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Progress of seabass, *Lates calcarifer* (Bloch, 1970) culture in Bangladesh: Field-level updates from the Bhola and Satkhira Districts

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A B S T R A C T

Since the high market value of seabass, *Lates calcarifer* (Bloch, 1970), mainly found in Bangladesh's coastal waters and tidal rivers of Bangladesh, farmers in those areas cultivate it alongside carp fish in ponds and shrimp farms. Even though farming began many years ago, progress in overcoming obstacles of only natural sources for hatchlings, supplemental feeding, and knowledge on advanced farming management in seabass farming at the field level has been prolonged. This study discusses the current farming and trading of seabass in Bangladesh's coastal districts. Seabass fry is collected from rivers and estuarine areas, grown in hatcheries or ponds, and sold to farmers in large sizes. Some farmers cultivate this fry in mixed fish culture ponds in the extensive method; some farmers cultivate them with carp fish in a semi-intensive method. Seabass feeds only live feed (Tilapia and carp fishes fry); continuous supply is difficult and expensive. In these ponds, seabass is cultivated in the traditional method in 18–20 months, weighing 7-8 kg, and in the advanced traditional method in 1 year, weighing 2-3 kg. The profit percentage of seabass farming with the semi-intensive method is 77.42%. To expand this profitable fish farming, it is crucial to acclimate the fish to induced breeding and supplemental food. The institutions involved should not work in isolation but rather collaborate on developing induced breeding techniques and expanding seabass farming. In this case, prosperous seabass farming countries' experience can be applied.

Keywords: Bangladesh, Coastal waters, Seabass, Farming, Induced breeding

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Introduction

According to "The State of World Fisheries and Aquaculture 2020" study by the United Nations Food and Agriculture Organization, Bangladesh is the second country whose fish production has increased over the past decade (FAO, 2020). Bangladesh ranks top among the eleven countries that produce hilsa, third in fish production in inland open-water bodies, fourth in freshwater fish production, and fifth in closed-water fish production globally. Apart from this, Bangladesh ranks fourth in the world and third in Asia in tilapia fish production. In addition, Bangladesh is the eighth-largest producer of marine and coastal crustaceans and the twelfth-largest producer of finfish in the world. At present, the people of the country are consuming 62.58 g of fish against the average requirement of 60 grams per person per day. Twelve percent of Bangladesh's total population, including approximately 1.4 million women, i.e., approximately two crore people, are directly or indirectly dependent on the fishing sector for a living. About 1.39 percent of the country's export earnings come from the aquaculture sub-sector (DoF, 2020).

In contrast, marine fish production in Bangladesh is primarily based on capture. Bangladesh is fortunate to have a 710 kilometer-long coastline (Pramanik, 1988). From the country's perspective, the most crucial component of this ecosystem is its Exclusive Economic Zone (EEZ), which extends 200 nautical miles out to sea (Kuperan and Jahan, 2010). Bangladesh had previously had unilateral access to its undisputed maritime area of approximately 50000 km^2. However, following the verdicts of the International Tribunal for Law of the Sea (ITLOS) on the disputed maritime boundary between Bangladesh and Myanmar in 2012 and Bangladesh and India in 2014, Bangladesh finally gained legitimate rights to the maritime areas, which have now increased to 118,813 km^2 (MoFA, 2014). This enormous body of water has opened a new vista for the nation's economic progress. Bangladesh's coastal regions have abundant fisheries resources (Karmaker and Das, 2001; Kuperan and Jahan, 2010; MoFA, 2014; Pramanik, 1988) and concerned individuals believe Bangladesh should prioritize marine aquaculture (mariculture) in order to exploit the immense potential of marine resources. The opportunities for mariculture have not yet been exploited in Bangladesh. Mariculture has been profitable in different countries, such as India, Thailand, the Philippines, Malaysia, and Indonesia.

In the coastal districts of Bangladesh, there is enormous potential for the culture of Seabass (*Lates calcarifer*), Greenback mullet (*Chelon subviridis*), Nona Tengra (*Mystus gulio*), Seaweed, Oyster, Green mussel, as an aspect of mariculture. Farmers in the coastal area have been attempting to grow high-market-priced seabass in ponds or other enclosed spaces, even though these commercially essential species have not been grown in mariculture. Sea bass can be found all over the Indo-West Pacific, including Bangladesh, India, Pakistan, Myanmar, Sri Lanka, Malaysia, Indonesia, the Philippines, Papua New Guinea, the Persian Gulf, Northern Australia, and Southern China (Al-Noor *et al.*, 2012; Siddik *et al.*, 2016a; Vij *et al.*, 2014). In the 1970s, farming began in Thailand followed by rapid expansion to Singapore, Malaysia, Indonesia, China, Brunei, Hong Kong, Saudi Arabia, and Australia (Chou and Lee, 1997; Frost *et al.*, 2006; Zhu *et al.*, 2006). Seabass aquaculture has also been brought to Iran, Guam, French Polynesia, the United States (Hawaii, Massachusetts), and Israel (Siddik *et al.*, 2016b). In Bangladesh, only a few nurseries use fertilized eggs and fry from natural sources to make fingerlings. Seabass has grown in coastal areas of Bangladesh in a traditional and semi-intensive way by stocking natural resources with seedlings. However, in this case, the biggest problem is that seabass have not adapted to supplemental commercial fish feed in culture ponds, so the farmer has to use live feed, e.g., tilapia or silver carp fish fry (DoF, 2013; DoF, 2018).

In Bangladesh, different organizations, including research institutions, are working on the artificial production of seabass fry, while extension-related institutions are working on expanding seabass culture. The Palli Karma-Sahayak Foundation (PKSF) is the country's apex development organization, founded by the Government of Bangladesh (GoB) to work with it's more than 270 partner non-governmental organizations to enhance the income of the underprivileged. Through the fisheries sector of PKSF, initiatives are being taken to expand high-value seabass farming through these partner organizations to poor farmers in remote coastal districts. Under the initiative, programs such as carp and seabass farming demonstrations, training, field days, billboard installation, market linkage workshops, motivational tours for farmers, and setting up seabass marketing centers/depots at the local level are being implemented. These activities are being implemented through 5 partner organizations of PKSF in 7 Upazilas of 5 coastal districts of Bangladesh. This report has been prepared to highlight the latest progress and problems in field-level seabass farming in Bangladesh in the light of the implementation of seabass farming activities by members of two PKSF affiliates, namely: Family Development Association (FDA) in Bhola district and "Nowabenki Gonomukhi Foundation (NGF)" in Satkhira district.

Materials and Methods

Study period

The information was collected for one year, from July 2021 to June 2022. Frequent visits to Bhola and Satkhira were performed to collect data from the fish producers in both areas.

Selection of study area

The study was conducted in one Upazila of Bhola district, namely Charfession, and the area is located between 21°54' and 22°52' north latitudes and in between 90°34' and 91°01' east longitudes. (Fig. 1) Moreover, two Upazilas of Satkhira district, namely Shyamnagar and Kaliganj area, are located between 21°36' and 22°54' north latitudes and in between 88°54' and 89°20' east longitudes (Fig. 2).

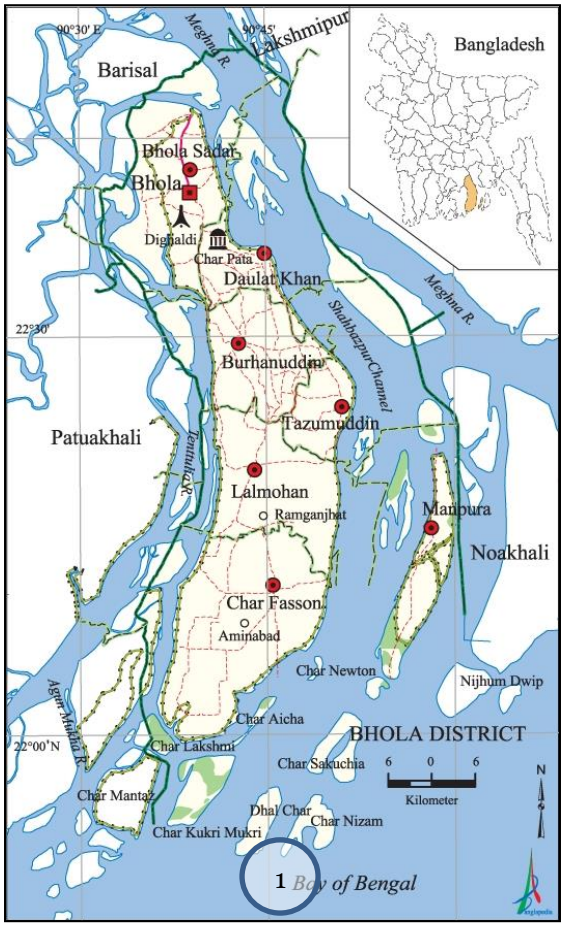

Fig. 1. Map of the study area (Bhola, Bangladesh); Map source: en.banglapedia.org

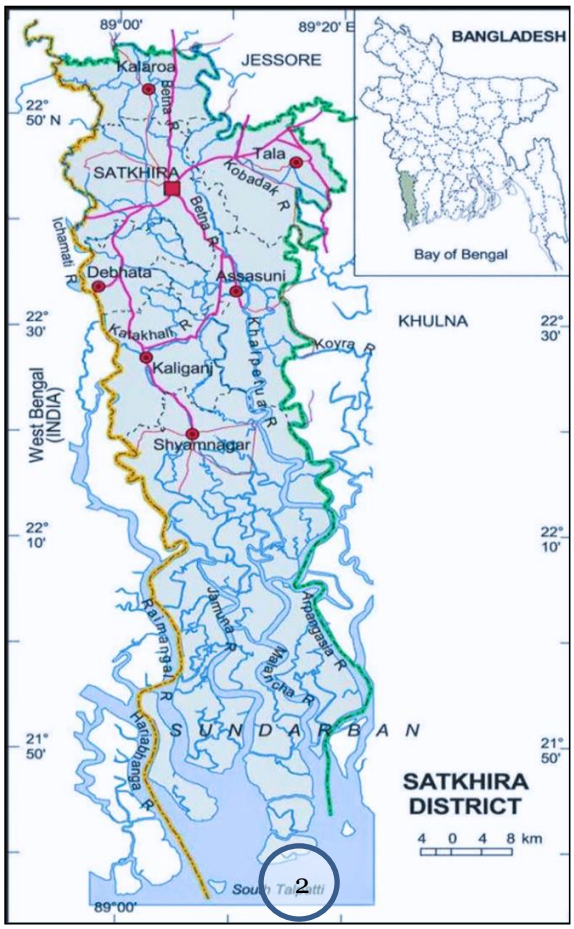

Fig. 2. Map of the study area (Satkhira, Bangladesh); Map source: bdmaps.blogspot.com

Collection of data

All of the information in this report about seabass cultivation methods and income expenditure was gathered from the books of 27 "seabass culture" demonstration farmers of the "Family Development Association (FDA)" of Bhola district and 60 "seabass culture" demonstration farmers of the "Nowabenki Gonomukhi Foundation (NGF)" of Satkhira district. During this study, personal interviews and FGD were also used to acquire significant issues such as the source of seabass fry, the price of seabass fry, marketing-related information about seabass, and seabass culture problems.

Analysis of data

The data was averaged and utilized to generate a figure depicting the average cost of income and a description of the seabass farming method. All possible errors and inconsistencies were eradicated for verification of the collected data. The tabular description procedure was mainly used to analyze the collected data. This tabular technique was applied to analyze data using simple statistical tools like averages and percentages with MS-Excel (Microsoft Excel 2019).

Results and Discussion

The latest iteration of seabass aquaculture in Bangladesh

In Bangladesh's coastal region, seabass cultivation in freshwater ponds and cage culture in rivers and estuaries has started. Larvae fry, and fingerlings of seabass are collected with different kinds of nets, such as set bag nets and small mosquito nets (Haque *et al.*, 2021; Azam *et al.*, 2014; Siddik *et al.*, 2016c) in the river estuaries, rivers, and pastures along the coasts of Khulna, Patuakhali, Barisal, Satkhira, and Cox's Bazar districts of Bangladesh.

How to get seabass fry

After ovulation the eggs and larvae are then carried to the estuary by the tidal water. Local fisherman captures the larvae as they move from the estuary to the higher portions of the river. When larvae are put in ponds, there is a high chance that they will die. Instead, larvae that come from natural sources are raised in one of two ways to make juveniles up to (3-5) inches.

Fig. 3-4. Seabass culture demonstration farmers

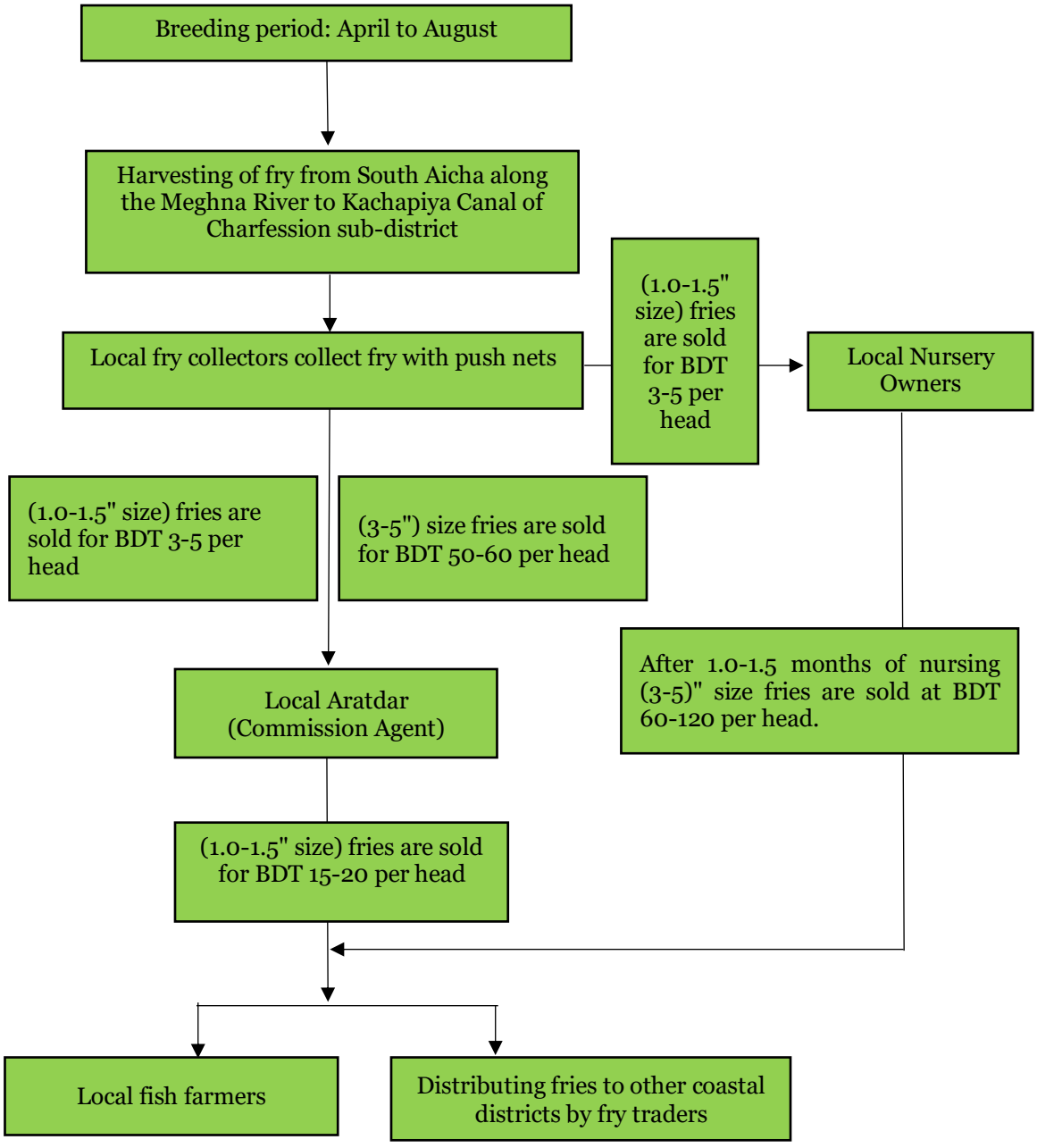

Fig. 5. Flow chart of channel for getting seabass fry from natural sources in Charfession sub-district of Bhola district of Bangladesh.

Seabass fry nursing in hatchery tank

Fries of 0.5-1.0 inch length are stocked at a density of 800-1100 per cubic meter in nursery tanks or ponds and fed moderate quantities of nursery feed. Many are also accustomed to eating fish meat and small shrimp, especially those who will later farm naturally with low concentrations of live food. As the seabass eat the smaller fish, the same-sized fry is nursed in the tank by the grading method, and the larger fries are selected and separated every 3–4 days. Every day, about 35% of the water in the nursing tank is replaced. The tank water is maintained at around 10 ppt as a semi-brackish water fish. After being reared in nursing tanks for approximately 30-40 days, the nursing tank survival rate is approximately 70-80%, and an average 3-5 inch size fish is collected for rearing in stocking ponds.

Seabass fry nursing in pond

Fingerlings measuring 0.5-1.0 inches are released at a rate of 25–35 per square meter by effectively netting the pond. The pond makes many zooplanktons and gets some nursery food in small amounts. After 20-25 days in nursing tanks, a typical 3-5 inch fish is gathered for further rearing in stocking ponds, where the survival rate is anywhere between 70 and 80%. Chakraborty *et al.* (2021) discovered that the survival rate of seabass fry is 50%.

Table 1. Price of fry observed in the project area.

Sl. No.	Fry Size (inches)	Price (Tk/piece)
01	1-1.5	15-20
02	2–3.0	40-50
03	5–6.0	100-120

Chakraborty *et al.* (2021) reported that a 1.0-1.5-inch fry costs BDT 8-10, a 2–3-inch fry costs BDT 15-25, and a 5–6-inch fry costs BDT 40-60 in Satkhira, Khulna, Bagherhat, Patuakhali, and Barguna, respectively.

Seabass farming method

In stock ponds, seabass is cultivated primarily by the extensive and semi-intensive methods. Siddik *et al.* (2016d) also found these two methods of seabass culture among the farmers in southwestern Bangladesh, specifically in the Satkhira district. During the nursing stage, a farmer must adapt the fish to the environment in which the fish will be grown. The fish are kept at the same level after being transported from brackish water. The pond is then desalinized through the gradual release of fresh water. In February and March, seabass farmers commence pond restorations. In most cases, the pond is prepared by removing all the fish, drying it out, and spreading lime. Many farmers prepare ponds for new spawning stock without first drying the ponds. Once the pond has been prepared, the growers contact the fry suppliers to obtain seabass fish fry.

Extensive culture method

With this approach, farmers can easily stock fry that are 4-5 inches long, 15-20 pieces each decimal, or 30–40 pieces per pond. The typical pond size of these farmers is 10–20 decimal. In this type of pond, stocking and harvesting occur continuously throughout the year. Depending on what is available, these ponds are stocked with various species of fish fry. Seabass fry sustains its life by eating zooplankton in the small stage. Later it hunts and eats small fish. Concerning the feeding of seabass, Al-Noor *et al.* (2012); Karmaker and Das (2001) and Kamruzzaman *et al.* (2013) have reached the same conclusion in their different studies. In the pond and gradually, after 18-20 months, it weighs 7-8 kg and becomes marketable. In this method, no external feed is applied to the pond.

Fig. 6. Seabass fingerling for stocking in ponds.

Semi-intensive culture method

Seabass, carp, tilapia, and small fish species are cultivated together in mixed aquaculture. The observed farm size of these farmers is 15-40 decimal. Chakraborty *et al.* (2021) found similar seabass farm size in their investigation of the coastal region of Bangladesh. In ponds, stocked tilapia produce fry that is used as seabass feed. In most cases, 25–35 pieces of seabass fry measuring 1.5–3.0 inches in size are stocked per decimal, and concurrently, 5 kg of tilapia fish fry of the same size are kept in storage at the same time.

Primarily, seabass feed on small tilapia and zooplankton; later, larger tilapia and carp fishes fry. Siddik *et al.* (2016e) discovered a similar phenomenon in seabass feed investigation. When the number of tilapia decreases, new tilapia fish fries are released, and in many cases, eel and trash fish are given as food. Stocking 5 kg of carp or tilapia fish fry per decimal every month for seabass feeding yields good results in this case. In this method, seabass gains 2-3 kg in a year and becomes salable. Chakraborty *et al.* (2021) also found that the growth of seabass in the mixed culture pond is relatively fast. Kamal *et al.* (2018)

also observed that 70 to 80 seabass fingerlings weighing 200 to 300 g were stocked in 15 decimal ponds, and small live tilapia, punti and tengra fish were given as seabass feed. After 30 to 40 days of cultivation, 50 percent of the weight of the seabass in a shrimp culture demonstrated farm in Ellarchar, Satkhira, gains up to 1.0-1.5 kg.

Market price of seabass

Like most other fish, the price of seabass on the market is mostly based on how much it weighs. Bigger fish cost more per kilogram than smaller fish.

Fig. 7. Seabass are harvested from mixed farming ponds in the Charfession sub-district of the Bhola district.

Table 2. The price of seabass in the project area's local market.

Sl. No.	Seabass weight	Market Rate (Tk Kg^{-1})
01	< 300 g	500-600
02	500 g	650-700
03	1 kg	700-800
04	>1 kg	850-900

Income-expenditure of seabass culture

Below are the average figures for seabass production and income expenditure in one year of polyculture with carp fishes in 0.134 ha. ponds in the Satkhira district.

Table 3. Income-expenditure of seabass culture with carp fishes.

Expenditure head	Cost (BDT)	Production and market rate	Market Price (BDT)
1 year lease value of 0.134 ha pond	12,000	660 kg of fish × BDT 600*	396,000
Price of 250 fingerlings of seabass (3–5-inch size)	25,000		
Pre-stocking pond preparation cost	20,000		
Feed cost in 1 year (supply of live fish fry)	151,200		
Aqua-medicines and other expenses	15,000		
Total Cost	223,200		
Net Profit (BDT) =(396,000-223,200) =172,800			

*At an average weight of 3 kg per fish and maximum mortality of 30 fish, the fish production is 220 × 3 = 660 kg, and at the farmer level, the selling price of fish per kg is a minimum of BDT 600.

Profit Percentage = (Profit/Cost Price) × 100
= (172,800/223,200) × 100
= 77.42%

Chakraborty *et al.* (2021) showed a net return of BDT 388,564 in cost and return of seabass production in one hectare (247 decimal) area under polyculture management with shrimp for 300 days, which is less than compared to the present study findings.

Marketing channel of Seabass

Seabass marketing is simple due to the large gap between demand and supply. If there are fewer fish after harvesting them from the farm pond, the farmers sell them in the local market. However, if the quantity of fish is more, it is sold to the local depo, or Fariya/traders buy fish from the pond or market and sell it to the local depo. Another group of foriyas/traders or businessmen buy seabass from the local depo or market and sell it in the large local market, Upazila depo, Upazila fish market, etc. Through such channels, the fish reaches the district or divisional markets.

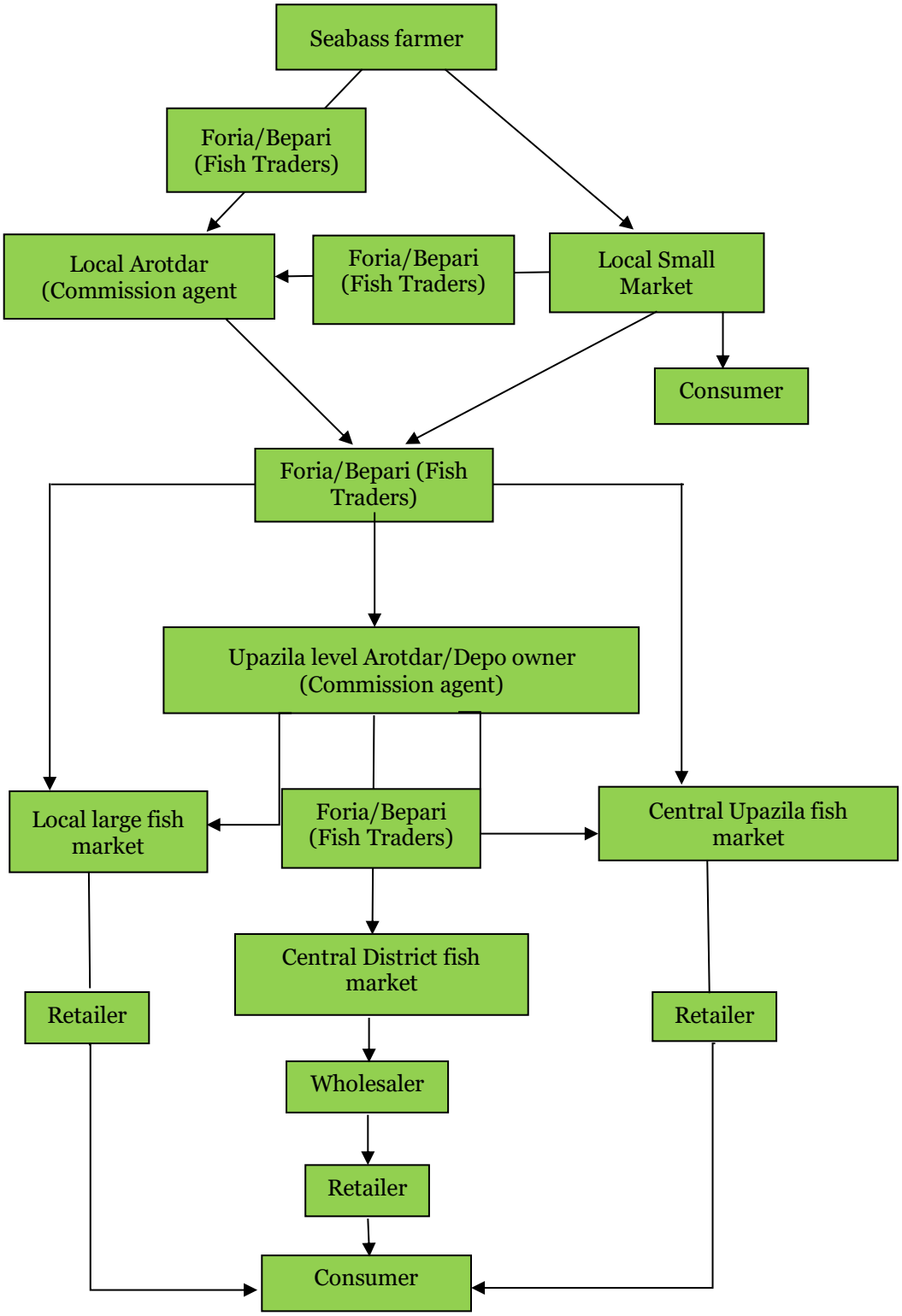

Fig. 8. A typical layout of marketing channels for seabass in Bhola and Satkhira Districts of Bangladesh.

Observed limitations in seabass farming expansion

There have been some setbacks in expanding seabass farming in the study area. Haque *et al.* (2019) also brought up the majority of these challenges in their discussion.

- Scarcity of fry in natural sources;
- Destruction of other fish larvae and aquatic biodiversity during the collection of larvae from natural sources;
- Not practice of artificial breeding of seabass still now;
- Not accustomed to supplementary feed;
- Trash fishes are scarce and expensive as seabass feed;
- They require saline water for reproduction and rapid growth;
- Due to the coastal location, the culture pond frequently sinks, and the fish emerge; and
- Fish that compete for food with seabass cannot be farmed in the same pond.

Summary of findings

Bangladesh is an excellent place to grow seabass because of its temperature and weather. It is an economically significant fish, particularly in the southern part of the country. Future implementation of the artificial breeding method for seabass in Bangladesh is feasible with the assistance of the information and experience gained in Thailand and Vietnam, two of our neighboring nations. Since seabass can be grown in both semi-saline and salty coastal waters, Bangladesh will have a huge area where it can be grown. Our coastal region's rivers and canals are also suitable for seabass cultivation. Seabass production and export potential are expanding once more due to the fish's immense domestic and international demand. The commercial production of seabass will revolutionize the economics and marine fisheries of the country.

Recommendation

Although the coastal areas of Bangladesh are suitable for seabass farming and there is a lot of interest in seabass farming among farmers on the ground, seabass farming has not grown because it takes too long to produce fry through artificial breeding. Research and specific strategies should be initiated immediately to develop and grow hatchery production and farming techniques for this highly promising species. In the Marine Fisheries Department under the Department of Fisheries, Bangladesh Fisheries Research Institute, and various universities, rather than conducting research in isolation, inter-coordination, and cooperation are required, in light of the experience of other countries and our country's coastal farmers in seabass farming, to conduct comprehensive research and technology transfer at the hatchery and field level in the following three subjects:

- Production of seabass fry by artificial breeding;
- Develop appropriate farming techniques.
- Acclimatization of sea bass to supplemental rather than live feed.

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References

Al-Noor, S.M., Kamruzzaman, S. and Hossain, M.D. 2012. Seasonal variation of food composition and feeding activity of small adult Barramundi (*Lates calcarifer*, Bloch) in the south west coastal water near Khulna, Bangladesh. *Our Nature*. 10(1): 119-127. https://doi.org/10.3126/on.v10i1.7772

Azam, A.K.M.S., Saha, D., Asadujjaman, M., Mahbub, K.R. and Minar, M.H. 2014. Fishing gears and crafts commonly used at Hatiya island: a coastal region of Bangladesh. *Asian J. Agril. Res.* 8: 51-58. https://doi.org/10.3923/ajar.2014.51.58

Chakraborty, B.K., Azad, S.A. and Ahmed, M.U. 2021. Status of sea bass farming in the coastal area of Bangladesh. *J. Nat. Res. Dev.* 16(2): 1-13.

Chou, R. and Lee, H.B. 1997. Commercial marine fish farming in Singapore. *Aqua.Res.* 28(10): 767-776. https://doi.org/10.1046/j.1365-2109.1997.00941.x

DoF. 2013. National Fish Week 2013 Compendium (*in Bangla*). Department of Fisheries, Ministry of Fisheries and Livestock, Bangladesh. pp. 34-37.

DoF. 2018. National Fish Week 2013 Compendium (*in Bangla*). Department of Fisheries, Ministry of Fisheries and Livestock, Bangladesh. pp. 125-130.

DoF. 2020. Yearbook of Fisheries Statistics of Bangladesh, 2019-2020. Fisheries Resources Survey System (FRSS), Department of Fisheries. Bangladesh. 37:141.

FAO. 2020. The State of World Fisheries and Aquaculture 2020. Sustainability in action. Rome, Italy. pp. 32-35. https://doi.org/10.4060/ca9229en

Frost, L.A., Evans, B.S. and Jerry, D.R. 2006. Loss of genetic diversity due to hatchery culture practices in barramundi (*Lates calcarifer*). *Aqua*. 3: 1056-1064. https://doi.org/10.1016/j.aquaculture.2006.09.004

Haque, M.A., Hossain, M.I., Uddin, S.A. and Dey, P.K. 2019. Review on distribution, culture practices, food and feeding, brood development and artificial breeding of Seabass, *Lates calcarifer* (Bloch, 1790):

Bangladesh perspective. *Res. Agric. Livest. Fish.* 6(3): 405-414. https://doi.org/10.3329/ralf.v6i3.44806

Haque, M.S., Hossain, M.I., Hasan, S.J. and Dey, P.K. 2021. Diversity of fishing gears and crafts used for harvesting the Asian seabass, *Lates calcarifer* along the Bay of Bengal, Bangladesh coast. *Bangladesh J. Fish.* 33(1): 147-155. https://doi.org/10.52168/bjf.2021.33.17

Kamal, B.M.M., Huda, M.N. and Ali, M.R. 2018. Nursery and culture management of seabass. National Fish week, 18-24 July 2018 compendiums (*In Bengali*). Department of Fisheries, Ministry of Fisheries and Livestock, Bangladesh. pp. 125-130.

Kamruzzaman, S., Al-Noor, S.M. and Hossain, M. 2013. Food and feeding habits of Juvenile white sea bass, *Lates calcarifer* (Bloch) from the Shibsha river in the South-Western coastal region of Bangladesh. *J. Bio-Sci.* 21: 141-144. https://doi.org/10.3329/jbs.v21i0.22528

Karmaker, J.K. and Das, N.G. 2001. Food and feeding habits of the bhetki, *Lates calcarifer* (Bloch). *Bangladesh J. Zool.* 29(2): 187-192.

Kuperan, K.V. and Jahan, K.M. 2010. Noncompliance a major threat in Fisheries management-Experiences from the artisanal coastal Fisheries of Bangladesh. *J. Int. Stud.* 6: 97-113. https://doi.org/10.32890/jis.6.2010.7911

MoFA. 2014. Press Release: Press statement of the Hon'ble Foreign Minister on the verdict of the Arbitral Tribunal/PCA. Dhaka, 08 July 2014. (Ministry of Foreign Affairs) http://www.mofa.gov.bd/PressRelease/PRDetails.php?txtUserId=&PRid=854

Pramanik, M.A.H. 1988. Methodologies and techniques of studying coastal systems: Case Studies II, Space and Remote Sensing Organization (SPARSO), Bangladesh, pp. 122-138.

Siddik, M.A.B., Chaklader, M.R., Hanif, M.A., Islam, M.A. and Sharker, M. 2016a. Stock identification of critically endangered olive barb, *Puntius sarana* (Hamilton, 1822) with emphasis on management implications. *J. Aqua. Res. Dev.* 7(2): 1000411. https://doi.org/10.4172/2155-9546.1000411

Siddik, M.A.B., Chaklader, M.R., Hanif, M.A., Islam, M.A. and Fotedar, R. 2016b. Length–weight relationships of four fish species from a coastal artisanal fishery, southern Bangladesh. *J. Appl. Ichthyol.* 32(6): 1300-1302. https://doi.org/10.1111/jai.13181

Siddik, M.A.B., Chaklader, M.R., Hanif, M.A., Nahar, A. and Ilham, I. 2016c. Variation in the life-history traits of a Schilbid catfish, *Clupisoma garua* (Hamilton, 1822) in the coastal waters of southern Bangladesh. *Chinese J. Oceanol. Limnol.* 35: 1189–1196. https://doi.org/10.1007/s00343-017-6008-6

Siddik, M.A.B., Hanif, M.A., Chaklader, M.R., Nahar, A. and Fotedar, R. 2016d. A multivariate morphometric investigation to delineate stock structure of gangetic whiting, *Sillaginopsis panijus* (Teleostei: Sillaginidae). *SpringerPlus.* 5: 520. https://doi.org/10.1186/s40064-016-2143-3

Siddik, M.A.B., Islam, M.A., Hanif, M.A., Chaklader, M.R. and Kleindienst, R. 2016e. Barramundi, *Lates calcarifer* (Bloch, 1790): A New Dimension to the Fish Farming in Coastal Bangladesh. *J. Aqua. Res. Dev.* 7: 461. https://doi.org/10.4172/2155-9546.1000461

Vij, S., Purushothaman, K., Gopikrishna, G., Lau, D., Saju, J.M., Shamsudheen, K.V., Kumar, K.V., Bashee, V.S., Gopalakrishnan, A., Hossain, M.S. and Sivasubbu, S. 2014. Barcoding of Asian seabass across its geographic range provides evidence for its bifurcation into two distinct species. *Front. Marine Sci.* 1: 30. https://doi.org/10.3389/fmars.2014.00030

Zhu, Z.Y., Lin, G., Lo, L.C., Xu, Y.X., Feng, F., Chou, R. and Yue, G.H. 2006. Genetic analyses of Asian seabass stocks using novel polymorphic microsatellites. *Aqua.* 1(4): 167-173. https://doi.org/10.1016/j.aquaculture.2006.02.033