

Effects of COVID-19 pandemic on *Baor* (Oxbow lake) fisheries: Decreased economic livelihoods and food security

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Abstract

The COVID-19 pandemic has had a negative impact on the global economy, with Bangladesh as a developing country exhibiting greater vulnerability. This pandemic has negatively affected the livelihoods and food security of the nation. *Baor* (oxbow lake) fisheries communities also were significantly affected during the pandemic, in terms of incomes, food security, health conditions, etc. Fishers have had to stop harvesting, or lower the quantity, of fishes, the sale of which was the main income source of the *baor* fishers' community because of reduced consumer demands during the lockdown conditions. The supply chains of fishes and fish culture inputs were also disrupted because of a lack of needed transportation, thereby hindering the availability of this convenient protein source from the fish. All these factors negatively impacted the incomes of the people dependent on this important fishery. If appropriate measures are applied to overcome these various difficulties, the *baor* fisheries may again contribute significantly to the livelihoods and food security of the population in the southwestern part of Bangladesh.

KEYWORDS

COVID-19, food security, livelihoods, SARS-CoV-2, wetland fisheries

1 | INTRODUCTION

The fisheries sector represents one of the most productive and dynamic sectors in Bangladesh by playing an increasingly important role in the economy of the country for the past few decades. The country has achieved outstanding progress in this sector since gaining its independence in 1971, ranking third in inland open water fisheries and fifth in global aquaculture production. The fisheries sector has a very significant role in the food security and socioeconomic development, deserving of potential for future development in the agrarian economy of Bangladesh. About 11% of the total population of the country is involved with this sector directly or indirectly (fishing, transportation, marketing, processing, exporting, etc.) for their daily livelihood. It contributes 3.50% to the national GDP and around one-fourth (25.72%) to the agricultural GDP. Bangladesh currently experiences surplus fish production (43.84 lakh MT), while the fish

demand is 43.41 lakh MT (Figure 1). The per capita fish consumption is 63.01 g, which is greater than their daily protein demand of 60.0 g. The country earned a significant quantity of foreign currency during 2018–2019 through exporting shrimp, fish and other fishery products that comprised 1.23% of its total export earnings. The quantity is BDT 4250.31 crore from the export of 73.17 thousand MT fishery products (DoF, 2020) that contribute to the livelihood of its peoples.

Bangladesh is blessed with vast fishery resources (i.e. fisheries properties with economic value for the welfare of human beings), including marine and inland fisheries. *Baor* fisheries are part of the inland closed fisheries. Generally, *baor* is a dead river used for fish capture and culture. It exists in as oxbow lakes, abandoned water meander systems becoming isolated from the mainstream channel and remaining filled with water. Most of the *baors* are located in the moribund delta of the Ganges of the southwestern (SW) portion of the country, covering an area of 5, 671 ha, which also increases in the

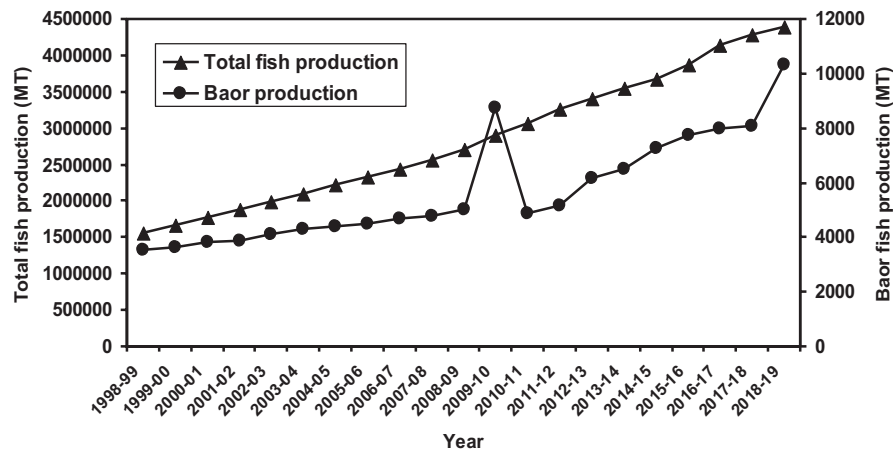


FIGURE 1 Total and *baor* (oxbow lake) fish production (MT) of Bangladesh from 1998–1999 to 2018–2019

rainy season, providing 10,343 MT fish production (Figure 1). The average *baor* production was 1824 kg/ha last year, which is higher than any other inland open waters (DoF, 2020). Despite a relatively small contribution to the national fish production, the *baors* offer tremendous scope and potential with their use as an important feeding and spawning ground for many freshwater fish species, supporting about 84,000 people directly, including more than three lakhs indirectly for their daily livelihoods. Bangladesh needs 80.00 MT of fish production by 2030 to achieve Sustainable Development Goals, with *baors* able to make significant contributions for fulfilling this target (Halim et al., 2018).

The COVID-19 pandemic resulted from the single-stranded virus named SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus-2). The city of Wuhan, China was the origin of this disease and its subsequent worldwide outbreak. The World Health Organization (WHO) declared it to be a global health emergency on 30 January 2020, and a pandemic on 12 March 2020. The virus is readily transmitted and easily infects people, with about 200 countries being affected by this pandemic (Saadat et al., 2020). Clinically tested vaccines have only recently been approved to try to control this disease. As per WHO suggestions, people begin staying at home to reduce the spread of the virus, as well as adopting preventive measures that included social distancing, mandatory lockdowns, working at home, restricting local and international travel, etc. The first confirmed COVID-19 infection in Bangladesh was reported on 8 March 2020 and the first death on 18 March in Bangladesh. To protect its population, the Bangladesh national government declared a first phase lockdown on 23 March, continuing until 30 May 2020, with the second phase being declared on 5 April 2021 and continuing (14 July, 2021; till article published). Measures such as regional lockdowns, maintaining social distance and reduced travel are now beginning to slow the progress of the disease. Bangladesh reached two grim milestones of 1,048,155 cases and 16,842 deaths, while there were 184,424,524 confirmed infections and 3,986,982 deaths worldwide on 14 July 2021 (Corona info, 2021).

Although COVID-19 is a health crisis, it may also result in food security issues if proper actions are not taken globally (Galankis, 2020). The earlier pandemics experienced by mankind have

demonstrated that the associated panic affects human activities and economic growth (Arndt & Lewis, 2001), resulting in increased malnutrition and hunger (Burgui, 2020; Sar et al., 2010). SARS, Ebola and MERS are examples of previous global outbreaks with detrimental impacts on food and nutrition security, especially in poorer nations and to vulnerable people (Hossain, 2020). When the Ebola pandemic struck Liberia, Guinea and Sierra Leone in 2014, domestic rice prices increased by 30%, while cassava, a significant staple in Liberia, increased by 150% (Fan, 2020). In the same manner, the productivity of agricultural crops (rice, wheat, vegetables, etc.), aquatic foods (fish, seafood) and livestock (egg, meat and dairy) may be seriously disrupted if the COVID-19 pandemic continues over a long time period (Bermejo, 2004). About 820 million people throughout the world are experiencing hunger according to the FAO (Food and Agriculture Organization). Accordingly, the world is very susceptible to food and nutrition security issues, with less developed, developing and lower-middle countries being the most susceptible (FAO, 2020a).

COVID-19 has already had negative effects on the world economy (Fernandes, 2020), with developing countries, including Bangladesh, being more vulnerable to its negative impacts. The livelihoods of the people of Bangladesh depend mainly on agriculture, including crops, fisheries and livestock (Hossain, 2020). Bangladesh is currently struggling to combat the adverse impacts of COVID-19, including a disruption of industry, poultry, dairy, agricultural and aquatic food systems that directly or indirectly threaten the livelihoods of dependent communities. The most susceptible are informal sector workers earning low incomes (i.e. day labourers; fishers), with the pandemic rendering about 80% unemployed (Mahmood, 2020). All fishers of the *baor* community were fully dependent on the *baor* for their livelihoods (Halim et al., 2018) although the resulting net profits are not satisfactory (Sharif, Ali, et al., 2016). The livelihoods of other peoples, including transportation owners and workers, sellers, feed suppliers, etc., are also indirectly dependent on this activity for their livelihoods.

The COVID-19 pandemic does not affect everybody in a similar manner, with different socioeconomic communities being affected in different ways. Although a few studies have been conducted on various aspects of the *baor* fisheries (Islam et al., 2018;

Sharif, Ali, et al., 2016; Sharif, Hassan, et al., 2016), no information is available on the effects of this pandemic on the fishery. Accordingly, the present study was conducted to determine the effects of the COVID-19 pandemic on community livelihoods and food security from the *baor* (oxbow lake) fisheries of southwest Bangladesh.

2 | METHODOLOGY

2.1 | Data collection

The present study was carried out in the Jhenaidah, Chuadanga, Jessore, Kushtia and Magura districts of Bangladesh where contain the majority of *baors*, with the livelihood study conducted on the basis of primary and secondary data. A survey was used to collect the primary data. Well-designed questionnaires, including many socioeconomic parameters associated with daily activities and survival strategies, were prepared. A random sampling method was followed for the questionnaire interviews. A participatory rural appraisal (PRA) tool (i.e. Focus Group Discussion [FGD]) was arranged with fishers, wholesalers, vendors and transporters. Cross-check interviews (CI) were organized with key personnel, including the Upazila Fisheries Officer (UFO), Assistant Fisheries Officer (AFO) and related NGOs employers. Some personnel were contacted via telephone during the lockdown, facilitating rapid collection of the data at low costs.

Secondary data were collected from published and online documents in different journals, newspapers and relevant websites. The data included an overview of Bangladesh, the status of the lockdown and the number of confirmed, convalesced and death cases. Data on the production, demand and supply of the fish and related aquaculture were collected from the DoF under the Ministry of Fisheries and Livestock of Bangladesh (DoF, 2020).

2.2 | Data analysis

The arranged quantitative data were transferred to an MS EXCEL calculation sheet, while the qualitative data were analysed through text analysis.

3 | RESULTS

The lockdown situation resulting from the COVID-19 pandemic had unpredictable influences on the global economy, especially for developing countries such as Bangladesh. The impacts of COVID-19 on global poverty are highlighted in Figure 2. Decreasing incomes of different professions in the country are summarized in Figure 3, with average costs being summarized in Figure 4. The Bangladesh fisheries sector also illustrated various impacts, with stakeholders of the *baor* fisheries in southwest Bangladesh, and the livelihoods of dependent persons being affected in the pandemic.

3.1 | Harvest, transportation and marketing

Most of the *baors* are managed through a community-based management (CBM) system, with fish harvesting done by individuals. The main challenge they face is the marketing of the fish. Because of the lockdown situation, transportation was significantly decreased, with fishers unable to market their harvested fishes, even though the fish were suitable for harvest in March. The price of fish decreased 15%–30% from normal prices, while the transportation cost increased from 50% to 80% during the same period (Tables 1 and 2). Fishers generally harvest fish in small amounts, with the remaining fishes kept in the *baors*, which exhibited diseases in some cases. Major problems facing the *baor* fisheries are illustrated in Figure 5, with the disrupted supply chain of the *baor* fishes illustrated in Figure 6.

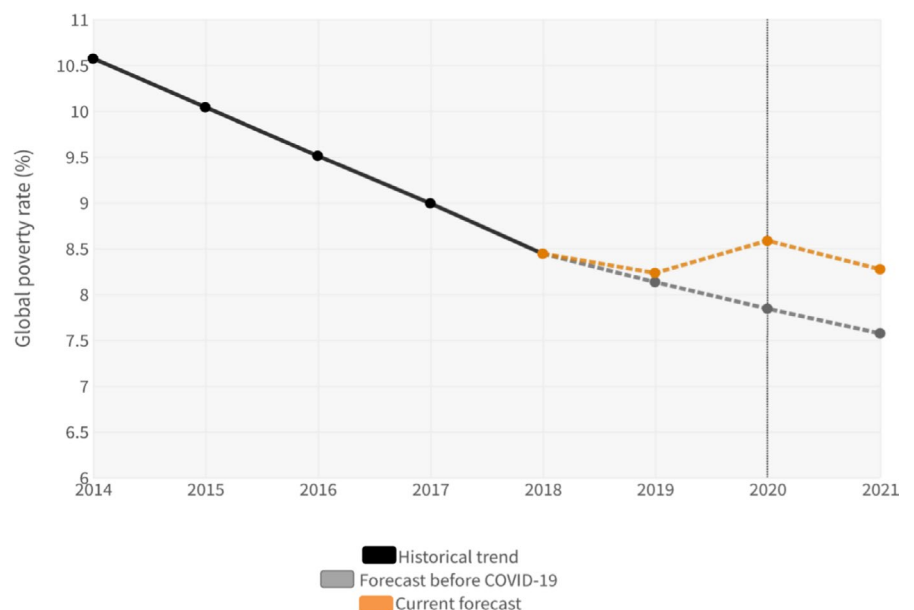


FIGURE 2 Impact of COVID-19 on global poverty rate (global poverty rate measured as global population living on <\$1.90 per day; Mahler et al., 2020)

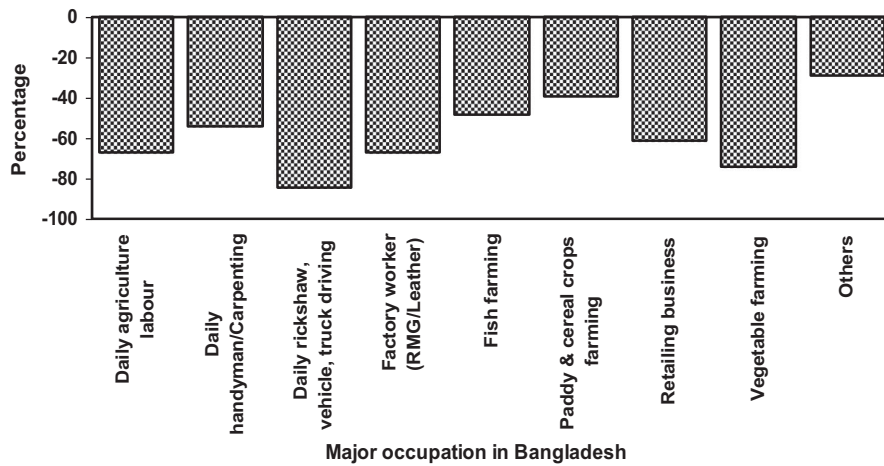


FIGURE 3 Decreased incomes of different occupations in Bangladesh (Kibria et al., 2020)

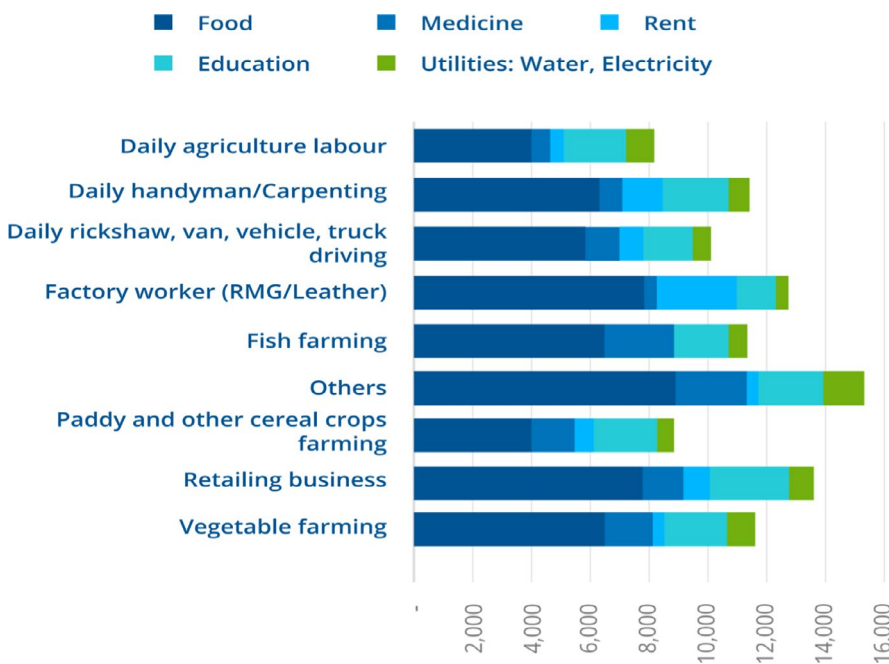


FIGURE 4 Average cost of living per category (BDT) by income category in Bangladesh (Kibria et al., 2020)

3.2 | Fry stocking

Most *baor* fisheries are now a mixed system of a culture of exotic carp and the capture of indigenous species. Because of the transportation problems, the marketing system and low fish prices, fishes deferred harvest in some *baors*, as well as not being able to stock new fry for the remaining fishes. Hatchery owners also did not produce fish fry since the lower demand for fish. The price of fry or fingerlings decreased approximately 20%, with the hatchery/nursery owners facing significant monetary losses.

3.3 | Feed and other inputs

Although feed is an obvious key requirement for fish culture, the supply of fish feed was not available in local markets because of the lockdown. Accordingly, fishers had to pay additional charges of 5%–10% to buy fish feed. At the same time, more feed was needed for

the remaining fishes in the *baors*. The availability of other inputs (e.g. lime; oil cake) was also lower, with prices increasing from 5% to 8%. The major disruption in the fish feed supply chain and other inputs are illustrated in Figure 7.

3.4 | Current status of fish stock and fisheries governance

The current status of the fish stock (i.e. species composition of fish production in the southwest Bangladesh *baors*) is summarized in Table 3. The *baors* were the assets of *zamindar* (landlords) during the British colonial period. *Zamindari* was abolished through the Tenancy Act (1950), with the *baors* being occupied by the state and placed under the authority of the Ministry of Land. Leasing to private individuals was then practised through auctions. *Baors* were consigned to the Department of Fisheries (DoF) and the DoF introduced the Development Management Scheme in 1968. The DoF employed

TABLE 1 Fish prices before COVID-19 pandemic and during lockdown period in Bangladesh (FAO, 2020d)

Species	Market price (BDT/kg) (12 March ^a)	Market price (BDT/kg) (14 April ^a)	Change in one month (%)
<i>Pangasius hypophthalmus</i> (big)	145	98	-32.4
<i>Gibelion catla</i> (medium)	355	315	-11.3
<i>Oreochromis niloticus</i>	130	145	11.5
<i>Pangasius hypophthalmus</i> (small)	85	125	47.1
Shrimp-small	550	650	18.2
<i>Cirrhinus cirrhosus</i>	225	190	-15.6
<i>Gibelion catla</i> (small)	240	255	6.3
<i>Labeo rohita</i>	290	270	-6.9
<i>Cirrhinus cirrhosus</i> (small)	248	175	-29.4
<i>Ctenopharyngodon idella</i>	120	270	125.0
<i>Hypophthalmichthys molitrix</i>	170	145	-14.7
<i>Heteropneustes fossilis</i>	625	410	-34.4
<i>Chitala chitala</i>	900	900	0.0
<i>Anabas testudineus</i>	250	475	90.0
<i>Clarias Batrachus</i>	575	800	39.1
<i>Wallagu attu</i>	900	650	-27.8

^a12 March before lockdown; 14 April during lockdown.

TABLE 2 Fish prices before and after COVID-19 pandemic (BDT/kg) in Farmgate, Dhaka, Bangladesh (Nazrul, 2020)

Species	Average price pre-COVID-19	Average price during COVID-19	Change in price (%)
<i>Labeo rohita</i>	180	160	-11
<i>Gibelion catla</i>	188	177	-6
Ompok pabda.	408	316	-23
<i>Pangasius hypophthalmus</i>	103	85	-17
<i>Oreochromis niloticus</i>	107	83	-22
<i>Macrobrachium rosenbergii</i> (Shrimp_Galda)	1300	625	-52
<i>Penaeus</i> sp. (Shrimp_Bagda)	733	378	-48

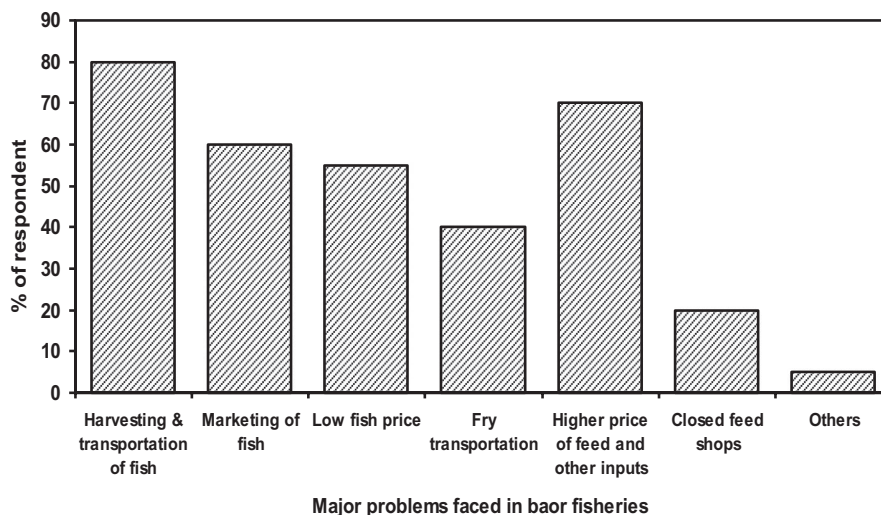


FIGURE 5 Major problems found in baor (oxbow lake) fisheries during COVID-19 through a baseline survey

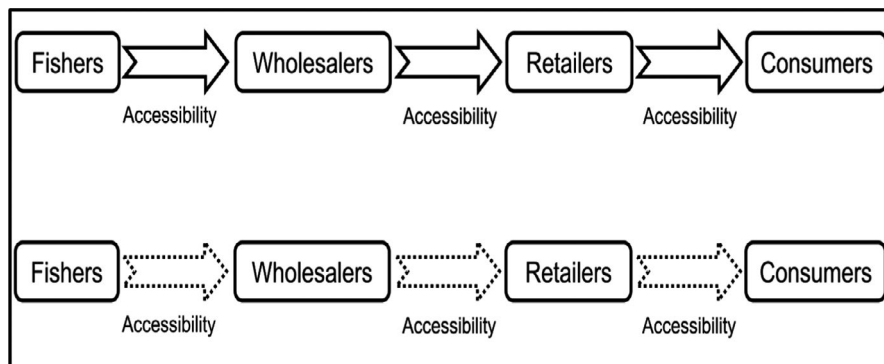


FIGURE 6 Supply chain of *baor* (oxbow lake) fishes in pre-COVID-19 time (upper) and disrupted supply chain during lockdown period (lower)

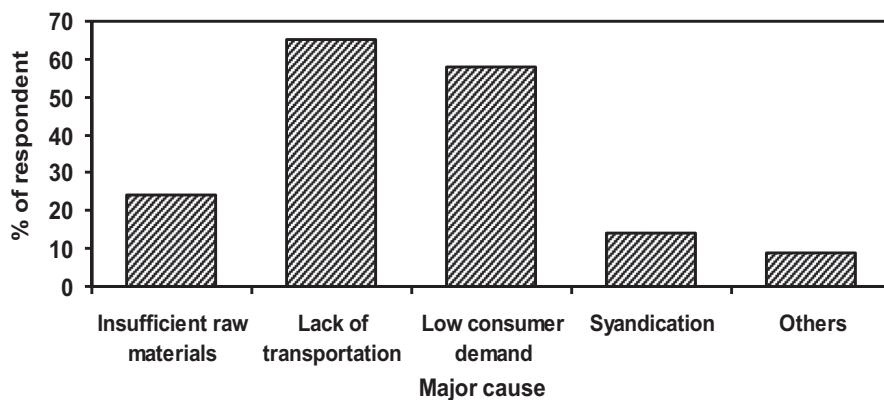


FIGURE 7 Major disruption in supply chain of fish feed and other inputs during COVID-19 situation

individuals to manage the *baors*, to remove water hyacinth and to stock the fishery, with the associated costs being covered under the lease value. Nevertheless, the funding level was not sufficient to increase the stocking levels. After the independence of Bangladesh in 1971, a World Bank-funded pilot project ('Oxbow Lakes Fishery Project [OLP 1]') was implemented through the Department of Fisheries, with the Government of Bangladesh meant to increase fish production during 1978–1986 in six *baors* under culture-based fisheries management. Upon completion of the project, the 'Oxbow lake Small Scale Fishermen Project (OPL 2)' was initiated in 23 *baors* during 1989–1997, with funding from IFAD and DANIDA. The fishers were institutionalized for the *baor* fisheries management through the formation of a 'Lake Management Group (LMG) group in the project. The LMG was formed by the Lake Fishing Team (LFT), which had rights to culture and harvest *baor* fishes. The management policy for these 29 *baors* was the same as for the earlier OLP 1 and OLP 2 to the present time, with the goal of increasing fish production and enriching the socioeconomic conditions of the fishers. The other associated entities are considered under the institutional framework of the *Jalmahal* Management Policy of 2009 (Ministry of Land, 2009). Only actual fishers can lease the *baor* through formation of a fisher's cooperative association officially registered to the Department of Fisheries. The genuine fishers comprise those living adjacent to the *baor*, with the catching and selling of fish being their only livelihoods. The *baors* are leased by the *Jalmahal* District committee on behalf of the Ministry of Land, as well as being co-managed by the fisher's cooperative association and the DoF of the Ministry of Fisheries and Livestock.

Bangladesh is one of the most densely populated, lower-middle-income riverine countries in southeast Asia (Sunny et al., 2020). Fisheries exhibit both positive benefits and negative challenges in the country. The *baor* fisheries are a vital source of earnings and micronutrients, including vitamins, iron, calcium and minerals (Kohinoor et al., 2001) for the surrounding communities. This includes not only the fishers, but also transportation owners and workers, feed suppliers, hatchery owners and labourers, all dependent on the *baor* fisheries for their livelihoods. At the same time, the COVID-19 pandemic is causing a dramatic drop in the incomes of these self-employed persons (Zurayk, 2020).

The serious consequences regarding income opportunities for rural communities in Bangladesh were primarily the result of a general system breakdown. A nationwide lockdown produced a demand-supply mismatch in the market, including a shortage of agricultural labour and an asymmetrical distribution of farm labour, resulting in unmet demands of companies and customers (Amjath-Babu et al., 2020). Limitations on transportation possibilities further exacerbated the situation. A breakdown of supply chains also occurred throughout the nation because of the nationwide supply demand mismatch of services and consumer goods resulting from a decreased customer demand for transportation services and commodities. A survey by Light Castle highlighted a 44%–64% decrease in income for rural people in Bangladesh during the lockdown period. It is clear that the pandemic has serious negative impacts on the economy of Bangladesh (Hasnin, 2020). The lockdown also affected the fisheries sector in differing degrees, and at diverse levels in the supply chain (Nazrul, 2020).

TABLE 3 Current status of fish stock (species composition of fish production) in baors of Bangladesh (DoF, 2019)

Species	2018-2019		2017-2018		2016-2017		2015-2016	
	MT	%	MT	%	MT	%	MT	%
Culture								
<i>Labeo rohita</i>	1491	14.42	1169	14.48	1159	14.48	1119	14.48
<i>Gibelion catla</i>	866	8.37	670	8.30	664	8.29	641	8.29
<i>Cirrhinus cirrhosus</i>	598	5.78	474	5.87	470	5.87	454	5.87
<i>Labeo calbasu</i>	41	0.40	26	0.32	26	0.32	25	0.32
<i>Labeo Bata</i>	232	2.24	186	2.30	184	2.30	178	2.30
<i>Labeo gonius</i>	18	0.17	9	0.11	9	0.12	9	0.12
<i>Hypophthalmichthys molitri</i>	1736	16.79	1355	16.78	1343	16.78	1297	16.78
<i>Ctenopharyngodon idella</i>	582	5.63	453	5.61	449	5.62	434	5.62
<i>Cyprinus carpio</i>	450	4.35	353	4.37	350	4.37	338	4.37
Other Exotic carp	49	0.47	38	0.47	38	0.48	37	0.48
Capture								
<i>Wallago attu</i> , <i>Sperata aor</i>	144	1.39	111	1.37	110	1.37	106	1.37
<i>Channa striatus</i> , <i>C. marulius</i> , <i>C. punctatus</i>	240	2.32	187	2.31	185	2.32	179	2.32
<i>Anabas testudineus</i>	12	0.11	9	0.11	9	0.12	9	0.12
<i>Heteropneustes fossilis</i> , <i>Clarias</i> <i>batrachus</i>	12	0.11	9	0.11	9	0.12	9	0.12
<i>Oreochromis mossambicus</i> , <i>O. niloticu</i>	398	3.85	312	3.86	309	3.86	298	3.86
<i>Puntius sarana</i> , <i>Barbonymus</i> <i>gonionotus</i>	185	1.79	143	1.77	142	1.77	137	1.77
Other Inland Fish	2859	27.65	2236	27.71	2217	27.70	2141	27.70
Big Shrimp/Prawn	14	0.14	9	0.11	9	0.12	9	0.12
Small Shrimp/Prawn	416	4.02	323	4.00	320	4.00	309	4.00
Total	10,343	100	8072	100	8002	100	7729	100

Abbreviation: MT, metric ton.

The aquatic food system significantly contributes to the food and nutrition security of the nation by providing consistently safer and good quality animal protein (Islam et al., 2018; Sunny et al., 2019). The *baor* fisheries also are facing the challenges surrounding food security during the COVID-19 pandemic, including negative impacts on fish prices, as well as a decreased fish catch, resulting in a smaller quantity of *baors* fishes, reflecting a lower market demand. Consumers had to stay at home to be safe from COVID-19, thereby decreasing fish demands in the market. Nazrul (2020) reported an approximately 35% consumer decline in the fish market during the lockdown period, with fish supply chains also being disrupted because of the lockdown conditions and transportation prohibitions (Rosen, 2020a). A survey reported a disruption of agricultural product supply chains attributable to poorer purchaser demand (78%) and the lack of transportation (41%; Hasnin, 2020). Closed warehouses (fish *arat*) were another reason for a lower fish harvesting rate, noting the associated smaller quantity of fish as food, also leading to lower incomes for the fisher communities (Habib, 2020). Fish farmers also experienced economic losses, with Nazrul (2020) reporting a 20%–50% loss in earnings for fish farmers in the country. Various fish diseases also were observed, perhaps as a result of the high density of the remaining fishes in the *baors* (Rashid, 2020).

The income of the intermediaries (e.g. wholesalers; retailers) in the fish market also decreased by an average of 53%, the basic reason being a decreased number of consumers in the market during the lockdown, compared to the pre-pandemic situation (Rosen, 2020b). Changes in the distribution, supply and purchasing habits impacted the demands for perishable foods, with the unavailability of fish possibly leading to a food crisis (Seleiman et al., 2020).

The strategy of the present *baor* fisheries included both fish capture and culture practised at the same time and in the same waterbody. As the wetland was previously used solely for capture fisheries, the introduction of aquaculture practices has increased the total fish production and incomes for people (Islam et al., 2018). The April–June timeframe was the best period for fry release (Rashid, 2020). However, because fishers had to keep the fish in *baors*, they could not release fry for the next culture season. Lack of transportation during the lockdown period was another reason impeding fry stocking. Hatchery owners also produced lower numbers of fish fry because of both a low demand and the availability of unsold fry (Kawsar, 2020; Rosen, 2020a), both with negative impacts on their potential profits (FAO, 2020b).

The livelihoods of *baor* fishers were at risk because of unsold fish, as well as the extra costs for providing extra feed for the remaining fish (Nazrul, 2020). At the same time, fish feed production also plunged by 75% (Kibria et al., 2020). Further, most of the ingredients in the fish food, especially proteins, were previously imported from other countries, a situation that was hampered because of the mandatory international embargo attributable to the COVID-19 pandemic (FAO, 2020c). Interestingly, except for the high transportation costs, Nazrul (2020) did not identify a valid reason for increased feed and other retail input prices. Accordingly, people involved in these sectors are at a risk of losing their jobs and livelihoods (Nazrul, 2020), with fish farming income having decreased by 48.32% in the country (Hasnin, 2020).

4 | CONCLUSIONS

Baors have an important role in fulfilling the demands for safe food for the country population and the national economy of Bangladesh. The COVID-19 pandemic, however, has changed the lifestyle of the country's peoples. The trade between the fishers and traders has decreased, with the volume and value of fish catches being immediately impacted after the pandemic's onset. If the proper authorities take the necessary steps to overcome the above-noted difficulties regarding the *baor* fisheries and the related impacts of the pandemic, it will be a major step towards ensuring food security, nutritional status, economy and employment in Bangladesh.

5 | RECOMMENDATIONS

According to the South Asian Network on Economic Modeling (SANEM), Bangladesh's poverty rate may double to 40.9% from the situation existing prior to the onset of the COVID-19 pandemic. Proper management of the *baor* fishery can be very significant in addressing this situation in regard to meeting the demand for protein for the country inhabitants, as well as providing livelihoods for the fishers and those dependent on their efforts. Accordingly, the following steps are recommended to further develop the *baor* fisheries, as well as the whole fisheries sector in general, as a means of addressing the present challenges of the COVID-19 pandemic:

- An accurate and reliable digital data collection system should be introduced to address any similar emergency;
- A digital or online (phone call or apps-based) buying and selling system should be implemented;
- A short supply chain (i.e. from producer to consumer) should be developed;
- Cold storage facilities should be developed to store harvested fish;
- Develop fish processing technology for ensuring the quality of the *baor* fisheries and other fish should be developed;
- A suitable packaging system to supply fresh/dried/processed fish should also be developed;
- A stable price should be established for aquaculture inputs (feed; lime; oil cake; etc.), as well as a means of ensuring a stable and sufficient supply;
- Fish and fisheries products are made exempt from any transportation restrictions or bans; and
- Cooperation between the public and private sectors should be enhanced and expanded.

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CONFLICTS OF INTEREST

The authors declare they have no conflicts of interest regarding this publication.

INFORMED CONSENT

Informed consent was obtained from all individual participants.

DATA AVAILABILITY STATEMENT

The dataset used and/or analysed during the current study are available from the corresponding author on reasonable request.

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