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Current Economic Performance and Export Potentialities of Fisheries Sector in Bangladesh

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ABSTRACT

Bangladesh is endowed with extensive and highly diversified fisheries resources. More than 60% of animal-based food protein in Bangladesh comes from fish, which is an essential source of micronutrients and plays a significant part in the country's diet. This paper reviews the effectuation of fisheries sector in the economic development of Bangladesh using data collected from secondary sources. Bangladesh is the world's 5th largest producer of fish-culture products, outranked by China, Indonesia, India and Vietnam. In FY 2018-19, the fisheries sector contributed 3.5% to Bangladesh's national GDP. More than 18 million people are directly and indirectly involved in fisheries sector. Fish is the most significant source of protein for the mass population and the per capita consumption was 21.8 kg in 2019. The fisheries sector has been growing steadily in the recent decade with a 5.3% growth over the period from 2009 to 2019. In FY 2018-19, 56.76% (2.49 million MT) of aquaculture fish was cultivated in closed water bodies. Out of the fisheries production, the majority (1.97 million MT) is cultivated in ponds, particularly carp, pangas and tilapia fish which jointly account for 93% of freshwater fish production. The average growth rate of fish production in ponds is 5.7%, while this is 8.9% for intensive production. Shrimp production from culture farms contributes 51.34%. This study also found that fish-culture has a profound impact on the income level, food security, and employment generation of the farming community. Bangladesh furthermore recognizes the shrimp sector as an important source of foreign trade contributing 75.8% of total agriculture trade. The majorly export markets are the EU, USA, and UK. Although, China is the chief importer of crabs there exists a potential market for shrimp (Bagda). Pangas and tilapia also possess relative advantages in export. Therefore, with the sustainable use of available resources with proper technological assistance, fish produced from fish-culture would efficiently meet the protein demand of growing population and thus alleviating poverty with significant employment opportunities for the country.

Keywords: Fish-culture, Production trend, Socio-economic impacts, Export scenario, and Bangladesh.

INTRODUCTION:

Bangladesh has a significant wetland area where marine and freshwater biodiversity supports livelihoods, food security, and nutrition for millions of people both directly and indirectly (FAO, 2020). The fisheries sector contributes 3.57% to our national GDP and more than one-fourth (26.50%) to agricultural GDP, according to Bangladesh Economic Review, (2021). Fish accounts for 60% of total

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national daily animal protein consumption (with a per capita consumption of 62.58 g/day versus a target demand of 60 g/day) (DoF, 2019). Fish was the most popular protein source (in weight) by Bangladesh is in 2019, with 21.8 kg consumed per capita. Over the last two decades, per-capita fish consumption has raised by 1.6 times, from 14.1 kg per year in 2000 to 22.84 kg per year in 2020 (BER, 2021). Fisheries sector contributes significantly following

an increase in production by 1.4 times since 2001-02 up to 4.53 million MT in 2019-20, by 2.7% year-on-year. The enriched and diversified fisheries resources of the country are broadly divided into three categories: inland capture fisheries, inland aquaculture and marine fisheries, of which the inland fish-culture sector is contributing more than 56.76 % of the total production (DoF, 2019). Bangladesh came in third in inland open water capture production, fifth in overall fisheries production and 11th in marine fish production according to "The State of World Fisheries and Aquaculture" report. Currently Bangladesh ranks 4th in tilapia production in the world and 3rd in Asia (FAO, 2020). In the last 10 years, Bangladesh has risen to the second position in terms of growth rate of fish production in inland water bodies. The national fish hilsa (*Tenualosa ilisha*) as a single species has been making the highest contribution (12.15%) to the country's total fish production (FRSS, 2020).

Moreover, Bangladesh ranked 1st among 11 Hilsa producing countries in the world (BER, 2021). The entire fisheries sector directly and indirectly supports the livelihoods of more than 12% of the country's population, or 18 million people (Acharjee *et al.*, 2021). For their livelihoods 80 percent of laborers, or 1.4 million women work in the fisheries sector, which includes fishing, farming, handling fish, and processing (BFTI, 2016). Over the last 12 years (2006-07 to 2018-19), the fisheries sector's compound annual growth rate (CAGR) has been 5.01 percent, with consistent average fish-culture growth of roughly 8.59 percent (DoF, 2019). Exports of fish and fisheries products bring in 477.37 million dollars to the country (EPB, 2021). Bangladesh exports fisheries products to about 50 nations worldwide, including the European Union (EU), the United States, and Japan (EPB, 2021). Inland cultural fisheries produce 24.89 million MT in 2018-19, accounting for 84.95 percent of overall production and spanning an area of around 8.22 million hectares. Coastal fisheries include shrimp, prawns, and finfish farming, as well as shrimp growing in ghers (ponds/enclosures) (Shamsuzzaman *et al.*, 2020). Capture fish production is currently down to roughly 50%, with a downward trend of 1.24 percent every year (Hossain, 2014). Fisheries, as opposed to has been Bangladesh's fastest-growing food-producing sector for decades, with constant increases in overall production. In order to address the existing challenges with

inland catch fisheries, inland culturing has exploded, gaining special attention from farmers. Because of its rapid spread, fisheries are generally regarded to have the ability to enhance food security among adopters and the general public. Fisheries are considered to promote food security both directly and indirectly by contributing to farm diversification, women's empowerment, and the creation of new employment opportunities and revenue streams. Fisheries have been advocated for decades as a vehicle for rural economic development with an emphasis on poverty alleviation as a result of this rationale (Temesgen, 2020; Dey *et al.*, 2005).

However, literature addresses the linkage of fisheries sector with relevance to development (e.g., the economic, social, and environmental dimensions of sustainability). Therefore, considering aforementioned facts, this paper attempts to explore the fish-culture's role for contributing to the favorable changes to the extensive economy of Bangladesh.

MATERIALS AND METHODS:

This is an exclusive review paper. So, no precise methodology is involved to prepare this study. All of the data and information was gathered from secondary sources. Topic-related books, journals, proceedings, reports, publications, and annual reports were among the secondary materials. Various published publications from various journals aided in the gathering of data for this article.

The data was gathered from multiple sources, including the Bangladesh Bureau of Statistics, the Food and Agriculture Organization, the Statistical Yearbook of Bangladesh, and the Bangladesh Dept. of Fisheries' Fisheries Statistical Report. The study was written without any primary data or empirical research. The study has a unique objective to get familiar with the role of fisheries sector to the economic development in Bangladesh. For meeting the specific objectives, the economic position of various fish species is studied in this study utilizing various graphs and figures.

The yearly growth rate of fisheries since the last 30 years and the export status of shrimp culture over the last 20 years are being classified into showcases. The supply chain for fisheries in the domestic and urban markets is being developed and middleman performance is being discovered. All essential data was thoroughly collected and sorted after it was gathered.

RESULTS:

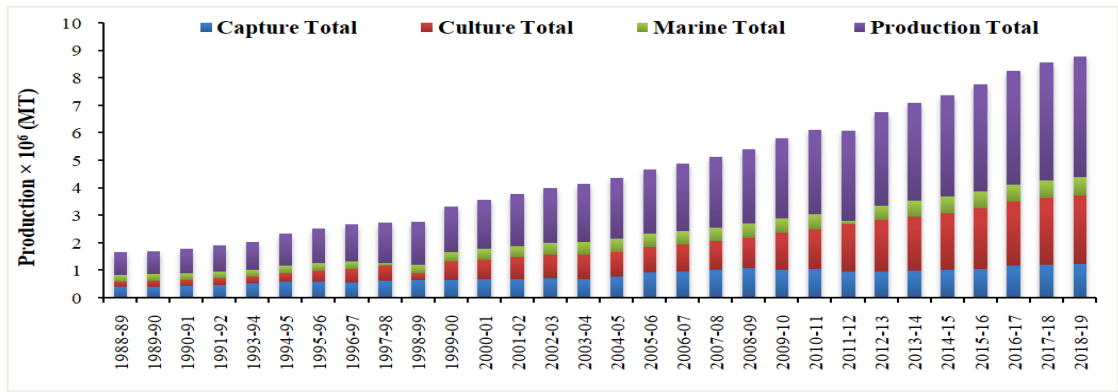


Fig. 1: Resource wise contribution of fish to total fish production in Bangladesh.

Overview of fisheries production status in various water resources

There was no primary data or empirical research in the study. The findings on this topic were reviewed using the library and website of Bangabandhu Sheikh MujiburRahmanAgriculturalUniversity (BSMRAU). Information was acquired from a variety of sources, including Google, Google Scholar, and others. Furthermore, I completed this work with the assistance of required comments and precise information from my acclaimed main professor and course instructors. All essential data was indirectly collected and sorted after it was gathered. Ponds had the highest output of inland closed water or culture fisheries, with 4964 kg/ha, and cage culture had the lowest productivity, with 22 kg/cu. Shrimp and prawn farms produced

2.58 lakh MT per year, accounting for 5.89 percent of total production, making them the second largest culture fisheries sub-sector (DoF, 2019). **Fig. 1** shows in 1983-84, when inland capture fisheries accounted for 63 percent of production and inland culture fishery accounted for just 15 percent, the situation has changed in sub-sequent years, with inland culture fishery accounting for 56.76 percent. In the case of marine fisheries, production increased by 22% in 1983-84. However, in recent years, the yield of marine fisheries has decreased. In 2018-19, marine fisheries contributed 15.05% of total fish production (**Fig. 1**). In 2018-19, marine fisheries contributed 15.05% of total fish production in (**Fig. 1**).

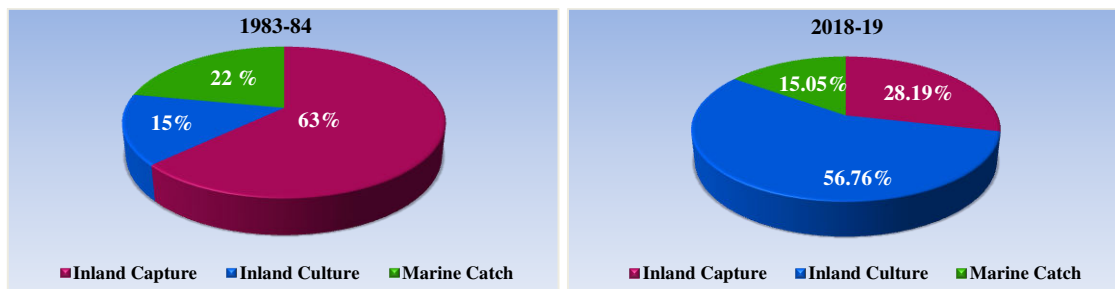


Fig. 2: Fisheries production trends compared to inland and marine capture fishery in Bangladesh over the years (1988-89 to 2018-19) (Source: DoF, 2019).

Fish production trend over the last 30 years

Total fish production in Bangladesh has increased 5.21 times in the last three decades from FY 1988-89 to FY 2018-19 year (Source: BBS, 2020). In 2000-01 there was a production of 17.81 lakh metric tons while it reached up to 43.84 lakh metric ton in 2018-19. A general trend of rising fish production was observed from 2008-09 to 2018-19 where the growth rate was 38.38 percent in the last 10 years. The yearly need for fish production was 40.50 lakh MT in 2016–17, whereas the annual output was 41.34

lakh MT, a significant accomplishment for the country. Fisheries production has expanded at a faster rate than inland and marine capture fisheries, as seen in **Fig. 2**. However, catches from open waterways are dropping worldwide, including in Bangladesh, as for overfishing and habitat loss. Environmental degradation caused by massive construction of flood control structures, over-exploitation, abstraction of water for irrigation, intensive agriculture and development activities, pollution, & destruction of mangrove forests are the main causes for the slow

growth of capture fisheries (Hoq, 2003). As a result, culturing has the potential to play a key factor in meeting increased demand for fish in the coming years.

Background of Fish-culture in Bangladesh

In its most basic form, fishery is the production of fish and other aquatic organisms, with 'farming' indicating some type of intervention to boost output, as well as some form of private rights for the stock under intervention (Beveridge & Little 2002). Bangladesh is a section of the Ganges delta, which is Asia's and the world's most populous river delta region (Ericson *et al.*, 2005). As a result, the country is characterized by a wide surface of Ganges, Brahmaputra, and Meghna River floodplains (80 percent) (World Bank, 2015). Rivers and inland water bodies occupy about 7% of Bangladesh's total land area, and their floodplains are regularly flooded during the monsoon season. Because of the climatic conditions and abundance of water bodies, fish production and harvesting are an imperative aspect of Bangladeshi rural life and cuisine. Over the last five decades, from 1970 to 2020, fisheries, or fish farming, have been the world's fastest expanding agro-food business. Overfishing and habitat deprivation are reducing the number of fish caught in open oceans around the world, including Bangladesh. As a result, NGOs, government agencies, and private businesses have stepped up to develop better fish farming practices, particularly in ponds and floodplains. Fish-

culture production systems in Bangladesh are primarily extensive and enhanced extensive, with some semi-intensive and, in a few cases, intense systems (Shamsuzzaman *et al.*, 2020). Bangladesh's contribution to global fisheries and aquaculture has more than doubled, from 1.30 percent in 1995 to 2.93 percent in 2018 (FAO, 2020).

Contribution of inland culture fisheries

Inland fishery has traditionally witnessed the fastest increase, especially in pond aquaculture, which accounts for additional 80% of total reported fisheries and aquaculture, as shown in Fig. 3. Fish production has more than doubled from 10.63 lakh MT in 2008-09 to 24.89 lakh MT in 2018-19, demonstrating sustained increase. The inland cultural fishery encompasses around 8.22 million hectares (FRSS, 2020). For pond, seasonal water body, baor (oxbow lake), and shrimp gher, the current unit area aquaculture productions (Kg/Ha) are 4851, 1584, 1471, and 983, respectively. In 2018-19, pond fishery provided 45.04 percent (19, 74, 632 MT) of total fish output in Bangladesh (BBS, 2020). Pen and cage culture, on the other hand, is becoming increasingly popular and is presently the most extensively practiced cultural system in Bangladesh. Coastal aquaculture, including shrimp and prawn farming as well as finfish farming, is growing, and overall shrimp and prawn production has increased in the last 18 years (Shamsuzzaman *et al.*, 2020).

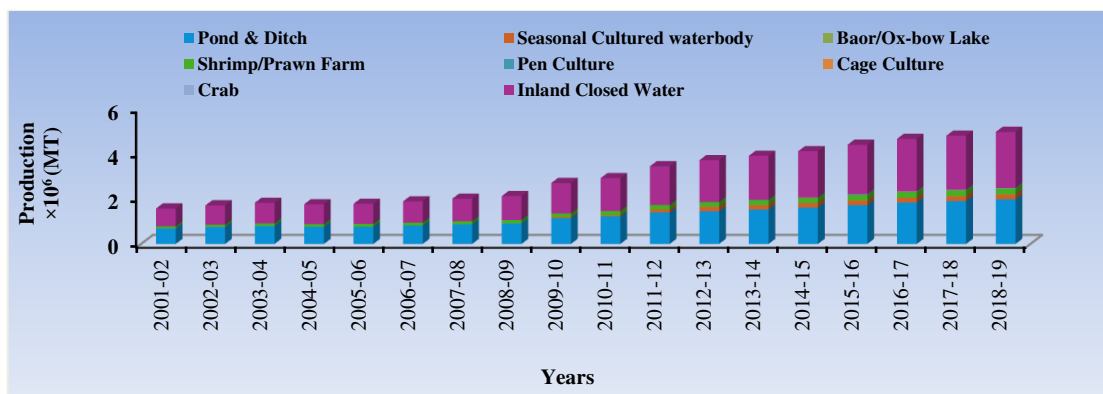


Fig. 3: Sector wise total fisheries production in Bangladesh from 2001-02 to 2018-19 (Source: FRSS, 2020).

Pond production in different culture systems

Table 1: Fish cultivation (ponds) practices in 2018-19 (Source: DoF, 2019).

Culture Method	Production Range	Number of Pond	Area		Production		MT/Ha	Growth Rate (%)
			(Ha)	%	(MT)	%		
Extensive	<1.5MT/Ha	498063	34125	8.58	44313	2.24	1.299	-4.63
Semi-intensive	1.5-4 MT/Ha	1438145	245486	61.71	876535	44.39	3.571	4.07
Intensive	>4 - 10MT/Ha	469473	100665	25.31	670749	33.97	6.663	7.13
Highly Intensive	>10 MT/Ha	75202	17498	4.40	383035	19.40	21.890	-0.63
Total		2480883	397775	100.00	1974632	100	4.964	3.91

The **Table 1** demonstrates that the semi-intensive culture approach is used to cultivate the greatest number of ponds. Semi-intensive and intensive farms produced 44.39 percent and 33.97 percent of total production, respectively. However, extremely intensive farms had the highest yield, with 21.89 MT/Ha. The year-round growth was positive and maximum in intensive farms, whereas it was negative in extensive and semi-intensive farms.

Species wise fisheries production

Fig. 4 reveals significant carp species like *Catla catla*, *Labeo rohita*, *Cirrhinus mrigala*, and *Labeo calbasu*, as well as exotic carp like silver carp (*Hypo-*

phthalmichthys molitrix), grass carp (*Ctenopharyngodon idella*), and common carp (*Cyprinus carpio*), are currently the most widely practiced and available in the market (FRSS, 2020). Live fishes such as koi (*Anabas testudineus*), singh (*Heteropneustes fossilis*), magur (*Clarias batrachus*), pabda (Ompok pabda), gulsha (*Mystus cavasius*), and others are gaining popularity these days. Both live fish and native carp fishes are in high demand and are gaining consumer preference (Shamsuzzaman *et al.*, 2020). From 456 38 MT in the base year of 2001- 02, live fish production increased to 1.52 lakh MT in 2018-19 (FRSS, 2020).

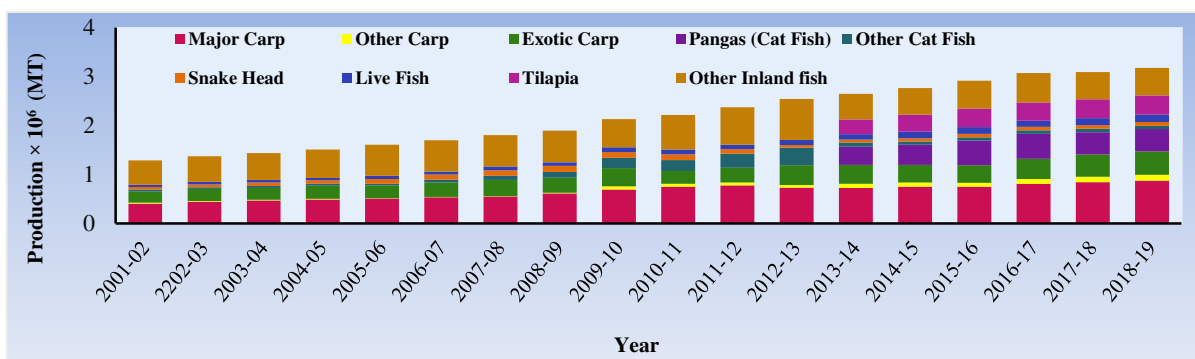


Fig. 4: Comparative production of major inland fish species in Bangladesh (Source: FRSS, 2020).

Shrimp culture

Fig. 5 shows that total shrimp production was 2, 54, 367 MT in 2017-2018 (DoF, 2019). Shrimp production shielded 258681 hectares of farmland, yielding 983 kg per hectare and accounting for 5.95 percent of overall fisheries production. Inland shrimp production, including big and small shrimp from rivers, contributed 7.26 percent (18,461 MT), culture farm production contributed 51.34 percent (1, 30, 589

MT), flood plain area production contributed 19.25 percent (48,956 MT), and the rest of the shrimp production came from marine sources, accounting for 22.16 percent (56,361 MT). Overall, total shrimp production from inland aquaculture is increasing, with positive upward trends. Shrimp production in 2018 grew by nearly twofold compared to 2006, and by 3.23 % compared to 2017.

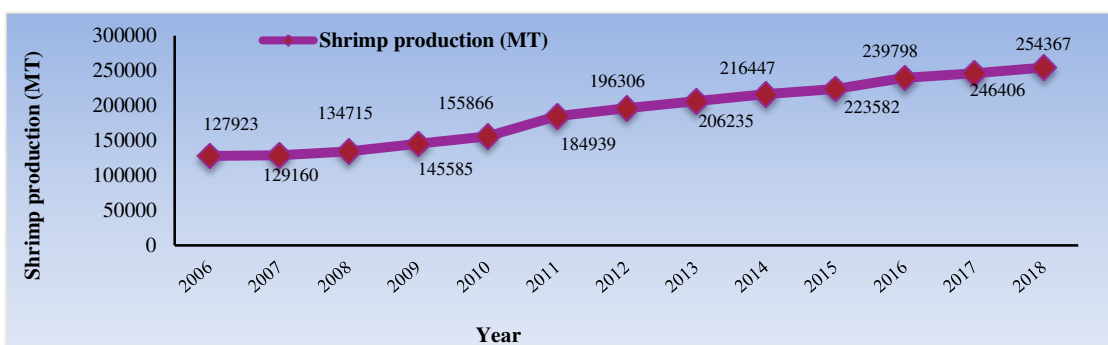


Fig. 5: Shrimp production from 2006 to 2018 (Source: Hosain *et al.*, 2021).

Fisheries Growth

Bangladesh's fisheries industry has grown considerably over the previous three decades. Although fish farming is still a low-intensity semi-subsistence activity in this country, fast commercialization, pro-

gressive intensification, and specialization have occurred over the previous decade, resulting in extraordinary growth in farmed fish production (Belton & Azad, 2012). Fisheries have been expanding horizontally on riverine floodplains that have been fenced to

promote production intensification. Many crop farmers have been converting their land to fish ponds in the recent years, primarily in Mymensingh and Rajshahi, in what many believe is a natural occurrence related to the ever-decreasing benefit-cost ratio they are receiving from paddy farming. Since 1990, the

average yearly increase (percentage) of aquaculture has been 10.81 1.79. **Fig. 6** demonstrates that aquaculture's yearly growth rate was only negative in 2003–2004, with the highest rates in 1995–1996 and 2008–2009.

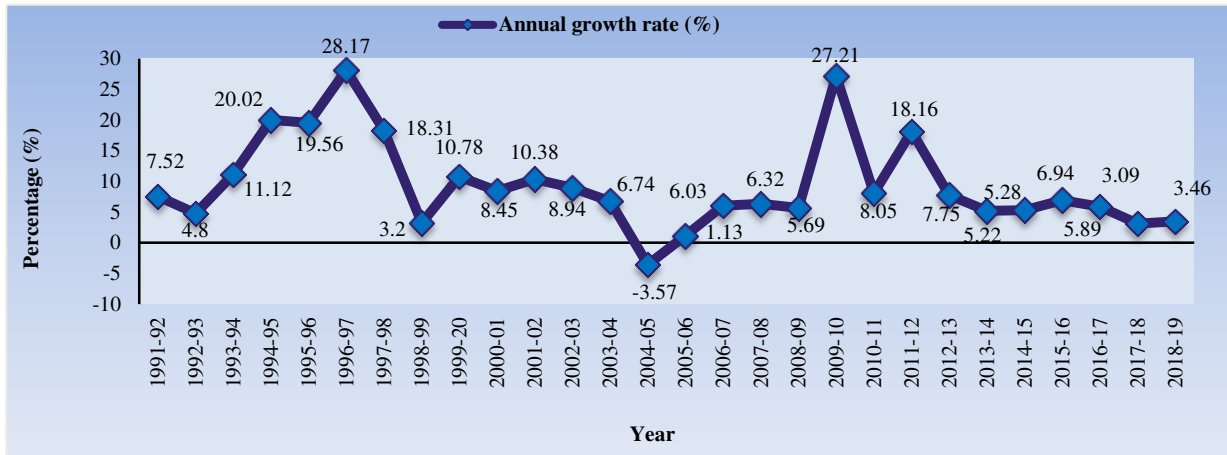


Fig. 6: Annual growth rate (%) of fish-culture during 1991-92 to 2018-19 (Source: DoF, 2019).

Marketing channels of fish

The route-to-market of farmed fish is governed by an intricate network of dealers, distributors, financiers, and retailers, as shown in **Fig. 7**. In Bangladesh, any actor who trades and/or distributes fish earns a mark-up per kilogram of fish product. Aratdars sell fish at auction and are paid a commission, the size of which varies depending on the fish species. The paiker (or bepari) is in charge of transporting big quantities of fish. The farmer pays nikari and forias commission

for establishing a link between the seller and the buyer. Fish is sold in urban areas by urban retailers, and fish is distributed to suburban areas by suburban retailers, who sell it at village markets. Aratdar is used by tilapia fish farmers to sell 85 percent of their fish to paiker. Fish farmers in Pangas sell 43% of their catch to paikers through aratdar, 54% to paikers directly, and 3% to merchants. Carp, tilapia, and pangas retailers sell the entire fish to end users.

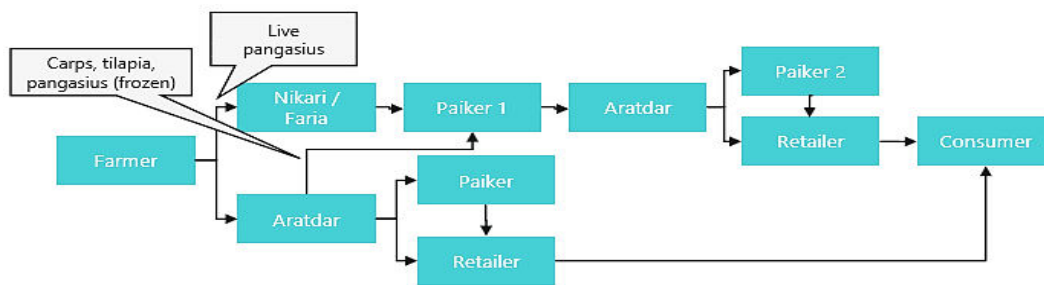


Fig. 7: Domestic marketing channel of carp’s, tilapia, and pangasius (Source: Alam *et al.*, 2012).

Changes in household income of landless & socially marginalized Adivasi (ethnic) communities

In 2007, the Adivasi households targeted by the intervention had an average yearly income of roughly US\$ 350; this amount increased dramatically (p ≤ 0.01), reaching over US\$ 570 in 2009. Such a significant rise in income indicates that the project participants' living conditions have improved in general. In 2009, the comparative contribution of fisheries or related value-chain activities to family income increased significantly in all intervention

groups, reaching 29 percent. Fish-culture's proportionate contribution to cage-culture and non-project households' income remained relatively stable.

In all groups, income from fish in 2007 refers to income from capture fisheries and related activities. In contrast, fishery value-chain groups, notably those that include fish and fingerling sellers, saw a significant increase in these activities' proportional contribution to income, indicating that they are becoming increasingly important to people's livelihoods.

Table 2: Changes in household incomes (US\$) of Adivasi communities (Source: Pant *et al.*, 2014).

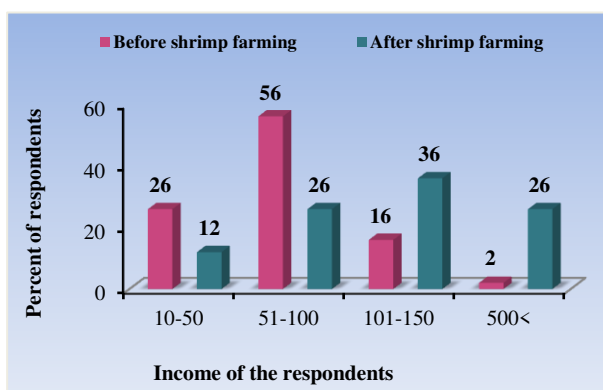
Particulars	Fish				Total	
	2007		2009		2007	2009
	Mean	% of HH income	Mean	% of HH income	Mean	Mean
i. Pondculture	55.6 ^a	15.4	158.0 ^c	26.2	361.0 ^{bc}	603.8 ^{bc}
ii. Rice–fishculture	45.1 ^a	16.5	143.9 ^{bc}	26.3	273.0 ^a	546.8 ^{abc}
iii. Cageculture	38.8 ^a	12.0	59.1 ^a	11.8	323.4 ^{ab}	500.0 ^{ab}
Fisheries Value chain related activities						
i. Food–fishtrading	117.8 ^b	31.6	319.7 ^d	48.7	372.4 ^{bc}	656.5 ^c
ii. Fingerlingtrading	34.3 ^a	9.0	291.5 ^d	47.8	379.2 ^{bc}	610.1 ^{abc}
iii. Pondnetting	59.7 ^a	14.4	103.8 ^{ab}	19.8	415.8 ^c	524.1 ^{ab}
Non-projectparticipants	47.2 ^a	13.5	68.5 ^a	14.0	348.7 ^b	490.7 ^a

(Note: Mean values with different superscripted letters denote statistically significant differences ($p \leq 0.01$).

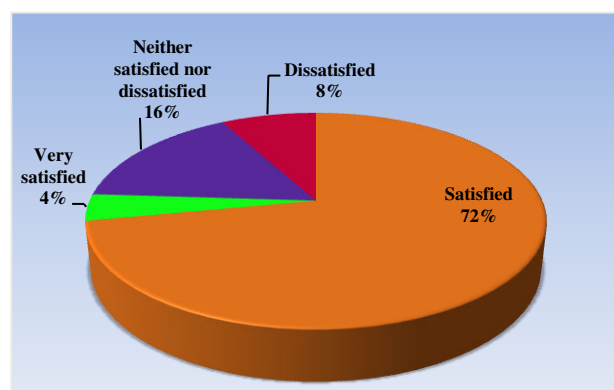
However, when related to the control group, the pond culture and rice-fish culture groups had a much-sophisticated contribution of fish farming to their family incomes, while it was still lower than the fish and fingerling trader groups.

Comparison of income and satisfaction levels of the shrimp farmer communities in coastal Bangladesh

The proportion of farmers with incomes between USD 51 and 100 was higher. Following the implementation of shrimp farming procedures, it was observed that the percentage of shrimp farmers with incomes between USD 101 and 150 increased from 16 to 36 percent (Fig. 8a). Only 2% of farmers made more than \$150 per month before, but after switching to shrimp farming that number rose to 26%.



(a) Income range of respondents



(b) Satisfaction level

Fig. 8: Comparison of income range (a) and level of satisfaction (b) among the shrimp farmers after shrimp farming (Source: Ray *et al.*, 2021).

Shrimp farming, rather than rice growing, has emerged as a new lucrative business for residents of the southwest coastal region, according to the data (Hossain & Hasan, 2017). Shrimp aquaculture has resulted in a huge increase in the revenue of stakeholders. Approximately 72 percent of fish producers are completely satisfied with shrimp farming, while 4% are extremely satisfied (Fig. 8b).

However, 16 percent were indifferent, meaning they were neither satisfied nor dissatisfied, and only 8% was disappointed following shrimp farming. In comparison to rice farming, each and every farmer has expressed happiness with shrimp farming (Saha, 2017).

Fish-culture’s effects on local food security from some selected fisheries practicing villages

Fig. 9 shows the household food insecurity access scores of fisheries producers and "no fishing" households, as well as the overall average. Fisheries-producing households showed lower household food insecurity access scores (i.e. were more food secure) than "no fish-culture" households in all six villages from Mymensingh, Khulna, and Jessore districts. Food insecurity access ratings were from 1.6 to 2.2 for all Medila households, whether or not they conducted aquaculture. Household food insecurity access scores of "no fish-culture" families in Bawalia were more than twice as high as aquaponics producers' (1.8 versus 4.1).

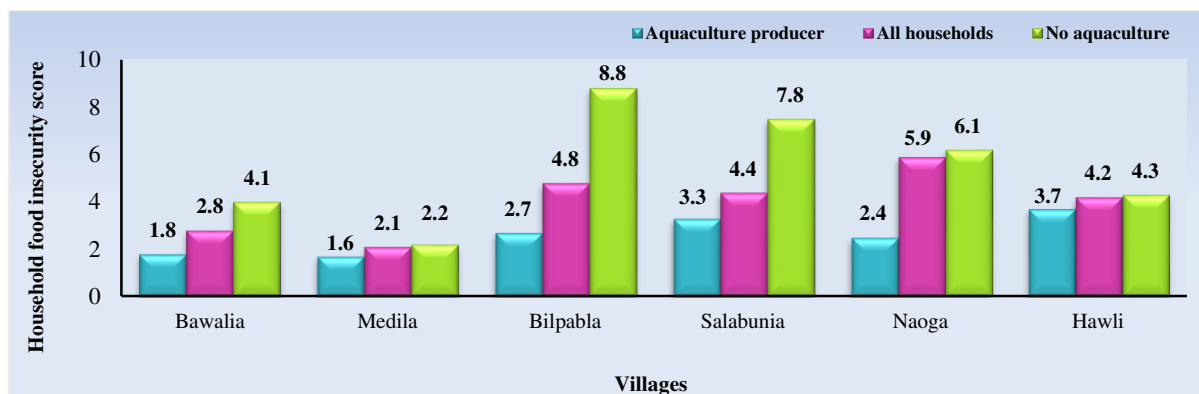


Fig. 9: Average household food insecurity access scores for households practicing and not practicing fisheries (Source: Belton *et al.*, 2014).

Food insecurity access ratings of "no fish-culture" households were highly high (8.8 and 7.8) in Bilpabla and Salabunia, exceeding those of fisheries households. Household food insecurity access scores of fish producers (2.4) and "no fisheries" households differed significantly in Naoga (6.1). These findings appear to indicate that households that are able to engage in fisheries benefit from significantly higher revenues, which translates to enhanced food security, whereas households that are unable to do so face a decline in food security.

Existing evidence on gender issues in fisheries value chains

Table 3 summarizes data from a range of sources on women's roles in fisheries value chains. In value chain nodes, women and men were employed in different proportions. Women have important roles in fish production, although they are frequently overlooked in value chain analysis (Rutaisire *et al.*, 2010;

Ndanga *et al.*, 2013). Women are engaged in fertilization and feeding in Bangladesh, especially when men are absent (Shirajee *et al.*, 2010). The findings show that the gender patterns in the post-production nodes of fisheries value chains differ significantly from those at the production nodes. Women constitutes between 77 percent and 97 per-cent of the permanent and temporary workers in the fish processing industry. Women's engagement in commerce and retail is estimated to be minimal. In Bangladesh's shrimp processing industry, men are more promising to hold a permanent contract than women, who are more likely to work on a seasonal basis. Women possess only 1% of farmland in Bangladesh, and only 1% of ponds are owned by women. Women's engagement is further limited by a dearth of technical knowledge, entrepreneurial and technical skills, and access to training (Ndanga *et al.*, 2013).

Table 3: Gender division of labor in fish-culture value chains (Source: Kruijssen *et al.*, 2018).

Particulars	Share of women	Specifics	Source
Pre-pro-duction/inputs	39% shrimp fry catching, 2% shrimp hatchery	Share of total labor days	USAID, 2009
	2% in feed mills	Share of women in people employed	Rahman <i>et al.</i> , 2017
Fish-culture production	Global-70% of 18.5 million	Share of women in total work force	Hishamunda <i>et al.</i> , 2014
	Asia-72% of 18 million	Share of women in total work force	FAO, 2014
	22% in homestead ponds, 5-24% in semi-intensive ponds, 2% in intensive koi & pangasius production, 6-17% in brackish water ponds, <1% pond ownership	The first four percentages relate to the contribution of women's labor, the last value is the share of women inter-viewed as pond owners.	Jahan <i>et al.</i> , 2015
	2% shrimp farming	Share of total labor days	USAID, 2009
Processing (capture & fish-culture)	62% shrimp processing	Share of total labor days	USAID, 2009
	77% of permanent workers, 97% of temporary/seasonal workers	Share of total work force in shrimp processing	Solidarity Center & SAFE, 2012
Trading and retail	1% shrimp auction	Share of total labor days	USAID, 2009
	0-1%	Trade and retail of farmed fish in southwestern Bangladesh	Kruijssen <i>et al.</i> , 2016

Consumption pattern of households between various protein sources

Fish is the furthestmost often consumed animal-source meal across all social strata, as well as the most frequently consumed nutrient-rich food, accounting for the second biggest share of food expenditures behind rice. The bioavailability and absorption of nutrients from plant-based foods is increased when fish and other animal-source foods are consumed (Neumann *et al.*, 2001). **Fig. 10** shows

that 34% of households consumed fish on a regular basis over the course of 11-14 days, while 25% and 13% of households had access to milk and fruit, respectively. Furthermore, fish, leafy vegetables, and fruit were available to 37 percent, 20 percent, and 15 percent of households on a weekly basis. However, within the previous two weeks, 79 percent, 63 percent, 60 percent, and 50 percent of families had access to meat, milk, egg, and fruit in 0-2 days of frequency.

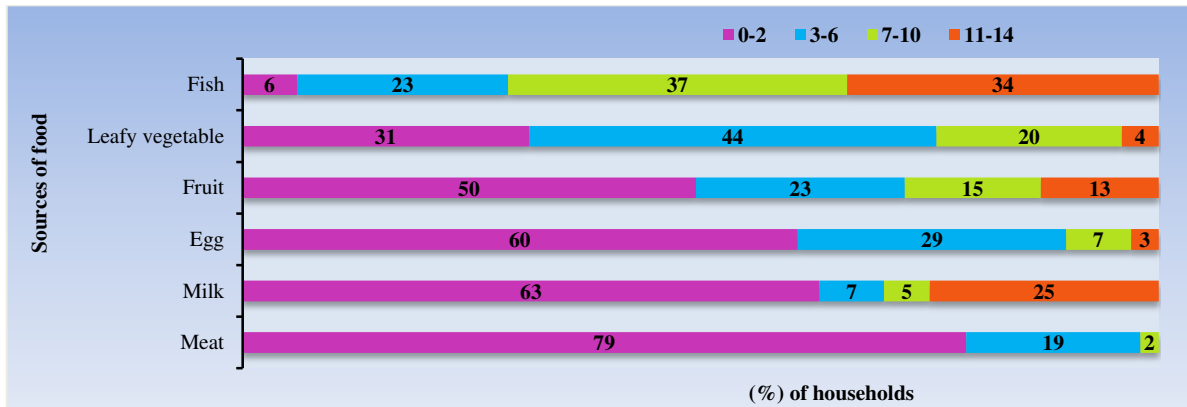


Fig. 10: Percentage of households taking nutrient rich foods on 0-2, 3-6, 7-10, and 11-14 days within the preceding two-week period (Source: Toufique & Belton, 2014).

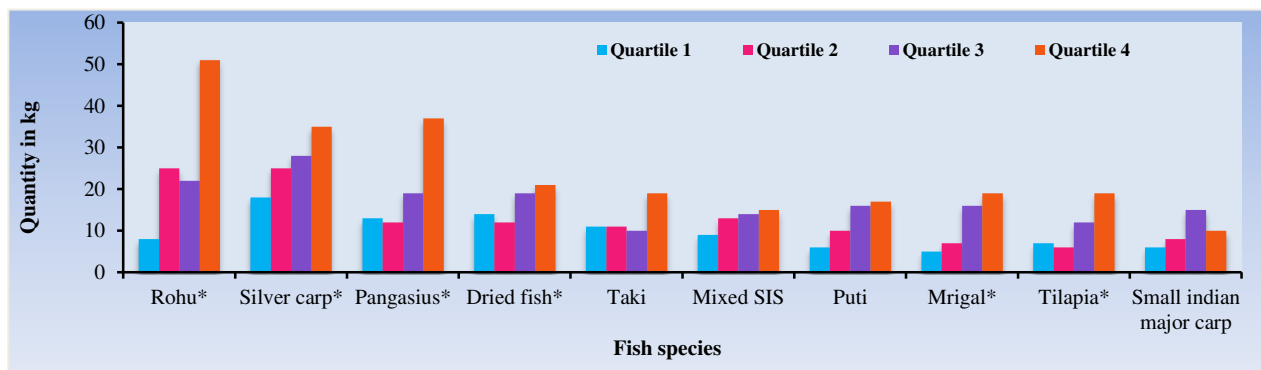


Fig.11: Quantity of fish consumption in the preceding three days (Source: Belton *et al.*, 2014). (Note: Fish originating mainly from aquaculture are marked with an asterisk to aid identification).

Quantity of consumption of the top ten most consumed fish species

Fig. 11 illustrates the volume of fish consumed by the top 10 most popular fish species, cracked down by income quartile. Quartile 1 refers to the poorest quartile, while Quartile 4 refers to the wealthiest. Out of a total of 53 varieties of fish, the top ten by amount accounted for 71% of total fish consumption. According to the study's findings, rohu (*Labeo rohita*), silver carp (*Hypophthalmic molitrix*), and pangasius (*Pangasius hypophthalmus*) are three of the top four most consumed species by volume Rohu is another popular freshwater fish species in Japan, but it is also one of the most expensive. The sub-

stantial consumption disparity between Quartile 1 and Quartile 4 consumers demonstrates this. Despite the fact that silver carp and pangasius are among the most affordable species, the amounts consumed by consumers in lower - and upper-income categories differed significantly. In terms of quantity consumed, three other farmed fish species, mrigal (*Cirrhinus mrigala*), tilapia, and small Indian major carps, exhibit roughly similar profiles across income quartiles.

Impacts of the blue revolution of small-scale freshwater fisheries in Mymensingh

Fisheries development appears to have a favorable impact on food availability, livelihood prospects,

revenue creation, and socioeconomic situations of linked groups in Mymensingh (Fig. 12). Food production is the most significant development brought about by aquaculture in Mymensingh. Overall, the expansion of fisheries has a favorable impact on food security (Ahmed & Lorica, 2002; Allison, 2011). In Mymensingh, fish selling has already enhanced food supplies (Young *et al.*, 2012). Kurien, (2004) claims that there is a link between aquaculture product trade and food security. Fisheries has boosted the livelihood security of farming households in

Mymensingh. In Mymensingh, around 5, 20, 000 individuals (excluding farmers) are involved in fish hatcheries activities. Fish-culture's rapid expansion in Mymensingh is good for growth, employment, and poverty elimination. Women's participation in small-scale fishery resources in Mymensingh has the potential to be extremely beneficial to their emancipation. Fish-culture's rapid growth in Mymensingh has resulted in societal shift among fish farming communities.

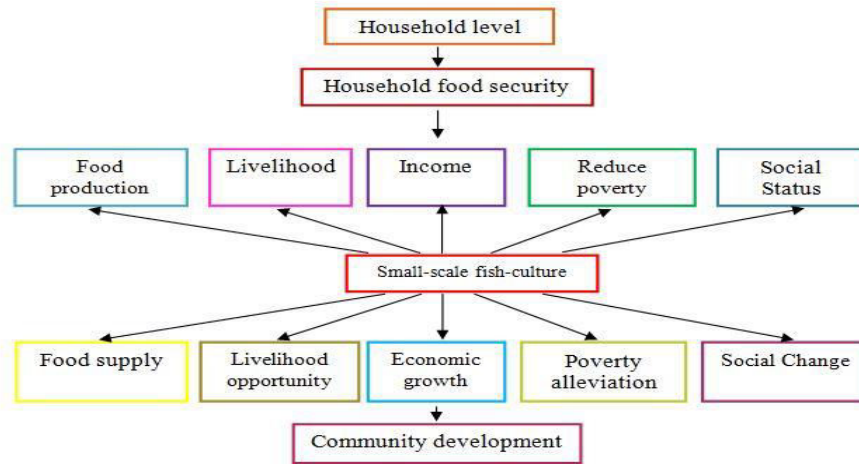


Fig. 12: Impacts of the blue revolution in Mymensingh on household and community level (Source: Ahmed & Toufique, 2014).

Exports trend of fish and fishery products in Bangladesh

International commerce has proved its importance in today's global fisheries sector as a driver of economic growth and contributor to global food security after more than 50 years of fast expansion. Fish and fishery products are still among the most widely traded foods, and they are vital to the economics of many countries and regions around the world (FAO, 2020). Exporting fish, shrimp, and other fisheries products earns Bangladesh a significant amount of foreign currency (Islam & Haque, 2018). In 2018-19,

the country made 4074.53 crore taka/USD 505.58 million by exporting about 7.31 million MT of fish and fisheries products, as shown in Fig. 13. (FRSS, 2020; EPB, 2021). This accounts for 1.23 percent of the country's overall export revenue. However, the growing trend in exports did not continue from fiscal year 2000 – 2001 to fiscal year 2018 – 2019. Between 2000 – 01 and 2010 – 11, there was an upward trend in the export of fish and fish products. However, the export quantity and revenues did not exhibit any significant trend in the years leading up to 2019.

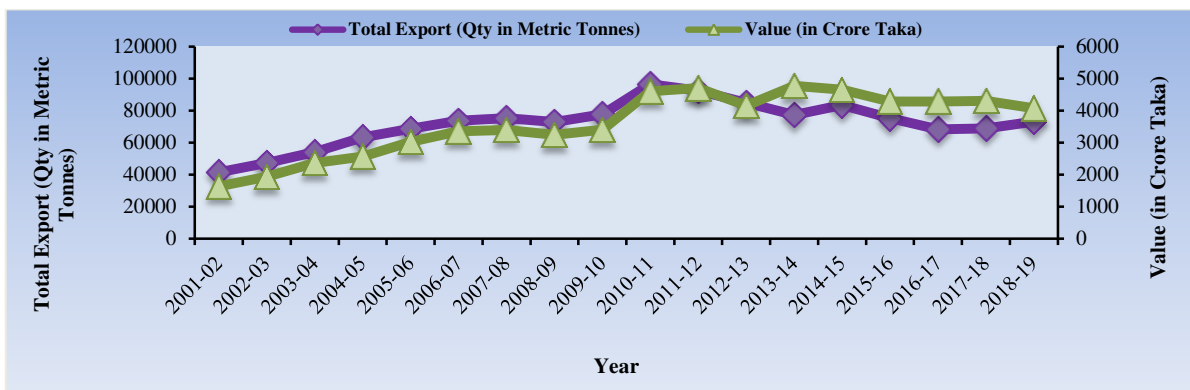


Fig. 13: Export trend of fish products in Bangladesh during 2001-02 to 2018-19 (Source: FRSS, 2020).

Exports of shrimp and prawn in Bangladesh

Exporting fish, shrimp, and other fisheries products earns Bangladesh a noteworthy amount of overseas currency (Islam & Haque, 2018). After textiles and footwear, shrimp is one of Bangladesh's most important export goods (EPB, 2021). Though shrimp culture production has been steadily increasing, export volumes have been steadily declining in last

year's. Shrimp production, as a fisheries sub-sector, has a lot of potential to boost the nationwide economy. **Fig. 14** depicts the volume and value of shrimp traded internationally. Shrimp accounted for 75.8% of overall fishery export earnings and 45.6 percent of total fish export volume (DoF, 2019). The shrimp sector contributes US\$ 358 Million in exports in 2019 (EPB, 2021).

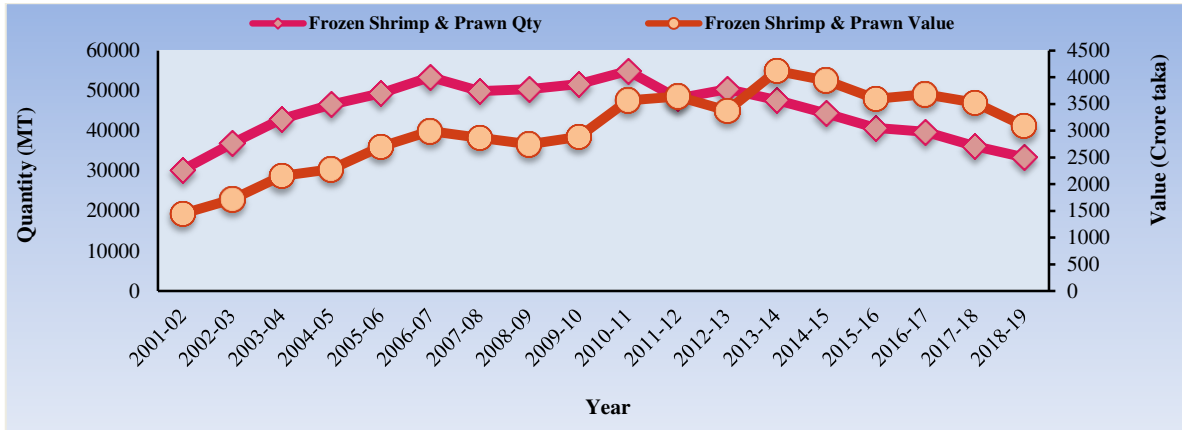


Fig. 14: Frozen shrimp export quantity and value from 2001-02 to 2018-19 (Source: FRSS, 2020; Hosain et al., 2021).

Frozen shrimp export statistic 2017-2018 has stated that, export price of Bagda (*P. monodon*) was 77.13% (\$321.03 million) of total shrimp statistic; while export price of Galda (*M. rosenbergii*) was 16.08% (\$66.92 million) and others species export price was 6.79% (\$28.27 million). According to the Bangladesh Ministry of Fisheries and Livestock, Bangladesh earned about 348 million US\$ by exporting 30,000 MT of shrimp in the FY 2019-20, which was about 365.44 million in the FY 2018-19.

shrimp sector has traditionally been a key export driver. In 2019, roughly 60% of shrimp farming was designated for exports, while 40% were thought to be consumed domestically. The size of sector has been shrinking gradually over the years both in terms of total production volumes & exports. International market prices of Bangladeshi Monodon have been declining during past years, worsening the export positioning of Bangladesh. Bangladesh has witnessed a decline in the price of shrimp in the export market in the recent years. As the higher priced Rosenbergii takes a larger share in the export basket, it was expected that the export price in 2019 skews upwards (Bangladesh Bank, 2021).

Export of shrimps and prawns from Bangladesh

Bangladesh exports more than 80% of its frozen shrimps to EU. Main importers from the EU include the Netherlands, Belgium and Germany. Other major buyers are the United States, Japan and China. The

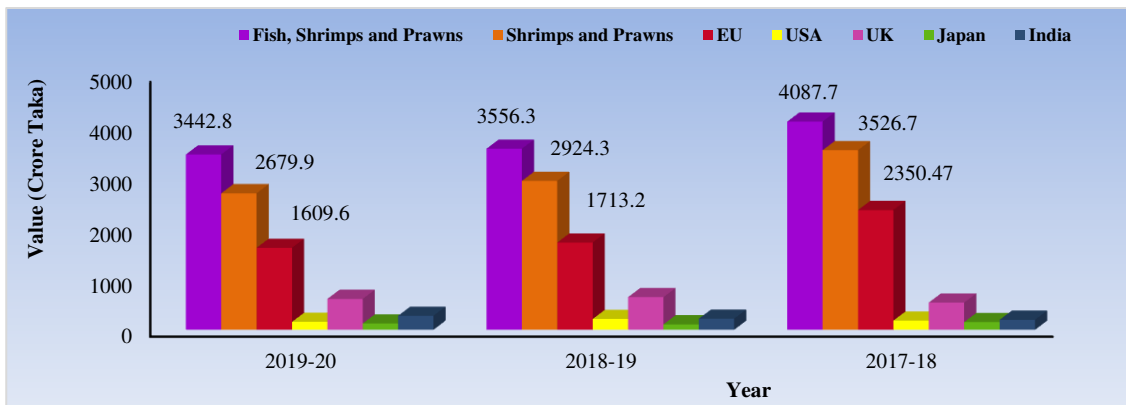


Fig. 15: Export receipts of fish, shrimps and prawns from major countries (Source: Bangladesh Bank, 2021).

Fig. 15 shows that, in 2019-20, the total export price of shrimps and prawns were 2679.9 crore taka, while export value of fish other than shrimps and prawns were 762.9 crore taka. Export value from EU was 1609.6 crore taka. However, exports have been declining slightly from 2017-18 by 15.77%. Bangladesh is becoming a more popular destination for Chinese customers looking for Monodon. However, a key issue in exporting to China is that the time between harvest and freezing is too long, resulting in poor quality. By reducing the supply chain to Chinese clients, China might become the next lucrative export destination for Bangladeshi Monodon.

Export of live fish, chilled fish and frozen fish over last five years

The export of live fish has surpassed the export of live crabs since 2018. Eels make up the majority of live fish exports, accounting for 96.5 percent and 99.3 percent of total live fish exports in 2019 and 2020, respectively. Eel, a relatively new export item, is gaining appeal among the people of Narail, Satkhira, Khulna, Chattogram, Mymensingh, Dinajpur, Sylhet, and Comilla (Jahan *et al.*, 2019). More than 50,000 fishermen, traders, brokers, transporters, and exporters depended on the mud crab fishery in the past, but the number has now risen to 300,000 households in the coastal regions of Satkhira, Khulna, Bagerhat, Chittagong, Cox's Bazaar, and Noakhali (Islam, 2015). Frozen fish and frozen crabs

exports from Bangladesh together US\$ 55.48 million in 2020. Unlike the frozen fish segment, frozen crab exports had seen a one-third drop in value in 2020, primarily due to demand impacts due to Covid-19 lockdown and restrictions in key markets such as China. It is estimated that over 95% of all finfish exports are white fish (with bones) of the local varieties destined for use by Bangladeshi diaspora abroad.

Fig. 16 shows that frozen finfish has had the highest export earnings of 38.09 percent in 2018-19, with the largest export value over the last five years. With 19.85 percent of the market, live crabs had the highest export value in 2015-16. While the biggest export value was earned in 2018-19 in the categories of live fish, chilled fish, and frozen crabs, with 36.4 percent, 32.52 percent, and 33.09 percent, respectively.

Export hubs of live fish, chilled fish and frozen fish from Bangladesh

The fish products are exported live/chilled, not frozen, in the case of live and chilled fish. They are exported to nearby regions. Some noteworthy pure-play live fish exporters are Anjum International and Surma Seafood. They mostly export eels and crabs. Bangladesh Live and Chilled Food Exporters Association (BLCFEA) has 216 members who export live and chilled fish and crabs.

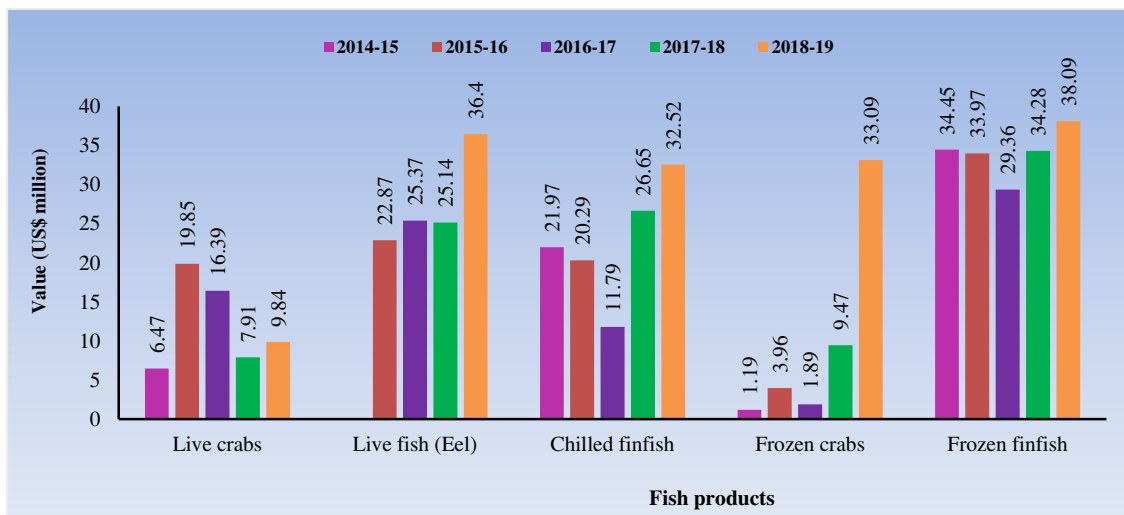


Fig. 16: Export value of live fish, chilled fish and frozen fish (Source: EPB, 2021).

Around 60 enterprises are active in the processing/packaging and export of live and chilled fish among them. Some notable pure-play chilled finfish exporters include Ocean Trade International and MM Enterprise. Crabs are exported live to China,

Taiwan, Hong Kong, Malaysia, Japan, EU and USA while Eel of Bangladesh are exported to many countries of Europe, Asia and Middle East (Islam, 2015; Jahan *et al.*, 2019).

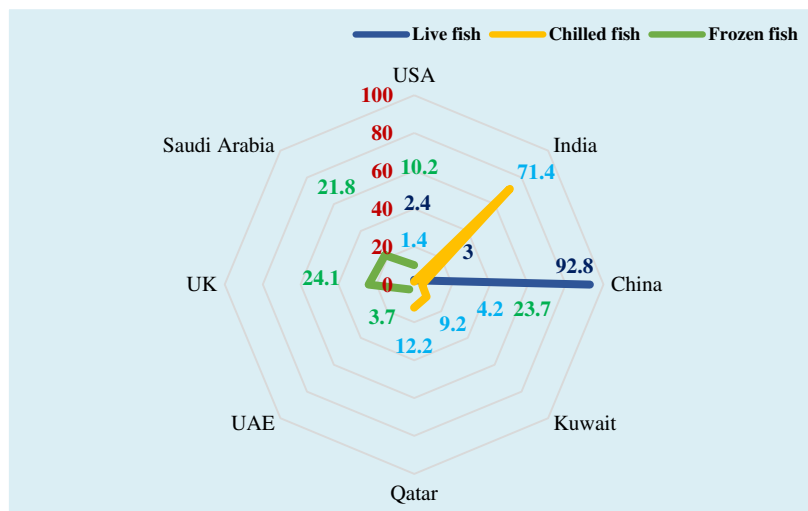


Fig. 17: Country wise total exports (%) of live fish, chilled fish and frozen fish in 2019 (Source: EPB, 2021).

Fig. 17 shows that China receives the greatest percentage of live fish exports, with 92.8 percent. With 71.4 percent of Bangladeshi chilled fish imports, India leads the way, followed by Qatar and Kuwait with 12.2 percent and 9.2 percent, respectively. The United Kingdom (24.1 percent), China (23.7 percent), Saudi Arabia (21.8 percent), and the United States (10.2 percent) are the top importers of frozen fish, respectively.

Export potential of pangasius and tilapia from Bangladesh

Border prices at the wholesale and producer levels were US\$ 1199 and US\$ 661 per MT, respectively, based on import parity for pangasius and tilapia fish.

Export parity, on the contrary, was expected to be US\$ 994 and US\$ 511 per MT, respectively. Table 4 also shows the relative benefit of pangasius and tilapia in Bangladesh, based on domestic resource cost (DRC) determined from tradable and non-tradable input prices. Import and export parities were predicted to have DRCs of 0.46 and 0.61, respectively, which were both less than one. Furthermore, the export parity DRC value was higher than the import parity DRC value. This meant that exporting pangasius and tilapia to foreign countries had a comparative advantage over importing them into Bangladesh. Pangasius and tilapia, according to Banrie (2013), have export potential in Bangladesh.

Table 4: Import/ export parity and Domestic Resource Cost (DRC) of pangasius and tilapia in Bangladesh (Source: Dhar et al., 2021).

Particulars	Import parity amount (US\$/MT)	Export parity amount (US\$/MT)
i. CIF price at the port of entry/exit in Chittagong	1149	1038
ii. Marketing margin from the port of entry/exit to the wholesale market	50	44
iii. Border price at wholesale level for import (i + ii)/export (i-ii)	1199	994
iv. Marketing spread between the wholesale and producer level	538	483
v. Border price at producer level for import/ export (iii - iv)	661	511
Domestic resource cost (DRC)		
i. Value of tradable inputs (US\$/MT)	47	47
ii. Value of non-tradable inputs (US\$/MT)	285	285
iii. Output price (US\$/MT)	661	511
iv. Value added by tradable inputs (US\$/MT) (iii - i)	614	464
v. Domestic resource cost (DRC) (ii ÷ iv)	0.46	0.61
Direction	DRC<1	DRC<1

CONCLUSION:

The evidence presented to this study clearly reveals that fisheries, as Bangladesh's fastest expanding food producing sector, has the potential to alleviate pro-

tein deficiency and malnutrition and generate jobs and foreign exchange revenues. With a production output of 24.89 lakh MT, inland fisheries provide 56.76 percent. Pond farming accounts for 45.04 per-

cent of overall production in the culture sector, with semi-intensive farms accounting for 44.39 percent. Carp (both native and alien), mekong pangas, and tilapia made up about 93 percent of freshwater fish farming in ponds. Furthermore, inland culture farms accounted for 51.34 percent of total shrimp output. Farmers engaged in fisheries value chain related activities had a 29 percent proportionate gain in revenue, while 72 percent of shrimp farmers were happier with shrimp culture than rice production, according to the findings. Furthermore, fish producing households were better off in terms of food security than non-fisheries households. The top three fish species consumed are rohu, silver carp, & pangasius, which are primarily consumed by upper-income groups and silver carp and pangasius by lower-income groups. Women were primarily involved in permanent (77%) and temporary (97%) fish processing activity in the fisheries value chain. In 2018-19, shrimp accounted for 75.8% of fishery export revenues, with Monodon accounting for 77.13 percent of earnings. In reality, the UK, China and India receive 80 percent of frozen shrimp, 92.8 percent of live fish, and 71.4 percent of chilled fish, respectively. China, along with the EU, could be a potential destination for Monodon exports. In terms of export, pangasius and tilapia both showed comparative advantage. However, these numerous findings show that the fisheries and fish farming industries are intimately intertwined and contribute directly or indirectly to the accomplishment of multiple SDGs. Bangladesh's challenge is to surge the efficiency of its fisheries production while retaining the organic structure of the entire fishery sector and fishermen, traders, processors, and the general public must be aware of these challenges in order to participate in the expansion of management plans and reap the benefits of the process.

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CONFLICTS OF INTEREST:

All authors declare no conflict of interest.

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