This rearing period is considered as a transitional phase where the fry can be weaned to the artificial feed and also can be acclimatized to the prevailing environmental conditions of the pre-grow out and grow-out culture system.

19. What are the methods that can be used for seabass nursery rearing?

Seabass nursery rearing can be done in three different systems. Seabass fry can be reared in small size ponds, hapas and tanks. Nursery pond size can be 200-500 m^2 area which can be maintained with a water depth of about 75 cm-1.0 m. The hapa, with the size of 2-4 m^2 with a mesh size of 1.5 - 3 mm can be used with 1 m depth. Nursery rearing tanks can be of 5 to 10 ton capacity.



Stocking of seabass fry in pond based nursery rearing



Seabass nursery system in open brackishwater

20. How is seabass nursery rearing carried out in ponds?

A well-prepared pond of 200-500 m^2 area with water depth of 1.0 m can be used. Organic manure is applied at the rate of 500 kg/ha. After the growth of phytoplankton in a week, zooplanktons, copepods, *Acetes*, etc. can be inoculated. Then, seabass fry 1-2 cm) can be stocked @ 40-50 nos/m^2. It is desirable to grow some zooplanktons, such as copepods, small shrimps and small fishes in another pond and kept ready for giving as feed. This feed can be partially used for feeding the seabass fry at the beginning and slowly changed (weaned) to formulated dry feeds. Dry feeds such as Seebass^{Plus} can be offered at 8-12% of total fish biomass in the pond. After 6-8 weeks, the fish will attain fingerling size (7.5 -10 cm) with survival of 50-60%. These fingerlings can be stocked in pre-grow out ponds.

Different life stages of seabass



Seabass fry (18 days old)



Fingerlings



Pre-adults

NURSERY REARING OF SEABASS FISH IN SMALL CAGES - A PROVEN LIVELIHOOD MODEL FOR THE FAMILIES IN COASTAL MAHARASHTRA

ICAR-CIBA and Mangrove Cell, Govt. of Maharashtra have initiated CIBA's three tier model seabass farming as a livelihood activity 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 coastal communities. A Self Help Group (Jai Ganesh SHG) comprising of 6 women and 2 men were formed and hapa-based seabass nursery rearing of Asian seabass were demonstrated.

CIBA team provided hands-on training and demonstration to SHG's on various aspects of seabass nursery rearing such as pond preparation, hapa installation seed stocking, grading, feeding, hapa cleaning and water quality management. Hapas (2x1x1m of 2 mm mesh size) were installed in a pond with water depth of 1.5 m. A total of 7500 seabass seeds (1.8-2.0 cm) were stocked at a density of 500-750 per hapa.

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 seed to avoid the differential growth and cannibalism. The grading helped to reduce cannibalism and improved the survival rate. After 75 days nursery rearing, the seed reached to the fingerlings size of 8-10 cm and 10-12 g with a survival of 71.9% (5394 fingerlings).

The harvested fingerlings were sold @ ` 20 per/seed to another SHG Vithal Rakhumai, Nivati for pre-grow out culture in the small volume cages. Through this activity, Jai Ganesh SHG earned a total income of ` 1,07,880/- In this model, Jai Ganesh SHG members by spending only 1-2 hrs daily, earned an income of ` 13,500 as an alternative livelihood.

21. How to practice hapa based nursery rearing?



Grading of seabass fry in nursery rearing

Coastal fishers can practice seabass nursery rearing in net hapas fixed in open water bodies or in ponds. Hapas can be fabricated using nylon or High Density Polyethylene net material of sizes such as 2mx1mx1m or 2mx2mx1m and can be fixed in water top layer at a required depth (1.0 to 1.5 m). Hatchery produced seeds of 1.5 to 2.0 cm size can be stocked in hapas @ 500 - 750 nos/ m^2. The fry can be fed with specially prepared nursery feed at 8-12% of the biomass/day split into 3-4 rations. Due to the cannibalistic behavior like larger fish feeding upon the small ones, grading at frequent intervals (weekly twice) is to be carried out to keep uniform-size juveniles together and facilitate maximum survival. Grading of fish seed at every 3-4 days interval at the beginning and later for every 10-15 days should be done manually. While grading, hapas should be cleaned to ensure removal of debris attached to the hapas for free flow of water to keep good water quality and oxygen level. The fry will reach a fingerling size of 7.5 – 10 cm long in 60-75 days with 65-75% survival.



Routine cleaning of hapas

22. How to select hapa size for seabass nursery rearing?

The size of hapa measuring 2mx1mx1m to 2mx2mx1m will be suitable with the mesh size of 1.5-3.0 mm. As the seed grow into bigger size the mesh size can be increased. Care should be taken to see that size of mesh selected can retain the seed in hapas without escaping the mesh. Before stocking the seed, all the hapas have to be examined properly to find out the damage. if any damage found, it can be rectified and used.

23. Explain the tank based nursery rearing method

In the tank based system, seabass fingerlings can be produced either by adopting flow-through method or Recirculatory Aquaculture System (RAS). The rearing tanks size can be 5-10 tons capacities. In the RAS, facilities such as drum filter, protein skimmers and filter, biological filter and UV filtration have to be incorporated to filter the water pumped from the rearing tanks.

The water level must be maintained minimum 1 m in nursery rearing tanks. There should be provision for water exchange whenever required. The density of 500 – 1000 fish fry/m^3 is desirable in RAS. Specially prepared floating or slow sinking pellet feed can be supplied @ 5-8% of fish biomass. Regular grading and cleaning of tank bottom and water exchange should be done to maintain good water quality. Tank disinfection has to be carried out every fortnight to maintain the fishes in hygienic conditions. Seeds will attain size of 7.5-10 cm in 60-75 days with 60-75% survival.

24. What will be the average market price for fingerlings?

The average market price of seabass fingerlings measuring 7.5 – 10 cm would be around ` 35-40.

25. How to increase the survival rate of seabass during nursery rearing?

Nursery rearing has to be done with proper stocking density, supply of appropriate feed, timely grading and proper management of rearing system can achieve better survival rate and fetch better rate.

CHAPTER – 4

SEABASS GROW-OUT CULTURE

26. Mention different types of seabass production systems

Seabass can be farmed in ponds and cages. In the pond system, seabass advanced fingerlings can be stocked @ 4,000-5,000 nos/ha to get the production around 4.0 tons/ha. Seabass can be farmed both in freshwater and brackishwater ponds. The preferred pond size can be 0.5 to 1.0 ha. The size can be either rectangular or circular and the dimension can be decided based on the production plan. Seabass advanced fingerlings can be stocked @ 25-30 nos/m^2 in the cage culture system and the productivity can be @ 20-25/nos/m^2. Recently, farming of seabass in land-based tanks with RAS facility has been gaining popularity, where the productivity can be increased. For cage culture in open water, parameters such as water depth, water flow rate, etc., need to be considered by selecting the site.



Seabass from pre-grow out system

NURSERY REARING OF ASIAN SEABASS IN POND AS A LIVELIHOOD MODEL FOR TRIBAL COMMUNITIES OF GUJARAT

Navsari Gujarat Research Centre of CIBA (NGRC), is actively involved in the research and developmental activities in the field of brackishwater aquaculture. The research work carried out in this station had resulted in several commercially viable technologies. NGRC has initiated developing customized farming models for finfish and shellfish culture for tribal communities. This initiative resulted keen interest among the tribal community to adopt the technology for their livelihood support. Therefore, a tribal SHG named Om Sai Self Help Group comprising of men (2) and women's (6) were formed to take up seabass nursery rearing as a livelihood activity.

The inputs required for nursery culture of seabass such as seed, feed, net materials, plastic wares for grading etc., were provided. The NGRC scientific team provided training and demonstration to SHG's on pond preparation, hapa installation, cleaning, seed stocking, grading, feed preparation, feeding and water quality management, etc. A pond in the size of 2000 m^2 with the depth of 1.5 meter was used. Prior to stocking of the seed, the pond was disinfected for removal of unwanted predatory fishes, crabs, etc., and used for stocking.

Hatchery produced seabass seed (10,000 nos; 1.5-2.0 cm) procured from CIBA hatchery, Chennai were acclimatized and provided to SHG members. The seabass seeds were stocked @ 500-700 nos/hapa. During rearing period, the fries were fed with CIBA formulated seabass larval feed (0.2 mm-1.2 mm) @ 8-10% body weight two times a day. For small seed (1.5-4.0 cm), the feed ball were kept in feeding tray which is tied inside the hapa while for fry size seed slow sinking pellet feed were dispensed slowly in the hapa.

Regular grading was done by the SHG members at the interval of four days to separate the shooters and to maintain uniform size. After grading, separated shooters and the small size seed were kept separately according to their sizes in different hapas. The grading helped to avoid cannibalism

and improved survival rate. After the nursery rearing of 90 days, the seed attained the fingerlings size of 8-10 cm and 10-15 g with survival of 60% (6,000 nos). The harvested fingerlings were sold at ` 25-45 to local farmers and entrepreneurs for grow out culture in pond and cages.

Based on the above activity, Om Sai Tribal Self Help group of Matwad, Navsari earned total income of ` 2.40 lakhs as additional revenue from sale of seabass fingerlings. Thus, the each member of SHG earned an additional income of about ` 10,000/month by participating one or two hrs/day in seabass nursery rearing activity.

27. What is the stocking density to practice cage culture?

In grow-out cages, advanced fingerlings of 80-100 g can be stocked @ 25-30 nos/m^3 in order to yield 20-25 kg/m^3 after 6-8 months of culture. The stocking density should be decided either to increase or decrease based on the water quality depth and management protocols.

28. Is it possible to grow more fish in cages than in the pond system?

Yes. In cages, free water exchange provides a natural condition to the growing fish which help them to undergo a normal growth pattern with suitable feed.

29. Can the small size fingerlings (5-7 cm) be directly stocked in the grow-out farms?

The fingerlings in the size of 5-7 cm need to be cultured in pre-grow out cages up to 12 cm size. Small size fingerlings cannot be stocked directly in the grow-out farms, since the cannibalistic behavior of seabass fingerlings can lead to low survival rate. Therefore, it is advisable to stock (80–100 g) advanced fingerlings in the grow- out culture, so that it can attain 1 kg body weight within 6-8 months.

30. What is the stocking density of advanced seabass fingerlings for one acre size pond?

The seabass advanced fingerlings (80-100 g) can be stocked @ 1,200-1,500 nos/acre to get an yield of 1– 1.2 ton /acre by adopting better management practices

CHAPTER – 5

SEABASS FISH FARMING - AN IMPROVED METHOD

31. How seabass can be grown in improved farming method?

In traditional methods, low-value fishes can be given as feed to seabass. However, such a feeding method may not be possible always as low-value fishes may not be available everywhere throughout the year. Besides the cost of low value fishes will be fluctuating and may not be available in adequate quantity which can affect the farming practice. ICAR-CIBA has developed a range of formulated feeds (Seebass^{Plus}) for different life stages specific to different rearing systems, such as ponds, RAS and open-water cages. Since, seabass require high protein energy rich feeds. To address this issue, ICAR-CIBA's Seebass^{Plus} has been widely demonstrated in different farming systems, with a FCR of 1.5-1.6. In the improved farming method, scientific



Battery of floating cages in open brackishwater for grow-out farming of seabass

practices are adopted with specific stocking density, feeding with formulated feed, regular monitoring of water quality and fish health in order to achieve good production.

32. What is the stocking density to be adopted in the improved farming method?

In the improved farming method, advanced seabass fingerlings (80-100 g) can be stocked @ 5,000 – 6,000 nos/ha so as to get a productivity of 4.5 to 5.0 tons/ha in the pond system in a period of 6 – 8 months.

33. What is the crop period of improved farming method?

The juvenile fish (80-100 g) stocked will grow into the average size of 1 kg in 6-8 months. They can also be reared further for another 4-5 months to get a size of 2 kg which can fetch premium price in market.



Organised seabass nursery rearing in pond based system

CHAPTER – 6

WATER AND SOIL QUALITY PARAMETERS

34. What is the desired depth of the water in the culture systems?

In cage based systems, the depth of water in open water bodies should not be less than 2 m. For hapa based nursery rearing in open water bodies, 1-1.5m water depth is required. In pond based culture system, the pond should have a minimum of 1.5 m water depth.

35. How can landless aqua farmer practice seabass farming?

Those who do not own a pond can use open water bodies to grow seabass as group livelihood activity. However, this can be taken up by the coastal fisher communities with the approval of competent local authority.

36. What are the factors to be considered for site selection of seabass in open brackishwater bodies?

The site selected should be away from river flow and industrial establishments. Water bodies with highly erodible nature should be avoided because it increases turbidity and siltation.

37. What are the optimum soil quality parameters to be maintained in seabass culture pond?

Soil quality should be maintained properly in seabass culture pond and soil quality indicators such as pH should be monitored at regular intervals. The optimum soil pH should be between 7.0 to 8.0. Organic carbon content in the pond soil has to be analysed to monitor organic load accumulation on the pond bottom.

38. How is the water quality maintained in fish culture pond?



Pond water quality is one of the most critical factors in seabass culture. To maintain the water quality within optimal level, proper management of feed, water exchange, aeration (if needed), etc. need to be provided based on standing biomass. Dissolved oxygen level has to be maintained @ 4.5 ppm and above. Water depth of 1.5 m needs to be maintained in grow-out culture pond. If necessary, water exchange can be done as per requirement.



Regular monitoring of water parametres using kits

39. What is the importance of pond water exchange in the grow-out culture ponds?

During the initial period of culture, water exchange may not require due to less biomass. However, in due course, as the biomass increases, dissolved oxygen level may come down to below 4.0 ppm which is considered as below the optimal range. During this time, aeration can be provided or water exchange can

be done. The water level in the pond may drop due to evaporation, which can be compensated by pumping the creek water into the pond as per the need either on a daily basis or on weekly basis to facilitate better growth.

40. What is the preferred time to exchange water in fish culture pond?

The best time to exchange water is early morning hours or evening hours.

41. What are the optimum water quality parameters to be maintained in seabass culture pond?

Parameter	Range
Water Temperature	27- 32^{o}C
Salinity	5.0 - 35 ppt
pH	7.5 - 8.2
Dissolved Oxygen	4.5 ppt or more
Ammonia	< 0.1 ppm

CHAPTER – 7

FEEDS AND FEED MANAGEMENT

42. State the importance of feed management in seabass culture?

Quality feed must be provided in right quantity to get maximum growth and to reduce the feed wastage besides reducing the cost of production. The size of feed particle should be suitable for mouth of fish and they should be trained to take feeds at certain time daily. Feed ration is calculated based on body size. The percent quantity of feed required is higher at the initial stages and as the fish grows, it decreases. But the absolute quantity of feed offered increases as



Pilot scale feed mill at Muttukadu Experimental Station of CIBA

the fish size increases during the course of culture. To start with, during the fingerlings stage it would be around 10% of total biomass of fish and the percent feed decreases to 2 to 2.5% at the time of harvest when fish attains about 1 kg. It is good to give feed in 3-4 rations per day in the early phase and then a minimum of 2 times feeding would be sufficient. Over feeding should be avoided to reduce direct feed wastage and to prevent water quality deterioration.

43. Can we feed small fishes as feed for seabass (or) can we use low-cost forage fish as feed for seabass?

Seabass stocked in grow-out farm can be fed with low value fishes like tilapia, minor carps, sardines etc., Due to the sustainable issue and feeding with trash fish elicits considerable concerns in recent days and hence, it is not encouraged primarily.

Small scale seabass culture can be carried out where small fishes not fit for human consumption are available in plenty as feed with an assured supply throughout the culture period. The main problem associated with feeding trash fish is erratic supply and necessity for cold storage. In addition, chance of introducing pathogens through this type of wet fish feeding poses a major risk. Hence, formulated feeds are best options for the culture of seabass. In the recent days, the cost of trash fishes are also in the increasing trend owing to the demand from other sectors such as poultry feed etc.

44. How to get training on formulated fish feed preparation for seabass?

ICAR-Central Institute of Brackishwater Aquaculture has developed a complete package of pellet feed formulation and processing technology available for transfer to the entrepreneurs on a non-exclusive basis. Those who are interested in the feed manufacturing technology can contact the Institute.

45. Mention different types of formulated feeds available for grow-out culture of seabass?

Seabass feeds are available as floating, slow sinking and sinking pellets. Formulated feeds for seabass feed can be produced using an extruder or ring die pelletizer.





Cost –effective formulated feeds for different life stages of seabass

46. Whether the same feed can be used for seabass during hatchery, nursery and grow-out phases?

No. The nutrient requirement of seabass varies with life stages and extensive research conducted at CIBA leads to the development of various types of feeds suiting to specific physiological stage.

47. State the different kinds of seabass formulated feeds developed and their nutrient contents?

CIBA's extensive and focused research efforts have resulted in the development of following feeds:

1. Seebass Larvi^{plus}

- This is a specialised feed meant for feeding in the hatchery. It is available as microparticulated as well as marumerized feed.
- Microparticulated feeds are available in three sizes ranging from 150 to 300 micron, 300 to 500 micron and 500 to 700 micron. The microextruded feeds are available as 300 and 500 micron size.
- These feeds contain 50 to 55% crude protein with 16 to 18% lipid.

49. Seebass Nursery^{plus}

- This is meant for feeding in the nursery phase. It is also available as microparticulated as well as marumerized feed.
- The microparticulated feeds are available in three size ranges of 700 to 900 micron and 900 to 1200 micron. The micro extruded feeds are available as 800 micron size feed.
- These feeds contain 45 to 50% crude protein with 14 to 16% lipid.

50. Seebass Grow-out^{plus}

- This is meant for feeding in the grow-out stage. It is available as sinking pellet feed as well as slow sinking and floating extruded feeds.
- These feeds contain 40 to 42% crude protein with 10 to 12% lipid.

48. What is meant by FCR and what is FCR of CIBA's seabass formulated feed (Seebass^{Plus})?

Feed Conversion Ratio (FCR) is the ratio indicating the quantum of feed required to produce one kilogram (wet weight) of fish. If the FCR of feed is lower, it indicates that nutrient content in the feed is optimum, better utilized and efficiently converted into fish biomass. Good feed management practices and water quality management may bring down the FCR. Our experiences with Seebass^{Plus} under Indian farming conditions resulted in FCR of 1.3-1.8 based on the culture systems and feed management.

49. Is the Seebass^{Plus} feed available for sale at CIBA to fish farmers?

CIBA is having a pilot-scale feed mill for producing feeds for research and demonstration purpose only and not for commercial use; however, fish farmers can approach ICAR-CIBA and undergo training regarding preparation of the same.

50. How many days Seebass^{Plus} feed can be stored without affecting the nutrient content?

If the feed is processed to a moisture content of less than 12%, it can be stored properly in a dry and well-ventilated place, approximately for three months.

51. How ICAR-CIBA can facilitate a farmer / entrepreneur to produce Seebass^{Plus} feed with the technical guidance of CIBA?

CIBA will provide a complete package of technical assistance to the clients. This includes training on the science of fish nutrition, practical feed formulation, and establishment of feed mill, procurement of machinery, sourcing of ingredients, and processing of feed. For this purpose, a Memorandum of Understanding (MoU) has to be signed.

52. Is there any farm-made feed that can be prepared and used in a simple and easy way to grow seabass?

Yes, CIBA has the technology for small scale farmers also and they can prepare their own feed for seabass at farm level and for more details, ICAR-Central Institute of Brackishwater Aquaculture can be approached.

53. Is there any other benefit in providing tilapia fish as feed to seabass

Technically speaking, offering live tilapia to seabass will be good option to maintain pond water quality. At the same time, too much forage fish density will deplete dissolved oxygen faster and create stress to seabass. It is economical sometimes, if tilapia is produced or available for free of cost or low price. However, feeding the fish with fish is discouraged due to inconsistent supply which can lead to societal concerns, cannibalism and differential growth.

54. What is the percentage of expenditure on formulated feed of seabass?

Generally, feed is the major recurring cost in any type of aquaculture operation including seabass culture and the cost of feed alone will contribute approximately 50-60% of the operational cost. High FCR between 6.0 - 7.5 is also another concern.

55. Mention the feeding rate of seabass in summer and winter seasons?

Seabass feed consumption depends upon the quality of feed and the water temperature in summer and winter months. In winter, very low temperature will cause a decreased appetite for feeding and it is advisable to feed during 9-10 AM and 4-5 PM whereas, in summer the feed can be given during 7-8 AM and 5–6 PM. Feed rations can be adjusted according to the daily intake quality.

56. How does feeding adjusted in the practical culture of seabass?

The feeding table given by the manufacturer is only a guideline. Seabass is to be fed until satiation and the moment pellets are left by the fish feeding should be stopped. Here, one has to be very careful as underfeeding results in poor growth and hungry ones will try to attack weaker ones, thereby paving the way for cannibalism and reduced survival. On the other hand, overfeeding not only increases operational cost but also causes water quality deterioration.

57. Whether seabass can be cultured using trash fish or formulated feed? What is the significance of using formulated feed over low value fishes/trash fish?

Yes. Seabass can be cultured using low value/trash fish as well as using formulated feed. When the trash fish is used, the farmer has to feed 6-8 kg of trash fish to produce one kg of live seabass. On the other hand, about 1.5 to 2.0 kg of formulated feed is sufficient to produce 1 kg of seabass. Hence, the farmer has to calculate the feed cost and fish cost to produce one kg of seabass and he can choose. However, trash fish will not be available in larger quantity and regular availability is also an issue. Further, the ease of handling and ready to use formulated feed is advanced in many aspects. Hence a quality effective is advantageous over feeding trash fish.

CHAPTER – 8

HEALTH MANAGEMENT

58. How to manage fish health during grow-out culture?

Seabass fish farmed in ponds or cages must be monitored at regular intervals not only for assessing the growth but also to check the health status from time to time. Water quality, temperature, dissolved oxygen level, salinity, and must be monitored daily, weekly and biweekly at regular basis. The growing fish have to be sampled every fortnight and examined physically for the parasitic or bacterial infection, if any. As long as the water quality management and feed management are done properly as per the protocols, fish may not have any stress. If the fish undergo any stress due to bad water quality or under feeding/over feeding, it may cause stress to the fish. Therefore, the recommended best management practices have to be followed at all the stages of seabass farming to maintain fish health in good condition.

59. Is it possible to culture seabass throughout the year?

Seabass can be cultured in all seasons. However, during the winter months, growth will be less due to low temperature compared to other months.

60. What are the common causes for disease occurrence in seabass farming?

The common causes are:

a. The fish seed stocked should be free of pathogens.

b. High stocking density and improper management of water quality.

c. Poor feed management (either under feeding or over feeding).

d. Frequent and unscientific fish handling.

61. What are the common pathogens observed in seabass farming?

Poor water quality in culture ponds, poor nutrition, pathogens like bacteria, fungus, protozoans, viruses, and other parasites can cause diseases in seabass. The most common pathogens observed are:

a. Parasites : *Caligus spp.*, *Argulus spp.*, Monogenea
b. Bacteria : *Vibrio* spp.
c. Virus : Betanodavirus



Occasionally, young seabass will get infested with external parasites and microbial pathogen

62. Mention the stages of seabass that are more vulnerable to diseases?

Diseases can happen at any stage in seabass if the stock is not properly managed. However, early stage (fry/ fingerlings) of seabass needs to be handled carefully, since they are reared in more crowded condition during hatchery/nursery stage than in grow-out ponds.

63. Which parts of the seabass get affected by diseases?

When disease occurs in seabass, external symptoms can be seen vividly on the body. Skin, eye, gill, and internal organs are examined to find out the exact disease. The disease can easily be diagnosed and proper treatment can be given according to the severity of disease.

64. What are the symptoms of infected or diseased fish?

Diseased fish display the following signs and symptoms:

a. The infected fish come up to the water surface or to the sides of pond, isolated from the healthy fish, restless and show unusual movements.

b. Fish appear darker in colour.

c. Gills and fins appear eroded.

d. Wounds or ulcers can be seen on the body.

e. Fishes do not take feed.

f. Gills will be pale in colour.

g. They shall rub against the edges of ponds very often.

h. Fish lose their weight and appear emaciated.

65. What are the common disease preventive methods?

In fish culture pond, water quality parameters have to be maintained in an optimal range. If the parameters are found deviated, proper remedies such as providing aeration, pond water exchange can be done immediately. The seeds to be stocked in pond must be screened for pathogens, if any, before procurement and only pathogen-free healthy seeds can be stocked in the ponds. The quantity of feed supplied and intake of feed must be monitored on a daily basis and feed ration can be adjusted and supplied to the farmed fish according to the consumption rate. Prevention is better than cure. Therefore, all precautionary measures need to be taken while stocking the seeds and during the culture period.

CHAPTER – 9

HARVESTING OF SEABASS

66. What are the types of nets can be used for harvesting seabass from culture ponds?

It is important to harvest seabass from culture ponds without any injury so that they can be sold in good condition. Drag nets can be used for harvesting the farm-grown seabass. Early morning will be the appropriate time for harvest. Before harvest, water level in the pond must be reduced to one foot and then the fish should be caught with a dragnet. Cast net can also be used to catch the fish from ponds at later stage when pond water depth is very low. Finally, fish that are found at pond bottom can be hand-picked to ensure that all fishes are harvested.



Harvest of seabass from brackishwater ponds using drag net

67. What is the best method to market seabass?

Live fish marketing is the most profitable. The fish harvested from pond must be given adequate care to avoid physical injury that degrades the quality and value. It should be washed to remove mud and then sorted according to size. Crushed ice should be placed along with fish in the insulated storage boxes in the ratio of 1:1 and then transported to the market.

68. What are the steps to be taken by the fish farmers to harvest seabass from ponds?

The farmer has to finalise the selling price with the traders who will purchase the harvested fish before harvesting. Harvest net, manpower to operate the net, pumping facilities to drain out the pond water, required quantity of ice, weighing balance, baskets to carry the harvested fish from pond site to processing yard have to be arranged. If partial harvest is planned, the harvest can be done as



Harvested seabass ready for marketing

per the local demand and also care should be taken not to injure the other fishes that has to be reared further in the farm. A dragnet of suitable size is recommended for harvest. After harvest, fish can be chill killed, washed, and sorted into different size groups before sending to market.

69. How are the harvested fish preserved with ice?

It is advised to chill kill the fish immediately after harvest to maintain freshness. The purpose of chilling is to prolong the shelf-life of fish. Crushed ice can be placed along with fish in the fish basket @ 1:1 ratio. It is preferable to use styrofoam boxes to transport the fish with ice.

70. How can seabass be harvested partially and sold in local markets?

It is better to get an idea about the demand of seabass in local market. Based on the demand, and required quantities in the local market, selected size can be harvested partially using dragnet on daily or weekly basis and then sold. Since the fishes that are weighing above one kg can offer better price, the farmer can harvest. The seabass that are above one kg can be sold in the market. At the same time, small sized fishes can be reared further in the pond till it reaches one kg size fish. Moreover, fish weighing one kg or above must be sorted and sent to market and low weighing fish can be left in the pond itself for further growth.

CHAPTER – 10

PRODUCTION AND SALES

71. What is the feed conversion ratio when seabass is farmed with trash fish feeding?

To attain 1.0 kg body weight, seabass has to be fed with 6.0-7.0 kg of low-value fishes, such as tilapia, sardines etc.

72. What is the cost of low-value fishes?

In current market conditions, the cost of low-value fishes, such as tilapia varies between ` 30 and 60/kg and the price depend on size of the fish, demand and supply. Some farmers produce tilapia and are using them as feed for seabass.

73. What is the cost of production for one-kilogram of seabass fish?

To grow seabass in cages or ponds, the cost of production of one kilogram of seabass ranged between ` 200-275. Farm gate price ranges from ` 400-600/ kg, according to the market and season.





Seabass- a fish highly amenable for family farming model

74. What is the preferred size in Indian market and what would be the ideal size for harvest to get better price?

Seabass that are harvested 1.0 kg and above can fetch better price, since it is the most preferred size by the consumers in domestic market.



Seabass, a fish highly suitable for farming in freshwater and integration with agriculture

75. What is the prevailing cost for different size of seabass seeds and what will be the selling price of seabass?

Fry size (1.5-2.0 cm)	- ` 4.5 - 7.0 /no
Fingerlings (5.0-7.5 cm)	- ` 25 - 35 / no
Advanced fingerlings (10.0-15 cm)	- ` 45 - 60 / no

Economic analysis of three-tier system cage aquaculture of Asian seabass in coastal waters

Module details	Unit & Details	Nursery (N)	Pre-grow out (PG)	Grow-out (G)
Fixed investments				
Hapas/Cages	` Lumpsum	20000	30000	75000
Accessories (Outer net, poles, HDPE nets, bird cover, ropes, sampling devices, moorings, float etc. including transport).	` Lumpsum	20000	30000	40000
Total fixed cost	`	40000	60000	115000
Depreciation	25% of the fixed cost in case in case of cages that last for 4 crops and for other items @ 8% which last long for 6 crops	6600	9900	21950
Interest on fixed cost	8% p.a.	3200	4800	9200
Insurance on the fixed investments	2% p.a.	800	1200	2300
Total Fixed cost per crop	` (d + e + f + g)	10600	15900	33450
Operational Expenses				
Seed cost including transport	Nursery : 10,000 nos of 2.5cm of fry @ ` 5 / per fry. Pre-grow out: 1800 juvenile fish @ ` 30/ fingerling & Grow-out: 1200@ ` 80/ fish	50000	54000	96000
Feed cost	` 90/kg	5400	20700	155520
Miscellaneous expenses	` Lumpsum	1600	1800	5780
Total operational expenditure	` Lumpsum	57000	76500	257300
Total expenditure	`	67600	92400	290750
Income and Profitability				
Production	Nursery: Fingerlings of 5-6 g size with 40% survival, Pre-Grow out: Juvenile fishes of 100g, 80% survival, Grow-out :fish with 1 kg ABW, 90% survival	4000	1440	1080
Cost of production		16.90	64.17	269.21

Module details	Unit & Details	Nursery (N)	Pre-grow out (PG)	Grow-out (G)
Gross income	` 30/fingerling; ` 80/ juvenile and ` 400/kg Adult fish	120000	115200	432000
Net income per crop	n-l	52400	22800	141250
Benefit Cost Ratio	Present value(PV) of benefits/PV of costs	5.31	1.48	4.97
Pay Back Period	in Months	3.05	10.53	4.88
IRR (in percentage)		130.12	30.20	121.79
Monthly income for the group in	**Months** Nursery : 2 Pre-grow out: 3, & Grow-out: 6	26200	7600	23542
Monthly income per person (2 hrs./day)	**Persons engaged** Nursery : 3 Pre-grow out: 2 & Grow-out: 3	8733	3800	7847

76. Which is the best season to market seabass so as to get better price?

The appropriate months to sell seabass for an attractive price will be festival season from October-January, during Dussehra, Onam, Deepavali, Christmas, Pongal, and April-May during summer vacations and during ban period of sea-fishing.

77. Which markets in India have more demand for seabass?

In West Bengal, seabass is locally known as Bhetki and can fetch a premium price in Howrah market and Sealdah. In other states, such as Kerala, Goa, Maharashtra, Gujarat, Karnataka, Tamil Nadu, and Odisha there is a great demand for seabass.

78. Will the price of seabass fish vary with regard to size in local markets?

Yes, the market price varies depending on individual fish weight. The fish that weigh above 1.0 kg can fetch ` 400/kg and above. Fish that are less than 1.0 kg can fetch the price from ` 250-` 350/kg.

79. What is the scope for seabass to sell in the overseas market?

There is a great demand for seabass fish in overseas countries, such as UAE and other Middle East countries, Europe, USA, Hong Kong, etc.



Customized cost-effective cages fabricated using steel frames and plastic barrels

80. What is the dressing percentage of seabass fish?

Though the edible portion is over 60% when the head, tail, skin, bone and fins are removed, dressing percentage of seabass fish is 50-60%. This means that about 50-60% of fleshy material will be available for cooking and eating after cleaning. This percentage may slightly differ depending upon the size and condition of individual fish.

81. Mention the techniques in seabass fish value addition

In India, consumer preference for value added fish products is less. In general, value addition is done mostly for low value fishes to get better price. Since seabass is a high value fish, domestic consumer directly purchases it from markets. However, in countries like Europe and Australia there is a great demand for fish fillets.

82. What is the procedure to sign a MoU with CIBA for working under PPP mode?

The farmer or entrepreneur has to send a request for the joint working by an email or a letter to The Director (director.ciba@icar.gov.in). Based on feasibility and Institute's mandate the individual will be called for a personal discussion for working out the modalities. The duties and responsibilities of the individual and institute will be mutually agreed upon and put in a formal MoU. The work can be initiated thereafter.

CHAPTER – 11

CAGE CULTURE

83. What is cage farming in brackishwater and what are their types?

Rearing of seabass in closed net enclosures in open water is known as cage farming. Based on the water depth stationary cages can be designed and customized according to the hydrodynamic conditions of the water body.

The cages can be categorized into three types, normally

1. Floating cage
2. Submerged cage
3. Stationery fixed cage



Customized cages fabricated using High Density Polyethylene frames and Polyvinyl chloride handrails

84. How to identify a suitable site for cage farming in brackishwater bodies?

Brackishwater lagoons, backwaters and estuaries >3 m depth with good water circulation are suitable for cage-based seabass farming. The optimum water quality parameters include salinity range between 10-35 ppt; pH 7.5-8.5; DO: > 4.0 ppm; Ammonia: <0/1 ppm and a water current of up to 30 cm/second. Besides, the site should be free from industrial waste discharge, access to road, free from fishing activity, people's movements and other anthropological activities may be considered for selecting a site for cage culture of seabass.

85. What are the advantages of cage culture?

a. Fish is cultured in the natural conditions hence better growth can be expected over pond culture.
b. The investment is relatively low vis-a-vis pond based farming.
c. The area required for farming is less.
d. Efficient utilization of brackishwater resources for fish produce.
e. Coastal fishers can take it as an additional income generation activity.
f. As cages are kept in places where there is free water exchange, the fishes can get better oxygen supply.
g. Culture practices can be scaled up in the open water bodies.
h. Easy to handle the fishes for sampling, grading and harvest.

86. Mention the shapes and dimensions of cages. What is the cage dimension used widely for seabass farming?

Cage can be either circular or rectangular in shape, and can be made with either GI frame or HDPE frame. Net materials should be made up of HDPE. Before stocking the juvenile fishes in grow-out cages, fingerlings (5-7.5 cm size) can be reared in pre-grow-out cages to grow them into juvenile size of 80-100 g. Grow-out cages can be customized as per the requirement. Cages of 4.0 m x 4.0 m x 2.0 m or 6.0 m x 3.0 m x 2.0 m are suitable for better handling. Size of cages can be altered based on the nature of water body. Usually, circular cages are preferred in open sea, whereas square or rectangular are preferable in shallow waters.

87. What is the mesh size of net used for grow-out cages?

In grow-out cages, HDPE nets with the mesh size of 20-24 mm can be used. During initial days of stocking, nets with mesh size of 10 mm-18 mm can be used since the seed size would be between 80 and 100 g and later, large mesh size can be used as the fish grows to bigger size.

88. What should be the suitable size of fish to stock in cages?

One can stock and grow seabass in a phased manner with respect to its growth. Farmers can name them as nursery cages, pre grow-out, and grow-out cages. In normal conditions with sincere efforts, seabass fry from hatchery can be grown from 2.0 cm to 8.0 cm in nursery hapas. The fingerlings of 8.0 to 10 cm can be stocked in pre-grow out cages and cultured till the fish gain the weight between 80 and 100 g. These juvenile can be transferred to grow-out cages and can be cultured to a table size of 1.0 kg and above.

89. What is the stocking density of seabass in grow-out cages?

Stocking density depends on the hydrodynamics, infrastructure and other resources. We can reverse calculate the stocking density from final target biomass. In grow-out cages, juvenile seabass @ 25-30 nos. /m^3 can be stocked to get a productivity of 20-25 kg/m^3.

90. What is the three-tier cage culture model?

Farming of seabass to produce fingerlings, advanced fingerlings and harvest size in three different rearing systems of nursery, pre-grow out and grow-out



Seabass farming in open brackishwater using three tier model

in the same water body is known as three-tier culture model. In this model, the input (seed) can be obtained from one tier to another, like supply of fingerlings from nursery phase to pre-grow-out phase and supply of juvenile from pre-grow out phase to grow-out culture. The growth has to be monitored till day become harvest size fish to complete the three-tier system.

91. What is the average survival rate of seabass in cage farming?

An average survival of 80% and 85% respectively can be realized respectively in pre-grow out and grow-out cages stages. The survival rate depends upon the management practices followed by the farmers.

92. What is the feeding rate and FCR in cage farming?

CIBA's Seebass^{Plus} feed can be used in all the stages of cage farming. The feeding rate is 6-4% of body weight in pre-grow out stage and 4-2% in grow-out stages on an average the FCR in pre and grow out stages are 1.5%. The daily ration is equally distributed in two feedings preferably in the morning and evening hours.



Timely feeding and its management are crucial for a successful harvest

CHAPTER – 12

GENERAL QUESTION

93. What are the major constraints in seabass farming?

a. Seabass seed is presently produced only from two Government hatcheries such as ICAR-CIBA and MPEDA-RGCA.

b. Cost- effective feed should be available for the farmers locally.

c. Full value chain for Asian seabass is yet to be established from regular supply of hatchery seed, pelleted feed and ready market.

d. Availability of required size seed/fingerlings is inadequate and unable to meet the demand.

e. Predominant cannibalistic behaviour during young stages (1-20 g) and grading is required. Nursery rearing activity is skill oriented and need adequate training.

94. Can seabass be farmed with forage fishes?

Yes, choice of forage fish will depend on its ability to reproduce continuously in sufficient quantity to sustain the growth of seabass throughout the culture period. Forage fish must be the species that could make use of natural food produced in the pond and should not compete for the feed with farmed fish.

95. Where to procure hatchery produced seabass seed?

Healthy fry/fingerlings of Asian seabass, is available for supply in ICAR- Central Institute of Brackishwater Aquaculture, Chennai, as well as in Rajiv Gandhi Centre for Aquaculture (RGCA), seabass hatchery, Sirkali, Tamil Nadu. The seeds can be supplied on a first come first served basis. Packing of seed in desired salinity/or freshwater shall be made upon request in advance.

96. What are the advantages of using hatchery produced seeds over wild seeds for nursery rearing purpose?

Hatchery Seeds	Wild seeds
Hatchery produced seeds can be weaned to artificial seed.	Do not accept pellet feeds immediately
Hatchery produced seeds can be free from pathogens.	Can carry pathogens
Exhibits uniform growth.	Assorted in size
Seed availability is all round the year	Seed availability is seasonal and inadequate

Happy farmers with large seabass targeted for premium markets





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