International Journal of Science and Technology Research Archive

ISSN: 0799-6632 (Online)

Journal homepage: https://sciresjournals.com/ijstra/

(Review Article)

Check for updates

Culture technique of seabass, *Lates calcarifer* in Asia: A review

Md. Amirul Islam [1], Aovijite Bosu [1], Md. Monjurul Hasan [1, *], Farhana Yasmin [1], Abu Bakker Siddique Khan [1], Mousumi Akhter [1], Md. Rahamat Ullah [1], Ehsanul Karim [3], Md. Harunor Rashid [2] and Yahia Mahmud [3]

[1] *Bangladesh Fisheries Research Institute, Riverine Sub-Station, Khepupara, Patuakhali 8650, Bangladesh.*
[2] *Bangladesh Fisheries Research Institute, Riverine Station, Chandpur 3602, Bangladesh.*
[3] *Bangladesh Fisheries Research Institute, Headquarter, Mymensingh 2201, Bangladesh.*

International Journal of Science and Technology Research Archive, 2023, 04(01), 006–017

Publication history: Received on 20 November 2022; revised on 30 December 2022; accepted on 01 January 2023

Article DOI: https://doi.org/10.53771/ijstra.2023.4.1.0174

Abstract

Mariculture could be a new horizon in Bangladesh, and seabass is one of the most promising species. This paper goes into detail about seabass culture techniques and their future potential. Two culture methods have been prominent: Nursery to grow out culture and cage culture in coastal water. The study's main finding is that cannibalism occurs, resulting in mortality and failure to reach predicted growth. For seabass culture, the suitability of the site, whether for a pond or cage, is critical. The culture relies heavily on optimal water quality, particularly salinity maintenance. Proper feeding and disease management are also critical for higher production from the culture. One of the key concerns in seabass culture is the availability of live feed. Sea bass cage culture is extensively established in Malaysia, Indonesia, Thailand, Hong Kong, and Singapore. It could be a good option for culturing seabass in the coastal environment of Bangladesh although proper monitoring should be conducted. Seabass culture both in ponds or cages may contribute to our mariculture development and boost our national economy. This review will help the researchers, policymakers, entrepreneurs, and commercial culturists to introduce seabass for mariculture in the coastal regions which are salinity prone.

Keywords: Sea bass; Culture technique; *Lates calcarifer*; Cage culture; Asia

1 Introduction

Mariculture involves the culture of fish, crustaceans, mollusks, algae, and other important marine or coastal organisms in the sea either open and enclosed or in coastal ponds with saline water and plays an important role in ensuring nutrition demand as well as a source of employment, foreign currency, income for many local communities. The entire world is working on the blue economy. Japan, China, the Philippines, and Vietnam are way ahead with the blue economy in Asia. Production of marine fish has increased due to vast diversity and economic benefits and is expected to continue. In Bangladesh, the blue economy has created lots of prospects and potential for the mariculture revolution. *Lates calcarifer Tenualosa ilisha, Mugil cephalus*, *Penaeus indicus*, *Penaeus monodon*, *Metapenaeus monoceros*, and *Scylla serrata* are the propitious fish species for mariculture. Additionally, several marine organisms that aren't typically found there, such as seaweed, microalgae, shellfish (like mussels and oysters), and sea cucumbers, have a lot of promise (Uddin et al., 2021). Asian sea bass is one of the marine species that are most suited for aquaculture. One of the species of the family Latidae that is available in the estuarine systems of the Bay of Bengal is *Lates calcarifer* (Hanif et al., 2015; Rahman, 1989). The Indo-West Pacific region is where seabass is found, from the eastern margin of the Persian Gulf to China, Taiwan, and southern Japan, and southward to southern Papua New Guinea and northern Australia (Ilham et al., 2016).

* Corresponding author: Md. Monjurul Hasan, Email: mhshihab.hasan@gmail.com

Copyright © 2023 Author(s) retain the copyright of this article. This article is published under the terms of the Creative Commons Attribution Liscense 4.0.

The Asian seabass *Lates calcarifer* mostly familiar as Bhetki/Koral in Bangladesh and India and barramundi in Australia is considered one of the most potential candidates species because of its high fecundity, captive breeding, fast growth rate, nutritious meat, and market demand. This fish is large, euryhaline, and catadromous in nature. This fish has a cannibalistic personality, is a protandrous hermaphrodite, and is exceedingly carnivorous (Boonyaratpalin, 1997). The life cycle of the species is biphasic, with the juvenile phases taking place in freshwater and then moving to the sea to reach sexual maturity and breed (i.e., catadromous). The larvae enter rivers, estuaries, tributaries, mangroves, and swamps from October to February. Spawning takes place between June and September (Uddin et al., 2021). Sea bass culture methods were established in Thailand in 1970 (Wongsomnuk and Manevonk, 1973), and they spread quickly over most of Southeast Asia. Israel, Guam, the United States of America, French Polynesia, Iran, and these countries have all adopted sea bass as an aquaculture product. Techniques used to cultivate seabass differ slightly between nations. Matured adult fish is either kept in captivity or introduced to spawn naturally or with hormone injections, or it is taken from the wild (Garrett et al., 1987). Rotifer and brine shrimp are used to raise sea bass larvae until they are big enough to grow out (SCS, 1982).

In various areas and nations, including Southeastern Asia, Australia, and Saudi Arabia, the culture of Asian sea bass has grown over the past ten years through cage culture and recirculation systems (Wongsumnuk & Maneewongsa, 1974; Bhatia & Kungvankij, 1971; Davis 1985; Kungvankij, 1981; Sakares 1982; Matthew 2009). Marine water, brackish water, and freshwater can all be used to cultivate seabass (*Lates calcarifer*) (Harpaza et al., 2005; FAO, 2006). In Asia, sea bass and tilapia can both be produced in brackish water ponds (FAO, 2006). In Thailand, seabass has long been raised alongside shrimp, mullet, and milkfish (Rauangpanit et al., 1984). In waters with varying salinities between 0 and 30 ppt, seabass is a superbly cultivable species (Mukhopadhya and Karmakar, 1981; James and Marichamy, 1986; Kungvankij et al., 1986). Since there isn't enough acreage to build aquaculture ponds, cage culture may be a viable option in Bangladesh to increase fish production (CUTS International, 2021).

In Bangladesh, the distribution of seabass mainly covers the coastal areas. An increased interest has recently been shown in seabass for partial induced breeding, tilapia polyculture in ponds, and experimental cage culture in the coastal waters of Cox's Bazar (Uddin et al., 2021). In the post-monsoon season, wild seabass fingerlings and fry are harvested from the Sundarban for commercial culture. In Bangladesh, seabass production is often done using a tilapia and seabass polyculture method. Because of the seasonal salinity variations (5 to 15 ppt) in Cox's Bazar's coastal regions, tilapia and seabass polyculture have the potential to be profitable in Bangladesh (Monwar et al., 2013**)**. A pilot study on the polyculture of seabass with tilapia was carried out in Bangladesh (Hossain et al., 1997). Seabass culture using natural feed through an extensive system has been introduced recently in coastal regions. No artificial breeding technique or appropriate seabass artificial feed has not yet been developed. In order to expand mariculture in terrestrial shore ponds and lagoons as well as offshore cages in suitable coastal areas, artificial breeding and large seed production in hatcheries are necessary. Domestication, captive breeding, and export-focused production have a lot of potentials to support Bangladesh's transition to a blue economy (Uddin et al., 2021). In this paper, seabass culture techniques and future potentiality at a glance are discussed.

2 Methodology

We used Google Scholar, Science Direct and Scopus as search engines to find out the relevant literature on the culture techniques of Seabass. For this purpose, keywords like Sea bass, Culture technique, *Lates calcarifer*, and Asia were searched in those databases. Moreover, pond culture, and cage culture were also utilized as key searches. A total of 77 articles were retrieved from which 50 articles have been reviewed. Furthermore, we have selected those articles for the review as we tried to demonstrate the Seabass culture techniques from nursery to grow-out phases including cage culture in Asian countries. For that, we didn't utilize the other articles which were not relevant to those criteria. This review article will help to find out suitable culture techniques for sea bass in different geographical environments as well as to sort out the constraints.

3 Results and discussion

3.1 Culture techniques

The most common issues that arise during the culture period: (a) cannibalism in the early stages (1–20 g), and (b) Live feed dependency which is less available in many countries. Despite certain constraints, basic seabass culture techniques have been developed and are now deemed economically feasible. As seabass is cannibalistic, it should be cultured in two steps: nursery and grow-out stage.

3.1.1 Nursery culture

Seabass fry is nursed to reach juvenile size (8–10 cm) which could reduce cannibalism (Kungvankij et al., 1985). So, to minimize the size variation, sampling should be conducted in regular intervals and the larger fish must be separated from the nursing pond (Aldon, 1997). Nursing can be done in either earthen ponds or nylon net cages.

Earthen Pond

Design and construction/preparation

Water depth and size of a pond can vary from 50 to 80 cm and 500 to 2000 m^2 respectively (Kungvankij, 1986). The average pond size is about 25 to 50 m^2 and 0.8 to 1 m in depth (SEAFDEC, 1984). The pond should be facilitated with water exchange through proper inlets and outlets (Khaimesh and Girija, 1986).

Stocking Density

The stocking density should be 20–50 fry/m^2 (Khaimesh and Girija, 1986) and 200-400 fry/pond (SEAFDEC, 1984) in nursery culture. Prior to stocking fry should be acclimatized.

Feeding management

Types of feed

Live feed or supplementary feed can be supplied to Seabass fry.

Live feed

Live artemia can be a suitable feed for seabass fry (Khaimesh and Girija, 1986).

Artificial/Supplementary feed

Seabass can be fed with trash fish which can be either chopped or grounded. The size of trash fish should be (4–6 mm^3) (Khaimesh and Girija, 1986; SEAFDEC, 1984).

Feeding rate and frequency

The feed can be applied at the rate of 100%<60%<40% of biomass (at 09:00–17:00 hours) in the first week<second week<third week respectively. The feeding frequency should be twice daily for better growth (Khaimesh and Girija, 1986). The feeding rate can be 8 to 10% of total body weight (SEAFDEC, 1984).

Pond management

Exchange of water is very important for seabass culture and at least 30% of the water should be exchanged daily (Khaimesh and Girija, 1986).

Duration of nursing

Seabass fry can be reared for 30–45 days when the fry became 5–10 cm in size (Khaimesh and Girija, 1986).

Nylon net cage

Seabass fry can be nursed in nylon net cages during the nursery phase.

Design and construction

The cage can be rectangular in shape. The cage material can be of synthetic nets (mesh size- 1.0 mm to 0.5 cm depending on fry size) to which wooden, GI pipe or bamboo frames can be attached. Cage size and depth can be 0.9 m × 2.0 m and 1.0 m respectively (Khaimesh and Girija, 1986). The surface area can be 20 to 25 m^2 and the depth is 2 m, and the recommended mesh size is 5mm for knotless netting (SEAFDEC, 1984).

Stocking Density

The stocking density can be either 300-500 fry per cage (SEAFDEC, 1986) or 80-100 m^2 (Khaimesh and Girija, 1986). Regular sampling should be done to protect fish from cannibalism.

Feeding management

Trash fish can be applied to 2.5–5.0 cm size seabass fingerlings. The feeding rate can be 8–10 percent of body weight. The supplementary feed could be given once in a day or it could be 4 to 5 times a day (Khaimesh and Girija, 1986).

Nylon net cage management

Daily net checking should be performed to secure fish from escaping and keep the net free from clogging through brushing (Khaimesh and Girija, 1986).

Duration of Nursing

Nursing can be done for 30–45 days prior to transferring to grow-out ponds (Khaimesh and Girija, 1986).

3.1.2 Grow-out culture

Fingerlings should be stocked according to their sizes to keep uniformity. In the international fish market like Malaysia, Singapore, Thailand, and Hong Kong, 700-1200 g size is demandable. On the other hand, the demandable market size is 300- 400 g in the Philippines (Khaimesh and Girija, 1986).

Pond culture

A brackish water pond can be used for seabass culture which is proved to be suitable (Khaimesh and Girija, 1986). Pond culture can be of two types-

Monoculture

Seabass can be cultured as single species in a grow-out pond although it has some disadvantages like sole dependency on artificial feeding (Khaimesh and Girija, 1986). The stocking density can be 16 no./m^2 (Khaimesh and Girija, 1986) and 10,000–20,000 per hectare in monoculture (Kungvankij et al., 1985).

Table 1 Ingredient Mixture percentage

Ingredient	Percentage (%)
Grounded/Chopped fish	70
Rice bran	30

Source: (Khaimesh and Girija, 1986)

Table 2 Moist feed mixture

Ingredient	Percentage (%)
Fish meal	35
Rice bran	20
Corn meal	10
Soybean meal	15
Leaf meal	3
Starch	8
Squid Oil (or fish oil)	7
Vitamin mix	2

Source: (Khaimesh and Girija, 1986)

Polyculture

Seabass can be cultured with other fish species where the forage fish utilize the pond's natural food and seabass capitalize on the fry of these species such as *Oreochromis mossambicus*, *Oreochromis niloticus,* etc. (Khaimesh and Girija, 1986).

Site selection criteria

- Water quality parameter

A suitable water quality parameter is shown below:

Table 3 Standard water quality parameter

Parameter	**Value**
Temperature	26–32°C
Salinity	10–30 ppt
Dissolved oxygen	4–9 ppm
pH	7.5–8.5
Turbidity	less than 10 ppm
H_2S	less than 0.3 ppm
NH_3	less than 1 ppm

Source: (Kungvankij et al., 1985)

- Soil characteristics

Clay content is very important for choosing a site as its capacity for holding water and avoidance of acid-sulfate soil is a must.

- Tide and water depth

2–3 meters tidal fluctuation is ideal for seabass and ponds should have the facility to admit and drain water during high and low tide (Khaimesh and Girija, 1986).

- Topography

Topography is another important criterion for selecting a suitable site that could reduce the cost.

- Accessibility

Transportation and another cost can be minimized if the farm is accessible.

Design & Construction

The shape of the pond can be rectangular, and the size can be 2000 m^2-2 hectare.

Pond depth can vary from 1.2 to 1.5 m.

- Fertilization

Pond can be prepared with organic manure at @2000 kg per hectare and inorganic fertilizer can also be used prior to stocking (Kungvankij et al., 1985).

Stocking density

Seabass of uniform size (8–10 cm in size) can be stocked either with matured tilapia or tilapia broods can be stocked separately prior to seabass. The stocking rate can vary from 3,000 to 5,000 per hectare. Three female and one male Tilapia should be ideal for stocking (Kungvankij et al., 1985).

Feeding management

- Types of feed
  - Natural/live feed

Seabass can enjoy live feed such as shrimp fry which comes from outside through the inlet and the tilapia fry which is the breed of broods.

  - Artificial feed

In this culture system, artificial feed such as chopped/grounded trash fish can be given as supplementary to natural feed.

- Site of feeding

The feeding site should always be the same to ensure proper feeding.

- Feeding method

Feeds should be distributed in such a way that maximum feed is utilized with no or very little waste.

- Feeding frequency

Currently, seabass culture is fully dependent on supplementary feed such as trash fish. Trash fish either chopped or grounded can be applied at 10% -5% of total biomass. The application of feeding can be extended to 90 days from initial feeding. The feeding frequency should be twice a day (Khaimesh and Girija, 1986). Chopped fish can be applied at 1.5 kg/day/100 fish and monitoring of water parameters i.e., salinity fluctuation is required (SEAFDEC, 1984).

Pond management-

- Water quality

Suitable water quality parameters is much necessary to keep the fish healthy (SEAFDEC, 1984).

- Dike checking

Dike checking is a regular work that helps to secure fish from escaping (SEAFDEC, 1984).

- Water exchange

Regular water exchange through the inlet is very important as it not only ensures a good aquatic environment but also helps to maintain the suitable salinity of water required for seabass culture (SEAFDEC, 1984).

- Predators and pests

Regular monitoring or frequent inspection for predators and pests such as crabs and water snakes is required, parasites and waterfowl should be removed with a soft brush (SEAFDEC, 1984).

- Mortality check

Dead fish should be taken out of the pond to keep the water free from further pollution (SEAFDEC, 1984).

Production/yield

In a brackish water pond, the average production of sea bass is 2000 Kg/ha. The growing period is six months, and the survival rate is about 60% (SEAFDEC, 1984). The highest production was recorded with the stocking ratio of seabass-tilapia at 1:4 (Monwar et al., 2013).

Cage culture

Seabass cage culture has gained popularity in Singapore Thailand, Hong Kong, Malaysia, and Indonesia due to its economic viability.

Site selection criteria

Suitable site selection is one of the major issues for successful cage culture. The followings are site selection criteria:

Water quality parameter

Water quality parameters are prerequisites for a suitable site selection.

- Salinity

  Salinity is an important parameter, and it should be 10-31 ppt for the cage site (Tookwinas and Charearnrid, 1988). Seabass adults migrate from freshwater to saline water (28-31 ppt), thus maturation occurs, and fish is ready to breed (Moore, 1982; Davis, 1985).

- Temperature

  Seabass grows best in warm waters of 26-32^0 C temperature is suitable for seabass growth. Lower temperature hinders growth even mortality can occur if it stays below 20^{0}C for a long time (Kungvankij et al., 1984).

- pH

  Normally pH of the water is 6.5 to 8.5. Despite this, fish growth and metabolic rate increase with pH which is slightly alkaline rather than acidic pH (Swingle, 1967). The desirable range of pH for fish production is usually 7.5-8.5 (Kungvankij et al., 1984).

- NH_3

  Excessive ammonia hampers the growth of fish, even though it might be the reason for toxicity (Abdulla, 1989, Beleau, 1988; Buttner et al., 1993; Champman et al., 1992; Hargreaves and Semra, 2001). The optimum ammonia level is usually less than 1 ppm (Kungvankij et al., 1984).

- DO

  The survival of fish and their growth largely depends on the DO concentration of the aquatic environment. The ideal DO concentration for fish culture would be 5-8 mg/l (DoF, 1996). Floating net cages is better for fish as it has increased DO levels in water (7-8 ppm) (Kungvankij et al., 1984).

- H_2S

  The optimum hydrogen sulfide level is usually less than 3 ppm (Khaimesh and Girija, 1986).

- Turbidity

  Turbidity can be caused by feed dust and fish waste in cages (Pergent et al., 1999, Ruiz et al., 2001, Hargrave 2003, IUCN 2007). Accumulation of biofouling has no positive influence rather cause's severe problems (Hargrave 2003, Alston et al., 2005). The increase or decrease of turbidity also depends on the flushing rates in water (Tanaka & Kodama 2007, McKinnon et al., 2008). The turbidity level should be less than 10 ppm (Khaimesh and Girija, 1986).

- Water exchange

  Tidal fluctuations of 2-3 m are suitable for a cage site. Alongside, 1-2 knots (50-100 cm/sec) currents is also ideal for cage culture. The distance between the bottom of the net in the floating cage and the riverbed should be 2 m which will facilitate easy passing of different wastes and silt. On the other hand, the distance between the bottom of the net in the fixed cage and the riverbed should be 1 m. Despite these, siltation can still create clogging in both floating and fixed net cages (Cheong, 1989). Floating net cages in Singapore are in a narrow waterway, to combat tidal movements (1-1.5 knots) yet relatively deep (8-10 m) and sheltered (wave heights not exceeding 1 m) conditions which are the best amongst the others (Cheong, 1989).

- Soil and other characteristics

  Sandy bottoms are suitable for the cage site and there should be no pollution (Tookwinas and Charearnrid, 1988). Additionally, the prevalence of biofouling organisms should be evaluated because a high prevalence of biofouling would necessitate intensive net cleaning (Cheong, 1989).

- Tide and water depth

  For 5 m × 5 m and 2 m deep cage, water depth should be greater than 2-3 meters. At spring tide's low water, the water depth should be not less than 2 meters due to tidal fluctuation (Tookwinas and Charearnrid, 1988).

- Current and waves

  The site should have shelter for protection from strong wind (Tookwinas and Charearnrid, 1988).

- Water circulation

  Water circulation should be good enough so that different waste materials can be washed away from the cage (Tookwinas and Charearnrid, 1988).

- Biofouling

  The cage site should be free from biofoulers like mollusks, edible oysters, and sand barnacles so that it won't hamper in fish production or cage net (Tookwinas and Charearnrid, 1988).

Design & construction of the cage

Cage can be of square and rectangular shape and size can be 20 to 100 m^3. Polyethylene net can be used with 2 to 8 cm mesh size depending on fish size (Tookwinas and Charearnrid, 1988).

Table 4 Different mesh sizes of cage netting for various sized fishes

Net mesh size (cm)	Fish size (cm)
0.5	1–2
1	5–10
2	20–30
4	> 25

Source: (Tookwinas and Charearnrid, 1988)

Cage preparation: Cage can be of two types (Tookwinas and Charearnrid, 1988).

Floating cages

Wooden, bamboo frames or GI pipes are used to keep afloat the cages. To maintain the shape, the cage bottom corners are attached to the concrete weights. The suitable dimension is 50 m^3 (5 × 5 × 2m) for a floating cage which is easy to manage (Tookwinas and Charearnrid, 1988).

Stationary cages

Stationary cages are easy to install although it has some problems like clogging. At first, the wooden or bamboo poles are fixed vertically and then the cage is fastened at its four corners.

Stocking density

Acclimatization should be done in accordance with cage temperature and salinity prior to stocking. The stocking size of the seabass juvenile should be uniform. In Thailand, initial stocking density varied between 40-50 per m^3 (first 2-3 months) and then reduced to 10-20 per m^3 (Kungvankij et al., 1984). In contrast, initial stocking density varied between 40-50 per m^3 in Singapore, then reduced to 33 per m^3. Sakaras (1987) found a higher survival rate in Thailand which used an initial stocking density of 1.3 per m^3, then increased to 77 and even up to 231 per m^3. In his study, the final mean weight was recorded as higher in larger juveniles (16 cm or 60 g) and lower in smaller juveniles (12 cm or 22 g).

Feeding management

Feeding management is very important in the cage culture system for seabass.

Types of feed

Ground trash fish can be a good source of feed for fingerlings of 2.5-5.0 cm. The feeding can be done with 8-10 % of body weight and the feeding frequency should be 4 to 5 times daily. Later, fresh, or frozen chopped oil sardines (*Sardinella longiceps*) can be applied. The feeding can be done with 5 % of body weight and the feeding frequency should be 2 times a day (Kungvankij et al., 1986). Thailand can be the ideal example of seabass feeding where the feeding ratio is 8-10% of the body weight of juveniles (< 100 g). The feeding ratio is then reduced to 5 % and 4% of seabass bigger than 100-600 g and 600-1000 g respectively. The feeding ratio is almost like Singapore where juveniles (20-< 100 g) are fed with 10 % of body weight. Then the feeding ratio is reduced to 8 %, 3-5% and 3% of seabass 100- < 300 g, 300- < 500 g, and 500-700 g respectively. Seabass Juvenile ranging from 10 to 100 g, 100-300 g, and bigger than 300 g size can be fed with 12%, 10% and 8% of body weight respectively (Ghosh et al., 2016). In the experiment, artificial feeds, like semi-moist feeds and dry pellets, are used on a limited scale. Hence, semi-moist feeds are utilized by incorporating a dry mash of fish meal, rice bran, etc. into minced trash.

Site
The feed should be given by spreading or by using trays till satiation.

Method
The fish must be chopped into small pieces or ground prior to application (SEAFDEC, 1984).

Frequency
The feeding frequency is almost the same (twice a day). The appropriate time for feeding seabass is morning and afternoon.

Cage management

Cage culture management is a must to get expected production.

Water quality
Water quality must be optimum and need to be monitored regularly (SEAFDEC, 1984).

Water current
In the case of net-cage culture, care must be taken that there is sufficient flow of water through the cage, and interference from strong wind and waves must be avoided (SEAFDEC, 1984).

Predators and pests

Regular monitoring is much needed to check predators and pests as these can damage cage nets (SEAFDEC, 1984)

Mortality check

The cage should be checked every day whether any dead fish are found to keep the cage environment safe (SEAFDEC, 1984).

Cleaning

Clogging by fouls and parasites should be cleaned at regular intervals to ensure a clean environment in the cages (SEAFDEC, 1984).

Production/yield

The production can be high as 25 kg/m^2 /yr. stocked with 25 fish/m^2 (Sirikul et al.,1988) and low as 3 to 5 kg/m^2/yr. stocked with 100 to 200 g/fish (SEAFDEC, 1984).

FCR

The feed conversion ratio was recorded at 4-10: 1 (Tookwinas and Charearnrid, 1988) and 7-10:1 (SEAFDEC, 1984) in Thailand.

Survival rate

The survival rate of seabass in cage culture would be 80-95% (Tookwinas and Charearnrid, 1988; SEAFDEC, 1984).

Disease

Health monitoring is much needed for successful seabass cage culture and its routine work (SEAFDEC, 1984).

Economy

It's very important to keep a record of the cost involved and should be checked regularly to ensure that cage culture is economically viable (SEAFDEC, 1984).

Limitations

- Stocking density should be appropriate, not high
- Selecting a suitable site is always a tough task in flowing water because of navigation and other activities
- Regular cleaning must be done as fouling occurs

- Predation and poaching can be major issues
- Fish escape has become a great concern
- Seabass can be vulnerable to disease

4 Conclusion

Bangladesh has immense opportunities for mariculture with vast coastal water bodies and suitable environmental conditions. Although different man-made activities have made it difficult to sustain. Seabass culture either in ponds or cages may contribute to our mariculture development or boost our national economy. To make it viable in our natural environment govt. should step forward and act accordingly. This review will help the researchers, policymakers, entrepreneurs, and commercial culturists to introduce seabass for mariculture in our coastal regions which are salinity prone.

Compliance with ethical standards

Acknowledgements

The authors are thankful to the "Development of Mariculture Practice of Seabass (*Lates calcarifer*) in the Southeast coast of Bangladesh (Component-C)" project of BFRI funded by the "Sustainable Coastal and Marine Fisheries Project (SCMFP)".

Disclosure of conflict of interest

The author(s) declare no conflict of interest.

References

[1] Abdulla A.F. The Effect of Dissolved Oxygen and Ammonia on *Oreochromis niloticus* (Nile Tilapia) and Its Dynamics in Fertilized Tropical Fish Ponds. *Agric. Sci*, Michigan State University, U.S.A (Ph.D. Thesis); 1989.

[2] Aldon E. T. The culture of seabass. *SEAFDEC Asian Aquaculture*. 1997; 19(4): 14-17.

[3] Alston D.E., Cabarcas A., Capella J., Benetti D.D., KeeneMeltzoff S., Bonilla J., Cortes R. Environmental and social impacts of sustainable offshore cage culture production in Puerto Rican waters. Final report to the National Oceanic and Atmospheric Administration, Contract NA16RG1611, 2005. Available at www.lib.noaa.gov/ retiredsites/docaqua/reports_noaaresearch/finaloffshore puertorico.pdf (Accessed 23 Feb. 2022)

[4] Beleau M.H. Evaluating water problems. Veterinary clinics of North America. *Small Anim. Pract*. 1988; 18: 293–304.

[5] Bhatia U. and Kungvankij P. Distribution and abundance of seabass fry in coastal area of the provinces facing Indian Ocean. Annual report, Phuket City (Thailand): Phuket Marine Fisheries Station; 14p. 1971.

[6] Boonyaratpalin M. Nutrient requirements of marine food fish cultured in Southeast Asia. *Aquaculture*. 1997; 151: 283–313.

[7] Buttner J. K. Introduction to water chemistry in freshwater aquaculture. 1993.

[8] Cage Fish Farming in India and Bangladesh: Prospects for Bilateral Cooperation. CUTS International, September, 2021.

[9] Champman P.M., Power E.A., Burton G.A. Integrative assessments in aquatic ecosystems. In: Burton, G.A. (Ed.), Sediment Toxicity Assessment. Lewis Chelsea, Mi, 1992; pp. 313–340.

[10] Cheong L. Status of knowledge on farming of Seabass (*Lates calcarifer*) in South East Asia.

[11] Advances in Tropical Aquaculture Tahiti, Feb.20 - March4, 1989. AQUACOP. IFREMER. Actes de Colloque. 1989; 9 pp. 421-428.

[12] Culture of Seabass, SAFIS extension manual series no 11. SEFDEC, Thailand. July, 1984. Retrieved from https://digitalgems.nus.edu.sg/shared/colls/blsea/files/safis-11.pdf [Accessed 22 Feb. 2022]

[13] Davis T.L.O. The food of barramundi, *Lates calcarifer* (Bloch), in coastal and inland waters of Van Diemen Gulf and the Gulf of Carpentaria, *Australia. J. Fish. Biol*., 1985; 26: 669–682.

[14] DoF (Department of Fisheries) Technologies and Management for Fisheries Development. 1996.

[15] FAO. 2006. Cultured Aquatic Species Information Programme. Text by Rimmer MA In: FAO Fisheries and Aquaculture Department, Rome. Retrieved from http://www.fao.org/fishery/culturedspecies/Lates_calcarifer/en [Accessed 22Feb. 2022]

[16] Garret R.N., M.R. Mackinnon and D.J. Russell. Wild Barramundi Breeding and its Implications for Culture. *Aust. Fish*. 1987; 46 (7): 4-6.

[17] Ghosh S., S. Megarajan, R. Ranjan, B. Dash, P. P. Aik, L. Edward and B. Xavier. Growth performance of Asian seabass *Lates calcarifer* (Bloch, 1790) stocked at varying densities in floating cages in Godavari Estuary, Andhra Pradesh, India. *Indian J. Fish*. 2016; 63(3): 146-149.

[18] Hanif M.A, Siddik M.A.B., Chaklader M.R., Nahar A., Mahmud S. Fish diversity in the southern coastal waters of Bangladesh: Present status, threats, and conservation perspectives. *Croat J Fish.* 2015; 73: 251-271.

[19] Hargreaves J. A. and Kucuk, S. Effects of diel un-ionized ammonia fluctuation on juvenile hybrid striped bass, channel catfish, and blue tilapia. *Aquaculture*. 2001; 195 (1-2): 163-181.

[20] Hargrave B.T. Far-field environmental effects of marine finfish aquaculture. *Can Tech Rep Fish Aquat Sci* 2450, 2003. Vol 1. DFO, Ottawa. Retrieved from http: // mmc. gov/ drakes_estero/pdfs/bivalve_aquaculture_03.pdf (Accessed 23 Feb. 2022)

[21] Harpaza S.T., Hakima Y., Slosmana T. and Eroldogana O.T. Effects of adding salt to the diet of Asian seabass (*Lates calcarifer)* reared in fresh or salt water recirculating tanks, on growth and brush border enzyme activity. *Aquaculture*. 2005; 248:315-324.

[22] Hossain M.A., Sultana N., Hossain A.M., Islam S.Q., Haq K.A. and Alamgir M. Determination of optimum ratio of sea bass, *Lates calcarifer* and Tilapia sp. for their mixed culture. *Bangladesh Journal of Zoology*, 1997; 25(1): 9-14.

[23] Ilham I., Siddik M.A.B., Fotedar R. Effects of organic selenium supplementation on growth, accumulation, haematology and histopathology of juvenile barramundi *(Lates calcarifer*) fed high soybean meal diets. *Biol. Trace Elem. Res.* 2016; 174: 436-447.

[24] IUCN (International Union for Conservation of Nature), 2007. Guide for the sustainable development of Mediterranean aquaculture. Interaction between aquaculture and the environment. IUCN, Gland. Retrieved from cmsdata.iucn.org/downloads/acua_en_final.pdf (Accessed 23Feb, 2022)

[25] James P.S.B.R., Marichamy R. Status of Seabass (*Lates calcarifer*) Culture in India. Eds: Copland and Grey. Proceeding of an International Workshop held at Darwin, Australia, 24-26 Sep., 1986 on Management of Wild and Culture Seabass. pp. 74-79.

[26] Khaimesh S. and Girija P.,1986. Culture technology for *Lates calcarifer*. Central Institute of Fisheries Education in India. Retrieved from http://aquafind.com/articles/Lates_calcarifer_Culture.php [Accessed 11 Jan. 2022]

[27] Kungvankij, P. 1981. Seed production of seabass. Satul Fisheries Station. Contribution No. 1, Satul, Thailand. 15 p.

[28] Kungvankij P., B.J. Jr Pudadera, L.B. Tiro and I.O. Potestas, 1984. Biology and culture of sea bass *(Lates calcarifer*). NACA Training Manual Series No 3: 67 pp.

[29] Kungvankij P., Tiro L.B., B.J Jr., Pudadera, Jr., and Potesta I.O., 1985. Training Manual Biology and Culture of Sea Bass (*Lates calcarifer*). Network of Aquaculture Centres in Asia Bangkok, Thailand.

[30] Kungvankij P, B.J. Pudadera Jr, L.B. Tiro Jr and I.O. Potestas. 1986. Biology and culture of seabass. SEAFDEC AQD Extension Manual No. 11.

[31] Kungvankij, P., 1987. Induction of spawning of sea bass (*Lates calcarifer)* by hormone injection and environmental manipulation, 120-122p. In J.W. Copland and D. L. Grey (eds.). Management of wild and cultured seabass/barramundi (*Lates calcarifer*): proceedings of an international workshop held at Darwin, N.T, Australia, 24-30 September 1986. ACIAR proceedings No. 20, 210p. Australian Centre for International Agricultural Research, Canberra.

[32] Mathew G., 2009. Taxonomy, identification and biology of Seabass *(Lates calcarifer)*. In: Imelda J, Edwin JV, Susmitha V, editors. Course manual: national training on cage culture of seabass. Kochi: CMFRI & NFDB; 38-43p.

[33] Monwar M. M., A. K. M. R. A. Sarker and N. G. Das, 2013. Polyculture of seabass with tilapia for the utilization of brown fields in the coastal areas of Cox's Bazar, Bangladesh. *International Journal of Fisheries and Aquaculture*, 5(6): 104-109. DOI: 10.5897/IJFA2013.0347

[34] McKinnon D, Trott L, Duggan S, Brinkman R, Alongi D, Castine S, Patel F., 2008. Environmental impacts of sea cage aquaculture in a Queensland context— Hinchinbrook Channel case study (SD576/06) final report. Australian Institute of Marine Science, Townsville.

Retrieved from www.aims.gov.au/c/document_library/get_file?uuid=965f17c9-b42b-4e41-a5a5e568a37a5459&groupId= 30301 (Accessed 23 Feb. 2022).

[35] Moore, R. Spawning and Early life history of Barramundi, *Lates calcarifer* (Bloc), in Papua Neu Guinea. *Australian journal of Marine and Freshwater Research*, 1982. 33 (4): 647-661.

[36] Mukhopadhyay M.K., Karmakar H.K., Effect of salinity on food intake, growth and conversion efficiency in juveniles of *Lates calcarifer*. *J. Inland Fisheries Soc. India*, 1981. 13(1):8-14.

[37] Pergent G, Mendez S, Pergent-Martini C, Pasqualini V., 1999. Preliminary data on the impact of fish farming facilities on Posidonia oceanica meadows in the Medi - terranean. *Oceanol Acta*, 22: 95–107.

[38] Rahman A.K. A., 1989. Freshwater fishes of Bangladesh. Zoological Society of Bangladesh. Department of Zoology, University of Dhaka, Bangladesh.

[39] Rauangpanit N., Maneewong S. and Pechmanee T., 1984. Fry Production of Sea bass, *Lates calcarifer* at National Institute of Coastal Aquaculture in 1983. In. Report of Thailand and Japan Coastal Aquaculture Research Project (April 1981, March 1984) 1:7-12.

[40] Ruiz J.M.., Perez M, Romero J., Effects of fish farm loadings on seagrass (*Posidonia oceanica*) distribution, growth and photosynthesis. *Mar. Pollut. Bull*. 2001. 42: 749–760.

[41] Sakaras W., 1987. Optimum stocking density of sea bass *(Laces calcarifer*) cultured in cages. In: Copland J.W. and Grey D.L., 1987 (Eds.). Management of wild and cultured sea bass/barramundi (*Lates calcarifer*): proceedings of an international workshop held in Darwin, N.T. Australia, 24-30 September1986. ACIAR Proceedings No 20: 172-178.Contributed Papers.

[42] Sakares W., The experiment on cage culture of seabass (*Lates calcarifer* Bloch) in different stocking densities. Working paper, Second Symposium on Brackishwater. Fish Culture. Brackishwater Fisheries Division; Bangkok, Thailand and the Gulf of Carpentaria, *Australia. J Fish Biol*., 1982. 26:669–682.

[43] SCS., 1982. Report of the training course on seabass spawning and larval rearing. Songkhla, Thailand, 1-20 June 1982. Manila, South China Sea Fisheries Development and coordinating programme. 67p. SCS/GEN/82/39.

[44] Sirikul B., S. Luanprida, K. Chaiyakam and R. Sriprasert, 1988. Aquaculture development in Thailand. In*:* Perspective in Aquaculture Development in Southeast Asia and Japan. Juario J.V., and Benitez L.V., (Ed.) Proceedings of the Seminar on Aquaculture Development in Southeast Asia, Iloilo City, Philippines, 8-12 September 1987, 129- 148.

[45] Swingle H.S., 1967. FAO Fish Rep., 44(4):397-421.

[46] Tanaka K., Kodama M., Effects of resuspended sediments on the environmental changes in the inner part of Ariake Bay, Japan. *Bull Fish Res Agency,* 2007, 19: 9–15.

[47] Tookwinas S. and B. Charearnrid, 1988. Cage culture of seabass (*Lates calcarifer*) in Thailand. In: Culture of the seabass (*Lates calcarifer*) in Thailand, NACA Training Manual, UNDP/FAO Bangkok: 50-58.

[48] Wongsomnuk, S. and S. Manevonk, 1973. Results of experiments on artificial breeding and larval rearing of the sea bass *Lates calcarifer* Bloch. Contrib. Songkhla Mar.Fish.Sta.5 (in Thai).

[49] Wongsumnuk S. and Maneewongsa S., Biology and artificial propagation of seabass (*Lates calcarifer,* Bloch). Manila (Philippines): Report on the First Mangrove Ecology Workshop, 1974. 2(3):645–664.

[50] Uddin S. A., Hussain M. G., Mamun A. A, Failler P., Drakeford B.M., On the potential and constraints of mariculture development in Bangladesh. Aquaculture International, 2021. 29:575–593.