Ministry of Foreign Affairs

Aquaculture Sector Study Bangladesh

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Aquaculture sector study Bangladesh

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Abbreviations

A	Actual
ASC	Aquaculture Stewardship Council
BAP	Best Aquaculture Practices
BRC	British Retail Certificate
BDT	Bangladesh Taka[1]
BFFEA	Bangladesh Frozen Foods Exporters Association
BFRI	Bangladesh Fisheries Research Institution
BMC	Broodstock Multiplication Center
BN	Billion
CAGR	Compounded Annual Growth Rate
CPDTO	Cooked Peeled and Deveined Tail On
CSR	Corporate Social Responsibility
CY	Calendar Year
DGGF	Dutch Good Growth Foundation
DoF	Department of Fisheries
EBITDA	Earnings Before Interest, Taxes, Depreciation and Amortization
EUR	Euro
F	Forecast
FAO	Food and Agriculture Organization
FCR	Feed Conversion Ratio
FOB	Free On Board
FVO	Fonds Verantwoord Ondernemen Funds for Sustainable Development
FY	Fiscal Year
G2G	Government-To-Government
Ha	Hectare
HLSO	Headless Shell On
HOSO	Head On Shell On
IQF	Individually Quick Frozen
K2K	Knowledge-To-Knowledge
kMT	Metric Kiloton (1,000 MT)
Larive	Larive International B.V.
MAC	Middle and Affluent Consumers
MN	Million
MRP	Maximum Retail Price
MT	Metric Ton
NBR	National Board of Revenue
NL	Netherlands
NVWA	Nederlandse Voedsel- en Waren Autoriteit / Dutch Food Safety Authority
p.a.	Per Annum
P&D T/ON	Peeled Deveined And Tail On
PBT	Profit Before Taxes
PDTO	Peeled Deveined And Tail On Deveined
PL	Post Larvae
PND	Peeled Deveined and Tail Off
PPS	Public-Private Partnership
PSD	Private Sector Development
PUD	Peeled and Deveined
RAS	Recirculation Aquaculture System
RVO	Rijksdienst voor Ondernemend Nederland / Netherlands Enterprise Agency
SDGP	Sustainable Development Goals Partnership
SO	Shell-On
SPF	Specific Pathogen Free
USD	US Dollars
USDA	United State Department of Agriculture
VAT	Value Added Tax
Y-o-Y	Year-on-Year
YEP	Young Expert Program

[1]For BDT to USD, an FX rate of 0.0118 was used. Source: Bloomberg, accessed 9-3-2021.

Background

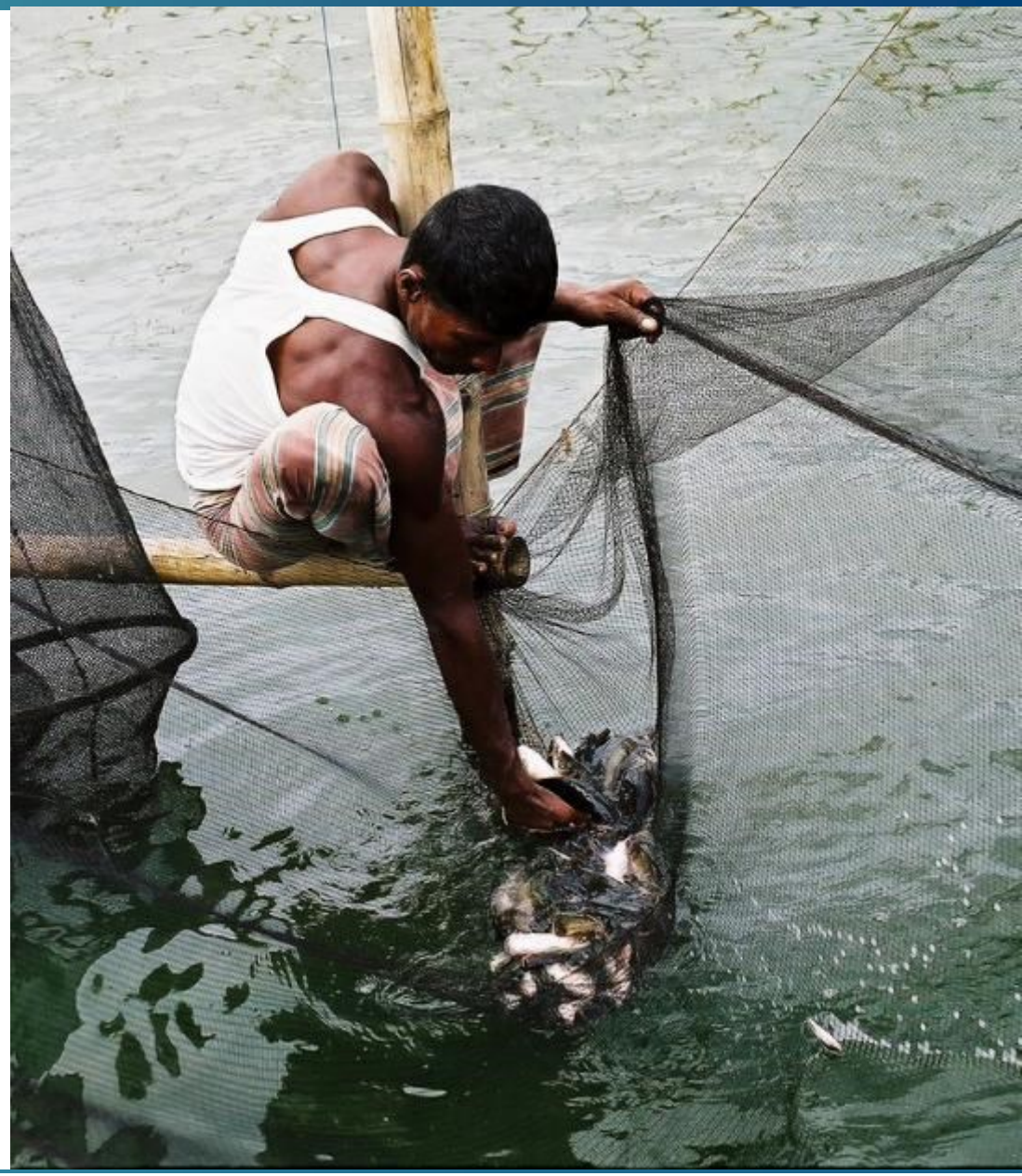
This study derives from the Netherlands multiannual strategy 2019-2022 on Bangladesh, which describes the intentions to conduct market scans to scope (business) opportunities. The Embassy of the Kingdom of the Netherlands in Dhaka identified the aquaculture sector as a key area to support trade and investment between the Netherlands and Bangladesh.

Given the climatic conditions and rich prevalence of water bodies, cultivation and catching of fish are an integral part of the Bangladeshi rural livelihood and its national cuisine. The aquaculture sector has been growing steadily over the last couple of decades due to rising demand and depleting fish stocks in rivers and marine areas. The aquaculture sector of Bangladesh thus offers promising potential to further food security and private sector development, however various challenges remain.

The Netherlands has a strong reputation in terms of innovativeness and sustainability in the international aquaculture sector, being home to global leading players in aqua genetics and feed and fish and shrimp importers. Hence, the Netherlands, with its knowledge and technologies, could play an important role in tackling the future challenges faced in the aquaculture sector in Bangladesh, while positioning itself as a partner for the local private sector in exploring and capturing market opportunities.

The Netherlands is gradually phasing out its bilateral aid support to Bangladesh and tries to facilitate the *aid to trade transition* by paving the way for Dutch companies and knowledge institutes, enabling them to (increasingly) engage in the Bangladesh market. As such, the Dutch government commenced this aquaculture sector study which aims to:

1. Map the aquaculture sector in Bangladesh (value chain, key actors and linkages, trends bottlenecks & opportunities).
2. Provide to-the-point details for Dutch companies and institutes active in the aquaculture value chain to elevate the aquaculture sector of Bangladesh through investments and/or knowledge and technologies.
3. Offer further insights and pave ways for interventions to relevant supervisory, facilitating and regulatory bodies and key chain actors in Bangladesh.
4. Increase awareness amongst Dutch stakeholders about the opportunities and developments in the aquaculture sector in Bangladesh.
5. Increase awareness amongst Bangladeshi stakeholders about the value proposition of Dutch companies and knowledge institutes (capabilities & solutions).



Approach and methodology

This study has been performed on behalf of the Netherlands Enterprise Agency by **Larive International B.V.**, a Netherlands-headquartered business development advisory firm specialized in assisting companies in developing and implementing their market entry or expansion strategies in(to) high-growth emerging markets.

Larive International is the parent of the Larive Group, a license-based network of independent business development advisory firms with exclusive members in 24 countries throughout Asia, Central & Eastern Europe, Turkey and Sub-Saharan Africa. In Bangladesh, Larive is represented by **LightCastle Partners Ltd.** (the combination is hereinafter referred to as "Larive-LightCastle").

The analysis has been completed on a 'best effort' basis through desk research and qualitative research, including a vast number of in-depth interviews with private sector players (independent and integrated companies active in breeding, feed manufacturing, farming, processing and channel players such as dealers, distributors, traders and retailers) in all Bangladesh divisions (Barisal, Chittagong, Dhaka, Khulna, Mymensingh, Rajshahi, Sylhet and Rangpur), public stakeholders (policy makers, regulatory departments, business associations, universities/educational institutes and NGO's) and financial institutions.

In addition to the expert interviews conducted by Larive-LightCastle in Bangladesh, a number of Dutch stakeholders active in the aquaculture sector have been contacted to get a better understanding of their views on the business opportunities in Bangladesh, how Dutch actors could strengthen the sector and how knowledge transfer between Bangladesh and the Netherlands can be stimulated.

This study has been conducted between December 2020 and April 2021.

Executive summary

Overview

- Bangladesh (167 MN inhabitants) has been the fastest-growing economy in Asia-Pacific in recent years (average growth rate of ~8% in recent years). Fish is the most consumed source of animal protein in Bangladesh (58% of total) and continues to rise due to increasing consumer purchasing power. Consumption of fish in 2019 has been estimated at 21.8 kg per capita and has grown gradually during the past decade (1.6% CAGR 2015-2019). In FY 2017-18, the fisheries sector contributed 3.6% to the national GDP and employed 11% of the country's total population.
- Bangladesh produced 4.38 MN MT of fish in FY2018-19, of which over 50% (2.49 MN MT) is cultivated in closed water bodies. Bangladesh is the worlds 5th largest producer of aquaculture products, outranked by China, Indonesia, India and Vietnam. Out of the aquaculture production, the majority (1.97 MN MT) is cultivated in ponds, particularly focusing on three species: carp (961 kMT), pangasius (447 kMT), and tilapia (321 kMT), which jointly account for 93% of freshwater fish production in ponds. As of 2019, shrimps were the most widely cultured crustacean in Bangladesh, with a production of 125 kMT. Shrimp culture is widely practiced in extensive polyculture form, resulting in a high production of fish in shrimp farms (133 kMT).
- With consumers' purchasing power improving, they gravitate towards higher value cultured species such as carps and newly-domesticated species. At the same time, demand for processed fish products in the domestic market, especially urban areas, is estimated to increase exponentially.
- Production of aquaculture in Bangladesh is geographically dispersed with concentrations in the Northern-Central and South-Western districts. The regions with the highest fish production are Mymensingh, Jessore, and Comilla.
- The aquaculture sector in Bangladesh has been growing steadily in recent years (5.3% CAGR from 2009-2019), however, offers substantial room for further professionalization from a technical and commercial perspective, enabling the industry to become more sustainable, more innovative, and more competitive. Main opportunities for improvement relate to the quality of fish and shrimp genetics & breeding, disease control & animal health management, the availability of high-quality feed, post-harvest practices, cold chain development and supply chain interdependencies.

Breeding (fish)

- As of FY 2019-2020, Bangladesh had a total of 1,038 registered hatcheries, out of which 103 are government-owned and managed hatcheries, while 935 are private-sector owned. Most hatcheries are clustered in Jessore, Bogra, Mymensingh and Comilla, which jointly account for 42% of total seed production. Hatcheries report profit margins ranging between 15% - 50%. Mega (Spectra), Nourish and Quality are the leading players in the formalized fish hatchery sector.
- The seed quality of both finfish and shrimp/prawn produced from most private hatcheries has been declining due to inbreeding, negative selection, non-availability of quality brood and improper brood management practices.

Breeding (shrimp)

- Bangladeshi shrimp is predominantly produced with wild-caught broodstock, which is significantly cheaper than imported/cultivated broodstock. High-quality broodstock as input for PL production is challenging to obtain in Bangladesh. In 2019, there were a total of 42 Monodon shrimp hatcheries and 35 Rosenbergii shrimp hatcheries listed by the DoF.
- Shrimp farms and breeders are asymmetrically distributed across Bangladesh. Most shrimp hatcheries are in the Cox's Bazar district, while numerous hatcheries have commenced operation in the Khulna Division (Satkhira and Khulna districts), including two new SPF hatcheries. Main shrimp breeding companies include MKA Hatchery and Desh Bangla Hatchery, which both import broodstock (4,500 broodstock imported by MKA Hatchery in 2019, 900 by Desh Bangla Hatchery). Fishtec is a new entrant to the shrimp breeding segment.

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Feed

- The total aquaculture feed market (demand) in Bangladesh is estimated at 1.05 MN MT in 2019, of which 58% is sinking fish feed. Most aquaculture feed (1,015 kMT) is used in fish farming, whereas commercial feed is relatively uncommon in the shrimp farming segment (35,000 MT – 3.3% of the total aquafeed market). Both the sinking fish feed market and the floating fish feed market have been growing steadily (5.7% CAGR and 6.5% CAGR from 2012-2020, respectively).
- The use of commercial feed is highest (100%) at intensive farms, 60-70% among semi-intensive farms, and <20% at extensive farms.
- The aqua feed sector in Bangladesh hosts approximately 200 feed companies, many of which operate informally. The top-four aqua feed producers (Quality, Mega, Nourish and ACI-Godrej) capture approximately 40%-50% of the total market, with Quality in the lead (149 kMT of feed sold in 2019). The main importers of shrimp feed include CP (sourced from India) and Uni-President (sourced from Vietnam). The raw materials required for producing fish feed include soybean meal, corn, rice bran, palm oil, minerals, medicines and packaging materials. A substantial part of the ingredients applied for aquafeed production in Bangladesh (50-60% of corn and 35-40% of soy) is imported, particularly from India, China and South America. Due to the varying quality of raw inputs, the feed is of inconsistent and relatively low quality.

Farming (fish)

- Comilla (7.3% of inland fish production), Jessore (5.4% of inland fish production) and Bhola (3.6% of inland fish production) are the three districts contributing the largest to inland fish production (both culture and capture). Most pond fish farmers use semi-intensive methods (44% of total production). Intensive systems account for 34% of fish production in ponds and grew at 8.9% CAGR during the past two years. Productivity in intensive systems ranges between 4 and 10 MT/ha. Fish production in highly intensive production systems contributes 19% to fish production in ponds, which has remained at par. Fish production in extensive ponds (2-3% of total production) shrank at a CAGR of -12.4% during the past two years.
- Feed is the largest contributor to the total production cost for fish products: 48% of the total cost (or USD 800/MT of the selling price of USD 1,647/MT) for pangasius and 28% (or USD 401/MT) for tilapia.
- Animal health is suboptimal throughout the sector, with diseases and low-quality seed leading to relatively low-quality output.

Farming (shrimp)

- Most shrimp production in Bangladesh takes place in Jessore, Khulna, Satkhira and Cox's Bazar (86% of total shrimp production). >95% of shrimp and prawn is produced in extensive polyculture ponds that were formerly used as rice ponds ('Ghers'). Monodon is the most cultivated species (~50% of total production), followed by Rosenbergii (~42% of total production). The remaining 8% are wild shrimp varieties.
- Shrimp production in Bangladesh has declined 0.2% YoY between 2014 and 2018. The production of Monodon shrimp had declined by 4.3% while the production of Rosenbergii had increased by 5.6%. The government is actively supporting the expansion of (semi-)intensive farming. As part of the Shrimp National Action Plan and the World Bank loan program, the DoF plans to expand the area under semi-intensive culture to 10,500 ha in 2030. Depending on the species, this will account for 40,000-80,000 MT of shrimp. Fahim Seafood and ACI-Godrej are expected to play a leading role.
- Feed is the largest contributor to the total cost of shrimp (19% of total cost).
- Bangladesh has two ASC-certified producers: Gazi fish farm (connected to Gemini Seafood) and Farisa Aqua Farms. All their shrimp is purchased by Apex Frozen Foods.

Executive summary

Processing and end markets

- There are 133 aqua processing plants in Bangladesh, the majority located in port cities (Khulna and Chittagong). The processing degree of fish is relatively low, as most fish is sold fresh on wet markets. Sales of processed fish in retail is likely to grow in tandem with growing welfare. For shrimp, the degree of processing is much higher, as shrimp are frozen before export. To enter more lucrative Ready-To-Eat segments, targeting higher value-added markets in Europe, processors invested in advanced processing beyond IQF and block freezing to include Ready-To-Cook lines. Alpha Seafood invested USD 3.5 MN in 2019, Primus Seafood USD 2.4 MN, and ACI-Godrej USD 1.8 MN.
- Bangladesh is the number 3 exporter of Monodon in the world, after Vietnam and Indonesia. Fish produced for exports <1% of total production. The shrimp sector contributed USD 358 MN in exports in 2019. Bangladesh's shrimp export volume has been experiencing a consistent fall over the past 3 years (-5.8% CAGR from 2014-2019).
- Large players such as BD Seafood, Fahim Seafood, Primus Frozen Food, Apex Food, and Seamark BD have ASC certification which is the most sought after to access the European market. Other certification schemes include BAP, BRC, HACCP and GMP.
- The EU is the largest importer (>80%) of frozen shrimps from Bangladesh. Key EU markets for Bangladeshi Monodon shrimp products are the Netherlands (7,115 MT in 2019), Germany (6,625 MT), Belgium (4,629 MT), the UK (4,365 MT) and France (3,223 MT). Non-EU export destinations include Japan (1,421 MT) and the USA (1,093 MT). China has emerged as the leading purchaser of live crabs from Bangladesh.

Stakeholders

- Commercial fish feed producers include Quality (15% market share in 2019), Mega (10%), Nourish (8%) and ACI-Godrej (8%). The top commercial shrimp feed producers are Quality (40% market share in 2019) and Bismillah and Titas (14% market share).
- Main Bangladesh shrimp farmers are Shetara Farming, Shawn Fish Products, and Messrs. Quest International.
- Leading processors include National and Organic (processing capacity of USD 36 MN) Jalalabad and Jahanabad Seafood (USD 29 MN), Modern Seafood and Bright Seafood (USD 24 MN), and Apex (USD 23 MN).

Executive summary

Themes currently hampering sustainable value chain development

	Lack of quality seed	Poor animal health	Low availability of high-quality feed	Post-harvest & cold-chain challenges	Inefficient supply chain
Bottlenecks Sorted by priority	In the breeding sector, the lack of high-quality seed is a major challenge. Inbreeding and high disease pressure have led to a low-quality broodstock, which has its impact on the technical performance of the farming segment (yields, quality of products). Although the availability of fingerlings is high, especially from private sector companies, the quality is low due to interbreeding. Consequently, animals have relatively high mortality rates and low technical performance.	Frequent disease outbreaks in hatcheries and farms are a result of relatively poor animal health policies, ineffective disease control measures, insufficiently controlled breeding/farming facilities and low biosecurity standards. Suboptimal farming practices, absence of bio-security standards and high prevalence of disease all pose a serious threat to the health of the animals, boiling down to relatively low technical performance and commercial results.	There are insufficient local raw materials for aqua feed available and prices fluctuate substantially, leading to relatively low and inconsistent quality aquafeed. Aflatoxins in raw materials for example are a substantial threat. As feed represents a substantial part of the cost price of farmed fish and shrimp, increasing the supply of quality aquafeed – in combination with effective feeding strategies – is considered crucial for the domestic industry to become more competitive. The industry has not yet tapped into the opportunities to substitute animal proteins (fish meal) in aquafeed.	The Bangladeshi aquaculture sector is characterized by inefficiencies related to the preservation of produce, transportation infrastructure and trading practices. Procurement through traditional value chain intermediaries is characterized by transportation without cold chain facilities, deteriorating the condition of shrimp and fish. Farmers face heavy post-harvest loss (25%) due to inefficient storage and transportation infrastructure. Investments in cold-chain infrastructure are often deemed not profitable due to too costly applications.	Bangladesh has not reached the full potential its aquacultural export market has, amongst others due to the absence of traceability within the value chain and non-compliance with food safety and hygiene regulations. The lack of certification of exporters results in relatively low prices, especially for shrimp. The fragmentation of the market makes it challenging to certify processes/companies. The fluctuation of shrimp prices in international markets and the failure to leverage its extensive farmed shrimp (as a premium product) has put pressure on Bangladesh export position versus competing (Asian) export markets.

Executive summary

Market roadmap for sustainable value chain development

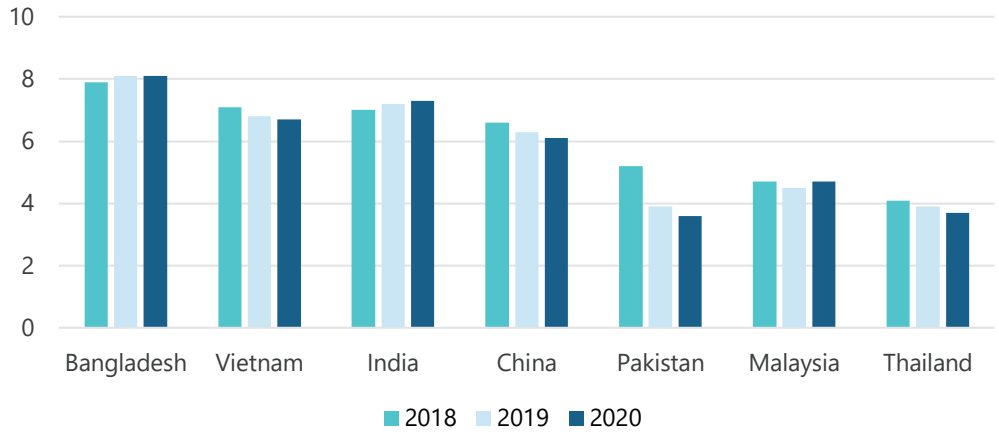
	Lack of quality seed	Poor animal health	Low availability of high-quality feed	Post-harvest & cold-chain challenges	Inefficient supply chain
Opportunities	**Training programs, protocols, and improved technologies** Increasing the availability of quality genetics, for example through developing local (CRISPR-Cas) breeding programs and training programs. Private sector players could capitalize on this opportunity by venturing into high-quality fingerling production. In addition, technical results at the breeding and farming level could be improved by introducing more controlled and more sustainable farming systems (such as RAS). K2K initiatives could focus on cross-country curriculum development for education institutes. G2G could support with setting up protocols, technical assistance, and developing breeding programs.	**Identify and prevent diseases** Private sector players could develop laboratory capacity and capabilities at the hatchery level to identify and prevent diseases more effectively. K2K initiatives could focus on training vets and developing training programs, tailored to local needs. The Dutch government could support Bangladeshi government departments by sharing their extensive knowledge of implementing proper guidelines for disease management, improving biosecurity, and ensuring food and animal safety. Workshops and seminars could be organized where government delegates interact to share knowledge and review policy regulations.	**Develop local high-quality feed capabilities** The private sector has a (relatively) first-mover position for various kinds of products and services in the aquaculture value chain and related industries. Improving feed formulation and increasing feed mill efficiency is among the opportunities. Setting up model farms offers feed suppliers the advantage of showing local farmers the advantages of the premium-quality products. Increasing the availability of high-quality feed, applying alternative proteins (as a substitute for fish meal), offers great opportunities for making the sector more sustainable.	**Investment in agro-logistics and cold-chain solutions** Long and complex supply chains call for the localization of cold-chain infrastructure. More effective supply chains require the development of a network of cold-chain facilities in main farming and processing regions. Improved preservation of produce (e.g. less post-harvest losses and improving product quality) enable to fulfil (part of) the requirements to enter premium export markets. Joint investments by farmer groups mitigate investment risks and make them more attractive to buyers.	**Strengthening capacities throughout the value chain** Professionalizing production technologies and systems is key. Reusing waste streams and improving circularity can improve sustainability throughout the sector. Dutch private sector players could offer technical services regarding quality control. In other Asian markets, mobile aqua labs with laboratory capacity have proven useful in assessing the quality of water, feed, or animals. Private sector, G2G and K2K initiatives could focus on assisting farms with achieving required quality standards for export, investing in value-added processing, training to ensure proper production practices, and key regulatory reform.

1. Aquaculture overview

Key characteristics of the country

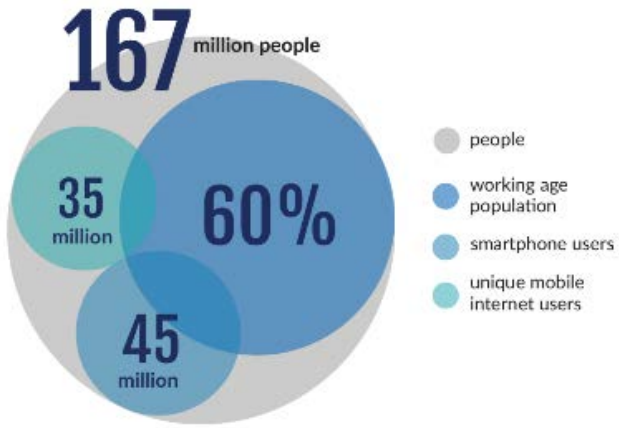
With a GDP average growth rate of 8% in recent years, Bangladesh is one of the fastest growing economies in the region

Regional GDP growth rate by country (%)



- Over the last few decades, Bangladesh has witnessed remarkable economic growth spearheaded by strong private sector consumption, steady export market growth and increased flow of remittances.
- Bangladesh recorded an annual **GDP growth rate of 8.1%** in 2019, up from 7.9% in 2018. In 2019, GDP equaled EUR 292.6 BN.
- The economy of Bangladesh is estimated to continue to grow on average by **7%** (2019-2024), which is higher than other Asian markets.
- The **GDP per capita** for the country has been on a steady rise over the last decade and currently stand at EUR 1,521 according to World Bank reported figures.
- This steady increase in GDP per capita has given rise to **higher disposable income** and a **shift in consumption patterns.**

Population of Bangladesh: 167 MN (2019)



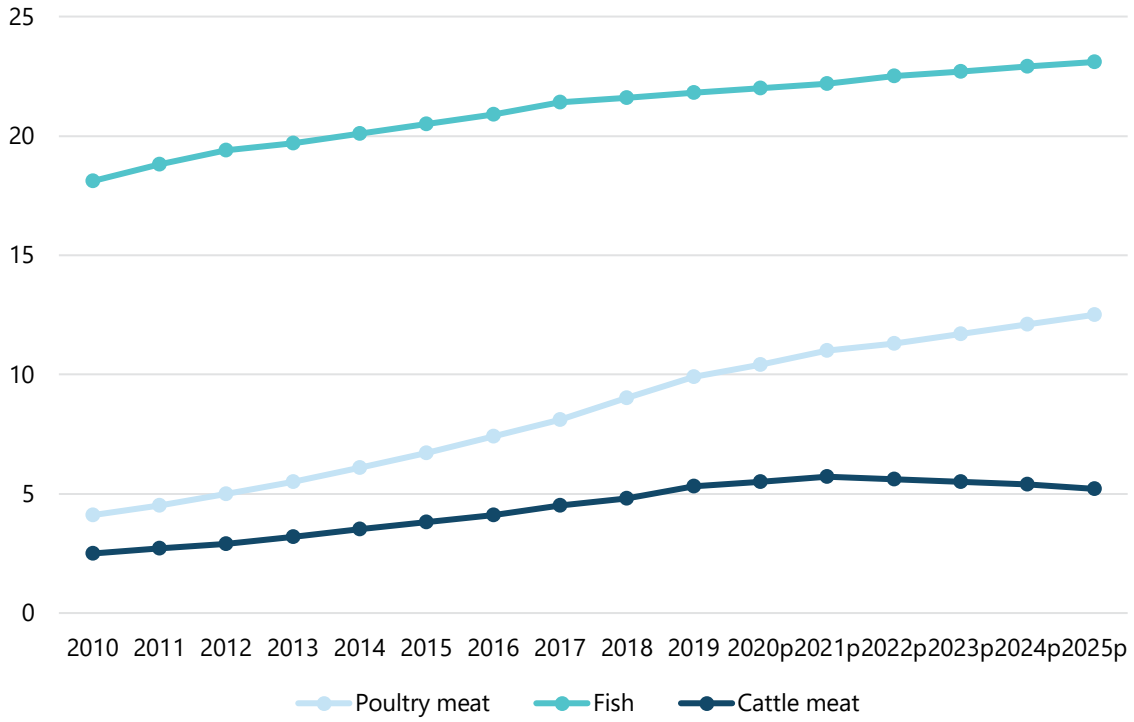
- Population growth rate has been stable at 1.2% since 2013 and the total population now stands at **167 MN.** The labor force is 56.2 MN people.
- The population structure has been stable for the last 6 years, with the **15-64 age group making up 60%** of the population. The median age is 27 years.
- Because of such large population living in an area of only 147,000 sq. km (3.5 times the surface of the Netherlands, meaning 1,260 people per km^2), the country enjoys **demographic density dividend:** with a concentration of consumers, businesses can reduce cost of operations, such as lower transportation and marketing costs.
- **Urbanization**: In 2005, 26.8% of the total population lived in urban areas, which has increased to 34.3% in 2015. By 2025, 42% of the population is predicted to be living in urban areas
- The number of cities with a concentration of **Middle and Affluent Consumers** ('MAC'- representing households with an average earning of >EUR 350 per month) is predicted to increase from 10 cities in 2015, to 25 cities in 2025. This will be achieved by greater investment in infrastructure and decentralization of the country.
- The current trends in household consumption and population structure combined with the forecasts for economic and income growth suggest that consumption will expand and shift towards high-quality products in the future.

Sources: Larive-LightCastle analysis (2020-21) and FAO (2017), Asian Development Bank (2019)

Overview of fish consumption in Bangladesh

At 21.8 kg of fish consumption per capita in 2019, fish is highest consumed protein source (in weight) by Bangladeshi

Per capita consumption of animal protein in Bangladesh (in kg/capita/year)



- Consumption of fish per capita in 2019 has been estimated at 21.8 kg[1] and has grown gradually during the past decade (1.6% CAGR 2015 – 2019) and is expected to remain growing in the medium- to long term.
- While various factors affect consumer trends, two underlying factors are expected to have affected changing fish consumption to the largest extent.
  - In line with the economic growth, an increasing number of Bangladeshi people can afford a higher standard of living and opt for an improved and more nutritious diet. Demand for fish, being a protein-rich product, has increased as it is an effective way to meet protein requirements.
  - Second, fish in Bangladesh is a relatively affordable source of protein. Among the less prosperous population, fish demand is strong as consumption of fish offers protein a comparatively low cost.

Per capita consumption of fish in Asia (2017)

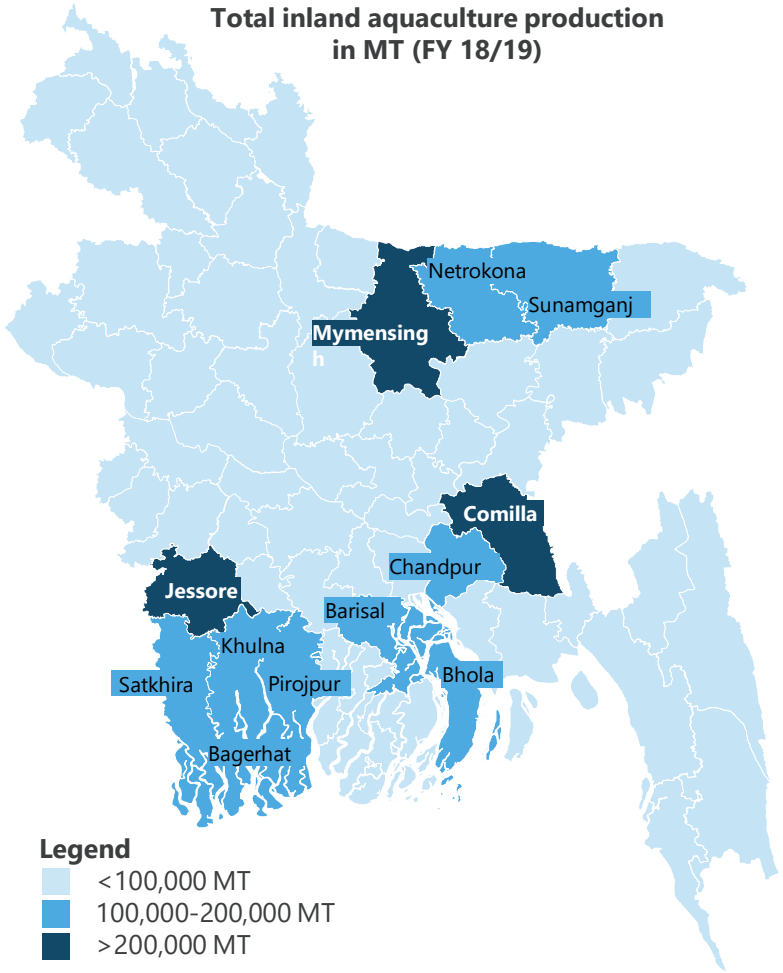
Sources: Larive-LightCastle analysis (2020-21) and FAO (2017)
[1]Source: Household Income and Expenditure Survey (2016) and WorldFish

High-level overview of aquaculture production in Bangladesh

While aquaculture is practiced throughout the country, Mymensingh, Jessore and Comilla are districts with the highest production

- Bangladesh is part of the Ganges delta, which is known to be the largest river delta region of the world. As such, the country is characterized by a large surface of **floodplains (80%)** of the Ganges, Brahmaputra and Meghna rivers. About 7% of the total surface of Bangladesh is covered with rivers and inland water bodies and their floodplains are routinely flooded during the monsoon season.
- In FY 2018-19, the fisheries sector contributed 3.5% to Bangladesh's national GDP and employed over 12% of the country's total population.
- Given the climatic conditions and rich prevalence of water bodies, cultivation and catching of fish are an integral part of the Bangladeshi rural livelihood and its national cuisine. Fish is the most important source of protein to the population, at **21.8 kg** per capita (2019) consumption. Most farmers are smallholders.
- The aquaculture sector has been growing steadily over the last couple of decades due to rising demand and depleting fish stocks in rivers and marine areas. Bangladesh furthermore recognizes the aquaculture sector as an important sector to meet fish export demand. The growing sector therefore is associated with significant employment opportunities. More than 18 MN people are directly and indirectly involved in aquacultural fish production.
- Total fish production in Bangladesh in FY 2018-19 was **4.38 MN MT**, of which **57%** (2.49 MN MT) was **cultivated** in closed water bodies. Inland capture accounted for 28%, marine fisheries for 15%[1]. The fisheries and aquaculture sector is expected to increase in the coming years to a volume of 5.67 MN MT by 2024 (CAGR 5.2% from 2019-2024), conditional to further implications of the COVID-19 pandemic.
- Some of the regions that have the highest fish production are:
  - Mymensingh (most popular variety is pangasius with 300,000 - 400,000 MT produced per annum).
  - Jessore (both fish culture and hatcheries producing carp).
  - Comilla.
  - Bogura, Rajshahi, Rangpur, Dinajpur and Sylhet.
- By using advanced production methods and higher nutrient feeds, the fish production has increased over the years. There is potential for increased production by application of more (semi) intensive methods, such as RAS. The average growth rate of fish production in ponds is 5.7%, while this is 8.9% for intensive production.
- Geographic prevalence of specific species of aquaculture:
  - Fish: Rajshahi, Bogura, Mymensingh.
  - Shrimp: Khulna, some areas of Cox's Bazar.

Total inland aquaculture production in MT (FY 18/19)



Source: Yearbook of fisheries statistics of Bangladesh 2018-2019, Larive-LightCastle analysis (2020-21) and FAO (2017).
Note: High-res images available upon request.

Impact of COVID-19

COVID-19 has greatly disturbed the market, increasing consumption while also increasing prices of fish feed drastically

Fish feed and other aqua input prices are increasing
- Mid-season activities were highly affected in 2020, and more disruptions are expected in 2021.
- Late season fingerling stocking was limited in 2020, likely to cause limited fingerling availability in the upcoming season next year and difficulty for farmers to buy new inputs.
- Farmer-to-farmer demand is determined by the number of clients being able to purchase inputs and collect loan repayments, which are both likely to be limited by the COVID-19 pandemic.

Farm losses increases due to delayed harvest
- Already 64% of farmers reported a forced delay in harvesting due to the lower price on local markets.
- Farmers are limited in their ability to fund mid-season new operations due to lack of cash flow.

Markets are still volatile; affected repercussion of supply chain disruption
- Average price of most fish species was 5% to 15% lower during April-May 2020 compared to pre-COVID-19 period. 37% of the farmers reported significant revenue decrease of at least 50%-100%. 51% have reported of revenue decrease ranging from 1%-50%. The rest 10% reported of not occurring of any type of revenue loss.

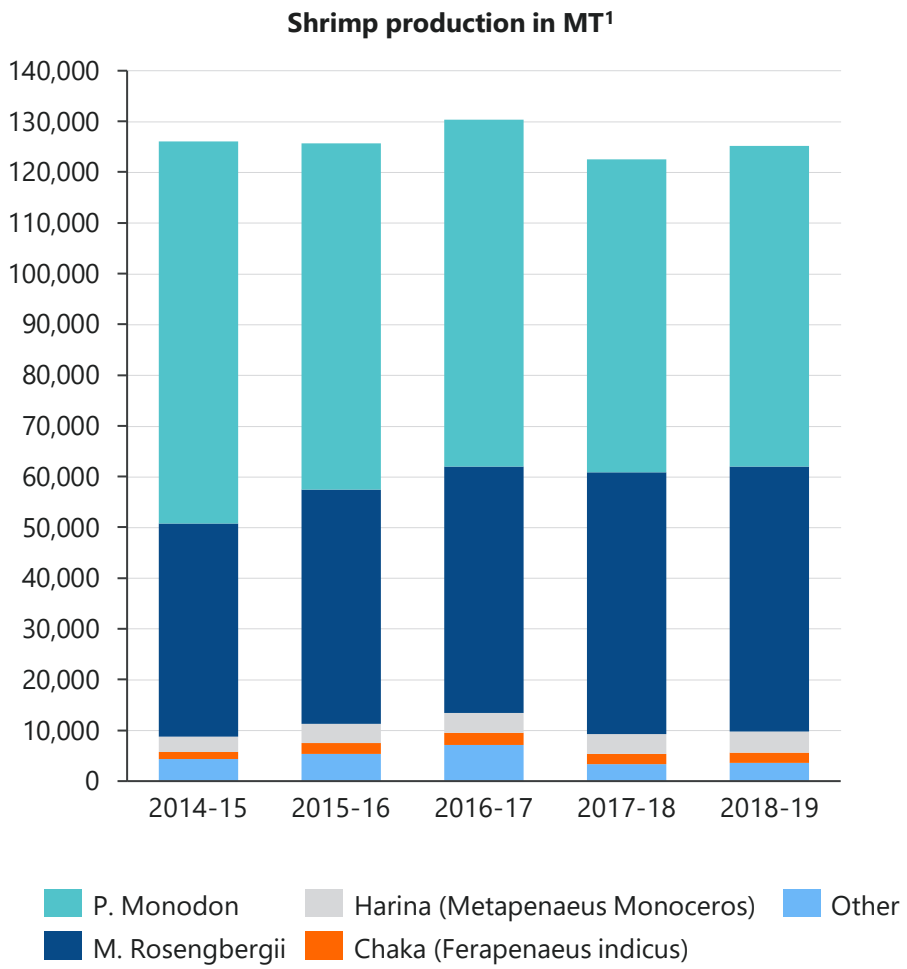
Increased local demand
- 97% of surveyed households consumed fish eat least one day a week. About 72% of the households had fish in their meals at least every alternate day in the week.
- Lower prices have had a positive effect by increasing fish consumption, particularly in rural population. Roughly 43% of households indicated that they increased fish consumption, 41% households stated that they their fish consumption remained the same and 16% of interviewed households consumed less fish.
- Consumption survey results show that the average per capita per day consumption of fish was 91g during the pandemic period, which is much higher than the national average of 62.6g.

Shrimp export plummeted and seed prices increased
- COVID-19 has led to a massive decline in international orders for processed shrimp, which had dipped since the beginning of 2020, and has almost trickled down to zero. Since Bangladesh markets Monodon shrimp in a category more premium than Vannamei, customers include high-end customers such as hotels. Processors feared that capacity utilization would drop below 30%.
- The depletion of local wild-sourced post larvae (PL) has coincided with cross-border trade with India (which was a source of approximately 49% of the country's supply of shrimp PL). This has resulted in a 200% - 250% increase in the price of PL cultured from wild broodstock in hatcheries, making the prices almost on-par with SFP PL.

*Source: LightCastle North Star report – Burgeoning Aquaculture Market in North Bengal (2020).

Shrimp production trends

Despite the potential of the shrimp farming sector, production has decreased slightly over the past years



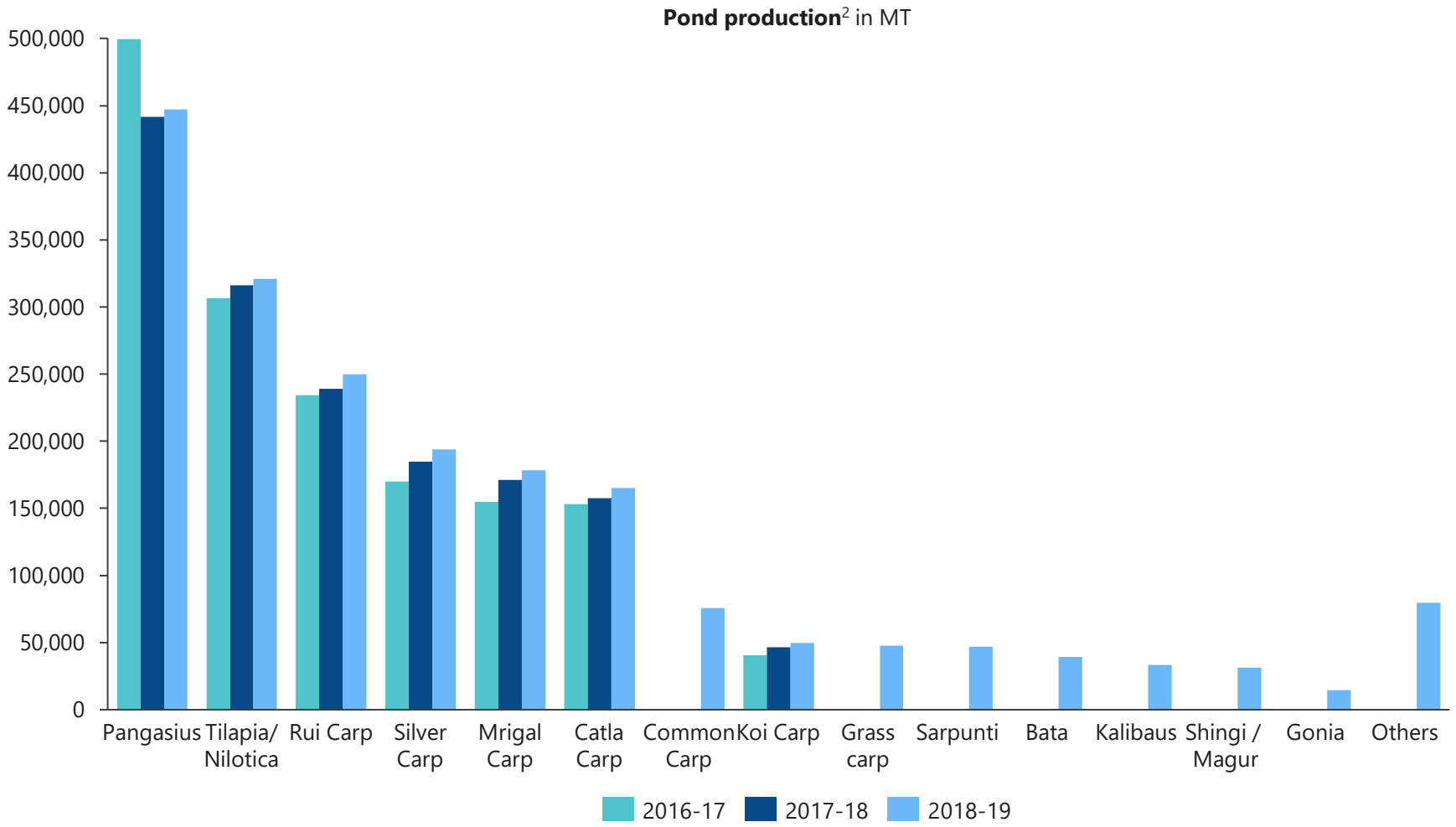
- Production of shrimp has decreased slightly during the past years, with different growth trends observed for Monodon and Rosenbergii. The slight drop in production can be explained with several observations.
- As of 2019, shrimps were the most widely cultured crustacean in Bangladesh, but following heavy losses in the sector over the last five years, farmers and officials are looking to diversify. These losses have mostly stemmed from stock losses due to spread of diseases, but the lack of farming knowledge (required for proper water quality management and proper diagnosis and treatment of diseases) as well as worsening climate events in recent years also contributed.
- Even compared to other South and Southeast Asian peers, shrimp farming in Bangladesh is highly disorganized and dispersed, characterized by the 300,000 small-scale extensive farmers. The sector has not been able to formally organize, and supply chain intermediaries still play an outsized role. The sector has not been able to take advantage of intensive and semi-intensive shrimp culture, constraining productivity.
- The sector has failed to achieve the international certifications necessary to required to fetch premium prices in the international market. This is a missed opportunity, as the country is well placed to position itself as a purveyor of high-quality organic shrimps (due to its extensive cultivation nature) to high-end international markets. Meeting these standards can, due to additional economic rents to be captured, provide incentives for private individuals to venture into shrimp farming. The production potential of the country can therefore be considered unmet.
- While in other large shrimp producing countries Vannamei is the most cultivated species, Vannamei production in Bangladesh is negligible. Only one private company (MU Seafoods) has received permission to culture Vannamei for the first time on a pilot basis in a quarantine environment in the Khulna district in 2020. The advent of commercial farming of Vannamei will hinge largely on the outcome of this pilot. Experts, however, believe farmers in Bangladesh have not reached the readiness to culture shrimp in large-scale intensive systems, which is crucial for the success of the commercial introduction of Vannamei. In general, the sentiment among businesses is in favour of adopting Vannamei culture, while the government prefers to emphasize more on proper branding and marketing of the country's Monodon and Rosenbergii production, which occupy a relatively upmarket segment in the international market compared to Vannamei.
- Several production bottlenecks, most notably in acquiring quality shrimp seeds (as most broodstock is still dependent on wild collection) furthermore have constrained production. This has had knock-on effects by inflating the price of inputs for farmers, leading many to close their farms.

Sources: Larive-LightCastle analysis (2020-21), Yearbook of fisheries statistics of Bangladesh 2018-2019.

[1]Note: the production of shrimp/prawn farms is 258 kMT in 2018-19, which includes fish produced at shrimp farms. The numbers in this graph solely represent shrimp production (excluding fish produced at shrimp farms). Research by Larive-LightCastle (2020-21) indicated the possibility these numbers are overestimated, based on interviews with industry experts and private sector stakeholders.

Pond production trend and forecast by species

Total pond production in Bangladesh in FY18-19 equals 1,974 kMT



Drivers for growth[1]

Carp

Total production of carp totaled 961 kMT in 2018-19. The production of carp is expected to increase, with carp being a fish favored by people across all age groups. As consumers' purchasing power improves, they will gravitate towards higher value cultured species such as carps and newly-domesticated species, possible at the cost of pangasius and tilapia.

Pangasius & tilapia

Pangasius and tilapia are perceived as lower-quality fish, due to low prices and perceptions about low-quality feed. Both pangasius and Tilapia have reached their saturation point, with prices of pangasius and tlapia dropping dangerously low and close to costs of production. Ironically, in remote areas, there is an under-consumption of animal protein, but fish do not reach them due to underdeveloped distribution systems and cold chains.

Sarpunti

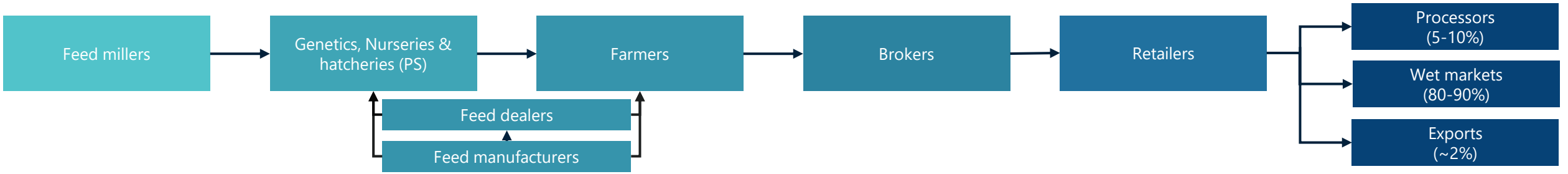
Sarpunti (or Thai Punti) is expected to retain a slow but steady growth.

Sources: Larive-LightCastle analysis (2020-21), Yearbook of fisheries statistics of Bangladesh 2018-2019.

[1]Note: based on research by Larive-LightCastle (2021).

[2]Note: shrimp is excluded from pond production trends, as 'shrimp farming' is considered a separate category.

Overview of the supply chain (fish)



The use and production of aquaculture feeds has increased in the past 10 years. The total **commercial feed demand** is **1,055K MT** (2019). Besides commercial feed, many farmers use locally-formulated feeds from village-based enterprises.

Raw materials and feed additives are mixed in a feed mill. Around 50% of aqua feed ingredients are from Bangladesh, with the remainder imported. Feed is sold to farmers through feed dealers (+6-7% price addition).

Aqua feed is mostly used for Nile tilapia, pangasius, and carps, but much less for crustaceans.

The quality of seed has been poor due to inbreeding and immature brood. Hatcheries now must register under the Fish Seed Act.

Juvenile fish are produced in hatcheries and full-grown fish are sold by farmers in regional fish markets (known as 'haats'), or to travelling retailers known as Noupali or Pikers.

Bangladesh is home to different types of fish breeders, including backyard hatcheries, large private hatcheries, distributors, and integrators. There are **1,038 hatcheries** in Bangladesh.

Most farmers use pond farming (52%), while others use floodplains (21%), or cage farming in rivers or lakes.

Extensive farming is most applied farming system (44%) while intensive farming is the fastest growing at a rate of 8.9% CAGR.

Total production[1]: **2.49 MN MT**

- Ponds: 1,974 kMT
- Seasonal culture waterbody: 217 kMT
- Shrimp farms: 258 kMT
- Crab production: 12 kMT
- Pen culture: 12 kMT
- Baor: 10 kMT
- Cage culture: 3.8 kMT

The brokers or middlemen sell the collected fish to local dealers at a commission who subsequently sell to regional dealers (wholesalers or 'aratdaars') or auction markets. The brokers receive a **2-6% commission**.

Offtake agreements are often informal and trust-based, which is beneficial in terms of the reduced administration cost and time, though also encompasses the risk of ex-post disputes.

Due to the informal character, in case of disputes, little can be done from a legal standpoint.

Through the wholesalers, fish are sent to faraway 'haats' (rural retailing) or, one of the 17,000 markets in cities and towns (urban retailing).

Sub-urban and rural retailers receive **3-6% commission**, whereas urban retailers receive **15-30% commission**.

The processing degree of fish is relatively low, as the majority of fish is sold fresh on wet markets.

The degree of processing is high for exported fish, as this is sold frozen. After purchasing raw produce from wholesalers, processors process the fish and deliver it to end-markets.

There are **133 processing plants** in Bangladesh, also processing shrimp. The majority of these are located in port cities (Kulna and Chittagong).

Source: CGIAR, WorldFish

[1]Source: Yearbook of fisheries statistics of Bangladesh 2018-2019

2. Breeding

Shrimp farms and hatcheries - geographical overview

Shrimp farms and breeders are asymmetrically distributed across Bangladesh

- Most shrimp production takes place in Jessore, Khulna, Satkhira and Cox's Bazar (86% of total shrimp production). Cox's Bazar district accounts for 5.8% of national shrimp production, which is the highest outside the Khulna division.
- Most monodon hatcheries are in the Cox's Bazar district, while numerous hatcheries have commenced operation in the Khulna Division (Satkhira and Khulna districts), of which two are the country's newest SPF hatcheries.
- Geographical concentrations of farming and breeding activities are disparate. Some shrimp production clusters are being obstructed from sea access due to a mangrove coastline. This is an unfavorable condition for hatcheries. Hatcheries in Khulna therefore tend to have more difficulties with accessing seawater for their facilities.
- In Jashore, salinity of water has been increasing due to north-moving saltwater intrusion, which makes the district more suited for Monodon aquaculture.
- As most hatcheries are in the Cox's Bazar region, the role of traders and agents is key in connecting farmers with hatcheries. Those distributing PL from hatcheries in Cox's Bazar supply extensive farmers predominantly. Several hatcheries are opening in the Khulna division (e.g., MKA Hatchery and Fishtec) to ensure a location close to farmers. These hatcheries ship sea water through river routes to their hatcheries.
- The mode of delivery for Monodon PL involves shipment of PL suspended in oxygenated water within transparent polyethene bags, which are placed in Styrofoam boxes for transportation. Each Styrofoam box can hold between 1,000 to 1,500 PL. This is the most common mode of delivery for PL over long distances (such as sending PL from Cox's Bazar to Khulna division) and shipments are transported using trucks, large passenger vehicles (micro-buses) or via air cargo.[1]
- Processors, having emerged in the late 1990s and early 2000s, base operations around Khulna division and Chittagong division to ensure quick access to seaports in Mongla and Chittagong, respectively.
- Despite the presence of farmers in Khulna and difficulty of transporting perishable seafood over longer distances, many processors and exporters are in the Chittagong zone. This is primarily because Chittagong seaport, the largest seaport in Bangladesh, is near those processors, which gives them access to improved road infrastructure compared to Mongla port in Khulna district, where roads are narrow and cannot accommodate container-loaded trucks.

Notes: [1] When PL is sold locally to agents or farmers, hatchery owners tend to cut costs by using jute bags instead of Styrofoam boxes to enclose the polyethene bags. Processor count is based on processors registered with the BFFEA.
Source: Statistical yearbook, Bangladesh Frozen Foods Exporters Association (BFFEA) and industry experts (LightCastle-Larive primary data)

Shrimp broodstock and breeding

> 95% of shrimp and prawn is produced in extensive polyculture ponds that were formerly used as rice ponds ('Ghers')

Shrimp broodstock

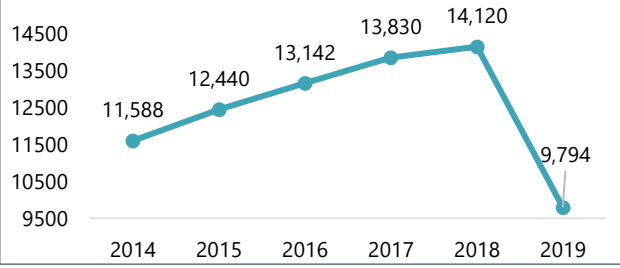
- Two players, MKA Hatchery and Desh Bangla Hatchery, import broodstock. The broodstock imports concern SPF monodon broodstock. No SPF-free Rosenbergii broodstock is imported into Bangladesh. MKA hatcheries, based in Cox's Bazar, produces mature adults ready for PL production. It leads the market in the breeding segment. The broodstock MKA uses originates from Hawaii. Desh Bangla hatchery, based in Khulna, started trial operations in 2018-19. In 2019, Desh Bangla Hatchery imported 450 pairs of adult broods from CP (Thailand) and produced 50 MN PL.[1] The price per pair of imported adult broodstock equals roughly US$ 480. The breeding capacity of Desh Bangla equals 2,000 pairs of broods annually. Combined importing capacity for breeding purposes of the two players is estimated at 6,000 – 8,000 pairs.
- Fishtec, traditionally being a fish feed and medicine player, is a new entrant into the breeding segment. Fishtec, based on Cox's Bazar, planned to commence operation in 2020 through sourcing broodstock from CP (Thailand) as well, alongside with technical assistance from Desh Bangla Hatchery.
- Wild caught broods are significantly cheaper than imported ones. Wild monodon broods are priced at BDT 3,000 and 5,000 (US$ 35 to US$ 60) per brood. Each mother Monodon produces PL a maximum of three times, with up to 5 MN PL each time. Wild caught Rosenbergii mothers are priced between BDT 400 and BDT 450 (US$ 4.70 to US$ 5.30). Each mother Rosenbergii lays between 20,000 – 50,000 eggs. At most, 7,000-8,000 of these survive as PL.

Number of broodstock imported (2019)[1] [2]

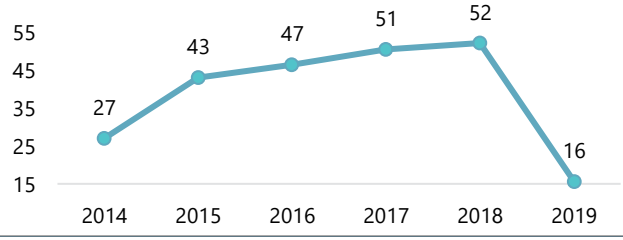
Shrimp breeding

- Bangladeshi shrimp is predominantly produced with wild-caught broodstock. Wild caught broodstock is commonly captured with trawlers and fishing boats in Cox's Bazar district. High quality broodstock as an input for PL production is challenging to obtain, which is apparent from the large price discrepancy between imported SPF brood stock and locally caught wild broods. In line with shrimp production, the number of monodon PL supplied is highest, followed by Rosenbergii PL. Provided that only two (monodon) SPF hatcheries operate, most hatcheries depend on wild-caught broodstock or cross-border imports from India.
- Production of Monodon PL had been gradually growing to beyond 14 BN throughout until 2018, while Rosenbergii PL production was 52 MN in 2018. However, in 2019, the production of Monodon PL reduced by 31% and production of Rosenbergii PL reduced by approximately 70%, which has been attributed to high prevalence of diseases among broodstocks and hatched shrimp. In 2019, there were a total of 42 Monodon shrimp hatcheries 35 Rosenbergii shrimp hatcheries as listed by the DoF. A small share (1-2%) of Monodon PL is supplied by SPF hatcheries that import broodstock. The remaining monodon hatcheries use wild caught broodstock (~210,000 broodstock were captured from the wild in 2019). Over-fishing of mother shrimp from the wild effectuated a rapid decline in stock of mother broodstock. The lower availability of wild caught broods hampered production of Monodon PL during recent years. One of the emerged bottlenecks in the shrimp sector is the lack of hatcheries adopting high standards and producing high quality SPF-free PL, particularly for Monodon.

Production of Monodon PL (MN)



Domestic Rosenbergii PL production from hatcheries (MN)



Notes: [1] Imports of broodstock are supposedly subject to 57% import duty and taxes.
[2] Chart shows imports of SPF broodstock exclusively. In 2019, approximately 210,000 non-SPF broodstock was collected.

Shrimp broodstock and breeding

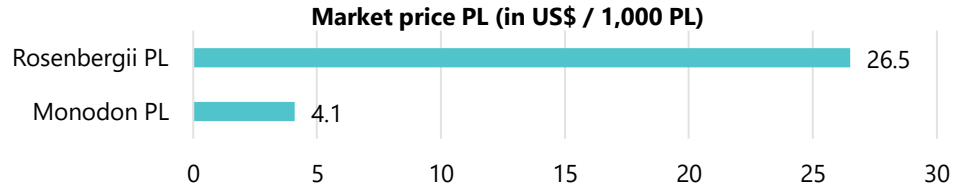
Lack of quality Rosenbergii broodstock presents an issue to shrimp farmers

Shrimp broodstock

- No SPF Rosenbergii broodstock is bred in Bangladesh. Rosenbergii PL used by farmers are either bred using local wild-caught broodstock or broodstock imported from India. Total demand for Rosenbergii PL in Bangladesh is estimated at 1,100 MN. Of this, less than 56 MN (5%) is estimated to be supplied by local hatcheries and > 50% of all Rosenbergii PL used by farmers is collected from canals and rivers in the districts around Khulna, which are sold directly to extensive farmers. The remainder is imported from India. Imported Rosenbergii PL accounts for 45% of the supply of Rosenbergii PL. Farmers prefer Indian Rosenbergii PL as these are characterized by higher survival rates, lower disease prevalence and higher productivity, despite being prices around 20-25% higher than PL produced by breeders/hatcheries.
- Commercial production of Rosenbergii PL not having taken off can be explained by improper brood nourishment, application of banned chemicals from the black market (formalin), prevalence of bacterial, fungal and viral diseases, and a lack of available trained specialists.[1] Due to volatile survival rates, supply is furthermore highly uncertain. These challenges also led to the industry facing losses and many hatcheries exiting the industry. As the production of Rosenbergii shrimp farming is growing, venturing into Rosenbergii PL production can attract new interest. There are 77 hatcheries in Bangladesh operational at present (42 Monodon, 35 Rosenbergii). Among these 77 hatcheries, 27 are owned and operated by the Department of Fisheries, and 50 hatcheries belong to the private sector with varying degrees of operation.
- The Bangladesh government implementing the US$ 287 MN Bangladesh Sustainable Coastal and Marine Fisheries project (majority-funded by the World Bank) can accelerate the attraction of new interest. The 5-year project beginning in late 2018 covers the shrimp sector and offers incentives to the private sector for setting up 10 SPF hatcheries to meet the PL demand.
- Rosenbergii PL are priced at a significantly higher level than monodon PL. Prices of Monodon PL are seasonal, with prices the highest in the start of the season (March/April) and then dwindling later in the cycle (August/September).

Shrimp breeding

- Most private Rosenbergii hatcheries are centered around Patuakhali and Bagerhat districts. Most Monodon hatcheries are based in Cox's Bazar district and they usually have zonal offices in Khulna division (Khulna, Satkhira and Bagerhat districts) to receive shipments and distribute them to nurseries and their commission agents.
- The Bangladesh government implementing the US$ 287 MN Bangladesh Sustainable Coastal and Marine Fisheries project (majority-funded by the World Bank) can accelerate the attraction of new interest. The 5-year project beginning in late 2018 covers the shrimp sector and offers incentives to the private sector for setting up 10 SPF hatcheries to meet the PL demand.
- Rosenbergii PL are priced at a significantly higher level than monodon PL. Prices of Monodon PL are seasonal, with prices the highest in the start of the season (March/April) and then dwindling later in the cycle (August/September). Production and hence margins are highly contingent on the survival of the PL stock. Survival rates of PL stock are highly uncertain and low survival rates can lead to operating losses for the entire year or multiple years. Multiple factors including quality of inputs (probiotics, feed and chemicals), diseases, technical competency of hatchery operators and external factors such as weather conditions are thought to impact the survival rates of PL. Best-case scenario is 50% survival rate of hatched PL. Quality of broodstock also affects survival and hence hatchery profitability, however wild-caught broodstock tends to be cheaper. According to industry insiders, Rosenbergii PL have exceptionally low survival rates, hovering around 20% -30% (considering survival rates from hatching to farm level delivery).



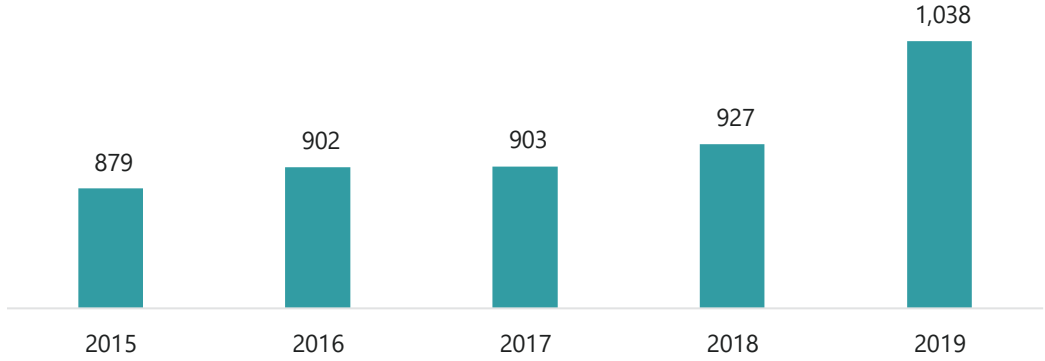
Source: Yearbook of fisheries statistics of Bangladesh 2018-2019, Larive-LightCastle analysis (2020-21).
Notes: [1] No technological breakthrough has materialized that can offer full explanations to the underlying causes of these challenges.

Fish hatcheries

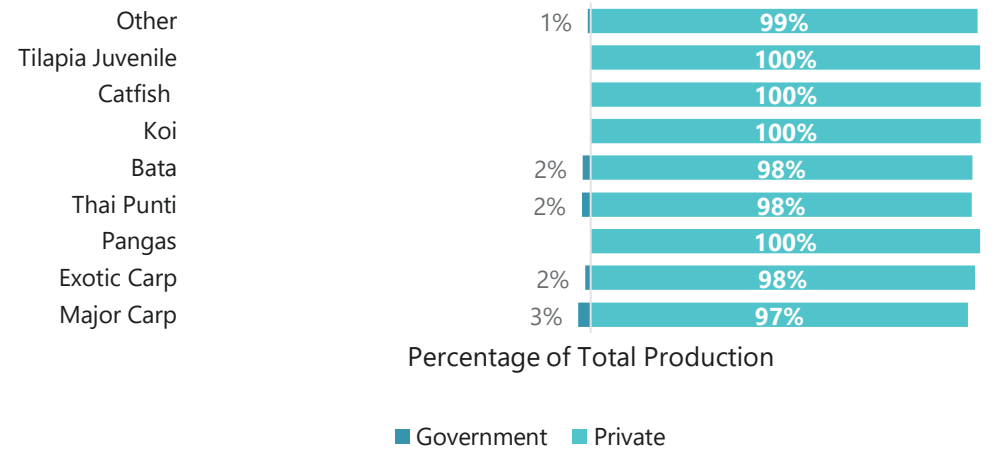
The number of hatcheries has increased, with >99% in the private sector

- It is a legal requirement that hatcheries are registered with the DoF.
- As of FY 2019-2020, Bangladesh had a total of 1,038 registered hatcheries nationwide. Of these, 103 (10%) are government-owned and managed hatcheries, while 935 (90%) are private sector owned.
- However, 99.5% of all seeds produced in FY 2019-20 were done so in private hatcheries. Government hatcheries make up only 0.5% of seed production.
- Seed production for the species of pangasius, koi and catfish (Shing & Magur) are almost entirely dependent on the private sector, with the government hatcheries producing zero or negligible amounts.
- The seed quality of both finfish and shrimp/prawn produced from the most private hatcheries has been declining in the later stage posing threat to further expansion of aquaculture industry. Reasons for carp seed quality deterioration included inbreeding, negative selection, non-availability of quality brood and improper brood management practices.
- As a result, despite their lower production volumes, seeds from government-owned hatcheries are perceived to be of better quality by farmers due to better hatchery management.
- The poor quality of seeds from private hatcheries are also a source of major risk and growth bottleneck for the aquaculture sector of Bangladesh.
- Hatcheries report a wide range of profit margins ranging between **15% - 50%.** The profitability depends on several factors including the quality of broodstock used and the hatchery's breed management practices (both of which impact yield and survival rates) and the species being bred, among others.

Total number of hatcheries



Hatchling production in 2019
(share of private vs. government hatcheries)[1]



Source: Larive-LightCastle analysis (2020-21).
[1]Note: Pangas refers to Pangasius.

Geographical distribution of hatcheries

The districts Jessore, Bogra, Mymesingh and Comilla account for 42% of total seed production

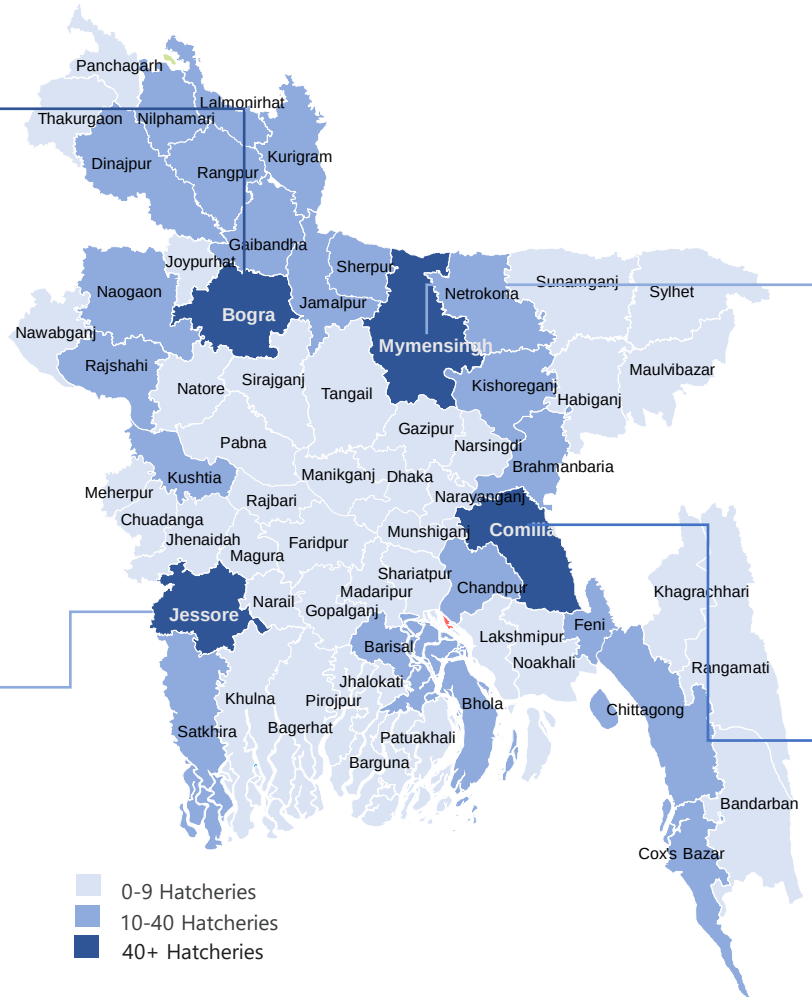
- Hatcheries and nurseries initially developed in four major clusters in Jessore, Bogra, Mymensingh and Comilla, close to government fisheries stations or where nursing of wild riverine seed was a traditional activity.
- Put together, these four districts account for 42% of the country's total seed production.
- According to WorldFish Center (2011), Jessore had 15 pangasius hatcheries producing around 3,200 kg of hatchlings.
- Mymensingh district is the largest hub of hatcheries in the country, accounting for 273 hatcheries. Seed production for certain species are heavily concentrated Mymensingh. For example, 64% of Catfish (Shing and Magur), 47% of Koi and 46% of Thai Punti national seed production happens in Mymensingh.
- Mega (Spectra), Nourish and Quality are the leading players in the formalized fish hatchery sector.

BOGRA DISTRICT
105 hatcheries

Hatchling production (in KG):
- Tilapia Juvenile - 111,195
- Major Carp - 36,320
- Exotic Carp - 48,728
- Pangasius - 11,263
- Bata - 9,365
- Catfish (Shing/Magur) - 8,220
- Thai Punti - 3,212
- Koi - 2,665
- Others - 8,247

JESSORE DISTRICT
41 hatcheries

Hatchling production (in KG):
- Tilapia Juvenile - 108,182
- Major Carp - 30,738
- Exotic Carp - 29,337
- Pangasius - 2,740
- Koi - 1,480
- Thai Punti - 1,050
- Bata - 822
- Catfish (Shing/Magur) - 409
- Others - 1,655



MYMENSINGH DISTRICT
273 hatcheries

Hatchling production (in KG):
- Tilapia Juvenile - 484,776
- Major Carp - 51,658
- Exotic Carp - 56,192
- Catfish (Shing/Magur) - 25,072
- Thai Punti - 13,685
- Pangasius - 7,654
- Koi - 4,706
- Bata - 2,695
- Others - 12,999

COMILLA DISTRICT
63 hatcheries

Hatchling production (in KG):
- Major Carp - 28,569
- Tilapia Juvenile - 23,584
- Exotic Carp - 10,578
- Pangasius - 5,399
- Bata - 570
- Thai Punti - 529
- Koi - 232
- Catfish (Shing/Magur) - 63
- Others - 25

Source: Larive-LightCastle analysis (2020-21).

Species-wise hatchling production

Tilapia is the main species produced throughout the country, with Mymensingh producing almost a quarter

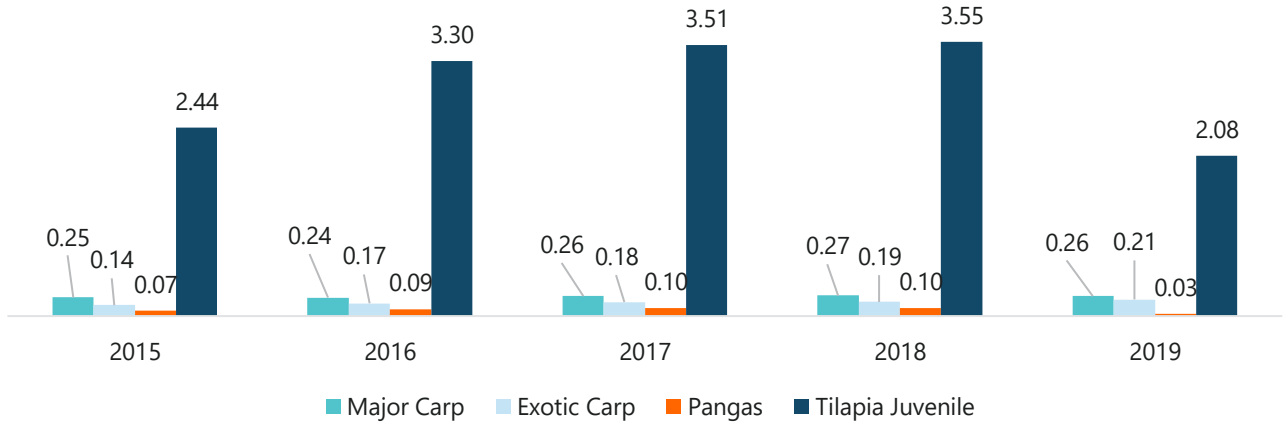
- Tilapia is the most widely produced and sold fish seed in the Bangladeshi market by the private sector. Tilapia is seed production accounts of 82% of the national production. Mymensingh district accounts for 23% of the national production. Tilapia seed production is almost entirely private sector oriented as government hatcheries produce less than 0.1% of the national supply.

- According to the DoF, 0.37% of carp hatchlings are sourced naturally, while the rest are sourced artificially from government and private hatcheries. After Tilapia, major carps and exotic carps are the most widely produced and sold fish seed by the private sector, accounting for 8% and 5% of the national production respectively. Mymensingh and Bogura account for 23% and 19% of the national major carp & exotic carp seed production. Major carp & exotic carp seed production is heavily private sector oriented as government hatcheries produce 2.5% of the national supply.

- Pangasius is another major species for seed production, accounting for 2% of nationwide seed production. pangasius seed production is most concentrated in Bogura district (particularly in Adamdighi union, where the first private pangasius hatchery was established in 1995), which accounts for one-third (34%) of the supply of national pangasius seeds. In addition, many of the districts where there is some production of pangasius seed are also importers of pangasius fingerlings from Bogra, suggesting local demand from grow-out farmers

- The other major species for seed production among the private sector are:
  - Thai Punti – 1% of all hatchling production
  - Bata – 0.9% of all hatchling production
  - Catfish (Shing/Magur) – 0.4% of all hatchling production; and
  - Koi – 0.3% of all hatchling production

Annual species-wise hatchling production (in MN kg)



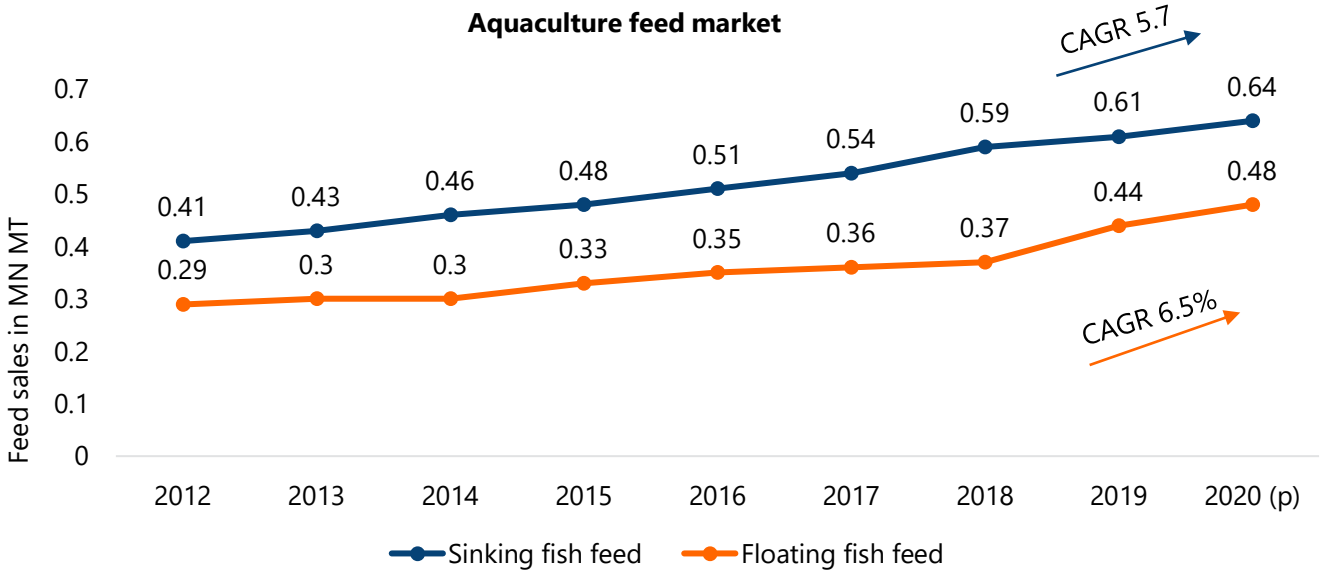
Hatchling Prices			
Species	**Price (BDT/KG)**	**Price (USD/KG)**	**Breeding period since hatching**
Tilapia	BDT 0.50 – 1.20/ fry	BDT 0.50 – 1.20/ fry	7 – 8 days
Carp	2,000-3,500 / KG	24-41 / KG	5-7 days
Catfish	3,500-8,000 / KG	41-94 / KG	From 5 days up to 30 days
Koi	4,000-8,000 / KG	47-94 / KG	5-7 days
Pabda/Gulsha	4,000-7,500 / KG	47-88 / KG	From 5 days up to 30 days
Tengra	6,000 / KG	71 / KG	6-7 days
Pangasius	1,000-2,000 / KG	12-24 / KG	6-7 days
Bata	2,000-6,000 / KG	24-70 / KG	6-7 days

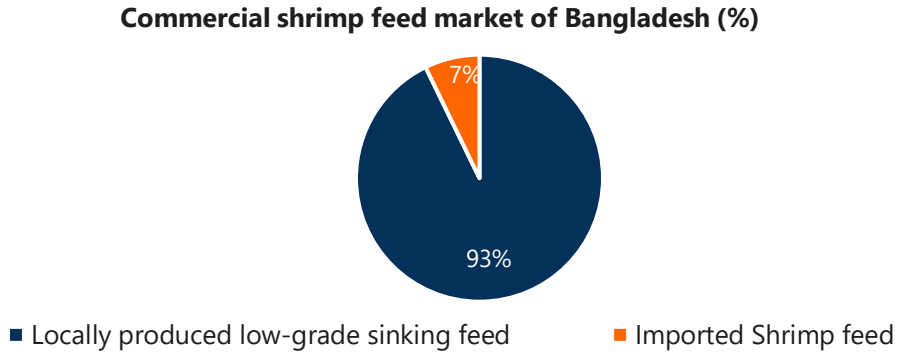
Source: Larive-LightCastle analysis (2020-21).
Note: pangas refers to pangasius.

3. Feed

Shrimp and fish feed supply overview

Most aquaculture feed is used in fish farming, rather than in shrimp farming, where commercial feed usage is relatively uncommon





- The total aquaculture feed market (demand) in Bangladesh is estimated at 1.05 MN MT in 2019, of which 58% is sinking fish feed. The remainder is floating fish feed. Larive-LightCastle estimates that 1.015 MN MT aquaculture feed is used for fish farming.
- The remainder, 35,000 MT, comprises of feed marketed as shrimp feed. The commercial shrimp feed market contributes 3.3% of the total aqua feed market (or 5.5% of the sinking feed market). Most shrimp farmers feed shrimp with generic sinking aqua feed or improved home-mixed feeds, which explains why the shrimp feed market is small. Most shrimp farmers are extensive shrimp farmers (<1 ha in land), which commonly rely on improvised feed such as rice bran. Farmers are gradually beginning to use a mix of commercial feed. However, they source this as domestically-produced low-grade sinking feed, which has a slightly higher protein content than white fish feed.
- The locally produced shrimp feed in Bangladesh which is widely marketed as "shrimp feed" mostly contains rapeseed extracts, soy extracts, fishmeal and maize as their main ingredients. These feed products have weak binders which dissolve quickly in water, making them inappropriate for shrimp feeding. The nutrient content found in locally produced shrimp feed is much lower than shrimp feed of global standards (which are entirely imported at present). Experts suggest that one of the key factors affecting the low survival rate of Rosenbergii PL is the failure to ensure adequate nutrients and essential components.
- Since most aquaculture is practiced near Mymensingh region, most fish feed manufacturers formed a cluster around those regions to establish a strong distribution channel. Production of local shrimp feed utilizes these existing sinking shrimp feed production lines at these sites. Feed production clusters are in the vicinity of fish aquaculture clusters, through relatively remote from shrimp aquaculture clusters. For shrimp, most major players have either set up depots or have exclusive dealers present in south-west Bangladesh to cater to the shrimp feed market.

Shrimp feed supply overview

Due to lack of local supply, high-quality feeds are mostly imported from India

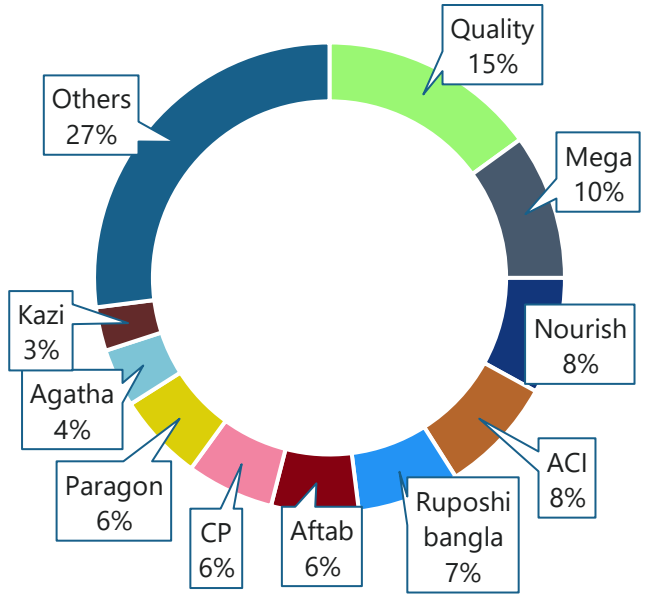
- The internationally marketed feeds have a higher nutrient content and last longer under water making it convenient for shrimp farmers. However, the price of imported shrimp feed is more than double the price of the locally circulated feed making its market very niche.
- Key local producers of domestic low-grade shrimp feed include Quality, Nourish, and Mega. They are using their existing sinking fish feed production lines to manufacture shrimp feed, adjusting their production and supply in response to the market demand and competing profitability of other types of feed that may be produced using the same production lines.
- Main importers of shrimp feed include CP (sourced from India) and Uni-President (sourced from Vietnam). According to industry experts, the imported feed sector of Bangladesh has not witnessed a significant growth in the past five years due to the price sensitivity and poor farming conditions. The industry expects this to grow with the introduction of Vannamei shrimp farming practices in Bangladesh.
- Quality Feeds is a pioneer in the shrimp feed segment having a plant dedicated solely to producing shrimp feed. However, due to insufficient market demand, they are yet to reach their full capacity in terms of shrimp feed production. They deliberately produce lower grade feed (but with better binding capacity compared to those of competitors), despite having the technical capability to producer higher grade feed. This is mainly in order to keep prices of their feed lower.

Fish feed supply overview

The majority of (semi-)intensive fish farmers use commercial floating aqua feed

- The loose feed industry is decreasing year on year due to urbanization and the gradual shift of rural producers to other production segments. Since commercial feed is has become more effective, farmers are willing to pay a higher price to subsequently earn a higher margin on their produce.
- The use of commercial feed is highest for farmers using intensive farming methods (70% of farmers use commercial feed). 50% of semi-intensive farmers use commercial feed, and only 10% of farmers using extensive farming practices use commercial feed.
- The total market size for commercial aqua feed is estimated to be 1.05 MN MT at present, segregated roughly 40/60 between floating aqua feed and sinking aqua feed. The aqua feed sector is composed of approximately 200 large national and smaller, regional feed companies many of which operate informally. There are regional players and SME based players who make loose feed with makeshift machinery.
- It is estimated that the top four aqua feed producers (Quality, Mega, Nourish and ACI-Godrej) capture approximately 40%-50% of the total market. Quality Feeds Limited is the market leader, accounting for approximately 15% of the market, with sales of 149 kMT in 2019 – the split being 89 kMT of floating feed and 49 kMT of sinking feed.
- Despite lower consumption at present and higher prices compared to sinking feed, the floating fish segment provides the most potential for growth, both as a percentage of current market size and in absolute numbers – as farmers increasingly switch to floating feed for enhancing yields.
- The raw materials required for producing fish feed includes soybean meal, corn, rice bran, palm oil, minerals, medicines and packaging materials. However, due to inadequate availability of raw materials, a major portion is currently being imported directly from India, China and South America. The two major ingredients, being corn and soya, are mostly imported. 40-50% of corn is locally sourced, and the rest is imported. 64% of feed demand of soya bean meal is met by local producers (USDA) while the rest is met by imports.
- There are three pricing segments – Economy, Value and Premium – in increasing order of pricing. With increasing farmer knowledge and awareness, the premium segment of the market has grown to capture 50% of the market for aqua feed, signaling a shifting preference towards high-quality, high-yielding formulations.
- In terms of life stage segments, there are five feed segments – Hatchery/Broodstock, Nursery, Starter, Grow and Finisher segments. Finisher and grower segments are the largest counting for over 60% of all consumption.

Market share of feed producers



Commercial feed demand estimation

Most farmers using intensive farming methods use commercial feed, whereas most extensive farmers rely on natural sources

- Looking at the production methods used for aquaculture (extensive versus (semi) intensive), and the different species cultured in different production systems (ponds, floodplains, rivers) the demand for commercial feed differs among different types of farmers.
- For intensive farming, most farmers are practicing the use of 100% commercial feed for proper control over FCR and fish quality. In semi-intensive farming farmers use a mix of homemade loose feed along with commercial feed to provide proper nutrition.
- In extensive farming practice, farmers are mostly dependent on natural sources for fish feed. However, farmers are now using a certain portion of commercial feed as the stocking density gets higher in extensive farming ponds.

% commercial feed in all feed consumed[1]

	FCR	Intensive	Semi-intensive	Extensive
Pangasius	2 (sinking) 1.5-1.6 (floating)	App. 100%	60-70%	Less than 20%
Tilapia	1.2-1.3 (floating)			
Koi	1.4			
Shingi/ Magur	1.4-1.5 (floating)			
Shrimp	2.2-2.4 (sinking)			
Carp / Rui	2 (sinking) 1.5-1.6 (floating)			
Other (Pabda & Gulsha)	1.6-1.8			

Production based feed requirements (MT/year)

	Commercial feed requirement	Share of feed	Type of feed
Pangasius	580K	54%	Floating / sinking
Tilapia	340K	32%	Floating
Koi	54K	5%	Sinking
Shingi/ Magur	11K	1%	Sinking
Shrimp	15K	1%	Sinking
Carp / Rui	46K	4%	Sinking
Other	10K	2%	Sinking
Total	**1,055K**	**100%**	

Source: Statistical Yearbook of Fisheries 2017-18 and LightCastle Primary Research

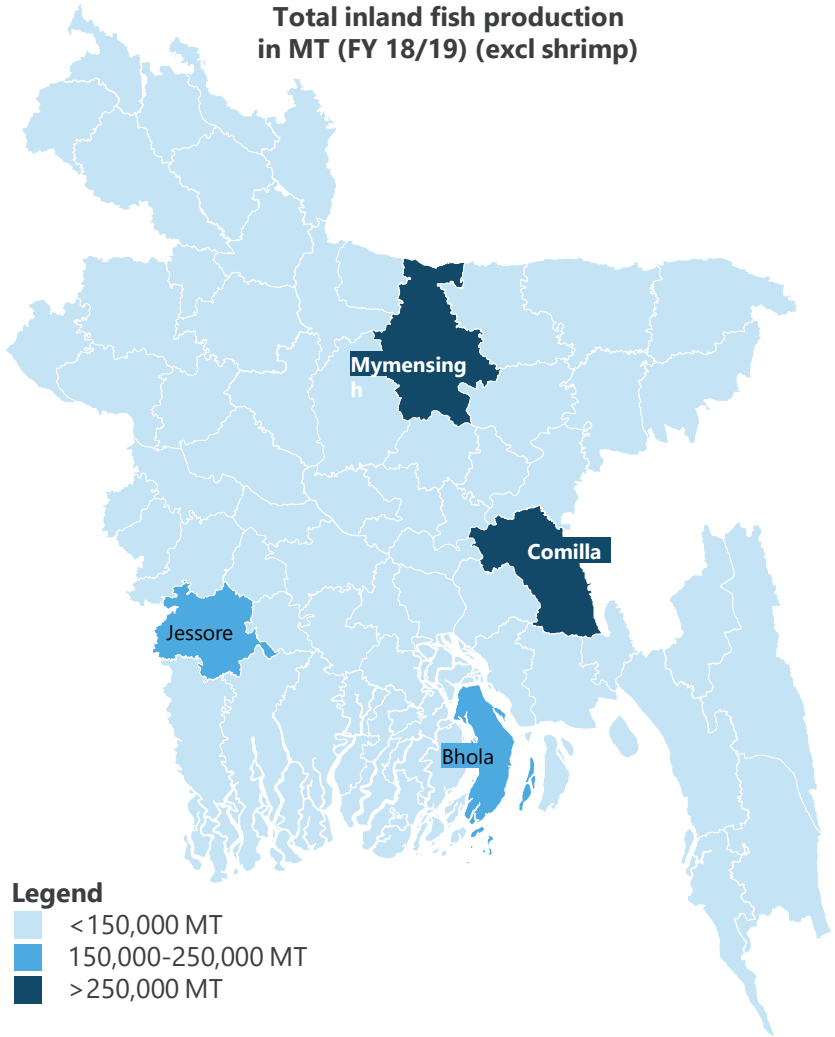
[1]Note: estimate per production system for the share of commercial feed per species not possible. Neither DoF nor feed companies track these figures.

4. Farming

Fish farms - geographical overview

The districts Comilla, Jessore and Bhola are the largest fish producers

- Comilla (7.3% of inland fish production), Jessore (5.4% of inland fish production) and Bhola (3.6% of inland fish production) are the three districts contributing the largest to inland fish production (both culture and capture).
- In Comilla, fish production in flood plains, ponds and seasonal water bodies is equally common. In Jessore, most fish produced is cultivated in fishponds (65%), whereas in the Bhola, as a coastal district with a delta with abundant rivers, most fish is produced in rivers.
- Jessore district in southwestern Bangladesh is an important source of fish seed in the country. Its Chanchra region is known as the capital of fish farming in Bangladesh with about 80+ hatcheries producing fish and meets demand of 70% spawns across the country (DhakaTribune, 2015).
- Most farmed fish species in Jessore are **Pangasius, Rui, Catla, Mrigel and other carps** (LightCastle Primary Research).
- Compared to the usage of the commercial feed, the farmers in Jessore are more inclined towards using home-made loose feed. Top brands in terms of commercial aquaculture feed in this region are **Nourish and Agro Tech** (LightCastle Primary Research).



Source: Yearbook of fisheries statistics of Bangladesh 2018-2019.
Note: high-res images available upon request.

Fish cultivation practices in Bangladesh

With semi-intensive farming as the most dominant production method, production is largest in intensive farming systems

	Pond production			Seasonal waterbody culture farms	Other farming systems (Baor, shrimp farm, crab farm, pen & cage culture, others)
	(Highly) Intensive farms	Semi-intensive farms	Extensive farms		
					
Production (MT)	1,053,784 (42% of total inland culture)	876,535 (35% of total inland culture)	44,313 (2% of total inland culture)	217,340 (9% of total inland culture)	296,629 (12% of total inland culture)
Area (Ha)	118,163	245,486	34,125	144,217	279,931
Average Productivity MT/Ha	8.92	3.57	1.30		0.94
CAGR 2016-2017 to 2018-2019	Intensive: +8.88% Highly intensive: -0.22%	+2.23%	-12.36%		
Common species	Pangasius, Tilapia, Rui, Silver carp, Mrigal, Catla and Koi			Rui, Silver Carp, Mrigal, Catla, Common Carp, and Tilapia	
Number of Ponds	544,675	1,438,145	498,063		
Average Pond Size (Acre)	0.54	0.42	0.17		
Stocking density	High stocking density (above 35,000 fingerlings/ha)	Intermediate level of stocking density (15,000–35,000 fingerlings/ha)	Low stocking density (below 15,000 fingerlings/ha)		

Source: WorldFish, Yearbook of Fisheries Statistics 201-2019, Larive-LightCastle Primary Data.

Fish cultivation practices in Bangladesh

Farmers can experience business risks in biosecurity, market prices, credit access, and quality inputs

	Pond production			Seasonal waterbody culture farms
	(Highly) Intensive farms	Semi-intensive farms	Extensive farms	
Survival rate	For intensive farming, with proper control and treatment, the survival rate is very high, which is usually more than 70%.	Up to 70-80%, depending on the quality of farm management	With extensive farming, farmers have less control and treatment. As a result, the survival rate is comparatively lower lying below 35%.	
Feed	In intensive farming, farmers use 100% commercial feed.	In semi extensive farming, farmers use 60-70% commercial feed and a mix of homemade loose feed.	In extensive farming, farmers mostly rely on natural source for feed and sometimes use a blend of commercial feed and homemade loose feed. The use of commercial feed is usually below 20%.	In seasonal waterbody culture farms, farmers are usually dependent on natural sources for fish feed.
Diseases	In terms of fish farming, the risk of bacterial diseases is high in closed production areas. However, control over treatment of these diseases is also better in closed production. In open production areas, although the risk of mortality is lower, the control over disease management is also low.			
Seed stock	Intensive and Semi intensive farms prefer to source from large organized hatchery players or government hatcheries.		Extensive and seasonal body farmers, typically source from smaller private hatcheries which sell low quality seeds at low prices.	
Role of aggregators	The role of aggregators are important for all categories of farmers, since only a very small proportion cultivated are sold within markets in close proximity. Intermediaries and aggregators play the crucial role of connecting farmers with wholesalers and retailers across the country. Extensive farmers, who tend to be smaller in nature may also rely heavily on their aggregators for a line of credit that allows them to purchase farming inputs and repay aggregators in kind when they harvest the fish. A small fraction of larger intensive and semi-intensive farmers may sometimes bypass intermediaries and aggregators altogether to supply various retail and super shop outlets.			
Business risks for farmers	Diseases and sub-optimal biosecurity standards; Volatility in market prices; Lack of access to cheap credit; Extreme weather events; Poor quality inputs dominate the market			
Payment terms	Larger intensive and semi-intensive farmers are usually able to purchase inputs using cash, whereas smaller extensive farmers are heavily reliant on credit from their input suppliers. Aggregators typically settle payments with farmers within 1-3 days of supplying.			

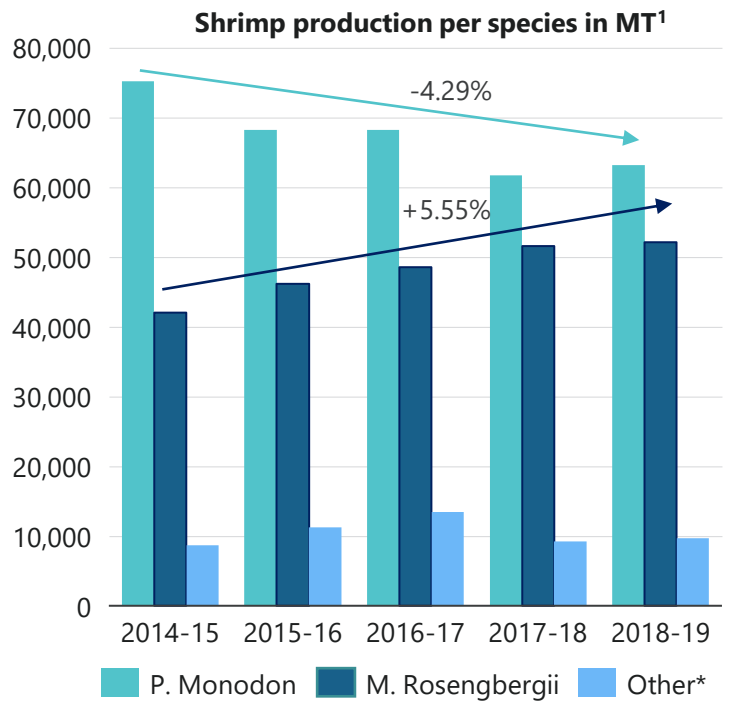
Production cycle

Shrimp type	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Carp												
Pangasius												
Hilsa (Caught)												
Catfish												

Introduction to shrimp cultivation in Bangladesh

The Monodon species is most commonly cultivated; production of Monodon has decreased, while Rosenbergii production increased

- More than 95% of shrimp and prawn is produced in extensive polyculture ponds that were formerly used as rice ponds ('Ghers'). Shrimp cultivation also takes place in ponds. Both species are mostly cultivated during May/June – Sept/Oct.
- The main shrimp species cultivated in Bangladesh are the Penaeus Monodon (Black Tiger, 50% of total production) and the Macrobrachium Rosenbergii (Giant Freshwater Prawn, 42% of production). The remaining 8% is accounted for wild shrimp such as Horina (Metapenaeus monoceros) and Chaka (Penaeus Indicus). According to statistics of the DoF, shrimp farming accounted for ~3% of all inland and marine fisheries in Bangladesh.
- The culture of Monodon is mostly combined with other shrimp species trapped in the gher when water is taken in. Monodon culture is mostly practiced in the low-lying tidal flood plains which are adequately inundated during the spring tides. Monodon is traditionally designated to the local high-end market because of its meat content and quality. Gradually, it has captured the export market. Monodon is mostly exported to the European Union followed by the USA, Japan and China.
- Bangladesh's favorable resources and agro-climatic conditions along with a vast area of water bodies provide a unique opportunity to produce giant freshwater prawn (Rosenbergii), in Bangladesh more commonly known as 'Galda'. Rosenbergii mostly captures the local market of Bangladesh.
- In 2019, the estimated production figures for Monodon and Rosenbergii were 63,171 MT and 52,197 MT[1]. Bangladesh is the number-3 global producer in terms of Monodon production after Vietnam and Indonesia. Shrimp production in Bangladesh has declined 0.2% YoY between 2014 and 2018. The production of Monodon shrimp had declined by 4.29%, while the production of Rosenbergii had increased by 5.55%
- The largest decline in shrimp production has been in Satkhira district, and Khulna district was the only major shrimp-producing district registering an increase in shrimp production in 2017/18. This increase in Jashore will like grow further if Vannamei is introduced, as this can more easily be produced in less saline areas.
- Compared to other major shrimp production Asian countries, cultivated Vannamei production in Bangladesh is virtually absent. MU Seafoods is the only private player that received permission to cultivate Vannamei on a pilot basis in a quarantine environment in Khulna district. The planned pilot has however been interrupted due to the COVID-19 lockdown and is expected to commence post-lockdown.
- There is optimism (although not shared by all stakeholders) that the planned introduction of Vannamei production can reform extensive farming by developing more commercially sustainable intensive farming methods.



Production cycle

Shrimp type	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Monodon												
Rosenbergii												

Notes: [1]Source: Yearbook of fisheries statistics of Bangladesh 2018-2019. Research by Larive-LightCastle (2020-21) indicated the possibility these numbers might be slightly lower, based on interviews with industry experts and private sector stakeholders.
*Others include Harina and Chaka shrimp, as well as other wild species.

Shrimp farming production systems

Most shrimp production is produced by extensive farmers using relatively low-quality feed

Semi-intensive shrimp farming

- Large, semi-intensive farmers have begun to emerge but still accounts for less than 1% of total shrimp production, as of 2018-19. The limited growth in semi-intensive farming is due to several factors: a lack of competent and experienced shrimp farming specialists (particularly as related to bio-security and water quality management), non-suitability of smallholder lands for large-scale farming and until recently, a lack of quality inputs (including SPF PL, feed and chemicals).
- The rise of semi-intensive farming (although gradually) leads to larger-sized shrimps, improved survival and productivity rates, and increased profitability.
- Semi-intensive monodon farms, contrary to the extensive farms, focus on the bigger sized shrimp from 8/12 / kg up to 21/26 / kg and for export. Hence, two parallel market has emerged with all domestic demand being fulfilled exclusively by extensive farmers.
- There are 100 farms registered with DoF for semi-intensive shrimp production, with 830 ha of land under semi-intensive shrimp culture in southwest Bangladesh. The top 10 farms jointly represent almost 65% and the top 20 farms represent more than 80% of total farm area.
- Farmers are dependent on rain to fill their ponds. In most cases, water is not treated before intake. In a few areas, farmers use open channels with sluice gates and during high tides, farmers take in freshwater into their ponds. For most farmers, the preparation of ponds starts in November after harvesting. For Rosenbergii, they must replace the water in the pond, for Monodon they don't need to.

Conditions at a semi-intensive shrimp farm

Extensive shrimp farming

- Shrimp farming is primarily extensive in nature (<1 ha farms), with >99% of shrimp production being accounted for by extensive farmers. Cluster farming methods follow extensive farming processes with low yields. About 300,000 extensive smallholder farmers are active, occupying around 258,553 ha of farming acreage. Majority of the extensive farmers prefer using low-lying rice fields (gher) as cultivation areas.
- Most extensive farmers rely on improvised feed such as rice bran. Farmers are gradually beginning to use more commercial feed. However, this is primarily domestically-produced low-grade sinking feed, which has a slightly higher protein content than white fish feed and is marketed as shrimp feed.
- Extensive farming of Monodon shrimp occurs mainly in ghers, which are shallow pools of brackish water in low lying rice fields, while Rosenbergii is primarily cultured in freshwater ponds and sometimes in ghers. Around 71% of the farmers use the gher system.
- The mixed culture of Monodon with various carps and fresh-water prawns is common in low-salinity areas.
- When cultivating shrimp in ghers, farmers usually strengthen and raise the walls of the rice paddies. Stronger dikes with the inclusion of a deeper canal along the sides maintain a deeper refuge area for the cultured prawns especially during the dry season when water levels drop drastically. The ghers are often quite large in area but also quite shallow.
- Though monoculture of shrimp farming is recommended, it is rarely practiced in Bangladesh with most farmers preferring to use polyculture methods along with carps (for Rosenbergii) and white fish (for Monodon).

Conditions at extensive shrimp farms

Source: Yearbook of fisheries statistics of Bangladesh 2018-2019, research by Larive-LightCastle (2020-21)

Semi-intensive shrimp farming in Bangladesh

The government is actively supporting the expansion of (semi-)intensive farming

- As part of the Shrimp National Action Plan and the World Bank loan program, DoF plans to expand the area under semi-intensive culture to 10.500 in 2030. Depending on the species this will account for 40,000-80,000 MT of shrimp. The expansion will partly be realized through establishing more corporate farms. However, also small-scale farmers will be supported to engage in semi-intensive shrimp production. Companies like Fahim seafood and ACI are expected to play an important role in this.
- Gazi fish culture has been certified by ASC since October 2019. The certificate is connected to Gemini Seafood. One of the major, and one of the few publicly listed, shrimp exporters. Gemini has been a preferred supplier to many EU retail buyers for many years. With Gazi fish culture, Gemini seafood can produce 260 MT of ASC certified shrimp per year (according to audit report ASC). With a cultivation area of 48 ha and two crops per year this would entail that the farm operates at a productivity of 5,4 MT per ha/year. The farm produces two crops per year.
- The only other ASC certified farm in Bangladesh currently is Farisa Agro Farms which has a cultivation area of 4,8 ha only. With a production volume of 60 MT annually this farm operates at a productivity of 12 MT/ha/year divided over two crops. All the ASC certified shrimp is purchased by Apex Frozen Foods which is the certificate and chain of custody holder.
- There are 100 farms registered with DoF for semi-intensive shrimp production. The top 10 farms jointly represent almost 65% and the top 20 farms represent more than 80% of total farm area.
- In a recent enquiry to the DoF offices in Khulna, Sathkira and Bagerhat, data provided showed that there are currently 830 ha of land under semi-intensive shrimp culture in South West Bangladesh, of which 40 Ha are in Bagerhat, 540 Ha are in Khulna and 250 Ha in Satkira.
- Assuming that these produce 4 MT/Ha/year they represent a production volume of 3,320 MT annually, which, according to LightCastle statistics, is around 4.5% of the total shrimp production (or 8.7% of total *Monodon* production). Semi-intensive farms, contrary to the extensive farms, focuses on the bigger sizes black tiger shrimp from 8/12 per kg up to 21/26 per kg.
- The biggest companies involved include Setara Fish Farm (101 ha), Shawn Fish products (82 ha), Quest International (83 ha), BG Black Tiger Agro (70 ha), Gazi Fish Culture (54 ha), and Pranti Aquaculture (49 ha), and Radiant (6 ha). Many of these farms are part of bigger aquaculture/seafood operations such as Pranti aquaculture which is part of Fahim Seafood and Radiant and Gazi fish which also operates a hatchery.
- Although the number of farms and the area under culture is still small, these semi-intensive farms are commercially operated and technically relatively well equipped. As soon as commercial culture of Vannamei will be approved in Bangladesh, it's likely that most farms will switch to the new species. Jointly these farms could produce about 6,000 MT of Pacific white shrimp.

Gazi fish culture shrimp farm and hatchery next to the Sundarbans forest in Khulna.

Setara Fish Farm: Khulna's biggest shrimp farm

Source: Yearbook of fisheries statistics of Bangladesh 2018-2019, LightCastle-Larive primary data (interviews).

Market for shrimp farming in Bangladesh

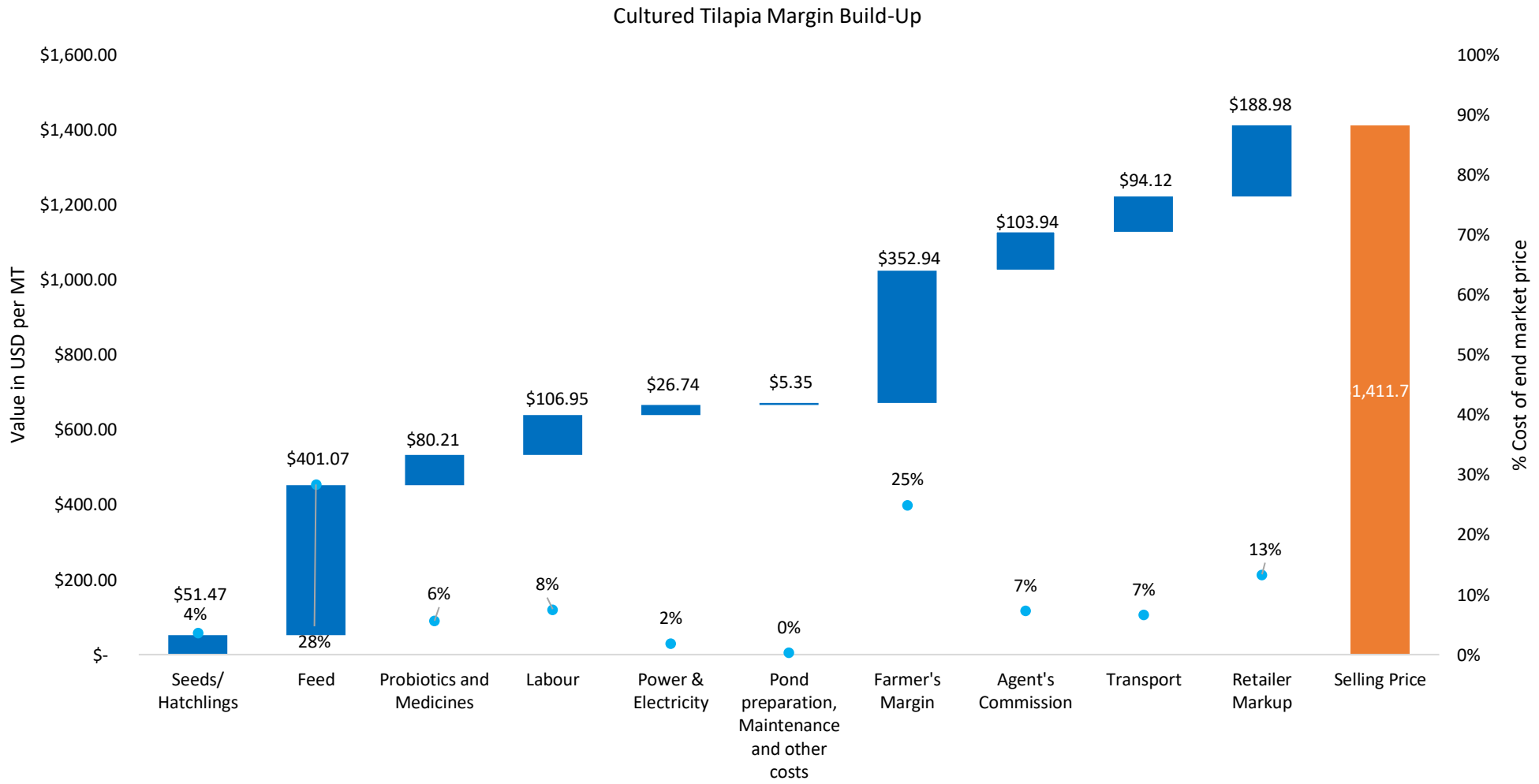
Shrimp aquaculture is dominated by smallholder farmers using extensive methods

Particular	Extensive farmers - Khulna	Extensive farmers - Satkhira	Extensive farmers - Bagerhat	Semi-intensive farmers
Average farm size	1.6 ha	0.64 ha	0.82 ha	8.4 Ha
Source of feed	➢ Improvised feed (such as rice bran) are primarily used. Commercial feeds used are predominantly locally-produced sinking fish feed marketed for shrimp farmers.			➢ Imported commercial shrimp feed.
Source of seed	➢ The majority of brood seeds are stocked from agents delivering PL from Cox's Bazar region. However, the number of hatcheries in Khulna division has been steadily rising, accounting for a significant source of PL for local farmers.			➢ Specific Pathogen Free (SPF) Monodon PL.
Destination raw material output	➢ Sold to middlemen who then sells it either to domestic market intermediaries or to shrimp processing factories. There are often multiple layers of middlemen, causing quality and traceability issues due to mixing of materials and lack of cold chain facilities.			➢ Sold directly in most cases (or through middlemen) to shrimp processors for export.
Role of aggregators	➢ Processing companies are the most influential among the aggregators. ➢ At the end of the year, the depot owners receive a certain portion of commission as an incentive.			➢ More limited as majority of semi-intensive farmers sell directly to processors.
Business risks for shrimp farmers	➢ Premature depletion of pond water due to gradually extending dry season. ➢ Saltwater intrusion makes the water bodies unsuitable for Rosenbergii farming. ➢ Spread of diseases. ➢ Pilferage.	➢ Premature depletion of pond water due to gradually extending dry season. ➢ Saltwater intrusion makes the water bodies unsuitable for Rosenbergii farming.	➢ Saltwater intrusion makes the water bodies unsuitable for Rosenbergii farming. ➢ Bagerhat is especially prone to flooding.	➢ Saltwater intrusion makes the water bodies unsuitable for Rosenbergii farming. ➢ Disease (especially white spot disease) can spread rapidly and decimate entire crops. ➢ Weather and climate dependency. ➢ Lack of trained specialists.
Payment terms	➢ Farmers usually receive credit from feed retailers for 15 days, which is enough to cover a full moon/new moon harvesting period. In rare cases, farmers also receive up to 4-5 months (which is the duration of one crop cycle) of credit from hatcheries for purchase of PL. ➢ Upon sale to aggregators, they usually receive payment in cash (when sold at depots) or within 7 days (from intermediaries such as local aggregators and commission agents).			➢ All purchases and sales are settled instantly or within 2-3 days using cash or bank transfer.

Source: Based on interviews with extensive farmers (LightCastle-Larive primary data)

Cost build-up for cultured tilapia

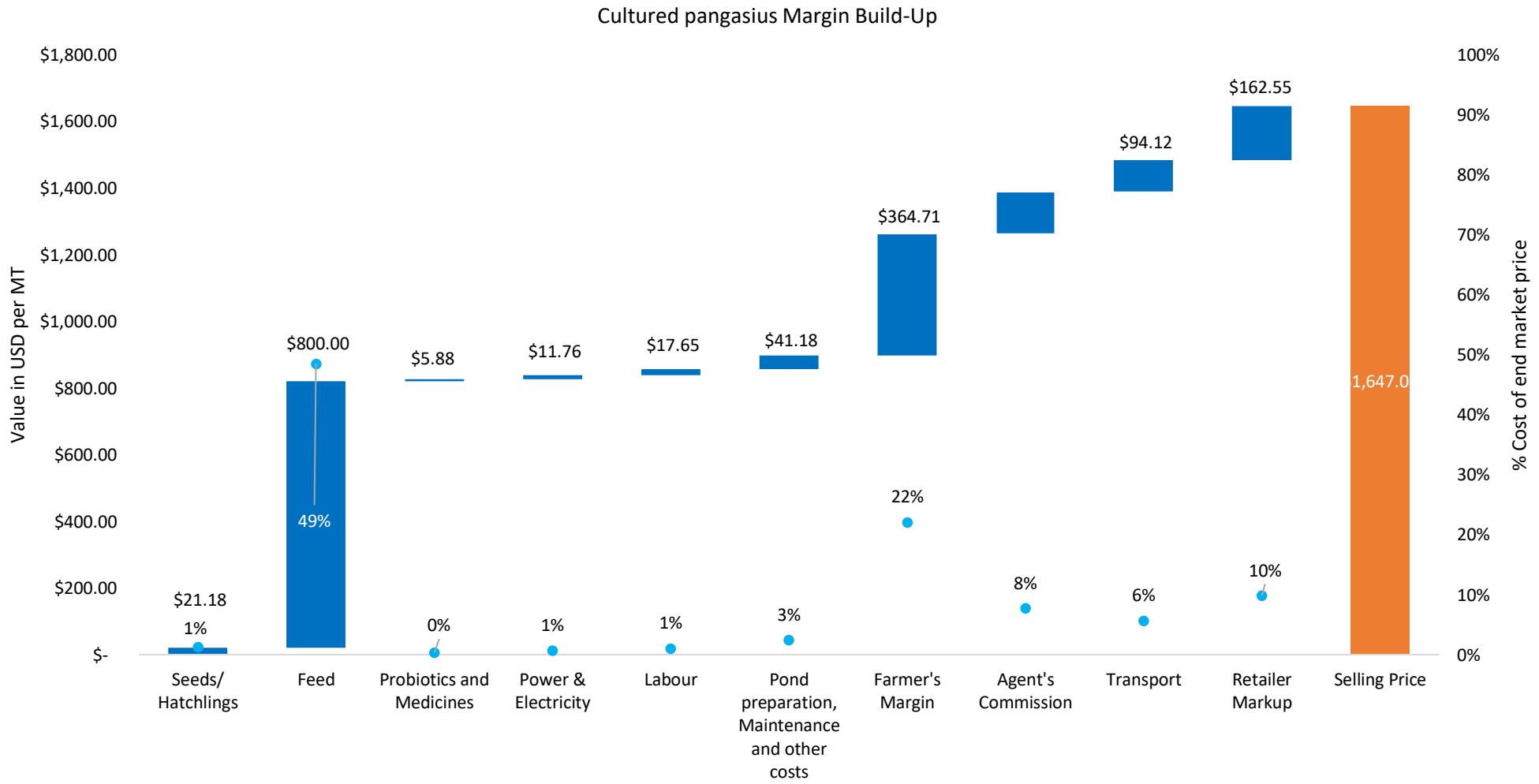
Feed is the largest cost contributor to farmers, making up 28% of the final selling price



Note: Market price of cultured Tilapia varies according to size/grade of fish and seasons. Tilapia is sold as whole fish.
Source: Larive-LightCastle analysis (2020-21).

Cost build-up for cultured pangasius

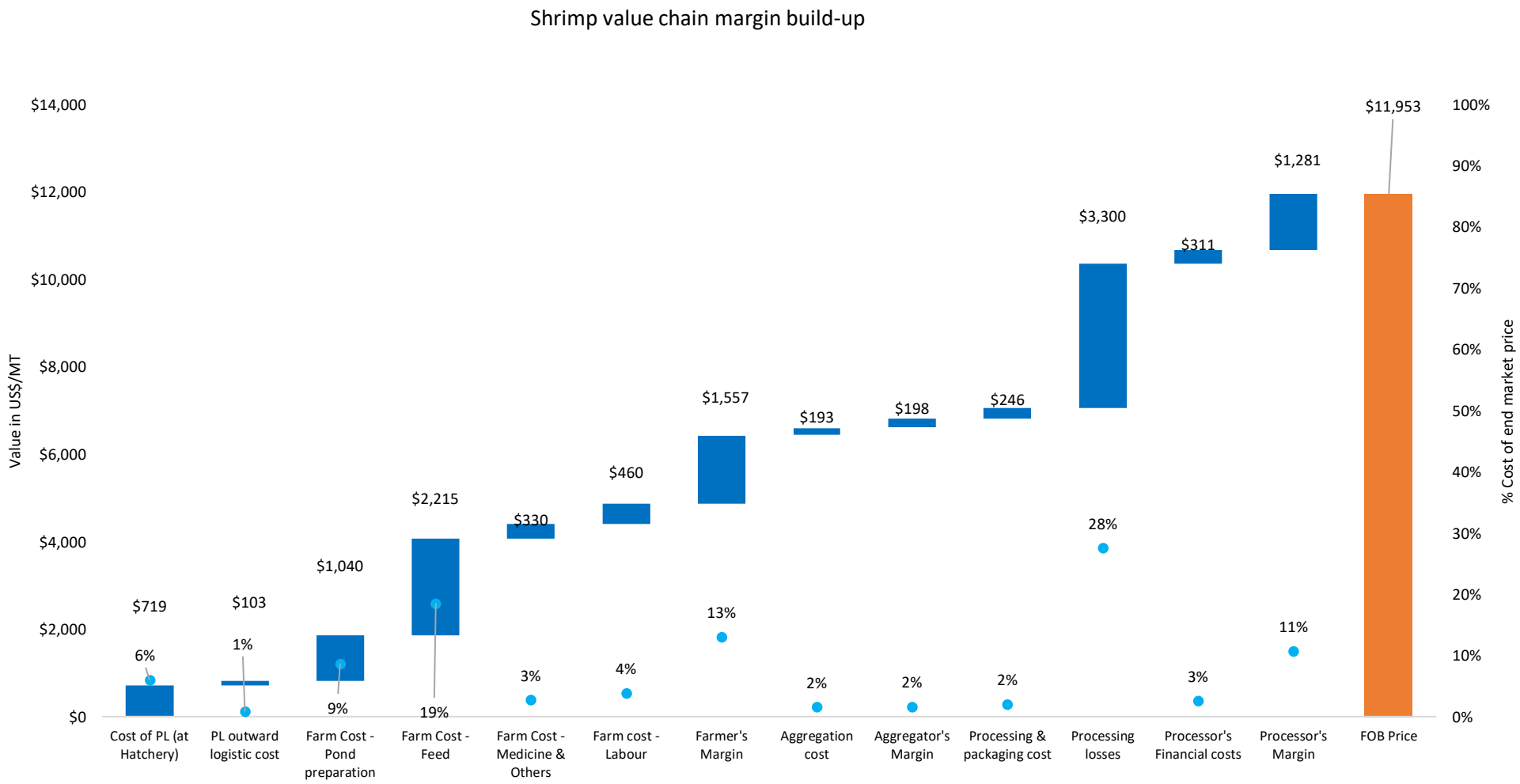
With 49%, feed is an even larger contributor to the total production cost for pangasius than tilapia



Note: Market price of cultured pangasius varies according to size/grade of fish and seasons.
Source: Larive-LightCastle analysis (2020-21).

Cost build-up for cultured shrimp

Approximately two-thirds of value addition takes place before shrimp processing



- The graph visualizes the average cost composition of shrimp farmed in Bangladesh (for different sizes/grades, species and farming methods).
- 'Mark up' has been used to depict additions to cost at every step of the value chain As such, 'mark up' includes margin and other expenses not captured in specific terms (e g in the case of farmers: 'mark up' includes the contribution of manpower of farmers (own labour).
- In the graph, the processor's margin is displayed separately as its cost that are not included in specific terms (e.g., processing losses) are presented separately

Source: Industry insider interviews, Larive-LightCastle primary data (2020).
FOB = Free On Board

Financing

Informal loans are generally provided to farmers interest-free, with lenders reserving the right to sell the product

There are different financing methods available to fish farmers, including:

1. Moneylenders (Mahajan)

- The title of 'Mahajan' or 'Dadandar' usually refers to the financiers of fish farms, providing loans and land to farmers. The interest-free loan is provided to producers at the beginning of the season with the agreement that all products will be sold through that same commission agent.
- As many moneylenders do not work with formal contracts, they cannot seek legal measures to recover loans through a court of law. For this reason, banks are not willing to extend loans to these financiers.
- Moneylenders indicate they would benefit from training on financial literacy and bookkeeping skills, to gain improved access to mainstream finance providers, such as banks and financial institutions, to cover their working capital and loan disbursements.

2. Banks in agro-food

There are three banks active in the agro-food segment in Bangladesh:

1. Krishi Bank: specialized in agriculture.
2. Rajshahi Krishi Unnayan Bank: a smaller specialized agricultural bank.
3. Sonali Bank: the largest state-owned commercial bank.

3. Non-bank financial institution

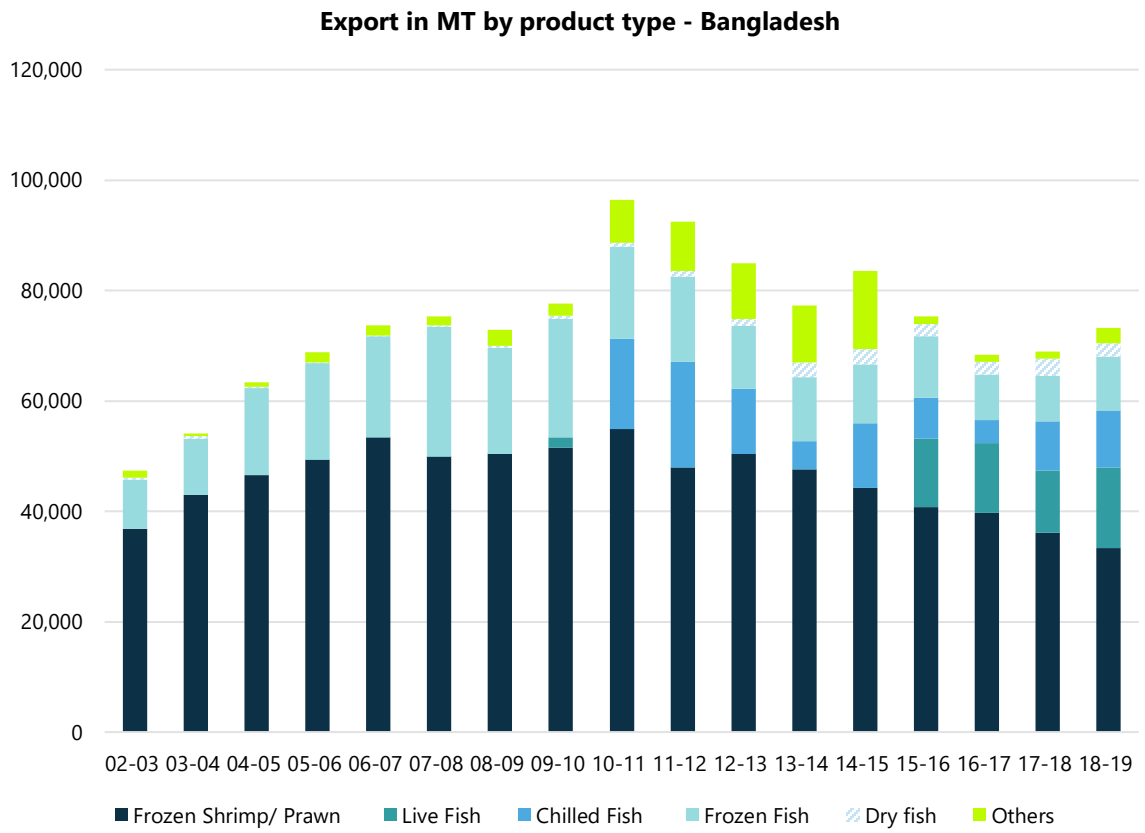
- IDLC Finance, a non-bank financial institution, provides small kitchen market vendors loans without any collateral or financial transaction records.
- These kitchen market loans (commenced in March 2020) have an interest rate of 14-15% and a credit ceiling of BDT 50,000 to BDT 200,000 (USD 592 to 2,367).

Source: LightCastle-Larive Primary Data, The Daily Star

5. Domestic and export markets

International trade overview

The export market for fish is small compared to overall production, while a large share of shrimp production is exported



- Fish and crustaceans contributed USD 500 MN to Bangladesh export[1] (shrimp[2] accounts for USD 358 MN). Fish produced for exports is less than 1% of total production.
- Some fish is exported to the 12 MN Bangladeshi living abroad (mostly in the middle east) and concerns primarily carp and hilsa. Hilsa is commonly exported to India. The export of live fish (eel) to eastern Asian markets (China) is increasing. Since it is transported in live form, not much processing is involved.
- There are two forms of processing: freezing/chilling for export in the West of the country, and processing for ready-to-consume (fish fingers, etc.) in the East of the country. Only a small number of players are active in fish processing. However, due to the fast-growing urban population, there is an opportunity to venture into processing to capitalize on the growing 'ready to eat' segment. Informal processing, in the form of drying fish, is practiced, but this is done locally and usually not hygienically.
- Key markets for Monodon shrimp products are Belgium, Netherland, Germany, and France in Europe. Within Asia, Japan and Vietnam are the key markets. China has emerged as the leading purchaser of live crabs from Bangladesh. It is estimated that a larger share of Bangladeshi shrimp exports could be destined for China in the future.
- Large players have Aquaculture Stewardship Council (ASC) Certification which is the most sought after to access the European market. Alternatively, Best Aquaculture Practices (BAP) is the next most-popular international shrimp certification. Companies also seek British Retail Certificate (BRC) for the UK, and HACCP and GMP certification for global markets. Currently, only seven companies have met the Chain of Custody requirement to obtain the ASC mark in Bangladesh. Among producers, only Gazi fish farm (Gemini) and Farisa Aqua Farms – both semi-intensive producers - are ASC certified.
- Permission is required by the Ministry of Fisheries and Livestock prior to setting up any processing facilities and the plans for establishment are scrutinized. Inspection is conducted by cross-ministerial teams including representatives of the Department of Health, Export Promotions Bureaus, Ministry of Industries and Department of Fisheries. Fire Safety Clearance, Environment Clearance and local council approval is also required. Companies also seek registration with the Bangladesh Frozen Fish Exporters Association (BFFEA) for added exposure.

[1]Source: Export Promotion Bureau (Jul 2018 - Jun 2019). Note: the Yearbook of fisheries statistics of Bangladesh 2018-2019 also refers to this document, but the data does not match.
The production of shrimp is shown in live weight of the caught shrimp, whereas exports are shown in net weight (i.e., the weight of the shrimp after processing and wastage).

Shrimp export trends

Bangladesh's shrimp export volume has been experiencing a consistent fall over the past 3 years

- Monodon is in high demand in export markets due to its premium quality. Monodon for domestic consumption is distributed to high-end markets.
- Bangladesh is the number 3 exporter of monodon in the world, after Vietnam and Indonesia. Other relevant producers of BT (but smaller than Bangladesh) in Asia are India and Myanmar, Madagascar in Africa, and in Australia in Oceania.
- While shrimp exports have declined over the past years, domestic consumption of shrimp has increased due to improved purchasing power. Domestically produced shrimp is furthermore priced competitively compared to international prices.
- Idle capacities have led to an erosion of profits, and companies which are operating at break-even are expected to move into the red in 2020. The situation is more dire for processors in Chittagong region, where only a small selection of processors remains.
- Bangladesh has been struggling to maintain international market share owing to the standards imposed by international buyers and expected by consumers. Bangladesh's share in the export market has been shrinking as Bangladeshi shrimp are priced at a higher point than Vannamei, which now dominates international shrimp trade.
- Although Monodon is a premium shrimp species, Bangladeshi product is mainly selling into the low-end food service market in Europe. This is despite the extensive character of BT farms in Bangladesh, which could give a premium market image. Problems derive from the long and fragmented supply chain between farm and factory and quality issues that derive from there. As well, the small size of the farmers makes certification (ASC/BAP) very complicated, restricting market access to retail markets.

Source: shrimp export in MT is from the Yearbook of fisheries statistics of Bangladesh 2018-2019.

Shrimp export trends

The price of shrimp in the export market has decreased in the recent years

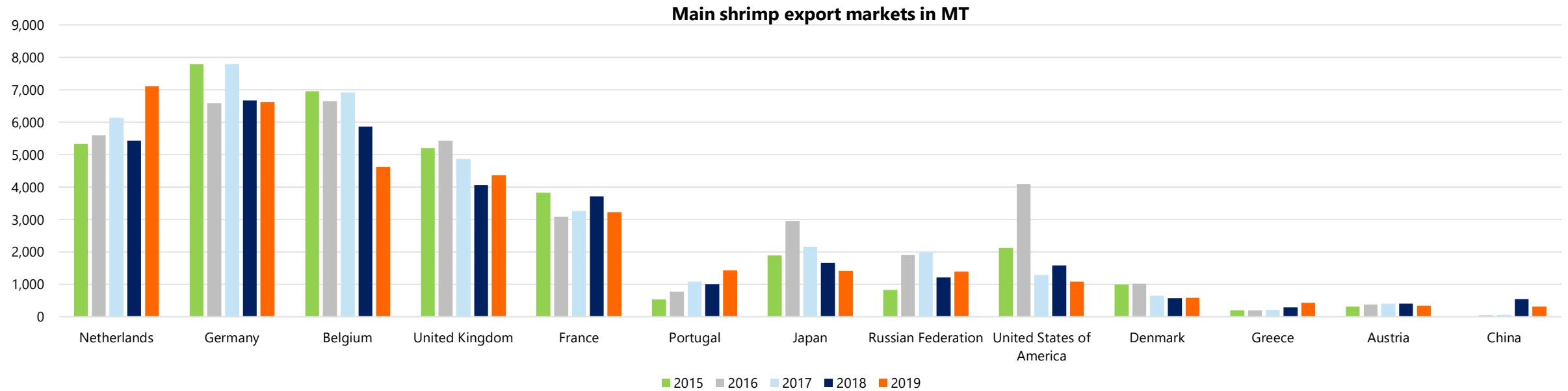
End-markets

- The shrimp sector contributes US$ 358 MN in exports in 2019. In 2019, roughly 60% of shrimp production were designated for exports, while 40% were thought to be consumed domestically. Rising disposable incomes led to a larger share of the country's shrimp production destined for the domestic market. The size of sector has been shrinking gradually over the years both in terms of total production volumes and 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 is expected that the export price in 2019 skews upwards.
- Monodon is mostly exported as 16/20 and 13/15 grades, as well as 21/25 and 26/30 grades. Different forms include Headless Shell-on (HLSO), Headless Shell-on Easy Peel, Head-on Shell-on (HOSO), PND, Peeled and Deveined (PUD), Cooked, peeled and deveined, tail on (CPDTO). Shrimp are commonly processed as Individually Quick Frozen (IQF), block frozen and Ready-to-Eat, in order of prominence. Monodon is exported as HLSO, Headless Shell-on Easy Peel, HOSO, PND, PDTO, P&D T/ON Butterfly, PUD Skewer in Block Frozen/IQF or Semi IQF forms.
- To enter more lucrative Ready-To-Eat segments, targeting higher value-added markets in Europe, processors invested in advanced processing beyond IQF and block freezing to include Ready-To-Cook (blanching, skewering, battering etc.) lines. The only recent capacity addition has been by ACI Seafood, who owns the largest retail in Bangladesh. Investments in processing to anticipate higher demand and growth in shrimp production have been common, but divestment is now much more common. The shrimp processing business is characterized by low-capacity utilization and decreasing profitability.[1] Reported capacity utilization ranges between 30%-40% in 2019, having dropped significantly in the past 2-3 years. During the pandemic, utilization dropped to 20-30% for some serving hotels and hospitality.

Source: Larive-LightCastle primary data (interviews) and calculations (2020), Export Promotion Bureau.
Notes: P = Projected. [1] Processing plants in Chittagong have been worst hit as they can no longer secure raw materials due to increased competition from closely located plants in Khulna division. Many smaller plants shut down or switched gears (some plants are now exporting vegetables instead).

Bangladesh's shrimp export hubs

Bangladesh exports more than 80% of its shrimp to the EU

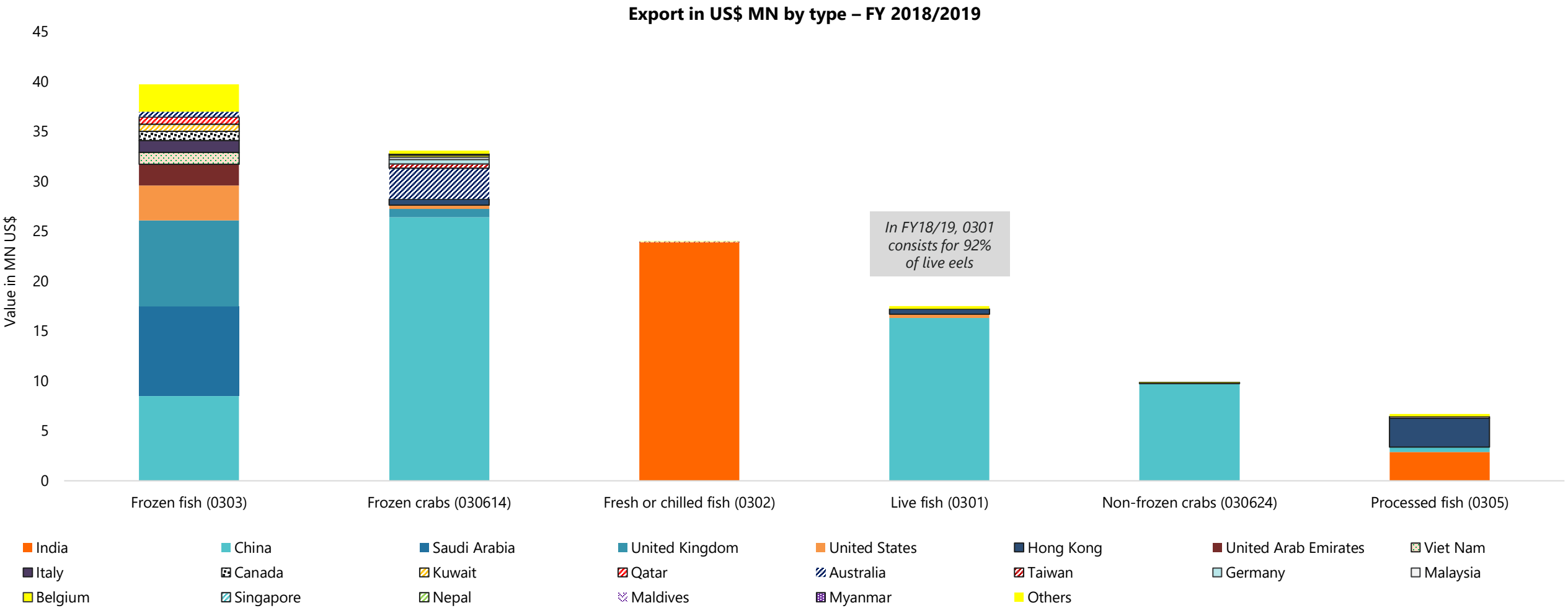


- The EU is the largest importer of frozen shrimps from Bangladesh (>80%). Main importers from the EU include the Netherlands, Belgium and Germany. The country exported shrimp (HS 030617) worth US$ 357.7 MN to EU market in between 2018 and 2019. Other major buyers are the United States, Japan and China.
- The shrimp sector in Bangladesh has traditionally been a key export driver, contributing US$ 358 MN in exports in 2019. However, exports have been declining slightly. During the first six months of the 2019-20 FY, shrimp exports have fallen by a further 4% year-on-year, down to US$ 215 MN from US$ 223 MN over the same period in 2019.
- Chinese buyers increasingly also look at Bangladesh as a potential source for Monodon, as other alternative sources are becoming scarce. Many European buyers expect that China buyers will come in and start to buy the bulk of the product from Bangladesh. A major challenge in exporting to China is that time from harvest to freezing is too long and therefore quality is not maintained for HOSO products exported to China. Several companies are working on solving this issue and are trying to set up a shorter supply chain to supply to Chinese buyers.

Source: ITC Trade map (2020)
Notes: Export figures include all types of shrimp. Export under HS030617 (Frozen shrimps and prawns) account for 94.5% of all shrimp exports in 2019.
Years depict calendar years.

Fish export overview

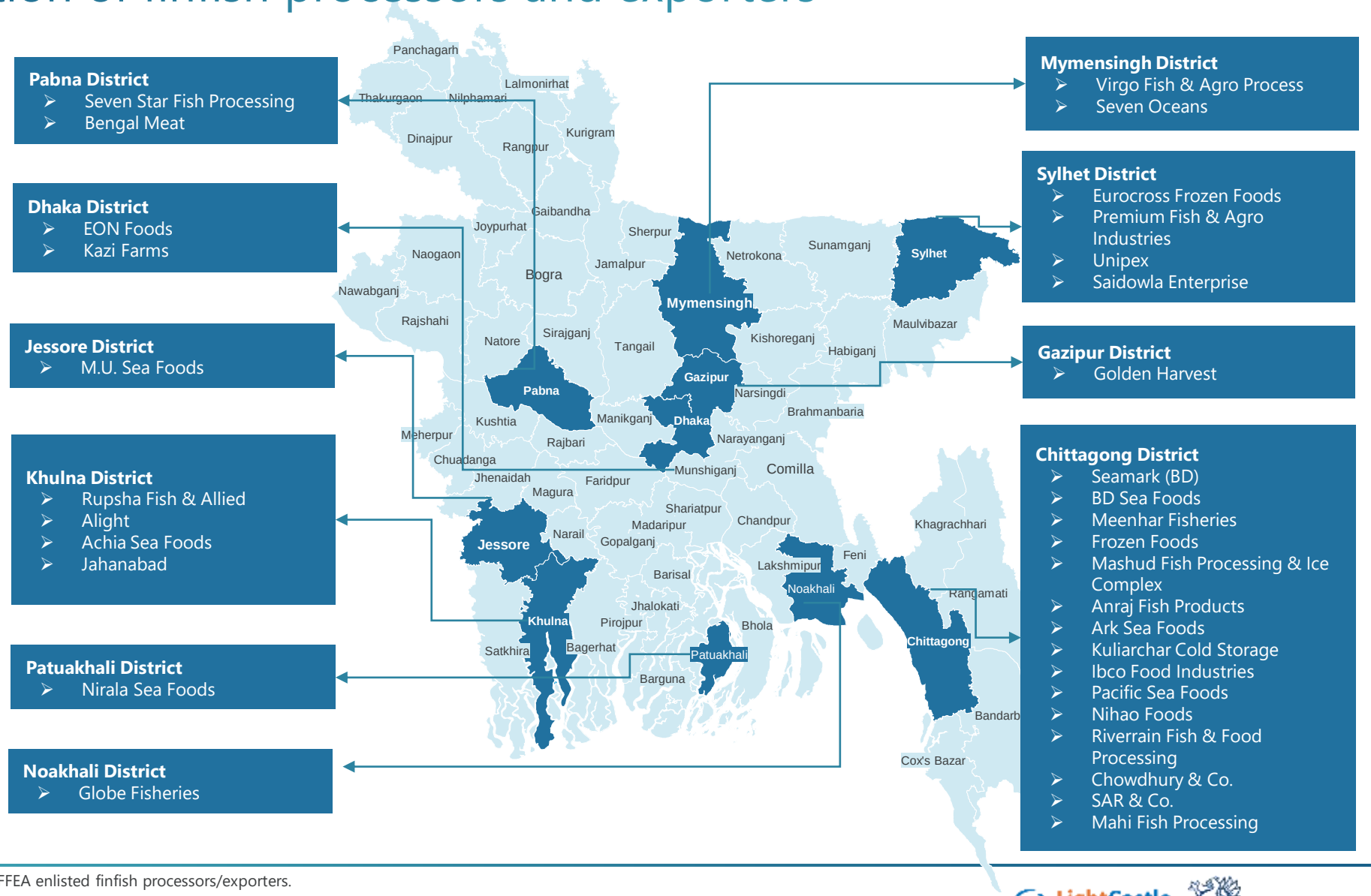
China is the largest importer of Bangladeshi aquacultural products (excl. shrimp), primarily including frozen fish, crabs and live fish



Source: Export Promotion Bureau (2018-2019)

Geographical distribution of finfish processors and exporters

- Finfish are processed both for domestic consumption and exports.
- Nationally, there are around 25-30 finfish processors registered with the Bangladesh Frozen Fish Export Association (BFFEA).
- Many finfish processors are engaged in both shrimp and finfish processing. Although they are based in the same plants, the processing of finfish and shrimp require different units. Processors and exporters do not report their annual exports to the BFFEA by segregating between shrimp and finfish.
- Therefore, as in the case of shrimp processors, the highest numbers of finfish processors are in Chittagong and Khulna districts.
- However, several finfish processors are also based in Sylhet district in the North-east. These processors mainly deal with the processing of local *haor* (seasonal wetland) catch for export.
- The processors based in and around Dhaka district, on the other hand, are mostly producing from the domestic market. They usually process meat-based products in larger volumes than fish-based products.



Source: Interview with BFFEA. List does not include non-BFFEA enlisted finfish processors/exporters.
Note: List is not comprehensive

Domestic finfish processing

Processors use imported fish, with limited quality considered as the main concern for domestically produced fish

- Most domestic producers of fish-based further-processed items rely on imported ingredients (such as fish paste), rather than using domestically cultured fish such as Pangas, Tilapia or Rui. Imports of fish and crustaceans (HS03) mainly comes from:

  1. China: USD 33,851 (40.7%).
  2. India: USD 28,330 (34%).
  3. Myanmar: USD 10,627 (12.8%).

- Product quality is cited as the primary concern in using locally produced fish as raw materials, with the underlying factors being poor local feed quality alongside the lack of a contract farming procurement mechanism to ensure end-to-end hygiene and effective procurement at stable volumes and price points.

- Bengal Meat, a local producer, is working with WorldFish to introduce fish products based on locally-produced carps on a pilot basis.

- Although the overall domestic frozen food market is growing at a 10-12% rate annually, and processed fish products are also seeing a commensurate growth, the overall market size remains relatively small and there are multiple new entrants in the sector, resulting in low volumes for each seller. As a result, none of the producers can reach large scale production and prices of processed fish items are extremely high and find it difficult to compete with cheap imports.

- Channel margins from supermarkets and indirect taxes from the government account for at least one-third of the retail price, leaving little revenue for producers.

Source: LightCastle-Larive Primary Data, ITC Trade map (2020).

End-markets

Majority of fish is sold at wet markets, though sales of processed fish in retail is likely to grow in tandem with growing welfare

- Most fish and shrimp is sold live or whole in wet markets. The gutting and filleting of fish is a complex task which is usually carried out by women. Due to rapidly growing garment industry that employs many women, fewer women have time available to clean fish at home. Consequently, fish processors, who appear to be mostly male, can be found at markets to fillet fish, such that the task of cleaning the fish has already been taken care off before the fish arrives home.
- Supermarkets have begun to sell processed fish, though processed fish sales are still minor compared to fish sold at wet markets. Some consumers are also wary about the freshness of fish sold in supermarkets. However, in line with the growing middle and affluent population, the 'ready to eat' segment is expected to grow. Supermarkets have expanded their reach from the capital city to other districts across the country. Fish in supermarkets are kept chemical-free. Prior to fish being sold in supermarkets, the fish are properly iced and are usually put in refrigerated boxes. The recent introduction of fish sausages, nuggets, balls and fillets entails new consumer utility and value addition. As supermarkets sell these value-added products, they will be one of the main beneficiaries of additional profits gained from a kg fish.
- Other new forms of selling fish have arisen. For instance, some fishers sell large-sized carps in live form. Live fish are available at big city markets and supermarkets and are sold at a premium (60-70% higher compared to average prices). Wealthy Bengali buy live fish as they are then assured that fish is formalin-free.
- The last mile distribution structure of fish and shrimp is characterized with numerous (upcoming) challenges stakeholders active in the aquaculture industry are ought to respond to. These include the need to install adequate cold storage facilities at markets (e.g., water and ice drainage equipment) and transport facilities such as refrigerated vans.
- Improved road networks will reduce the need for intermediaries in the supply chain. Assemblage centers with refrigerated storage facilities would facilitate intermediate perishability checks at a larger scale, enabling assemblage centers to distribute the fish in bulk to the next destination. This supports in reducing product loss and widens the bandwidth of the purchasing price intermediate value chain actors pay to farmers.
- There are some cold storage facilities available, but these belong to the private sector and utilized for freezing and storage of white fish, shrimp and other seafood for exporting. The Bangladesh Fisheries Development Corporation (BFDC) operates cold storage facilities is key marketing spots, though these are unreachable for small-scale fishery actors supplying the domestic market.

6. Stakeholder analysis

Public stakeholders and regulatory environment Bangladesh

The Ministry of Fisheries and Livestock (MoFL)'s role is ensuring sustainable utilization of fisheries and livestock. The **Department of Fisheries** (DoF) is a branch of the MoFL, with overall responsibility for fisheries and aquaculture development, management and conservation.

Bangladesh Fisheries Research Institute (BFRI) mainly focuses on research, although occasionally providing training programs.

The Directorate General of Drug Administration (DGDA) is a branch of the Ministry of Health & Family Welfare. Their primary responsibility is to act as the drug regulatory authority of the country. The DGDA supervises and implements prevailing drug regulations in Bangladesh. The DGDA furthermore regulates procurement of raw ingredients and packaging materials and the production, trade and sales of finished drugs.

The Feed Industries Association of Bangladesh (FIAB) was established in 2008 and is the only body for poultry, aqua and cattle feed manufacturers in Bangladesh. FIAB is a member of the Federation of the Chamber of Commerce and Industry (FBCCI). FIAB conducts compulsory tests of feed ingredients in labs before the products are being offered on the market. Their main objectives include monitoring, promoting safety measures, and protecting trading interests of poultry, aqua and cattle feed producers. FIAB furthermore collects data on feed manufacturing, which is being shared with the association's members. Besides, FIAB assists their association members with purchasing land and raising finance. The following parties are registered as members of FIAB; Quality Feeds, Aftab Feed Products, Aleya Feeds, Spectra Hexa Feeds, United Feed, Nourish Poultry & Hatchery, Padma Feed & Chicks, Bengal Feed & Fisheries, Bengal Feed & Fisheries, Paragon Poultry, Nahar Poultry, Agro-Industrial Trust (AIT), and Agata Feed Mills.

The Animal Health Companies Association of Bangladesh (AHCAB) is the only body involved in promoting animal health of poultry, cattle, fish, shrimp. They advocate for sustainable animal industries. Besides, the association tries to ensure high-quality domestic protein supply through education and transferring appropriate technology.

The Sher-e-Bangla Agricultural University was established for the expansion of higher agricultural education. The university is committed to promoting research in various fields of agricultural sciences. Several research projects have been undertaken by different departments of the University.

Bangladesh Agricultural University (BAU) was established to improve the quality and standard of higher agricultural education. The university promotes good agricultural practices. Currently, the university produced 200+ research papers on agricultural practices in Bangladesh.

Bangladesh Rural Development Board, located in Dhaka, is a government board which holds responsibility for the development in rural areas, including fisheries.

Land Administration and Land Reform Division is responsible for the leasing of public water bodies.

Export Promotion Bureau is a government agency of the Ministry of Commerce responsible for the export of aquaculture products, together with the **Bangladesh Frozen Foods Exporters Association**. The specific relevant associations include the **Bangladesh Frozen Fish Exporters' Association (BFFEA)** and the **Bangladesh Live and Chilled Food Exporters' Association (BLCFEA)**.

External Resource Division, a government division of the Ministry of Finance, is responsible for external aid for aquaculture development.

Associations include the Other stakeholder such as banks (Bangladeshi Krishi Agriculture Bank and Bangladesh Samabay Co-operative Bank), NGO's, and international organizations (NORAD, World Bank, IMF) provide credit to the aquaculture sector.

Sources: LightCastle-Larive Bangladesh poultry sector study (2019), FAO (2005)

Enabling environment

Taxes, duties and subsidies applicable to aquaculture

Taxes

The National Board of Revenue (NBR) is the central authority for tax administration in Bangladesh. A 5% advance trade value-added tax (ATV) applies for all ingredients and machinery imported into Bangladesh. This tax adds on top of regular custom duties (CD), advance income taxes (AIT) and regulatory duties (RD). In Bangladesh, the most common taxes include:

- Customs Duty: The custom duty for imports of chilled and frozen fish is 25%. On exports, there is no duty levied. For machinery for preparing animal feeding stuffs, custom duty is 1%.
- Supplementary Duty: May be levied on certain products but is not applicable for fish and shrimp products.
- Excise Duty: Excise duty is levied on locally produced goods.
- Value-Added-Tax (VAT): The standard rate of VAT in Bangladesh is 15% levied on transaction value of most of the imports and supplies of goods and services. VAT is calculated on the sum of the CIF value, applicable duty, supplementary duty and regulatory duty.
- Individual Income Tax: Individual income tax ranges from 10 to 30% for amounts above BDT 3 MN (~USD 35,500).
- Corporate Income Taxes: For the 2015/16 tax year, publicly traded companies pay 25% corporate tax. Non-publicly traded companies pay 35% corporate tax. For financial institutions and band tax rate may be as high as 42.5%.

In Bangladesh, 100% foreign equity is allowed (except for defense machinery, nuclear energy, currency and forest plantations). Foreign investors can invest in domestic bourse without restrictions. Regulations applicable to FDI and other potential benefits offer numerous opportunities. Specific taxation policies can be found in Annex V.

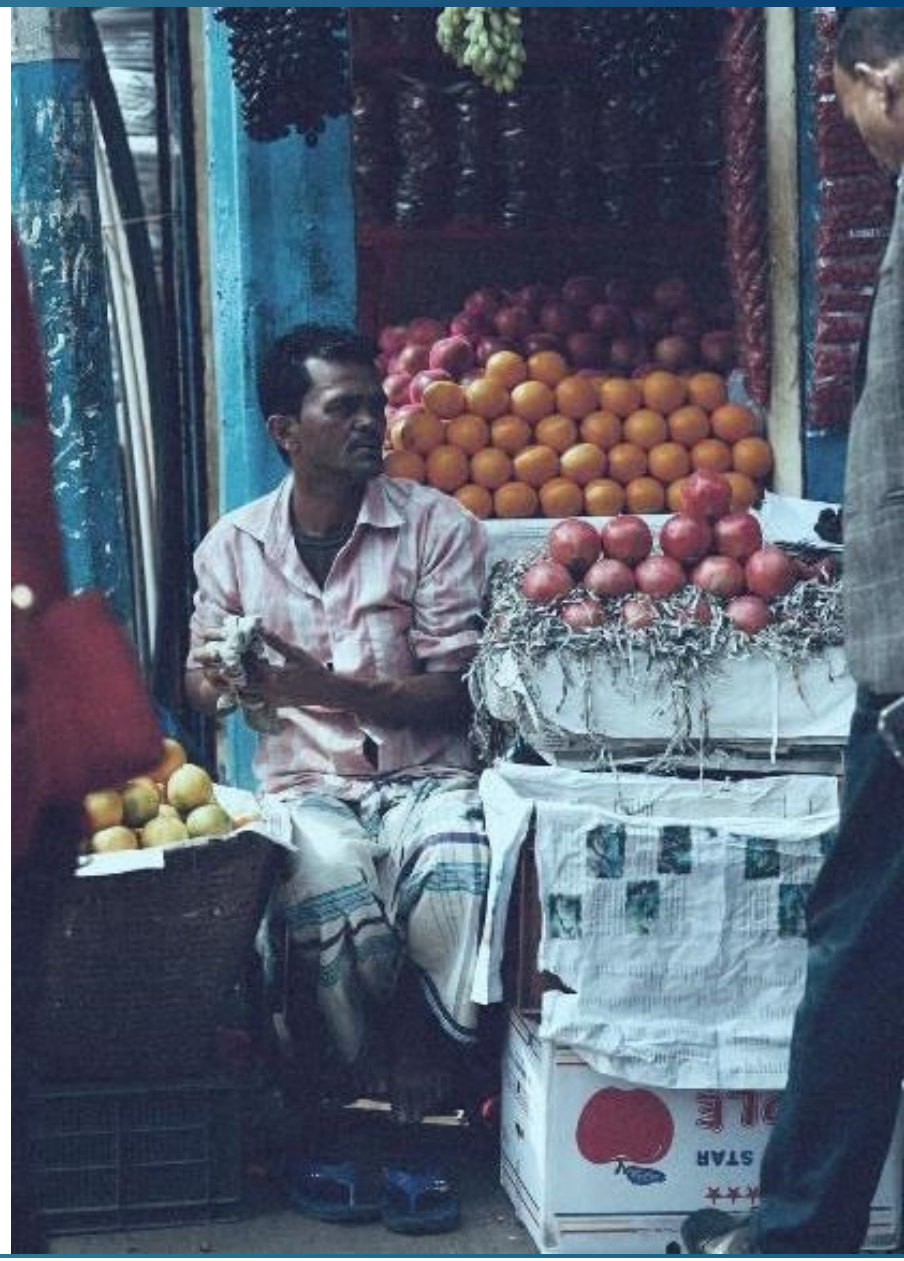
Export subsidy

In Bangladesh, the frozen fish industry currently gets 10% cash incentive for shrimp and 5% for other fish exports.

Source: NBR, Seafood Tip

Relevant government regulations & policies

- The basic act regulating inland fisheries is the Protection and Conservation of Fish Act (1950) , as amended by the Protection and Conservation (Amendment) Ordinance (1982) and implemented by the Protection and Conservation of Fish Rules (1985).[1]
- The Protection and Conservation of Fish Rules, for instance, specifically deal with the protection of certain carp species, prohibit certain activities to facilitate their augmentation and production and stipulate that licenses for their catch shall only be issued for purposes of aquaculture.[1]
- Other legislation that is relevant to aquaculture includes the Tanks Improvement Act (1939), which provides for the improvement of tanks for irrigation and aquaculture purposes. The Shrimp Culture Users Tax Ordinance (1992) stipulates that shrimp cultivation areas developed by the government by construction of embankments, excavation of canals or other water management structures shall be liable to payment of tax. In addition to these laws, aquaculture, and the conditions of its development, are affected by a variety of other laws, such as land laws, water laws and environmental regulations.[1]
- "The National Aquaculture Development Strategy and Action Plan of Bangladesh 2013–2020 constitutes 16 outputs under four objectives. These are geared to pursuing the mission of the aquaculture sector that its stakeholders have charged it with: "To improve the welfare of the resource-poor people depending on the aquatic resources for livelihood, reduce poverty by stimulating employment and improving income, conserve if not enhance the natural resources on which livelihoods are based, promote the sustainable development of rural communities, increase export earnings, and contribute to the creation of wealth for the nation and improvement in the welfare of the people."[2]
  - Social: To enhance the health and well-being of the people through the production of nutritious food and the development of productive and secure livelihoods.
  - Economic: To stimulate more economic activities in rural communities, create more rural employment opportunities, increase incomes of rural households, and save or earn foreign exchange through import substitution or more export earnings.
  - Ecological: To promote the conservation of aquatic biodiversity, enhancement of genetic resources, conservation of natural resources, and ecological resilience.
  - Institutional: To establish the enabling environment and develop the capability to effectively manage the sector, provide the support services needed for sustainable and responsible development, and ensure equity and fairness in the allocation of production resources and distribution of benefits.



[1]Source: FAO, 2005
[2]Source: National Aquaculture Development Strategy and Action Plan of Bangladesh 2013–2020

Institutional framework

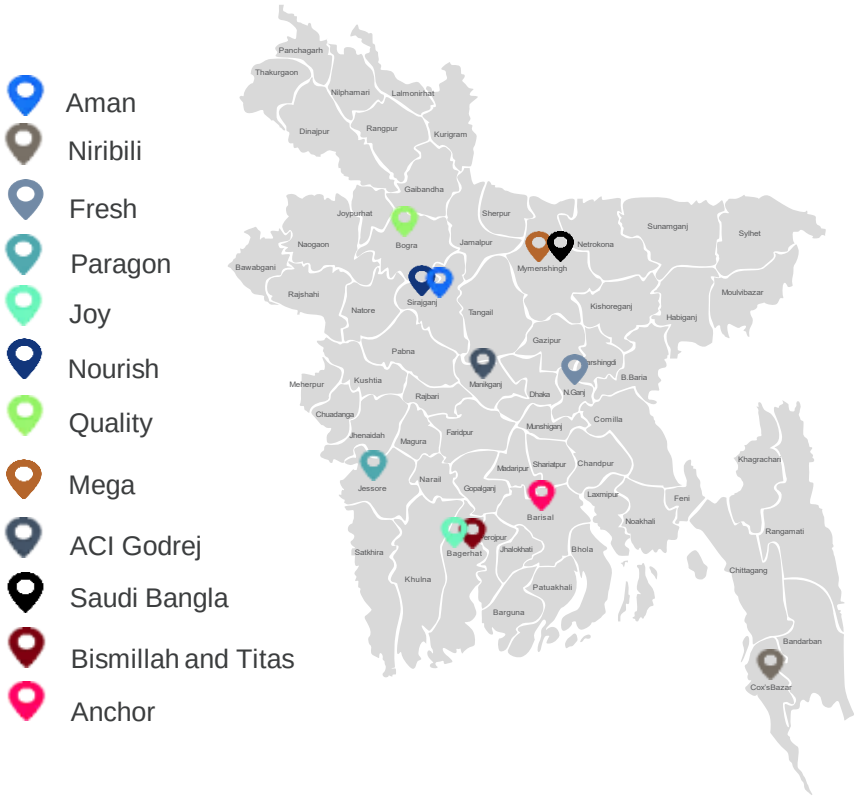
Segment	Key regulations and policies
Breeding	➢ As fry collection from nature can result in long term ecological destruction, in 2000 the government - reportedly - prohibited the collection of fry or post larvae of fish, shrimp and prawns of any kind, in any form and in any way in estuary and coastal waters. ➢ Fish hatcheries must be licensed by the Department of Fisheries in order to operate. Fish hatcheries are guided by the Fish Hatchery Act, 2010 & Fish Hatchery Rules, 2011. Operational activities of the licensed hatcheries are monitored by the Local Competent Authority (LCA) of the DoF. However, the PL market itself is highly unregulated, suffering from a huge black market of shrimp PL imports from India.
Feed Manufacturing	➢ Manufacturers, retailers, distributors of aquaculture Feed must abide by the Bangladesh Fish Feed and Animal Feed Act, 2010. Without proper licensing, performing any function relating to production of fish feed and animal feed, processing, import, export, marketing, sale, distribution and other related matters is banned by the law. ➢ Fish and shrimp feed (along with all other animal feed) is subject to the Bangladesh food safety act 2013.They also must maintain BSTI standards and abide by Bangladesh Consumers' Rights Protection Act 2009. ➢ However, many small producers operate in this segment who are not registered under any authoritative bodies and do not maintain any certifications or licenses.
Farming	➢ The Shrimp Culture Users Tax Ordinance (1992) stipulates that shrimp cultivation areas developed by the government by construction of embankments, excavation of canals or other water management structures shall be liable to payment of tax. ➢ Large farms/market players need to obtain a license from the DoF in order to operate legally. However, small local players practice farming without any licenses due to the lack of strong law enforcement. The DoF issues an optional registration number against an inspection of the farming facilities, but this is not mandatory. As of 2018-19, 206,000 farmers had obtained licenses from the DoF. Farms are expected to be guided by the Fish Feed and Animal Feed Act 2010 and the Fish Feed Rules 2011. ➢ The DoF sets the protein content guidelines for shrimp and fish according to species. They also collect samples and test them to check the quality.
Processing	➢ The Fish and Fish Product (Inspection and Quality Control) Ordinance (1983) prohibits the operation of a fish processing and packing plant without a license and stipulates that the processing of fish must take place in accordance with hygienic rules and conditions. The Ordinance is further implemented by the Fish and Fish Product (Inspection and Quality Control) Rules (1997), which include HACCP requirements for shrimp and fish processing plants. ➢ Permission is required by the Ministry of Fisheries and Livestock prior to setting up of any processing facilities and plans for establishment scrutinized. Inspection is conducted by cross-ministerial team including representatives of the Department of Health, Export Promotions Bureaus, Ministry of Industries and Department of Fisheries. Fire Safety Clearance, Environment Clearance and local council approval is also required. There is a mandatory evaluation for Issuance or Renewal of License. ➢ Processed finfish exporters receive a cash incentive from the GoB amounting to 5% of the invoice value, upto a ceiling price of USD 1.97 per KG. ➢ Frozen fish exporters receive a cash incentive of 10% for the export of frozen shrimp, upto a ceiling price of USD 4.90 per KG.
Export	➢ All fishery and aquaculture export products used to have an export subsidy of 10% provided to the export license holder. Nowadays, this export subsidy only applies to shrimp. Exporters can use the revenue at their own will and are not obliged to reinvest the subsidy into the fishery or aquaculture sector. ➢ A rate of 0.30% of Advance Tax (AT) is levied on exports. ➢ In the EU, Bangladesh has an EBT status, which denotes 'everything but arms'. This means that 0% of import duties are levied on imports. In the US, Bangladesh also enjoyed the GSP status, but this has been withdrawn since the collapse of textile factories and worries about human rights in Bangladeshi industries.

Key private players in feed production

Quality is the main private sector player in feed production

Commercial fish feed market	Market share (2019)	Production (MT)
Quality	15%	157,500
Others	11%	112,000
Mega	10%	105,000
Nourish	8%	84,000
ACI	8%	84,000
Ruposhi bangla	7%	73,500
Chhuya Agro Products	7%	73,500
Paragon	6%	63,000
Aftab Feeds	6%	63,000
CP	6%	63,000
Kazi feeds	4%	31,500
Agatha	4%	42,000
Provita	3%	31,500
Aman	2%	21,000
National feed	1%	10,500
Total	100%	1,015,000

Commercial shrimp feed market	Market share (2019)	Production (MT)
Quality	40%	14,000
Bismillah and Titas	14%	5,000
CP	6%	2,000
Joy	6%	2,050
Paragon	6%	2,050
Mega Feed	6%	2,050
Saudi Bangla	3%	1,000
ACI Godrej	3%	1,000
Fresh	1%	500
Niribili	1%	500
Aman	3%	1,100
Anchor	3%	1,100
Nourish	3%	1,100
Saguna	2%	700
One feed	1%	500
Uni President	1%	350
Total		35,000



Bangladesh farms

Three major shrimp farms are located in the South West regions

- Shetara Farming, Shawn Fish Products and Messrs. Quest International are the largest producers. All are privately held and use semi-intensive and extensive farming methods.
  - Shetara Farming is the largest farm in Bangladesh, with 222 ponds and an average pond size of 0.45 ha. The headquarters is in Munshiganhj Satkhira, with operating facilities in Satkhira. Shetara Farming actively practices contract farming. Its major shareholder is Mr. Montu.
  - Shawn Fish Products Ltd. is active in semi-intensive farming, with 180 ponds of an average 0.46 ha. They are the official importer of Shrimp feed of CP. The main shareholder is Mr. Abdul Sattar Morol Harinagar.
  - Messrs. Quest International Ltd. is active in semi-intensive farming, and have the largest ponds involved in shrimp farming compared to other market leaders. Its headquarters is in Dacope, Khulna. The company has 40 ponds of average 1.88 ha. The shareholder is Prof. Md Mahbubul Alam Hanif.
- Bangladesh has two ASC-certified producers: Gazi Fish Culture Ltd and Farisa Agro Farms Ltd. Gazi fish farm is connected to Gemini Seafood: one of the major and few publicly listed shrimp exporters. The other ASC certified farm is Farisa Agro Farms. All their shrimp is purchased by Apex Frozen Foods.

Player name	Farming (Ha)	Locations of farms (State/Province)
Shetara Farming	101	Satkhira
Shawn Fish Products	82	Satkhira
Messrs. Quest International	75	Khulna
Messrs. BG Black Tiger Agro	70	Khulna
Gazi Group	54	Satkhira
Messrs. Masum Shrimp Farms	50	Khulna
Pranti Farming	43	Bagerhat
Messrs. Shrimp & Pond Culture	30	Khulna
Radiant Shrimp Culture	26.5	Satkhira
Saphoyana Aquaculture	24	Paikgacha

Source: LightCastle-Larive primary data (interviews).

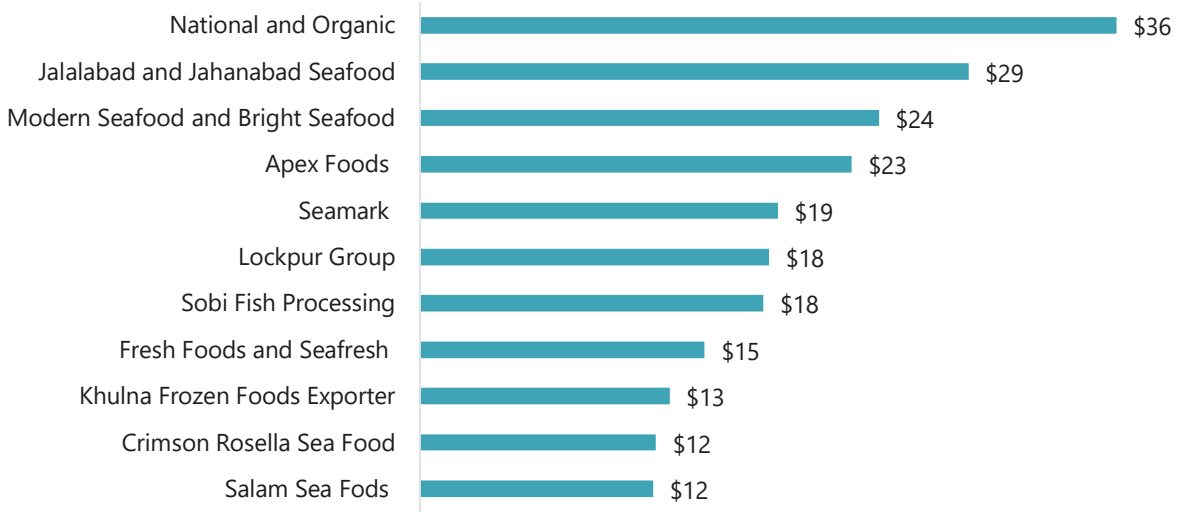
[1]Note: We are awaiting response from the DoF if a full list of fish farmers is available.

Key private players in processing

Key players active in processing include EON Foods, Sea Natural Food and Bengal Meat

- Bangladesh has over 100 listed exporters but only an estimated 30 groups are operational. Two-thirds of listed exporters (67%) are based in Khulna division (covering Jessore, Satkhira, Khulna and Bagerhat districts) which is consistent with the concentration of shrimp farming in the region.
- Recent investments in shrimp processing have also been centered around the Khulna region, taking advantage of the shorter distribution lines. For a country like Bangladesh, where the cold chain management system is still in the very nascent stage, proximity to farmers ensures better preservation of shrimp prior to processing and freezing
- The shrimp processing/exporting market can be considered concentrated given that the top 15 players cover 50% of the market for processed shrimp products. Some exporters have set up import companies in countries Bangladesh exports shrimp to.
- There are six shrimp exporters that export ASC certified black tiger shrimp: Seamark Bd Limited, Apex Food Limited, Primus Frozen Foods Limited, Fahim Seafood Processing & Farming Ltd, Mostafa Organic Shrimp Products Ltd. and Bd Seafood Limited.[1]

Processing capacities (in MN US$) by leading shrimp processors (2019)



Notes: Yearly shrimp procurement by processors and exporters is estimated to be roughly around 40,000 MT. Roughly 90% of procurement is done through value chain intermediaries (e.g., araths (commission agents)).

[1] Source

7. Challenges

Bottlenecks hampering development of aquaculture

Lack of integrated solutions, quality inputs and poor animal health hinder the sector

Fish

The fish sector faces several challenges, from input of quality seed and feed to an efficient organization of the value chain. This culminates in low productivity and low resistance to diseases. Poorer farmers opt for cheaper low-quality seeds as the prices are often 30% - 50% lower - and as a result there is perpetually low productivity until the entire hatchery sector shifts to standard production practices.

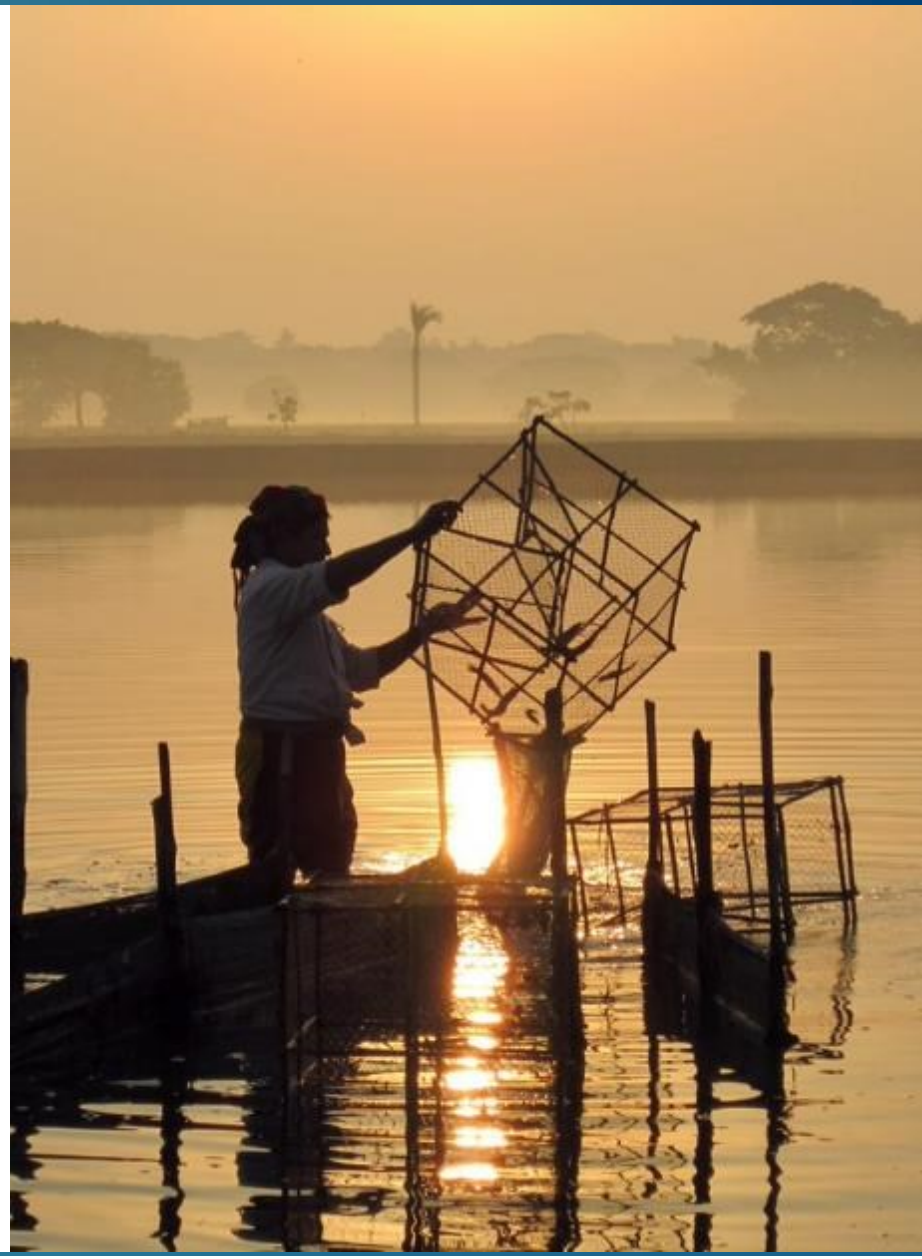
Unaffordability of quality feeds and limited awareness about the benefits of quality feeds poses a challenge for farmers, while feed producers struggle with volatile prices of raw materials and unfavorable regulations. Farmers struggle with the lack of qualified technicians and training opportunities, while weather and natural risks increasingly pose challenges.

Limited assurance of traceability and compliance with food safety and hygiene regulations is a recurring problem throughout the sector, leading to Bangladesh not having reached its full potential its aquaculture, both for the domestic and export market.

Shrimp

In essence, the monodon is a premium shrimp, but the sector fails to capitalize on this due to the prevalence of extensive and inefficient production practices. The growth of semi-intensive farms is taking place gradually and has led to larger-sized shrimps, improved survival and productivity rates and increasing profitability of those active in the sector. An accelerated transition towards semi-intensive shrimp farming will aid in making the sector in further becoming profitable. This requires business involvement and provides significant opportunities for businesses.

The potential for exporters to fetch premium prices in international markets is due to the organic structure of the shrimp paired, characterized with comparatively little usage of inputs and chemicals. Limited usage of inputs and reliance on natural feed stemming from the environment may not be optimal in terms of productivity. The challenge for Bangladesh is to make its production more efficient, while maintaining the organic structure of its shrimp.



Challenges matrix in Bangladesh

	Breeding		Feed		Farming		Processing and end-markets	
Inputs	No disease screening for broodstock	Shortage in Tilapia genetics (seasonality)	Inconsistent nutritional composition due to high competitiveness and price sensitivity	Shortage of raw material supply (domestic production / unfavorable import regulation)	Limited financial resources to fund working capital	Limited availability of products apart from feed and PL for optimal farm management	Intermediaries hindering full utilization of supply	Insufficient cold-chain facilities at processing hubs / retail leading to expiry
	Price volatility in genetics due to lack of in-house breeding		Contaminated or poor-quality raw materials & decay of raw materials	Variation of raw material supply or prices throughout the year	Wastage of PL	Wastage of feed	Limited storage capacity at processing hub / retail	Bottleneck in capacity of transportation between farm and processing hub / end-markets
Production, technology and equipment	Low penetration of SPF hatchery (shrimp)	Quality reduction due to excessive crossbreeding	Inadequate feed production knowledge	Raw material loss	Farmers illiterate and unaware of best practices	On-farm fish wastage / expiry of products after harvest	In-plant product wastage	Production shortage (labor/ capacity of processors)
	Capacity underutilized from June-February	Inefficient hatchery management & suboptimal conditions	Production shortage (labor/ capacity of feed millers)	Inefficient production	Sub-optimal bio-security standards and high prevalence of diseases	Suboptimal production conditions (biosecurity, diseases, water pollution, salinity, weather, floods etc.)	Shrimp processing plants underutilized (15-25% used)	Degree of sophistication of processing equipment (e.g., value-added)
Output quality, handling and sales	No quality seed available for farmers	Expiry or quality deterioration of products due to inadequate storage	Shortage of feed	Expiry of products due to inadequate storage and/or transport	Extended dry season and saltwater intrusion threatens culture environment	Weak negotiation power reducing farm profitability	Current processed fish types and/or volume does not fulfill potential (export) demand	Non-certification of exporters leads to lower prices
	Expiry or quality deterioration of products due to inadequate transport		Export unreadiness	A credit driven market pushing out players with low working capital	Significant default risk due to volatile production conditions (pushing farmers to use cheaper inputs to reduce risk)		Curtailed market volume potential due to not meeting (export) requirements	Expiry of products due to inadequate storage and transport

Prioritization (based on impact on sector performance and opportunities offered)

Overview of sector risks (CSR)

Aquaculture can pose risks to the environment and animals, human health, and social structures

Pathogen risk

- The transport of animals, especially live animals, is a risk for the spreading of disease. Disease can spread rapidly on farms, infecting other animals.

Ecological risk

- Chemical contamination to nature, habitat destruction, invasion of exotic species, infection with disease organisms, or other potential stressors cause damage to the environment. An example of habitat loss is the destruction of mangrove forests to make room for aquaculture farms. As mangroves provide habitat and nursery for thousands of species, this is very destructive for nature.

Environmental risk

- Damage to ecosystem functions, abstraction of water, sediment deposition and benthic impact, effluent discharge, environmental contamination and human health risks associated with veterinary drugs, groundwater contamination, exotic species introduction, genetic impacts on wild populations, introductions of pathogens and pests.
- The expansion of the aquaculture industry usually goes at the expense of the natural environment of rice ponds that provide aquatic flora and fauna. The increasing conversion from rice fields to ponds and water bodies for aquaculture harms biodiversity and all wildlife dependent on this biodiversity (aquatic birds, crabs, frogs, snails and turtles).
- Natural freshwater bodies are under pressure, which may increase when aquaculture expands further. Aquaculture ponds as connected to natural water bodies and the synthetic nutrients, pesticides, antibiotics and other chemicals used in pond farming and breeding are commonly released into these freshwater bodies, posing threats for local and natural fish species. Bangladesh has established a gene bank to protect local fish species, though this does not address the root cause of the problem.
- With any form of production with animals, there is the risk of limited animal welfare, even though knowledge on the topic is limited. By limiting diseases and optimizing the conditions of animals, animal welfare is optimized as much as possible.

Food safety and public health risk

- Excessive usage of antibiotics in food can lead to antimicrobial resistance (AMR) in both the animals and the people consuming the product.
- Food-borne illnesses continue to be a global problem. Fish and shellfish can be contaminated and provide a health risk to consumers.

Social risk

- Gender inequality: with fixed gender roles in Bangladeshi society, men and women are not necessarily equally able to participate in the aquaculture sector. Women are often expected to manage households and nursing tasks, leaving the share of women active in the aquaculture value chain very low.
- Unsafe working conditions: although working conditions are generally under-reported globally, it is acknowledged that aquaculture can present risks for workers working in the heat, dehydration, neck or other body disorders, parasites from bacteria, and other hazards. Another social issue is related to resource utilization and access.

Source: FAO (2009)

Insurances in the aquaculture sector in Bangladesh

Primary focus on shrimp insurance: High risk for natural disasters and important to export

- The Bangladeshi Ministry of Livestock and Fisheries and the Department of Fisheries has identified a need to develop suitable aquaculture insurance products for the sector. Initial work is being focused on the shrimp (and prawn) sector given its importance to farmers located in the southern coastal regions of Bangladesh and the high-risk exposure to tropical cyclone damage and tidal surge and the fact that shrimp exports are an important source of foreign exchange for Bangladesh. Diseases in shrimps (including white spot virus disease) are a major challenge not only for the industry, but also for insurers and their reinsurers.
- The two main shrimp insurance covers that might be developed in Bangladesh are (1) a named-peril cover for commercial shrimp producers located in Khulna Region, and (2) an all-risks cover for shrimp hatcheries located in Cox's Bazar. A named-peril shrimp mortality insurance policy would enable the many small-scale extensive shrimp producers to intensify their cultivation systems through modest investments in higher levels of inputs, improved technology, and better husbandry practices – and in this way to possibly double their shrimp yields.
- A series of major issues and challenges for the design and implementation of shrimp insurance in Bangladesh will need to be addressed at a later stage. These include:

1. The lack of aquaculture underwriting expertise,
2. The lack of shrimp mortality data and statistics for risk assessment and rating purposes,
3. The unknown demand for shrimp insurance cover by Bangladeshi shrimp farmers,
4. The need to identify and partner with cost-effective distribution channels for a shrimp insurance cover,
5. The need to develop accurate and cost-effective individual-farmer shrimp loss assessment systems and procedures,
6. The need to define the roles of the commercial insurers and the government of Bangladesh/department of livestock services,
7. The need to obtain support from specialist international aquaculture reinsurers,
8. Skill gaps and low levels of management in artisanal small-scale fisheries and aquaculture enterprises, where losses may be mainly due to poor management rather than insurable risks – management related risk is often very difficult for insurers to control.

Source: Bangladesh Agriculture Insurance Analysis, Bangladesh: Policy Options for crop and livestock and aquaculture insurance by the World Bank, EKN, US Agency for International Development (USAID), Global Facility for Disaster Reduction and Recovery (GFDRR)

8. Opportunities

for public and private sector co-operation and business between the Netherlands and Bangladesh

Opportunities for the private sector, G2G, and K2K

Capturing the potential of fish and shrimp farming in Bangladesh

This chapter elaborates on the opportunities embedded in the Bangladeshi aquaculture sector, which, upon capitalized on, can be both beneficial for the sector as a whole and individual private companies.

A multiangled approach is required to effectively develop more efficient and sustainable fish and shrimp farming. Bringing about a single intervention that fits into the broader picture of a sustainable and profitable industry, although certainly a desirable outcome, will likely not yield the potential outcomes if it is not accompanied with other changes necessary for the intervention to succeed.

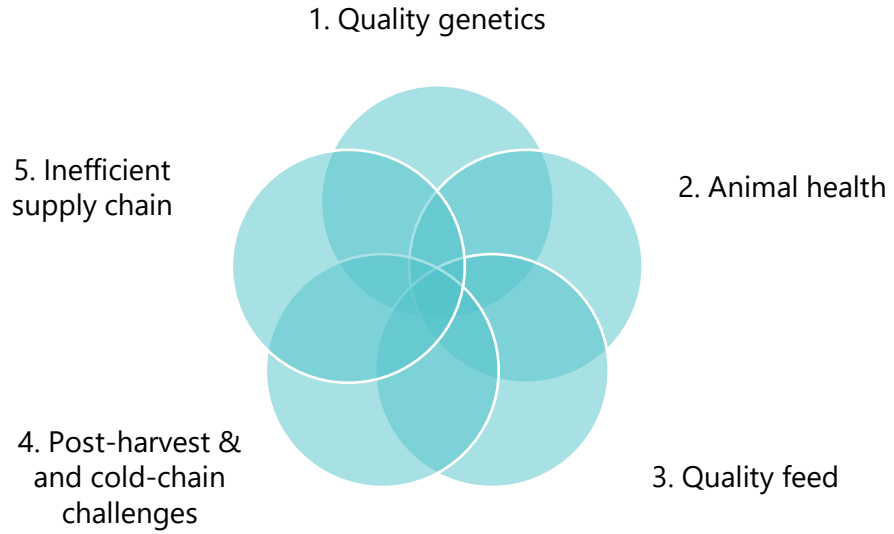
A holistic approach will most likely instigate transformative sector growth most effectively. Potential interventions should therefore consider what other interventions are required for the first intervention to succeed and what second-order effects can take place that could potentially alter the desired outcome of the intervention. Interventions should be paired with interventions on which the former can synergize on, and the implementation of interventions should be designed in a way that they are resilient to second-order effects, such as behavioral changes. Specific attention should be paid to those interventions where the one intervention that is supportive to the other is unaffordable or which actors are not willing to pay (e.g., training).

The opportunities are relevant for the private sector stakeholders, government-to-government (G2G) and knowledge-to-knowledge (K2K).

The following sections describe possibilities through which private sector can involve in this development.

1. Increasing the availability of quality genetics.
2. Improving animal health.
3. Increasing the availability of feed and other inputs.
4. Improving post-harvest logistics and cold-chain solutions.
5. Improving supply chain efficiency.

This report does not substantiate opportunities with a detailed business case, but rather sketches possibilities for private and public sector involvement. With the first-mover advantage mover advantage still existing, private sector investments and other forms of involvement can yield promising returns.



Increasing local availability of quality genetics

An integrated approach for improved genetics

- Both for shrimp and fish genetics, the broodstock is mostly wild catch. This puts **pressure on the stock of wild broodstock** and genetics are often low-quality. This signifies a possible opportunity to supply high-quality genetics locally.
- To improve the quality of shrimp production, the private sector can overcome these challenges by **increasing the availability of quality shrimp genetics to fill the supply gap of shrimp broodstock and PL.** Capitalizing on the low availability of high-quality shrimp seed can accelerate semi-intensive farming.
- Improving the quality of fish genetics through integrated solutions and local breeding programs, e.g., through innovative solutions such as CRISPR-Cas. High demand for quality fish genetics is likely to be accelerated due to further intensification of fish farming.
- Supplying high quality broodstock is one part of the story. Proper product handling and creating transparency into what products are being sold contributes to higher survival rates and an improved understanding of the quality of input that is being traded upon point of sale, respectively.

Potential implementing partners NL	Aeres, Agri Terra, Aquaculture ID, Hendrix Genetics, Hogeschool Zeeland University of Applied Science, Landing Aquaculture, TilAqua, TopsyBait, Viqon, Wageningen University & Research (WUR),
Potential implementing partners	Bangladesh private sector, Bangladesh Agricultural University (BAU).
Suggested support tools	EKN Dhaka (ODA), SDGP, Impact Cluster, DHI, PSD Toolkit (Pre-PPS funding), Nuffic (K2K), potentially DGGF.

Integrated approach including proper practices & transparency

Establishment of breeding multiplication centers (BMC)
A BMC localizes the production of genetics based on a parent stock. In a BMC, parent broodstock is converted to first generation genetics, which is then distributed to hatcheries. A BMC is typically geared towards the domestic market, increasing the availability of high quality broodstock.

Establishment of nurseries[1]
Putting PL into a nursery aids in the acclimatization the PL and improves survival rates. Some existing nurseries in Satkhira are profitable and there is potential to establish new nurseries in Khulna, Satkhira and Bagerhat districts.

Investment in educational resources can encourage farmers to so utilize nurseries. Successful private sector involvement would require a strong collaboration between the ones interested in investing in nurseries, (clusters of) farmers and broodstock suppliers.

Development of a local breeding program
The volatile supply and poor quality of genetics combined with an industry whose demand for broodstock will grow will inevitably require a shift in how broodstock is supplied currently. Further research is required to determine more accurately any untapped potential for the supply of quality fish genetics locally and the size of the opportunity. To ensure that the local breeding program is tailored to local conditions, the initiative would require technical cooperation with Bangladeshi livestock universities, who can support with broodstock development, and development bodies, who can support with implementation and encouraging take-up.

Source: LightCastle-Larive primary interviews, analysis, FAO – 'An assessment of impacts from shrimp aquaculture in Bangladesh and prospects for improvement (2017)'
Notes: [1]A nursery is an intermediary step between the hatching of genetics and farming.

Improving animal health

Preventing disease through improved testing and training

Identify and prevent diseases

- Private sector players could support local hatcheries to establish laboratory capacity and capabilities to identify and prevent diseases. Capacity building and knowledge transfer is essential for improving biosecurity, farm management, and mediation use on-farm. Demonstration facilities could improve practices through 'seeing-is-believing' and vocational training. Training regarding business acumen could greatly improve access to finance for small-scale farmers.
- K2K initiatives could focus on training vets and developing training programs especially tailored to local needs.
- The Dutch government could support the local governments by sharing their extensive knowledge of implementing proper guidelines for disease management, improving biosecurity, and ensuring food and animal safety. Workshops and seminars could be organized where government delegates interact to share knowledge and review policy regulations. Finding ways to encourage the clustering of farmer could help overcome several challenges in the sector due to its fragmented nature.

Potential implementing partners NL	Agriterra, DL Plastics, FMO, Hendrix Genetics, Hogeschool Zeeland, Landing Aquaculture, Rabobank, TipTopp, TopsyBait, Viqon, Wageningen University & Research.
Potential implementing partners	Bangladesh private sector, Bangladesh Agricultural University (BAU).
Suggested support tools	EKN Dhaka (ODA), SDGP, Impact Cluster, DHI, PSD Toolkit (Pre-PPS funding), Nuffic (K2K), potentially DGGF, Young Expert Program (YEP).

Mobile labs with laboratory capacity

Challenges in breeding, farming, and feed, are often related to lacking insight into the quality of the product. This could relate to the quality of water for farming, the quality of feed ingredients, or the quality of the animal. Large players can provide complete technical support services including mobile labs. These labs have laboratory capacity which allows farmers to check the quality of their farming inputs and animals on-site, for example for disease or aflatoxins in feed.

Capacity building and knowledge transfer:

Training of farmers on equipment, biosecurity, farm management and proper usage of medication (including reduction of antibiotics). This will allow farmers to realize a better technical performance.

Access to finance:

Inclusion of financial institutions providing capital for investments and work capital.

Demonstration:

Demonstrating the technical and commercial viability of semi-intensive production systems; showcasing different forms of affordable, modular Dutch technology.

Aggregating of farmers:

Grouping of medium scale farmers to collectively purchase more expensive but essential hardware and follow training programs.

Increasing the availability of high-quality feed

Increasing the availability of feed and feed formulation quality

Invest in local high quality functional feed production

Show how the proportion of semi-intensive fish shrimp farming has changed across the years could be an indicator of whether the number of farmers that will consciously use feed to improve their production cycle will expand. A strong private sector drive could enable the construction of demonstration farms. These farms include knowledge-intensive farming systems (such as RAS), where farmers can see how the technology work in the local setting. This can also serve as a distribution hub for high-quality feed. The farm hubs are also a center for meeting other stakeholders and receiving (practical) training.

Furthermore, improving the quality of locally available fishmeal key to sustainable local feed sector development. Increasing the production of alternative proteins, e.g., by developing a local insect-based circular protein industry, could greatly increase the affordability and quality of local protein. Specialized Dutch Black Soldier Fly (BSF) consultancy companies such as ProEnto could assist with the establishment of the first commercial BSF farm in Bangladesh.

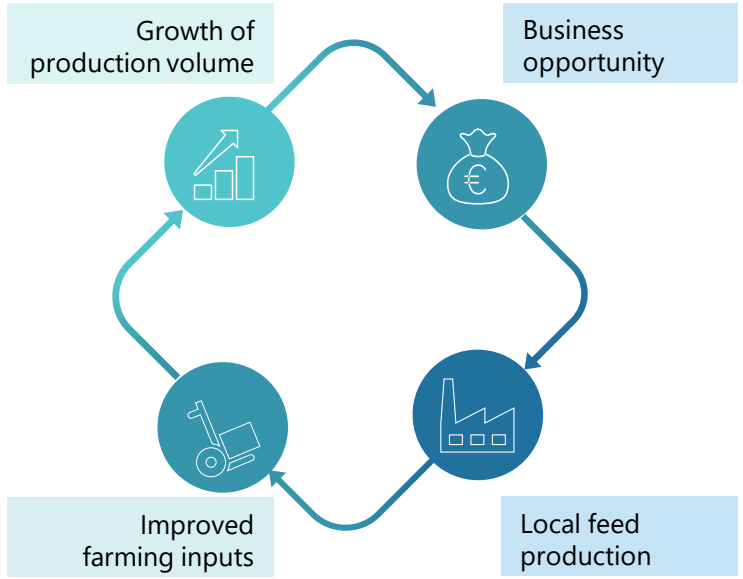
Increasing the availability of high-quality shrimp feed

Most feed used in shrimp cultivation consists of low-grade fish feed. The shrimp sector is largely captured by extensive shrimp farmers who, under current production circumstances, are not expected to display growing interest in using commercial feed alternatives.

In case Bangladesh succeeds in significantly growing its semi-intensive farming base, demand for commercially produced feed grow. An expansion of semi-intensive farming in Bangladesh has not come up to speed yet, and this is a crucial factor for establishing a market for commercial shrimp feed. Given the competition Bangladesh faces in international seafood markets, the country may be urged to improve its productivity and lower its cost per produced shrimp. Productivity improvements are typically paired with an intensification with the production system, and possibly an increased adoption of commercial shrimp feed.

If this proves to be the case, the Dutch animal feed sector, renowned for both its high-quality feed production and expertise in animal feed production and related equipment, may benefit from this trend by participating in the market. Such market participation can express itself into the export or local production of animal feeds or raw inputs, or sales of production equipment.

Potential implementing partners NL	Agrifirm, Almex, Bioseutica, Coppens, De Heus, DSM, ForFarmers, Mavitec, Ottevanger, ProEnto, Rabobank, Skretting, TipTopp, Van Aarsen, Wageningen University & Research.
Potential implementing partners	Bangladesh private sector, Bangladesh Agricultural University (BAU).
Suggested support tools	SDGP, Impact Cluster/DHI, PSD Toolkit (Pre-PPS funding), potentially DGGF, YEP, K2K.



Implement cost-harvest & cold-chain solutions

Improving infrastructure will improve product quality and access to premium markets

Farmers experience a ~25% loss due to lack of cold-chain logistics and poor infrastructure. The fragmented market leads to limited opportunity for centralized storage. However, decentralized storage and small-scale cooling solutions close to production sites could provide great improvements to the sector. Clusters of farmers can aggregate their harvest in close-to-farm cooled storages to simplify transport to markets and improve product quality.

The Netherlands has a strong knowledge and skill set in organizing market linkages and improving agro-logistics and chain control.

Potential implementing partners NL	Anova Seafood, ASC, Celtic Cooling, De Ridder Packaging, Fisherman's Choice, GEA Refrigeration, ITS Transport, Innotec, Parlevliet & vd Pas., Primstar/Cornelis Vrolijk, Seafood Connection.
Potential implementing partners	Bangladesh private sector.
Suggested support tools	Development Related Infrastructure Vehicle (DRIVE), DGGF.

Reducing supply chain inefficiencies

A holistic approach is required to boost the sector in a durable and sustainable manner

Inefficient production leads to lower quality production, both for fish and shrimp. Reusing waste streams and improving circularity can improve sustainability throughout the sector. Dutch private sector players could offer technical services regarding quality control. In other Asian markets, mobile aqua labs with laboratory capacity have proven useful in assessing quality of water, feed, or animals.

The demand for high-quality shrimp is high in the Netherlands – Dutch importers can assist with improving practices throughout the value chain in Bangladesh. The Dutch government offers support for Dutch government aiming to improve practices of their suppliers abroad (Fund for Sustainable Development).

Possible solutions for increasing efficiency throughout the fish- and shrimp value chain are:

- Improving production systems and technology. To maintain the organic and 'clean' nature of the Bangladeshi shrimp, productivity improvements should be realized through interventions that cause no farm for the environment and biodiversity (mangrove forests).
- Assisting farms and processors with achieving required quality standards for export for those actors with above basis level of production practices.
- Investing in value-added fish processing to serve the domestic market & capture vast export potential. This could capture a large potential market, as a gradual change in consumer preferences toward processed foods can be perceived.
- Cross-country curriculum development (G2G-K2K).
- Training to ensure proper production practices to capture potential of high-quality inputs, feed and other inputs.
- Key regulatory reform and public involvement. Drafting a national guideline for fish farming, informing actors what requirement they need to fulfill in order to participate in the export market, could help to shift the industry from a fully-domestic industry toward a partial export-industry.

Potential implementing partners NL	ASC, Embassy of the Kingdom of the Netherlands, Hogeschool Zeeland, Ministry of Agriculture, Nature and Food Quality (LNV), NVWA (Dutch Food Safety Authority), Wageningen University & Research, Solidaridad.
Potential implementing partners	Bangladesh private sector, Ministry of Fisheries and Livestock, Bangladesh Agricultural University (BAU).
Suggested support tools	DGGF, Fund for Sustainable Development (Fonds Verantwoord Ondernemen or FVO), G2G, K2K.

Note: see Annex VIII for more information.

Opportunities for G2G engagement and knowledge transfer

Providing a base for university graduates interested in venturing into sustainable aquaculture

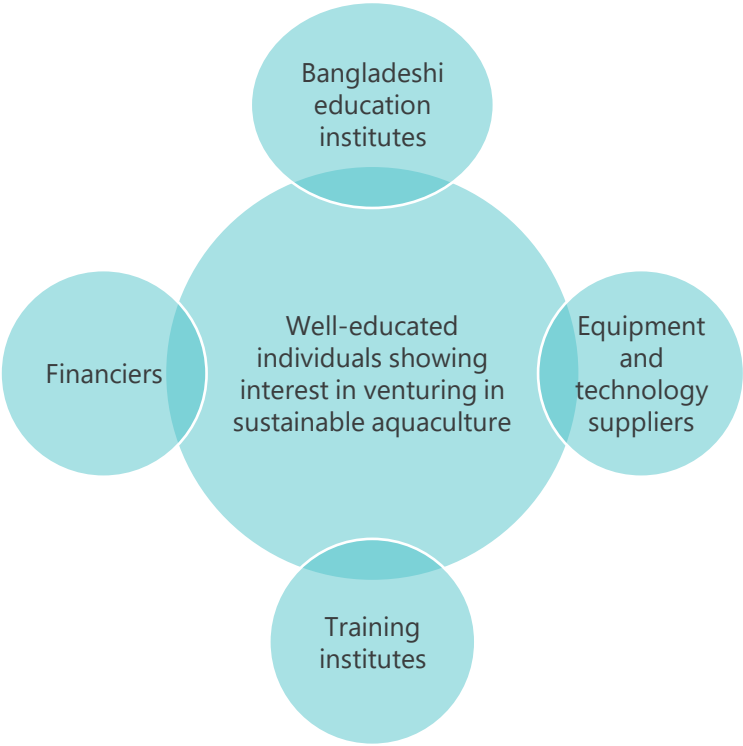
Although a sustainable transformation of the aquaculture sector requires the inclusion of all stakeholders with different backgrounds, university graduates whose aim is to participate in the private sector form an interesting pool that can contribute to positively transforming the sector.

University graduates possess the theoretical foundation on which sound aquaculture practices rest and endorse the importance of sustainable aquaculture. University graduates are knowledgeable and, upon effective engagement in the sector, they can accelerate a transition towards sustainable production.

The opportunity for the aquaculture sector lies in facilitating those with an interest in starting sustainable fish/shrimp farming with the practical knowledge and a loan to cover start-up costs and thereby lower the burden of realize these sustainable ambitions.

This would require effective cooperation between different stakeholders including:

1. Bangladeshi education institutes informing (to be) graduates about the opportunity to take part in an 'acceleration' program, linking students to the program and encouraging them to take part in the program.
2. Financiers (examples include Aqua Spark, FMO, Rabobank, Triodos) who are willing to set up an impact fund dedicated to facilitating those willing to engage in sustainable aquaculture and provide start-up capital to bridge the hurdle of initial investments into for example RAS technology. A monitoring program can be set up to steer beneficiaries, providing farmers with appropriate practical guidance, support and monitoring until has been ensured that financial duties will be fulfilled in the long term. Combined with conditions and terms that can be jointly set up with aquaculture experts, financial risk can be kept below a threshold.
3. Training institutes, either Dutch or foreign, can aid the program beneficiaries with necessary practical training that complements theoretical knowledge, contributing to the implementation of adequate aquaculture practices.
4. Renowned aquaculture equipment suppliers aid in providing the technical and infrastructure base.



G2G engagement in quality assurance

Institutional collaboration and capacity building for increased food safety

- Should Bangladesh increase their export or import of fish and shrimp, the importance of quality control increases. At present, the quality assurance is suboptimal, as local governments in Bangladesh do not fully implement proper guidelines throughout the value chain (including SPF PL, proper farming practices and adhering to international standards, disease management, biosecurity, cold chain maintenance, reducing antibiotic usage and improving animal safety). The increased need for laboratory control and food safety throughout the value chain creates opportunities for G2G collaboration and institutional development.
- The Netherlands has extensive experience in quality assurance in the agro-food sector. The Dutch Food Safety Authority ('NVWA') and the Dutch Ministry of Agriculture, Nature and Food Quality, possess an abundance of knowledge on food and animal safety, biosecurity, veterinary practices, food circulation and how to limit the impact of aquaculture on the environment. The Dutch government could play a guiding role in each of the value chain segments, in close collaboration with the private sector.
- The Dutch and Bangladeshi governments are strong bilateral partners, collaborating in for example the Delta Plan 2100, a holistic plan for the Bangladesh delta. This long-term strategy could be complemented with aquaculture and fisheries initiatives and professionalization.
- The Bangladesh Government and public institutes could be supported by Dutch governmental organizations to learn from Dutch experiences. A collaboration between Dutch regulators (as well as public research institutes or universities) and Bangladesh could strengthen the capacity of the Government of Bangladesh in developing regulatory and quality assurance capabilities.
    - The Bangladeshi regulatory bodies could improve their protocols on effective responses to handling disease outbreaks or other sector-related risks.
    - The NVWA could assist the Bangladeshi government in providing training programs and workshops for improving quality assurance through knowledge sharing and executive reviews on regulations.

SWOT analysis

Strengths
- Sizeable population (167 MN in 2019).
- Robust macroeconomic fundamentals.
- Stable government.
- Advantageous incentives to stimulate (FD).
- Fish is the most consumed protein source in Bangladesh.

Weaknesses
- Underdeveloped physical infrastructure (ports, roads, power).
- Lack of transparency, burdensome and slow bureaucratic processes and institutionalized corruption.
- Underdeveloped financial sector.
- The country's vulnerability to natural disasters (landslides, cyclones, floods, earthquakes, etc.) and the effects of climate change.
- Inadequately diversified export, being dependent on the textile industry.
- Poor animal health practices, lack of disease control measures and food safety law enforcement.
- Substantial underinvestment, lack of knowledge and inefficiencies in all segments in the fish and crustaceans value chain.

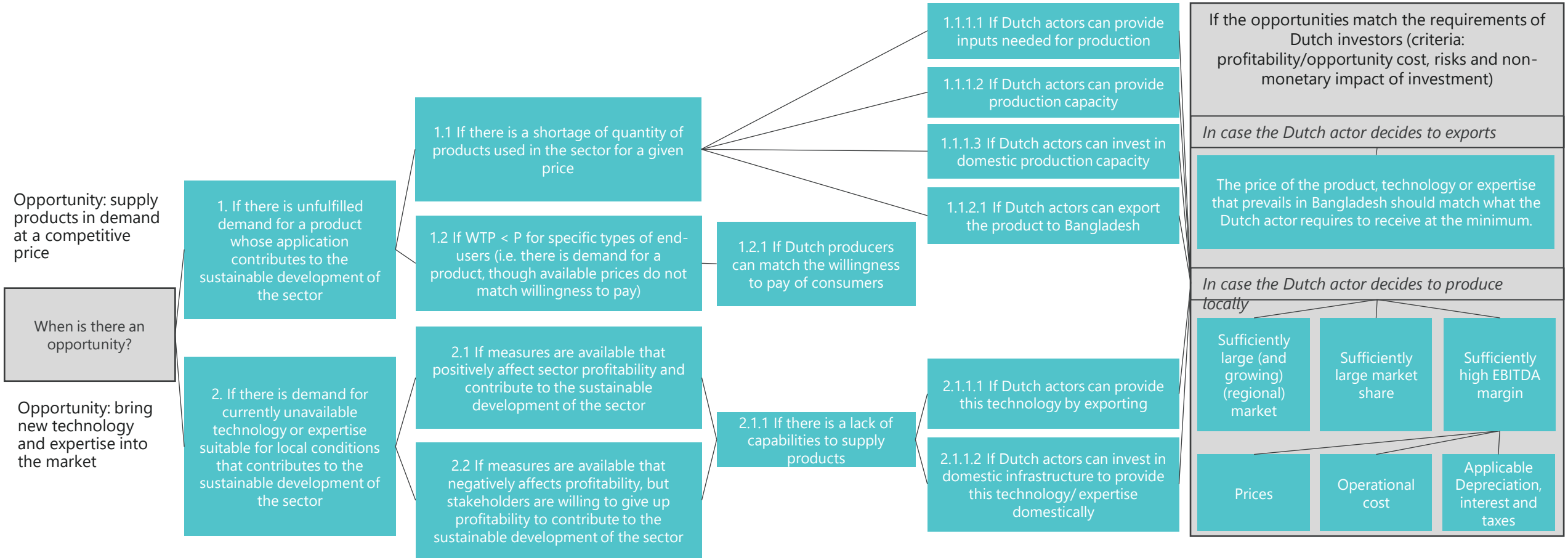
Opportunities
- Growing per capita fish consumption.
- Increasing domestic demand for processed fish.
- First-mover advantage for various kinds of products and services in the aquaculture sector and related industries.
- Availability of low-cost labour.
- Strategic position to supply North East India (so-called 'Seven Sister States': Arunachal Pradesh, Assam, Meghalaya, Manipur, Mizoram, Nagaland and Tripura).

Threats
- Disease outbreaks.
- Increase in interest (credit dependency).
- Competition of Asian players who offer cheaper, lower-quality equipment and solutions.

Annex

Hypothesis tree

An opportunity is a business intervention that contributes to the sustainable development of the sector which matches the criteria set by Dutch investors

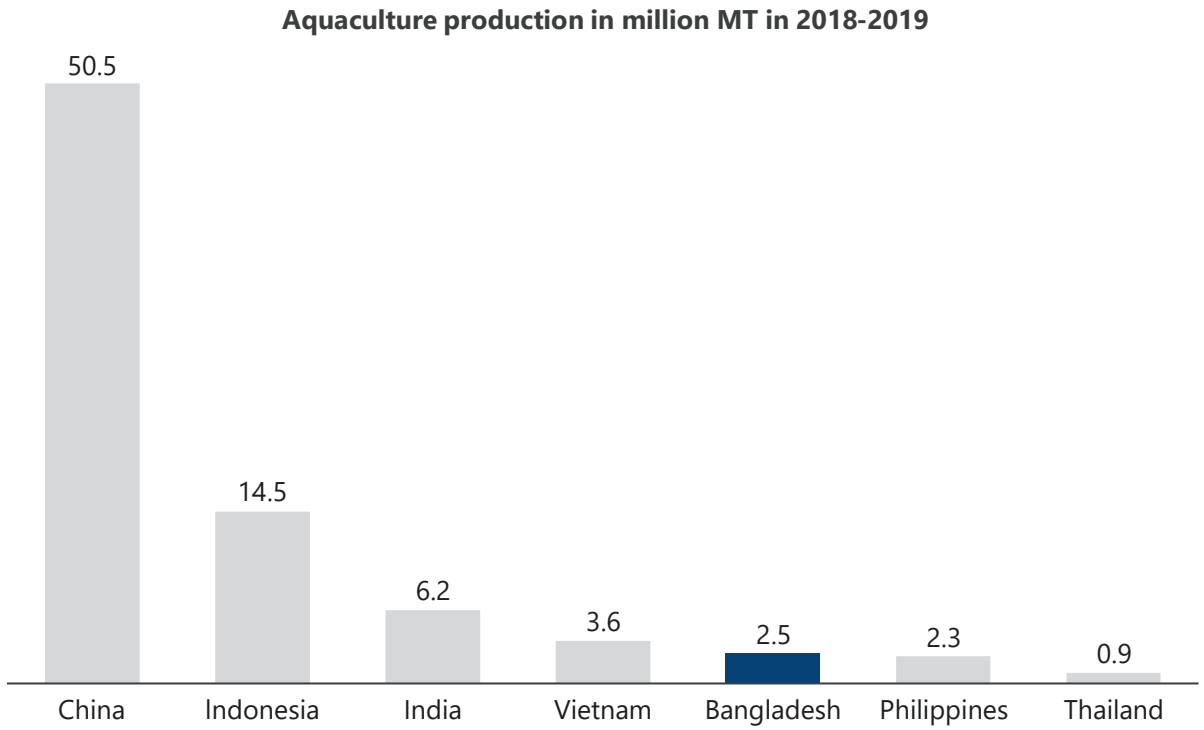


Annex I: Global comparison of aquaculture production

Bangladesh is one of the world's largest aquaculture producers

- Bangladesh ranks fifth worldwide in terms of aquaculture. Fish production has increased in the past 20 years, with rapid changes in fish farming. Fish production more than doubled in size, increasing from ~1.8 MN MT in 2000-2001 to 4.39 MN MT in 2018-2019.
- Bangladesh is one of the world's most important inland fishing nations. Since 1999, Bangladesh also belongs in the top three inland water capture producers, only outranked by China and India.
- Roughly 85% of fish production in Bangladesh is contributed by inland capture and aquaculture, whereas 15% of fish production is through marine fishing.
- Cultured fish farming (57%) and captured fisheries (28%) jointly constitute production coming from inland fisheries. Capture fishery gradually declined, while the share of aquaculture increased. This is the same for Indonesia, where aquaculture now accounts for ~40% of total fish supply.
- The Bangladesh Blue Economy Dialogue on Fisheries and Mariculture aims to enhance environmental and social sustainability of fisheries and aquaculture and to explore new opportunities in marine aquaculture.

	Total	Inland capture	Aquaculture	Marine capture
2018-19 in MN MT	4.385	1.236	2.489	0.660

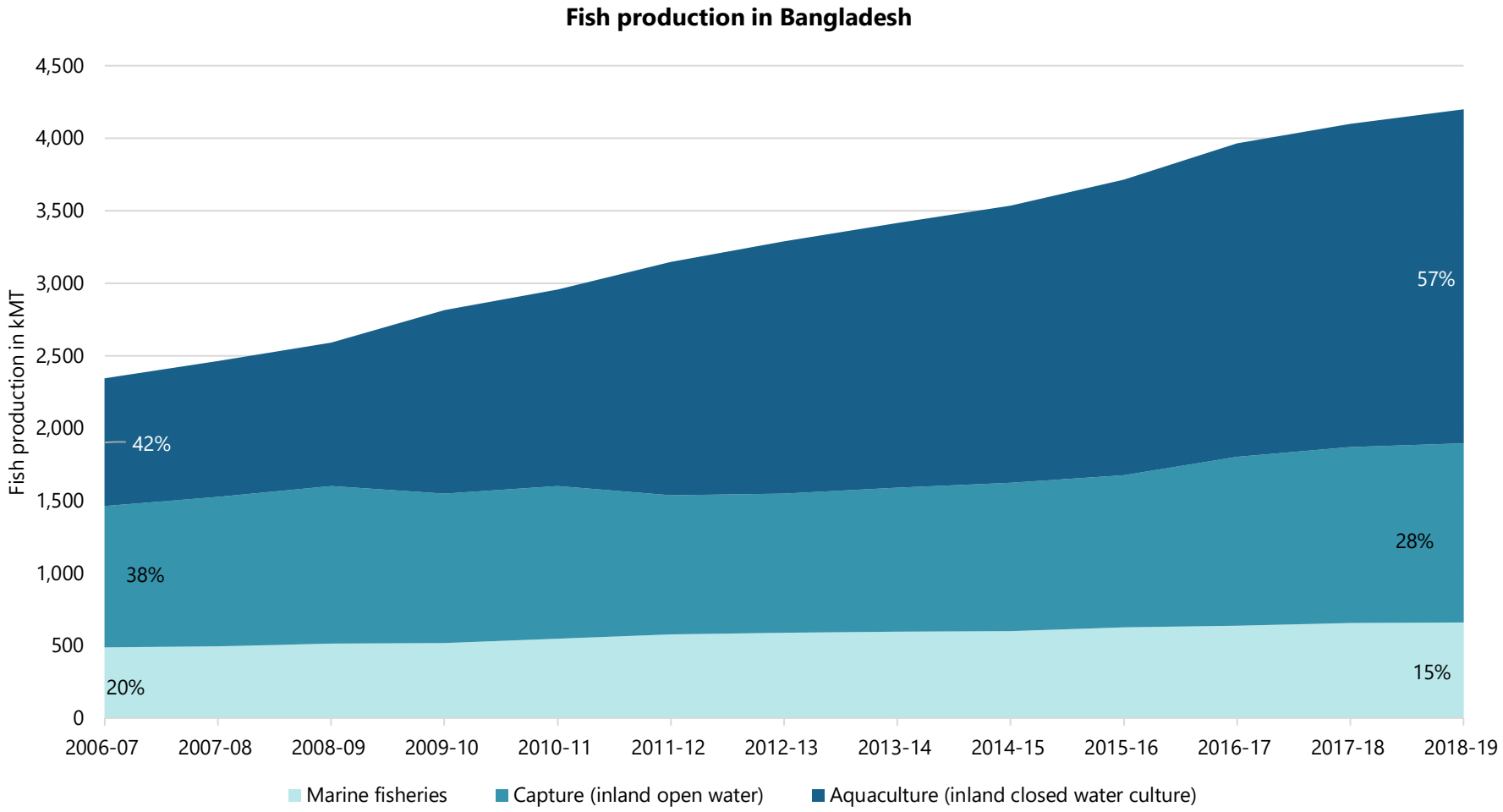


Source: FAO (2020) and USDA (2020)

Sources: Larive-LightCastle analysis (2020-21), FAO (2020), and Shamsuzzaman et al. (2020).

Annex I: Identification of species and production overview

Total fish production in Bangladesh in 2018-2019 equals ~ 4,385 kMT



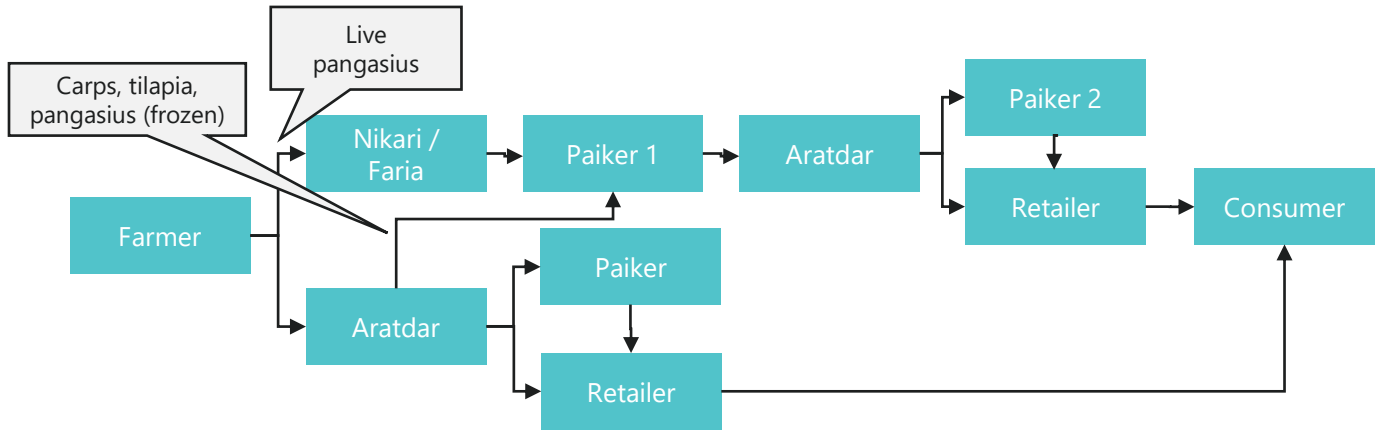
Sources: Yearbook of Agricultural Statistics Bangladesh 2019, Larive-LightCastle analysis (2020-21).
Notes: [1]Shrimp production data has been amended by LightCastle-Larive.
[2]Inland fisheries production includes both (marine) aquaculture and inland capture.

Annex I: Marketing channels - fish

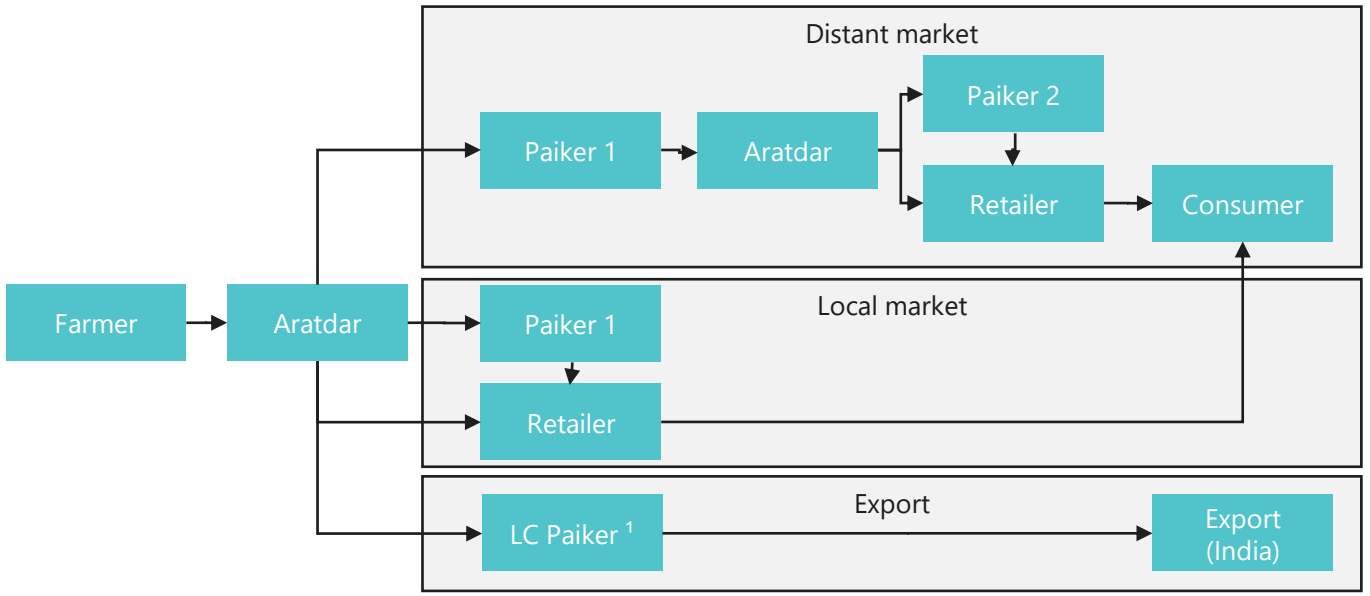
Aratdars (commission agents) have a strong influence

- The route-to-market of cultured fish is controlled by an integral network of traders, distributors, financers and retailers. Each actor trading and/or distributing fish in Bangladesh receives a markup / kg of fish product. The size of the markup depends on their negotiation power with the stakeholders with which fish is traded.
- *Aratdar, the* commission agents, are the main and most influential actors in the fish value chain. *Aratdars* negotiate sales of fish on behalf of the producers/ seller and are in control of each sale. *Aratdars* sell fish through auctioning and receive a commission, of which the size depends on the fish species. *Koyals* work on behalf of *Aratdars* and organize the auctions.
- The *Paiker* (or *bepari)* takes care of the transportation of large volumes of fish. They often fulfill an assembly role in the supply chain. *Paiker* can also purchase fish from *aratdars* and sell the fish to second-tier *aratdars,* who in turn sell to retailers. Hence, in some cases, produced fish can be routed through secondary or tertiary markets when it passes through multiple commission agents.
- Smaller and less-influential actors can be active at the beginning of the supply chain. The *Nikari* and *Forias* are middleman that distributes fish without having ownership of the product. Through establishing a bridge between the seller and buyer, it receives commission from the farmer.
- Two forms of last-mile distribution are common. One form is where urban retailers sell fish in urban areas in fixed stalls or by taking the fish to homes. The other form is where retailers distribute fish to suburban areas where fish is sold at village markets and bazaars around city towns.
- The traditional marketing system entails significant problems, including loss of fish and suboptimal quality. Since fish supply generally falls short of demand, little incentives exist for suppliers and trader to change the system.

Domestic supply chain tilapia, carp and pangasius



Supply chain hisha



Source: Marketing of Major Fish Species in Bangladesh: A Value Chain Analysis - Ferdous Alam et al (2012).

Notes: [1] The LC paiker, in the export chain, is the authorized holders of the letter of credit.

Annex I: Transport

Limited infrastructure causes challenges in transport and reduced product quality

Transport processes

- The logistics of transporting live fish over long distances is delicate and requires specialized vehicle and equipment such as oxygen supply and containers. Species-specific transport:
  - Live carps are transported in large trucks lined with plastic sheets and are fitted with pumps to recirculate water around to maintain oxygen level.
  - Puti fish that are brought live, using oxygen bags. Puti fish are shipped in bags of 1.5 – 2 KG each. Pabda, Gulsha and Kholshe fish are also brought in live using this process.
  - Jiyol fish are transported in drums with perforated lids.
- Fish is a perishable good with strict requirements for transport. Transport players are utilized at various stages of the value chain, picking up and delivering shipments between each adjacent actor in the supply chain. They provide important transport services through their fleet of trucks and pick-up vehicles, and contracts with the transporters are often based on a lump-sum price depending on the size of a vehicle and the distance to be travelled.
- Carrying-containers, even for live fish, are usually not provided by the transporters, but by moneylenders (Majadan) or retailers (Paikars). Containers can also be hired from the transporters on a pay per-use basis.
- An estimation of transportation cost using covered van and container trucks from Dhaka to major divisions of Bangladesh is provided in the following table:

Division	Distance (KM)	Covered van		Container truck	
		BDT	**EUR**	**BDT**	**EUR**
Chittagong	244	13,544	135	13,842	138
Khulna*	270.3	17,783	178	25,195	252
Rajshahi	247.7	13,750	138	14,052	141
Mymensingh	112.3	6,234	62	6,371	64

Infrastructural challenges

Fish sellers are hampered by a lack of good transport infrastructure. Particularly, shipments from Jessore, Khulna and Satkhira region suffer from delays and lost production value due to the difficulty of crossing the ferry at the Padma river. Passenger vehicles are provided priority during ferry crossing and trucks carrying shipments must wait for many hours to cross, which is detrimental for perishable products like fish.

Domestic transport

Source: LightCastle-Larive Primary Data, The Daily Star

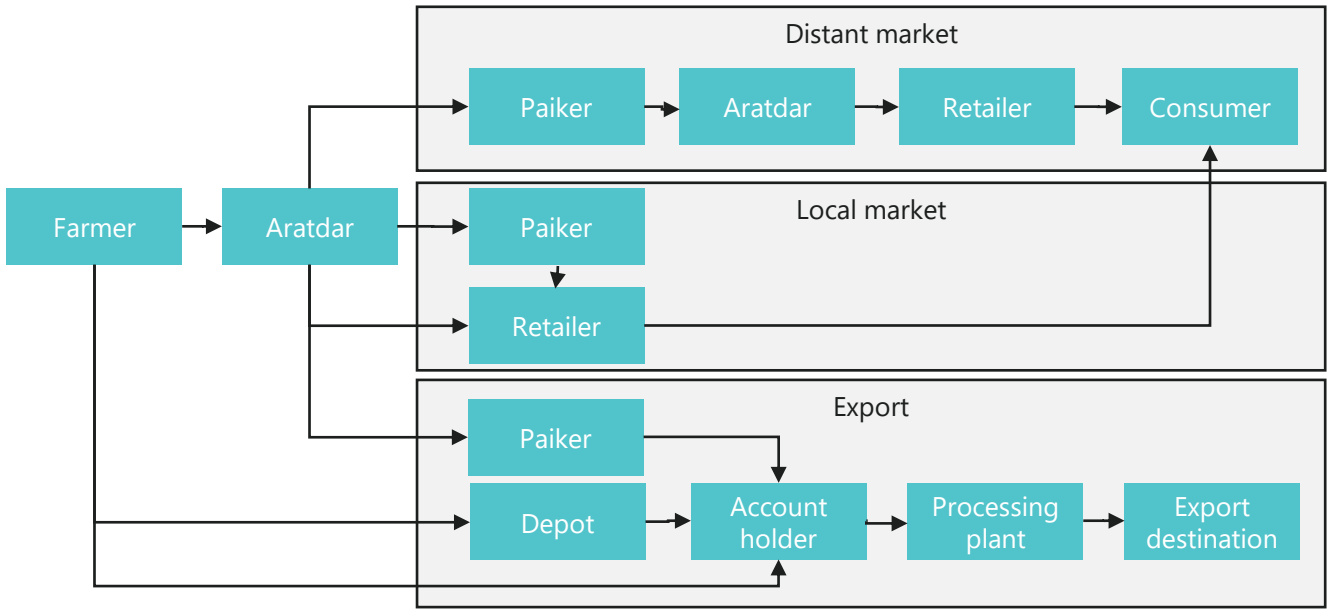
*Khulna is estimated to have a higher logistical cost per km as vehicles must cross a ferry to reach Khulna from Dhaka.

Annex I: Marketing channels - shrimp

Depot owners trading shrimp for the export market face competition from 'paikers' offering more favorable prices to farmers

- Shrimp depots are shops with own properties and staffs and act as the intermediary between farmers and commission agents. Depot owners offer *dadon* (cash loans to farmers). In return, they negotiate buying shrimp at a fixed price, which can be below the market price. Product adulteration, such as injecting water, tends to happen at depots. Depot owners face competition from *Bepari* who source shrimp from *aratdars,* after which they sell shrimp to account holders. The price for a kg of shrimp received by farmers is higher compared to compensation from depot owners.
- In the export value chain, account holders act as the commission agents. They are the actors earning the highest profit margin with low risk. They finance paikers and farmers and provide credit terms to processors. As they finance both actors up- and downstream, they possess an influential role is the export chain. They determine to a large extent the prices in the market. Due to their strong influence, farmers, bepari or depot owners cannot sell to processors directly. Account holders sell shrimp to processors. Processors usually have access to a network of four to five account holders.
- Upon sales of shrimp harvest to depots, extensive farmers usually receive immediate payment in cash. Upon sales of shrimp harvest to collectors or commission agents, farmers expect to receive their payment after a period of 7 days. Semi-intensive farmers rely less on credit and settle payments through either cash or bank transfers within 2-3 days of transaction. This applies for both input purchases and sales to forward markets.
- Almost all farmers extensive farmers who practice on leased land are indebted, both to their suppliers and also to local moneylenders on high interest loans. Many extensive farmers are able to secure loans from their local collectors (*Nikari/Faria*) or depot owners as working capital, sometimes interest-free, on the condition of off taking produce to the loaning collector or depot. No form of contract farming is practiced in the shrimp sector of Bangladesh (neither for extensive or semi-intensive farmers).

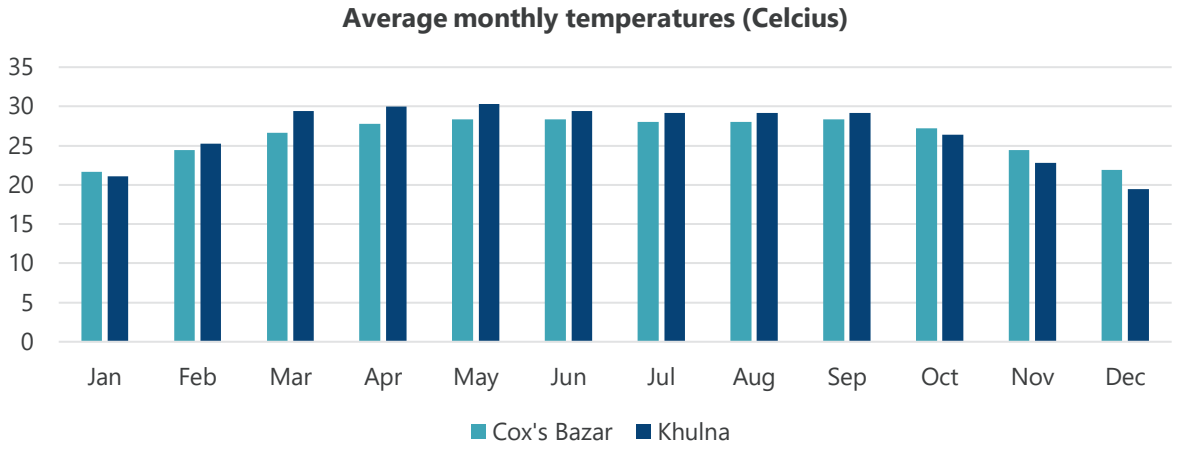
Supply chain shrimp

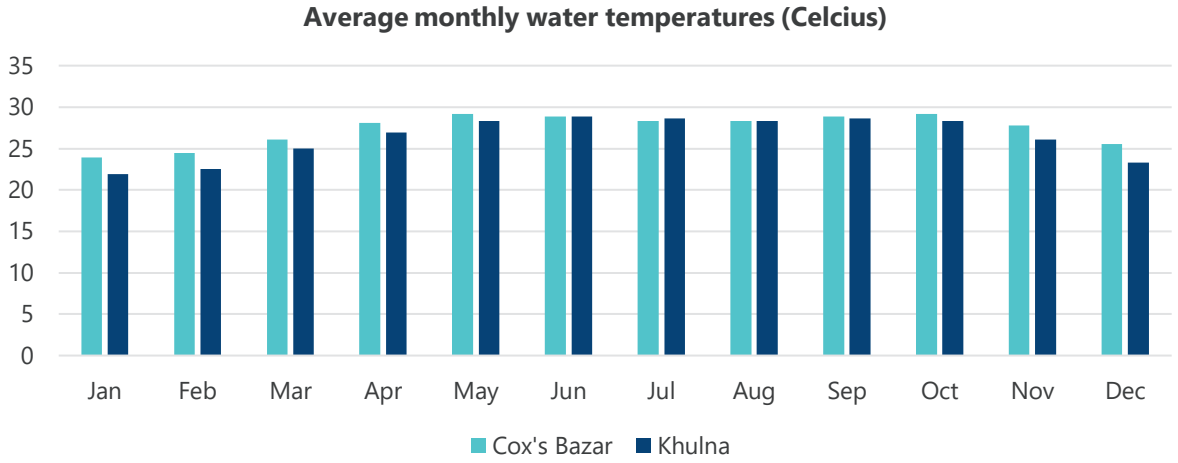


Source: Marketing of Major Fish Species in Bangladesh: A Value Chain Analysis - Ferdous Alam et al (2012).

Annex I: Bangladesh's climate conditions for aquaculture

Highest water temperatures are observed in April-Oct, which coincides with the shrimp and fish aquaculture season





Climate conditions

- Temperatures in Bangladesh are highest during the summer months of April-Oct.
- Water temperature variability is higher during winter than during summer months For measured water temperatures, the variability during winter months is even more substantial.

Conditions for shrimp farming

- Vannamei shrimp can thrive under a range of diverse temperatures yet grows optimally between 23 30 ºC The optimal temperature approximates 30 ºC for small (1-5 gram) and 27 ºC for larger shrimp Vannamei can tolerate temperatures as low as 15 ºC up to 33 ºC without complications but will grow at a slower rate Vannamei can be cultivated all year round in India given its broad temperature tolerance.
- Rosenbergii shrimp can thrive under a range of diverse temperatures yet grows optimally between 24 - 29 ºC. At 34 ºC M. Rosenbergii shrimp growth starts to decline, they can tolerate temperatures as low as 15 ºC and as high as 33 ºC.
- Monodon shrimp can thrive under a range of diverse temperatures yet grows optimally between 25 - 30 ºC. At 36 ºC Monodon shrimp growth starts to decline; they can tolerate temperatures as low as 12 ºC and as high as 37.5 ºC.
- Temperatures in the two main growing regions, Khulna and Cox's Bazar, are very similar throughout the year.

Conditions for fish farming

- The optimum temperature for tilapia cultivation ranges between 28 ºC and 30 ºC. Body weight growth reduces swiftly when the water temperature falls below 20 ºC.
- Carp grows best between 23 °C and 30 °C. Carp can survive cold winter periods.
- When cultivating pangasius, water temperature should fall in the range of 22-30 °C.

Source: Weatherspark.com (2020), FAO (2005) and IJESE (2010).

Annex I: Shrimp production - geographical overview

Highest productivity for Monodon and Rosenbergii cultivation is observed in Satkhira and Cox's Bazar, respectively

Region	Total shrimp production FY 2017-18 in MT	% of total	Total shrimp production FY 2013-14 in MT	CAGR	Rosenbergii production FY 2017-18 in MT	% of total production 2017-18	Rosenbergii production FY 2013-14 in MT	CAGR	Monodon production PY 2017-18 in MT	% of total production 2017-18	Monodon production FY 2013-14 in MT	CAGR	Nr of Monodon hatcheries	Monodon PL production in 2017
Bagerhat	33,193	27.08%	37,007	-2.15%	14,962	29.01%	13,801	1.63%	16,242	26.32%	21,635	-5.57%		
Jashore	9,850	8.04%	5,504	12.34%	9,207	17.85%	5,246	11.91%	507	0.82%	235	16.62%		
Khulna	28,346	23.13%	28,270	0.05%	14,502	28.12%	12,539	2.95%	12,463	20.20%	14,965	-3.59%	8	1.16 BN[1]
Satkhira	30,176	24.62%	29,744	0.29%	6,363	12.34%	6,665	-0.92%	20,941	33.94%	18,373	2.65%	14	1.58 BN
Cox's Bazar	12,733	10.39%	13,593	-1.30%	454	0.88%	198	18.03%	10,175	16.49%	12,947	-4.70%	34	9.87 BN[2]
Narail	2,658	2.17%	1,895	7.00%	2,478	4.80%	1,122	17.17%	-	0.00%	-	0.00%		
Total	**116,955**	**95%**	**116,009**		**47,966**	**93%**	**39,571**		**60,328**	**98%**	**68,155**			

Notes: Only d*istricts with total production of over 2,500 MT have been shown here.*
[1]Note: SPF Monodon PL production of 50 MN in 2019
[2]Note: SPF Monodon PL production of 250 MN in 2019

Annex II: Fish hatchery segment

The lack of quality seed is a major challenge for farmers

➢ **Logistics**

- Transported through pickup van/truck using large polythin bag or plastic drum filled with oxygen.
- Incoming shipments of broodstocks are transported using trucks, through large plastic drum filled with oxygen. The broodstock can survive 6-8 hours on in stagnant water and 10-12 hours in artificially circulated water.
- Seed traders play an important role in bridging the supply chain between hatcheries and client farmers (see picture on the right – courtesy of WorldFish).

➢ **Credits and working capital**

- Payments to suppliers by hatcheries are made via advance payment or in cash at the time of delivery or in credit – or a mix of all these. When credit is involved, the repayment period is generally one week. Several factors dictate the mode of payment such as the availability of broodstock at a certain point in time, the relationship with the supplier etc.
- Similarly, when it comes to receipts, hatcheries generally offer a choice of cash payments or credit or a mix of both. The credit cycle is longer for sales as farmers are offered repayment periods ranging one month up to several months as dictated by the time to harvest and sell the fish produced in the marketplace.
- Hence, hatcheries do require a large amount of working capital to manage their operations.

➢ **Challenges and quality issues in the fish hatchery segment**

- Proper selection of breeders is not maintained (poor selection of broodstock); in many cases, hatcheries source seed from local ponds and mother broods from the local wet markets.
- Closely related and small stocks have been repeatedly used generation after generation resulting in inbreeding, genetic drift and reduced resistance to diseases.
- Negative selection are made for smaller size at sexual maturation.
- Failure to follow selection criteria for improved varieties of mirror carp and GIFT tilapia results in loss of improved performance;
- Hazardous and indiscriminate hybridizations result in genetic introgression of several species.
- Due to poor quality of broodstock and seeds, survival rates for hatchlings can be as low as 30-40% for some nurserers who rear hatchlings purchased from these hatcheries.
- Nurserers also have very little regard for bio-security, using the same pond both for nursing and then farming purposes within the same year.
- Prices of hatchlings fluctuate widely based on the season of the year; times of shortage can lead to price spikes.
- Seed traders often operate with very limited working capital, taking short-term renewable loans of several days from hatchery owners, rather than paying cash in advance each time they obtain seed.

Source: Larive-LightCastle analysis (2020-21).

Annex II: Definition of species

Fish Group	Fish species (local name)	English name	Scientific name	Major feed type	
				Sinking	Floating
Major Carp	Rui	Rohu	Labeo rohita	X	X
	Catla	Catla	Catla catla	X	X
	Mrigel	Mrigal	Cirrhinus cirrhosus	X	
Other Carp	Kalibaus	Orange fin labeo	Labeo calbasu	X	X
	Bata	Bata	Labeo bata	X	
	Gonia	Kuria Labeo	Labeo gonius	X	X
Exotic Carp	Silver Carp	Silver Carp	Hypophthalmichthys molitrix	X	X
	Grass Carp	Grass Carp	Ctenopharyngodon idella	X	X
	Common Carp	Common Carp	Cyprinus carpio	X	X
	Mirror Carp	Mirror Carp	Cyprinus carpio carpio	X	X
	Big Head Carp	Bighead Carp	Hypophthalmichthys nobilis	X	X
	Black Carp	Black Carp	Mylopharyngodon piceus	X	X
Other Catfish	Boal	Freshwater Shark	Wallago attu	X	X
	Ayre	Long-whiskered Catfish	Sperata aor/ Aorichthys aor	X	X
	Silon	Silond Catfish	Silonia silondia	Could not be identified	
	pangasius	pangasius	pangasiusianodon hypophthalmus		X
	Ritha	Rita	Rita rita	X	
Snake Head	Shol	Striped Snakehead	Channa striatus	X	
	Gajar	Giant Snakehead	Channa marulius	X	
	Taki	Spotted Snakehead	Channa punctatus	X	
Live fish	Koi	Climbing Perch	Anabas testudineus		X
	Shing	Stinging Catfish	Heteropneustes fossilis	X	
	Magur	Walking Catfish	Clarias batrachus	X	
Prawn	Golda	Giant Freshwater Prawn	Macrobrachium rosenbergii	X	
Shrimp	Bagda	Giant Tiger Prawn	Penaeus monodon	X	
Tilapia	Tilapia	Tilapia	Oreochromis niloticus		X

Source: LightCastle Primary, WorldFish (http://pubs.iclarm.net/resource_centre/WF_2970.pdf) and other Secondary sources

Annex II: Glossary of local fish species

Sl. No.	Local Name	Scientific Name
1	Ayre	*Aorichthys aor*
2	Bagair	*Bagarius bagarius*
3	Bagda	*Penaeus monodon*
4	Baila	*Glossogobius giurus*
5	Baim	*Mastacembelus armatus*
6	Banshpata/Kajoli	*Devario devario*
7	Bata	*Labeo bata*
8	Batashi/Tinkata	*Neotropius atherinoides*
9	Black carp	*Mylopharyngodon piceus*
10	Boal	*Wallagu attu*
11	Catla	*Catla catla*
12	Chanda	*Chanda nama*
13	Chapila	*Gadusia chapra*
14	Chela	*Salmostoma bacila*
15	Chitol	*Notopterus chitala*
16	Coral	*Heniochus acuminatus*
17	Darkina	*Esomus danricus*
18	Dhela	*Osteobrama cotio*
19	Foli	*Notopterus notopterus*
20	Gajar	*Channa marulius*
21	Golda	*Macrobrachium rosenbergii*
22	Grass carp	*Ctenopharyngodon idellus*
23	Guchi	*Mastacembelus pancalus*
24	Gulsha	*Mystus bleekeri*
25	Gura Chingri	*Macrobrachium tenuipes*
26	Gutum	*Lepidocephalichthys guntea*
27	Ilish	*Tenualosa ilisha*
28	Kalibaus	*Labeo calbasu*
29	Karfu	*Cyprnus carpio*
30	Kechki	*Corica soborna*

Sl. No.	Local Name	Scientific Name
31	Khalisha	*Colisa fasciatus*
32	Koi	*Anabas testudineus*
33	Lachu/Raikhon	*Aspidoparia jaya*
34	Magur	*Clarias batrachus*
35	Mola	*Amblypharyngodon mola*
36	Mrigel	*Cirrhinus mrigala*
37	Nilotica	*Oreochromis nilotica*
38	Pabda	*Ompok pabda*
39	Pangasius (or pangas)	*pangasiusianodon hypophthalmus*
40	Piyali/Joya	*Cirrhinus reba*
41	Poa	*Otolithoides pama*
42	Potka	*Tetraodon fluviatilis*
43	Puti	*Puntius puntio*
44	Ritha	*Rita rita*
45	Rui	*Labeo rohita*
46	Rupchada	*Pampus chinensis*
47	Sarputi	*Puntius gonionotus*
48	Shing/Kanos	*Heteropneustes fossilis*
49	Shol	*Channa striatus*
50	Silver carp	*Hypophthalmichthys molitrix*
51	Taki	*Channa punctatus*
52	Tengra	*Mystus vittatus*
53	Tilapia	*Oreochromis mossambica*
54	Vetki	*Lates calcarifer*
55	Gura Chingri	*Macrobrachium lamiri*
56	Faisa	*Settipina Phasa*
57	Bighead Carp	*Hypophthalmichthys nobilis*

Annex II: Overview of hatcheries

Name of Hatchery/ Owner	Location	Area of Pond (Ha)	Production Capacity	Production in 2020	Notes on companies
Quality	Bogura	167 bighas	175 MN fry (to be upgraded to 195 MN in 2021)	175 MN fry	Partnership with Asian Institute of Technology (AIT). Produces Tilapia and pangasius fry
Spectra/Mega	Jessore and Mymensingh		100 – 150 MN fry	200 MN fry	Partnership with Namsai from Thailand. Produces only Tilapia fries now but expecting to pilot produce pangasius in 2021
CP			100 – 150 MN fry	Not known	Tilapia fry
Paragon			<10 MN fry	Not known	Tilapia fry
Nourish	Gazipur		Not known	Not known	Partnership with Asian Institute of Technology (AIT) and AARM to produce Nile Tilapia fry. Unclear if they are still in operation.
Md. Abdul Kader	Mymensingh	4.04	44,500 KG	35,000 KG	Largest listed hatchery with DoF in Mymensingh
Md. Kudrat Elahi	Mymensingh		16,000 KG	15,000 KG	Second- largest listed hatchery with DoF in Mymensingh
Hritish Chandra	Mymensingh	10	8,500 KG	8,000 KG	
Deshbondhu Hatchery & Nursery	Mymensingh	5	9,000 KG	8,600 KG	
Babu Kuber Prasad Chowhan	Mymensingh	2.12	11,920 KG	9,400 KG	
Muktesshore Hatchery	Jessore		3,500 – 4,000 KG		
Shamsuddin (Kalu)	Cumilla	25 tanks and 110 bottles	13,650 KG	13,450 KG	Specializes in Silver Carp, Bigheaad Carps, Katla, Mrigel, Kalibaush, pangasius and Rui. Largest hatchery in Cumilla.
Jalal Ahammad	Cumilla	10 tanks and 85 bottles	8,160 KG	8,140 KG	Specializes in Silver Carp, Bigheaad Carps, Katla, Mrigel, Kalibaush, pangasius and Rui. Second largest hatchery in Cumilla.
Md. Shafiqul Islam	Bogura	5 circular tanks and 15 cistern tanks	15,000 KG	7,885 KG	Largest listed hatchery with DoF in Bogura. Specializes in pangasius, Rui, Mrigel, Silver Carp, Bighead Carp, Mirror Carp, Grass Carp, Shing, Koi, Bata and Magur
Partner Agro Fishery Farm and Hatchery	Bogura	5 tanks and 37 bottles	10,000 KG	5,520 KG	Specializes in Rui, Mrigel, Katla, Silver Carp, Bighead Carp, Mrigel, Grass Carp, Rajputi, Bata, Black Carp, Kalibaush, Monosex Tilapia, Raikhor, pangasius, Shing, Magur, Gulsha, Pabda, Guchi and Indigenous Koi

Source: DoF Mymensingh and interviews with Hatchery owners.

Notes: DoF measures hatchlings in KG, while large organized hatcheries measure pangasius and Tilapia hatchlings in number of fry.

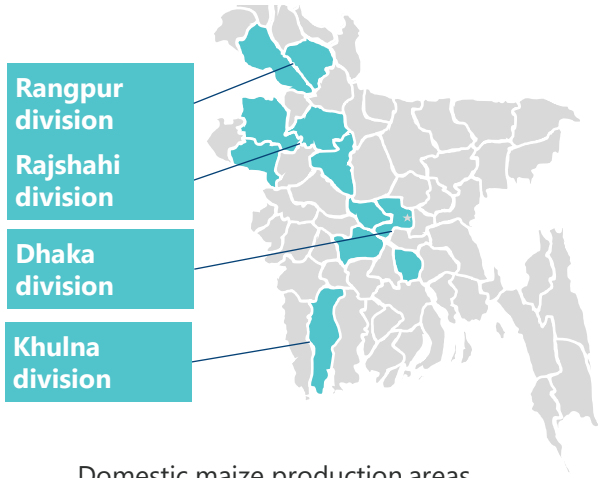
Annex III: Regions producing feed ingredients in Bangladesh

Bangladesh is mostly import-dependent for sourcing raw materials required for feed production

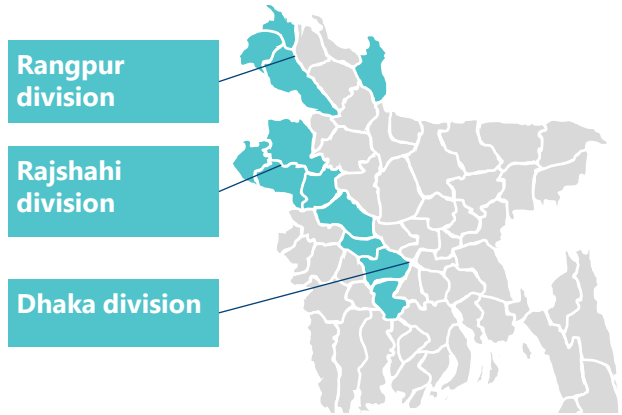
Division	Rape and mustard seed (MT)	Soybean (MT)	Wheat (MT)	Maize (MT)
Barisal	2,175	7,572	6,441	3,721
Chattogram	22,018	103,209	7,452	97,093
Dhaka	59,694	-	181,365	239,453
Khulna	30,401	-	95,218	753,801
Mymensingh	14,573	3	21,317	108,287
Rajshahi	147,417	-	403,614	421,689
Rangpur	31,504	1	298,624	1,945,214
Sylhet	3,958	-	2,707	63

- The major ingredients used to produce feed in Bangladesh are rape seed extracts, soybean extracts, sterilized fishmeal, rice bran, and wheat. Other ingredients such as canola meal, vitamin premix, mineral premix, binders are also used.
- For maize and soybean, the country is dependent on local production and import from India and South America.
- Rape seed and wheat are mostly locally sourced and exported from India.
- For fish meal, the country is mostly dependent on import from India.

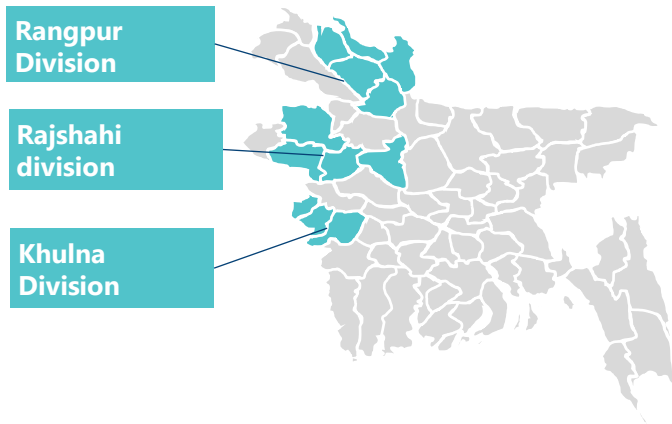
Domestic rapeseed and mustard production areas



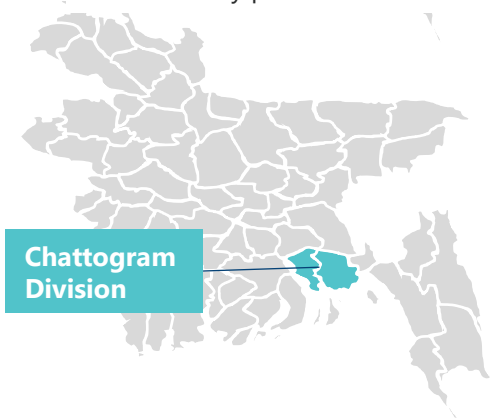
Domestic wheat production areas



Domestic maize production areas



Domestic soy production areas



Source: Agricultural Yearbook of Statistics 2019, LightCastle-Larive primary data (Interviews).

Annex III: Fish and shrimp feed pricing overview in Bangladesh

Aquaculture floating feed segment

Brand name	Bag size	Feed type	Price per kg (EUR)
Quality	25 kg	Finisher	0.36 – 0.37
	20 kg	Grower	0.58 – 0.59
		Starter	0.68
CP	10 kg	Starter	1.30
	25 kg	Finisher	0.50 – 0.51
		Starter	1.28 – 1.29
Mega	50 kg	Finisher	0.38 – 0.39
Aman	20 kg	Starter	0.45 – 0.46
	25 kg	Starter	1.10

Aquaculture sinking feed segment

Brand name	Bag size	Feed type	Price per kg (EUR)
Quality	25 kg	Finisher	0.34
	20 kg	Grower	0.58
		Starter	0.63
CP	10 kg	Starter	1.21 – 1.24
	25 kg	Finisher	0.45 – 0.46
		Starter	1.19 – 1.21
Mega	50 kg	Grower	0.37– 0.38
Aman	20 kg	Grower	1.10 – 1.20
	25 kg	Starter	1.08 – 1.09

Shrimp only – feed segment

Type of feed		Price (US$/Kg)	FCR	% of total sales	Commission (%)
Gold Plus (Premium segment)	Pre-Nursery	1.18	2 – 2.5	14%	8% -9%
	Nursery 1	0.83			
	Nursery 2	0.83			
	Starter	0.71			
	Grower	0.65			
Special (Value Segment)	Nursery 1	0.61	3 – 3.5	80%	7% - 8%
	Nursery2	0.61			
	Starter	0.57			
	Grower	0.53			
Shundori Plus (Economy Segment)	Starter	0.48	3.5 – 4	6%	7%
	Grower	0.46			

Aquaculture floating feed segment

	Pellet Size (mm)	Bag (Kg)	Price Per Kg (EUR)
Fingerling	0.5	10	1.10
	0.8	10	0.94
	1	20	0.99
	1.5	20	0.69
Brood	2	20	0.52
	3	20	0.54
	Grower	20	0.47
	Finisher	20	0.46

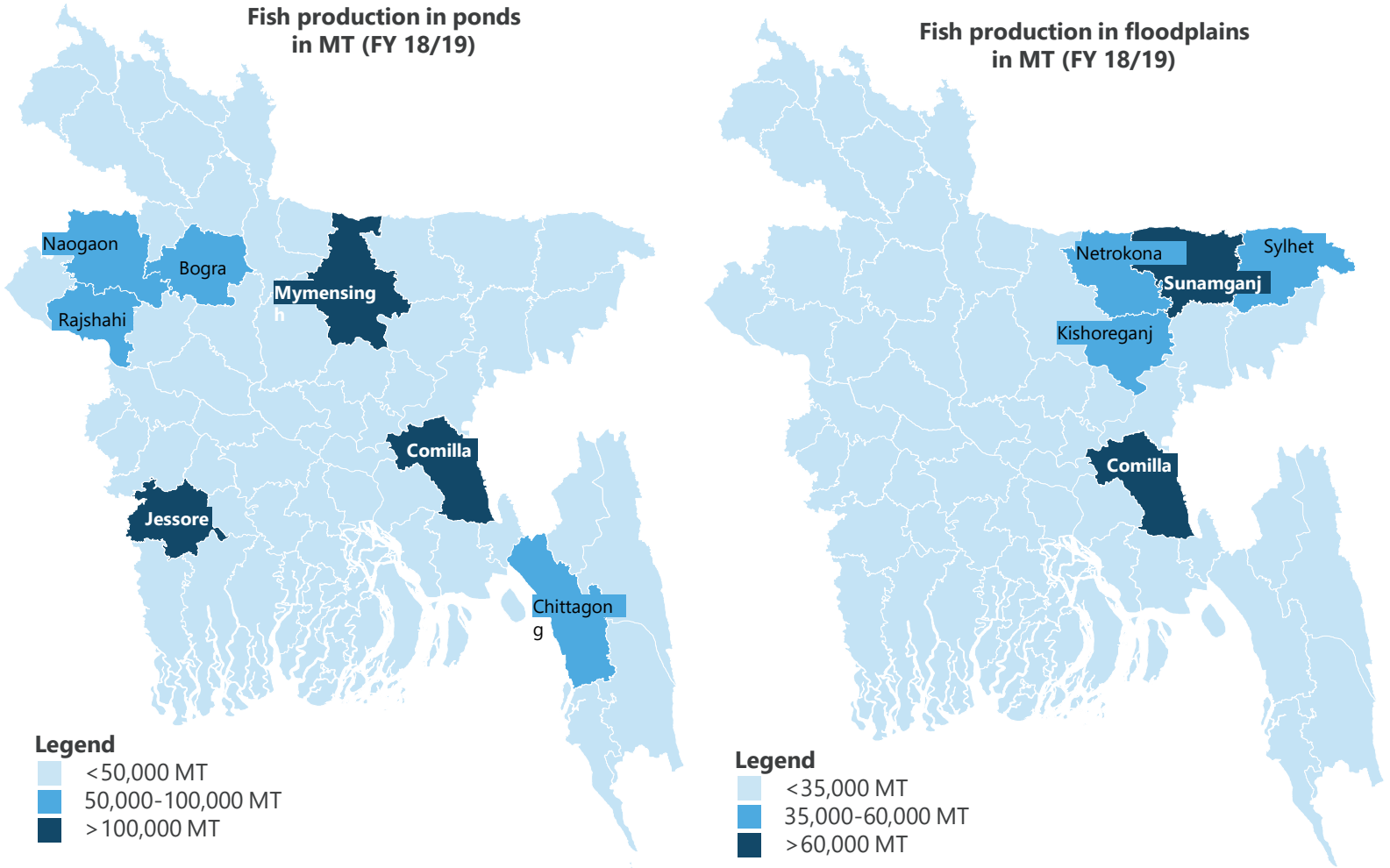
Aquaculture sinking feed segment

Type	Species	Bag (Kg)	Price Per Kg (EUR)
Grower	Carp	25	0.31
	pangasius	25	0.37
Starter 1	pangasius	20	0.48
Starter 2	pangasius	20	0.50
Starter 3	pangasius	25	0.41
Finisher	pangasius	25	0.37

Annex IV: Geographical distribution of production in ponds and floodplains

The North-Eastern regions are mostly used for floodplain production, while pond production is the dominant method

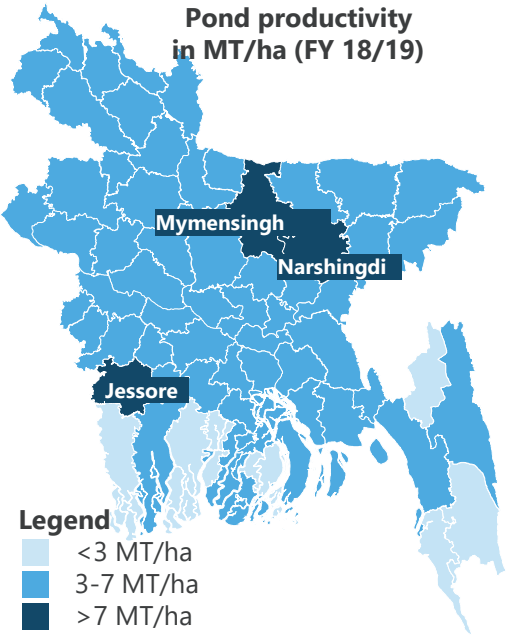
- Most fishponds are in the Jessore and Comilla regions. Other fishpond-dense areas are Bogura and Chittagong.
- Located in the Ganges Delta, Bangladesh is a country of rivers and prone to floods. 80% of Bangladesh consists of floodplains, meaning low-laying ground near rivers.
- During the rainy season, floodplains are flooded and can be used for fish farming. Crops such as rice can be cultivated during the dry season.



Source: Yearbook of fisheries statistics of Bangladesh 2018-2019.
Note: high-res images available upon request.

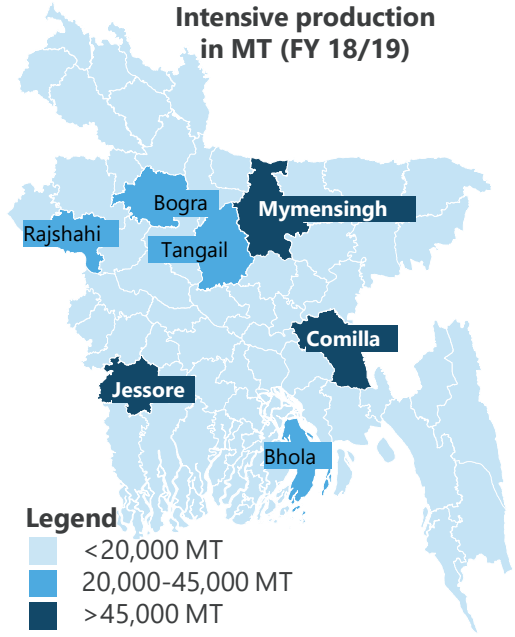
Annex IV: Geographical distribution of production in ponds by intensity

The majority of fish farmers use semi-intensive methods – however, intensive farming is increasing rapidly

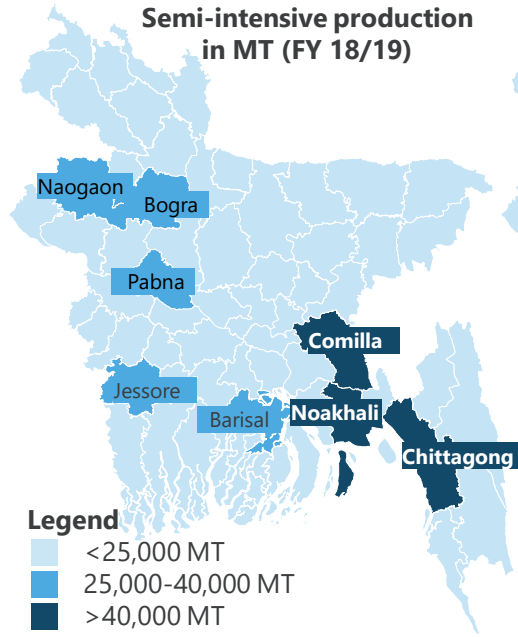


- The productivity spread of pond cultivation in Bangladesh in large. Productivity in Narshingdi, Jessore and Gazipur is highest, ranging from a yield of 6.5 to 8 MT per hectare per year, whereas productivity in Southern and North Western areas is lower reaching 2.5 MT / ha per year.

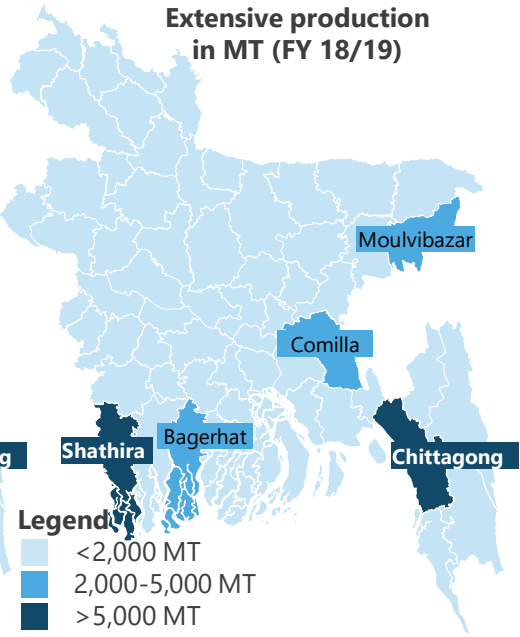
- Fish production in highly intensive production systems contribute 19% to fish production in ponds, which has remained at par. Productivity in highly intensive systems is over 10 MT/ha.



- Intensive systems account for 34% of fish production in ponds and grew at 8.9% CAGR during the past two years. Productivity in intensive systems ranges between 4 and 10 MT/ha.



- Semi-intensive systems amount for 44% of fish production in ponds. Semi-intensive pond production grew at 2.2% CAGR.
- Productivity in semi-intensive systems ranges between 1.5 and 4.0 MT/Ha



- Extensive systems amount for 2-3% of fish production in ponds.
- Fish production in extensive ponds shrank at a CAGR of 12.4% during the past two years.
- Productivity in extensive pond systems is lower than 1.5 MT/Ha.

Source: Yearbook of fisheries statistics of Bangladesh 2018-2019.
Note: high-res images available upon request.

Annex IV: Fish cultivation practices in Bangladesh

With semi-intensive farming as the most dominant production method, production is largest for intensive farming systems

	Pond production			Seasonal waterbody culture farms
	Intensive and Highly-intensive farms	Semi-intensive farms	Extensive farms	
Farm infrastructure	(Highly) Intensive farms are usually smaller in size and with expensive infrastructure. Farmers tend to clean their tanks with limestone before setting up. Furthermore, fertilizers and medicines are added to the water after analyzing the necessity and considering the quality of water manually. In Bangladesh, most farmers tend to distribute feed manually. In terms of recirculating the water, farmers tend to pipe in and out the water simultaneously when needed. Farmers also use motors to regulate the oxygen supply/ meter in the water. Farmers use nets to protect the water from getting contaminated and to provide a controlled environment. The water is sourced from natural sources however, it is treated before use.	Semi-intensive fish culture system is more prevalent and involves rather small ponds with higher stocking density that extensive farms. Most farmers tend to distribute feed manually taking into consideration that natural feed are also available in that environment. The water is sourced from natural sources however, it is treated before use. In semi-intensive farming, farmers do not necessarily use any pump or motor to maintain the oxygen level of the water as they are mostly dependent on the natural supply and recirculation. Additionally, farmers tend to pipe in and out the water simultaneously when needed.	In extensive fish farming system, the fish production relies merely on the natural productivity of the water which sometimes is only slightly enhanced. In most cases, farmers tend to allow the natural cycle to continue. However, sometimes farmers are required to put in medicine if there are any risk of virus being present in the fish. Extensive fish farms are relatively larger in size and comparatively inexpensive to maintain and built. The source of water is the natural source that is available in the region.	Seasonally waterbody culture farming is similar to extensive farming method. However, it is completely dependent on naturally provided resources. Additionally, seasonal waterbody culture farms are smaller in size depending on the location.
Cultivation practices	In (highly) intensive farms, farmers tend to practice both monoculture and polyculture. In Bangladesh, farmers are learning and adapting to new technologies enhancing the abilities of intensive farming. Farmers practice regular feeding with commercial feed. Farmers have strong control over stock management, and they regularly conduct pond monitoring. Frequent recirculation of water is practices, and the level of productivity is higher.	In semi-intensive farms, polyculture is mostly practiced by farmers. Farmers tend to use fertilizers regularly with occasional use of low-quality supplemental feed consisting of rice bran and oil cakes. Fish nutrition is derived from both natural feeds produced in the pond and from external input. Farmers have control over stock management in the pond. The pond water is occasionally changed depending on the need. It has moderate to high level of productivity.	In extensive farming, farmers practice polyculture. Farmers depend mainly on the natural productivity of the waterbody for fish growth. There is minimal use of low-quality supplemental feed such as farm by-products, rice bran, mustard oil cake, etc. Fertilizers are rarely used. The farmers have low level of control over stock management. The productivity of fish is also low.	In seasonal waterbody culture, fish farming are mostly conducted along with crop farming. The fish get fed by the by-products from the crop farming along with naturally available feed. The fertilizer used for the crops also benefits the water. The level of productivity is significantly low in this farming practice.

Source: WorldFish, Yearbook of Fisheries Statistics, Larive-LightCastle Primary Data

Annex IV: Semi-intensive Monodon farming practices

Cultivation period	There are two major crop cycles – one from March – June/July and the second one from June/July – October/November. The second crop is more lucrative and centered around the global Christmas demand.
Stocking density	10 - 15 PL/m2
Productivity	According to government figures, the productivity of semi-intensive Monodon hovers around 4MT/Ha. However, semi-intensive growers interviewed were found to have achieved as high as 7 – 14 MT/Ha by operating well-maintained facilities.
Survival rate	Typical PL survival rate is until harvest is around 70-75%, going up as much as 84%. The opening of SPF PL Hatchery in Khulna (southwest Bangladesh) has resulted in improved PL survival rates as losses during transportation have been reduced.
Feed	At least 90% of all feed consumed by semi-intensive farmers are imported through authorized dealers. CP is the largest brand (imported by same owner of Desh Bangla) and Uni-President, a Vietnamese import (imported by the same owner of MKA Hatchery). Other imports from India are - Avanti brand (imported by Fishtec), Falcon brand and Lion Brand. Prices range from 110 BDT (US$ 1.30)/KG to 138 BDT (US$ 1.60)/KG. Semi-intensive farmers generally do not prefer local shrimp feed as their nutritional quality and FCR are not as high as imported ones, and they are also detrimental to water quality.
Culture practices	Semi-intensive farmers practice mono-culture of Monodon. There were no semi-intensive Rosenbergii farms as of 2019.
Popular district	There are currently 830 ha of land under semi-intensive shrimp culture in South West Bangladesh, of which 40 Ha are in Bagerhat, 540 Ha are in Khulna and 250 Ha in Satkira.
Disease	Mostly challenged by virus-derived illness such as White Spot disease, which is made more contagious due to the congested nature of semi-intensive farming.
Parent PL stock	- Semi-intensive farms only use SPF PL, but in exceptional circumstances when there is a shortage in supply, they have to use wild-caught broodstock seeds.

Source: Interviews with extensive farmers and BFRI (LightCastle-Larive primary data)

Annex IV: Extensive Monodon and Rosenbergii farming practices

	Extensive Monodon Farmers	Extensive Rosenbergii Farmers
Cultivation period	Cultivation starts around April and ends in November.	The main harvesting takes place during the monsoon season (June to October).
Stocking density	In extensive farming system, the stocking density is usually around 10-15 PL/m sq. In semi-intensive farming system the stocking density is usually 18-25 PL/m sq.	The stocking density of Rosenbergii ranges from 5-8 PL/m sq. using the extensive farming method.
Productivity	The productivity of Monodon ranges from 200 kg/ha to a maximum of 400kg/ha depending on the size of the pond/*gher* and the farming system used.	The productivity ranges from 170 kg/ha to 500 kg/ha depending on the pond/*gher* size.
Survival rate	When the extensive farming method is used the survival rate is less than 25%.	In extensive farming, the survival rate can be up to 50%.
Feed	In most cases the feed is homemade using wheat and protein, while some farmers mix commercial feed. The protein content of the feed is increased as the shrimp grows. The protein content is heavier for Monodon compared to Rosenbergii .	In most cases the feed is homemade using wheat and protein (including pulses), while some farmers mix commercial feed. The protein content is heavier for Monodon compared to Rosenbergii.
Farming culture	Polyculture is prevalent among the large majority. Monodon is usually cultured with white type fishes. Polyculture is more common among extensive Monodon farmers than extensive Rosenbergii farmers	Polyculture is prevalent among the large majority. Rosenbergii is usually cultured with carp type fishes and in rice fields. Polyculture is more common among extensive Monodon farmers than extensive Rosenbergii farmers
Popular district	A few popular districts for Monodon cultivation are Satkhira (34%), Bagerhat (26%), Khulna (20%), and Cox's Bazar (16%). In Bagerhat and Khulna Rosenbergii is also heavily cultivated while some production of Rosenbergii also takes place in Satkhira and Bagerhat.	A few popular districts for Rosenbergii cultivation are Bagerhat (29%), Khulna (28%), Jessore (18%), and Narail (4%). In Bagerhat and Khulna, Monodon is also heavily cultivated while in Narail Rosenbergii is cultivated exclusively.
Disease	Mostly challenged by virus-derived illness such as White Spot disease.	Black Spot or Shell disease, White Muscle, and bacterial diseases are the common diseases.
Parent PL stock	Farmers are mostly dependent on the wild capture of larvae for their source of Parent PL Stock.	Farmers are dependent of capture of wild larvae and technology-based production.
Debt Situation	Almost all farmers who practice on leased land are indebted, both to their suppliers and also to local moneylenders on high interest loans.	

Source: Interviews with extensive farmers and BFRI (LightCastle-Larive primary data)

Annex IV: Local market prices for major finfish species in 2019 (pre-COVID-19)

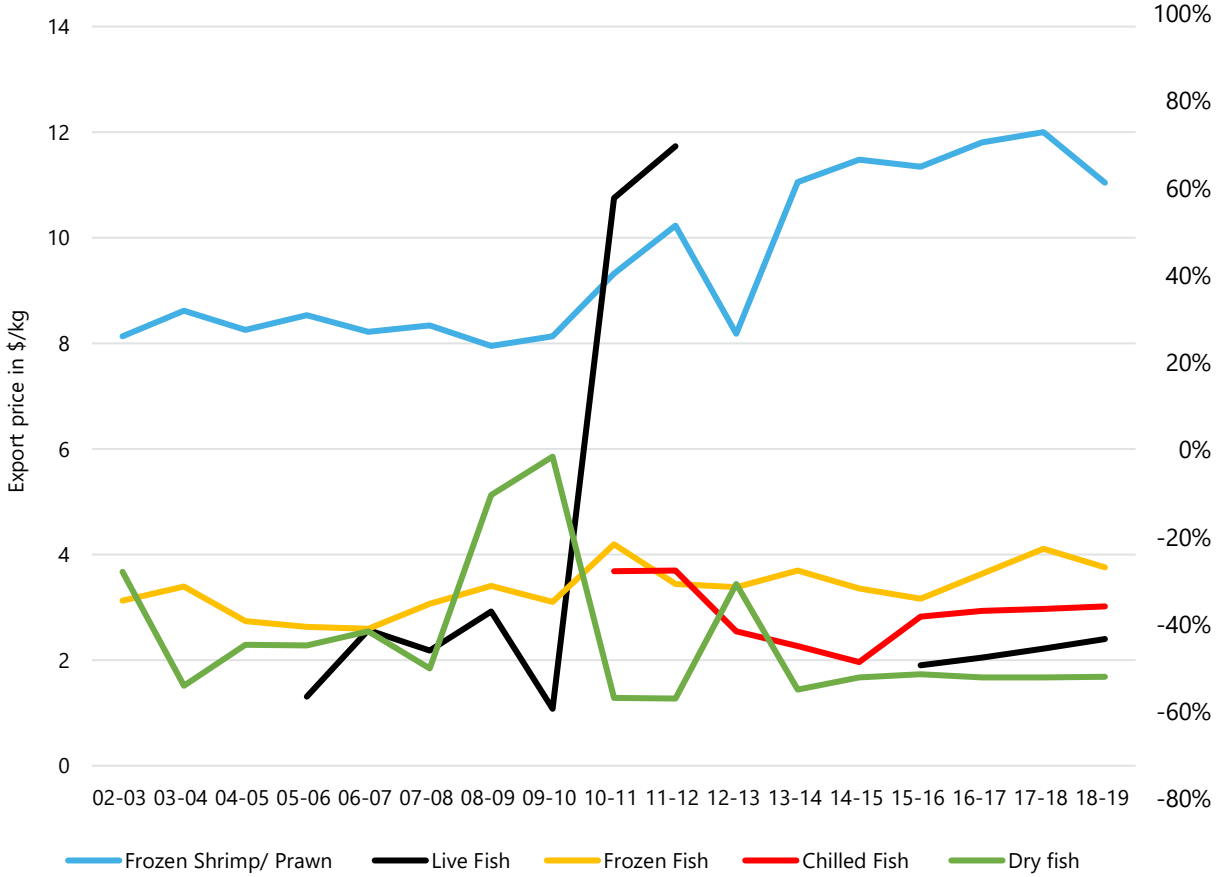
	Major fish species	Average price USD/ KG
1	Rui	2.75
2	Catla	3.09
3	pangasius	1.63
4	Koi	2.94
5	Silver Carp	1.68
6	Ilish	12.35
7	Tilapia	1.93
8	Shing	5.32
9	Pabda	5.28
10	Bata	2.15
11	Mrigel	1.97
12	Tengra	4.94
13	Puti	2.93
14	Shol	5.22

Source: LightCastle Primary Data from market surveys conducted in June, September and October 2019.

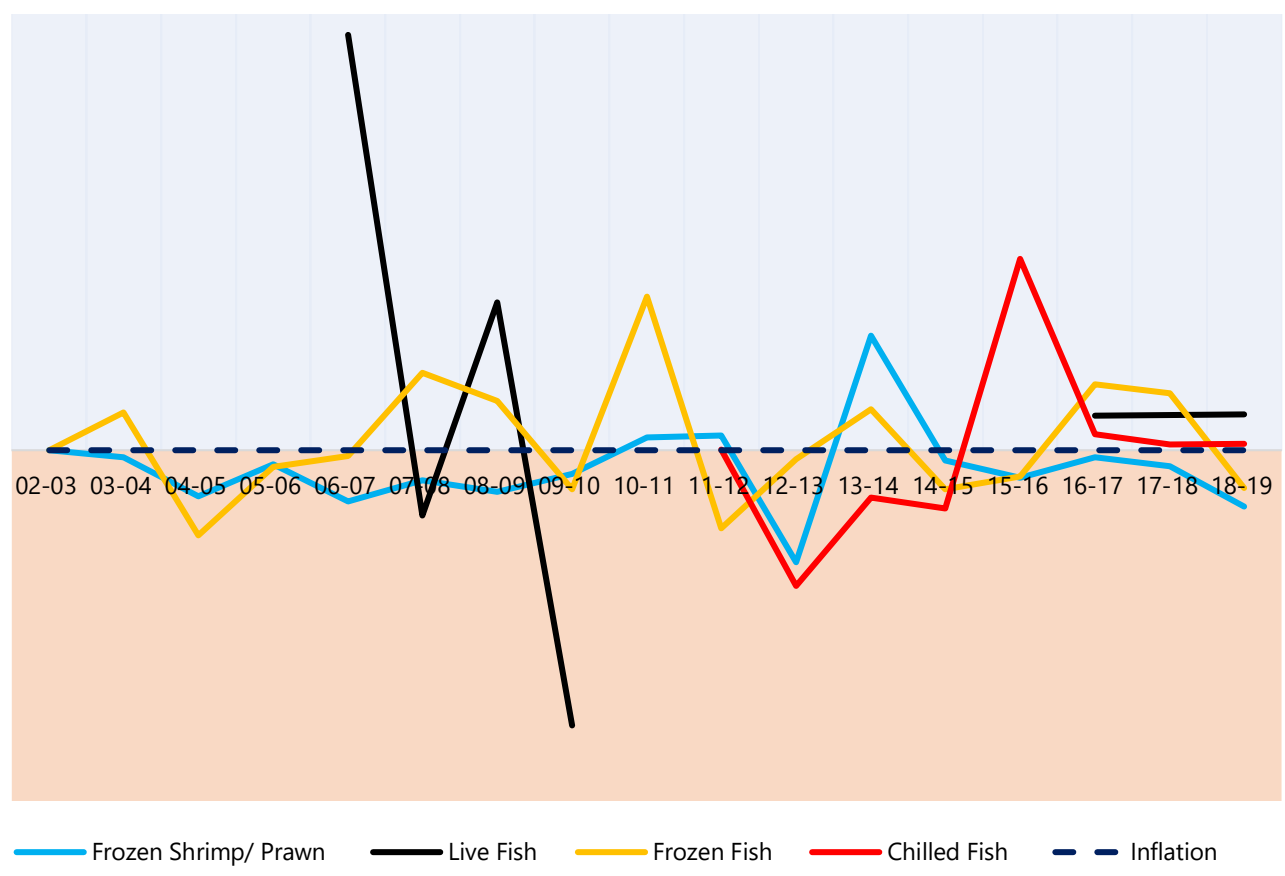
Annex V: Export – Pricing of types of fish

Export value / kg of frozen fish and shrimp is relatively stable; value / kg of products exported in lower quantities is more volatile

Export value per kg fish products - Bangladesh



Volatility in real fish export value per kg (y-o-y, corrected for inflation)
>0 real price increase, <0 real price decrease



Notes: The export volume tends to negatively correlate with the volatility of export prices. Hence, the larger the export volume, the lower the price volatility.
Note that the displayed export prices reflect the average price of all products in that specific export basket. Price change in the export basket do not necessarily imply that export price have risen as it could also be that the export basket contains more expensive products in terms of volume compared to previous years.

Annex V: General incentives

Setting up a business in Bangladesh

Tax holiday and exemption:
- 5 to 10 years of tax holiday and reduced tax depending on the area.
- Dhaka and Chittagon: 5 to 10 years of tax holiday and reduced tax depending on the area.
- Dhaka and Chittagong divisions, excluding Dhaka, Mymensingh, Narayanganj, Gazipur, Chittagong, Rangamati, Bandarban and Khagrachari districts, for a period of 5 years.
- Rajshahi, Khulna, Sylhet, Barisal and Rangpur divisions (excluding city corporation area) and Rangamati, Bandarban and Khagrachari districts, for a period of 10 years.
- 100% tax exemption on income and capital gain for certain projects under Public Private Partnership (PPP) for 10 years.
- 100% tax exemption from software development, Nationwide Telecommunication Transmission Network or Information Technology Enabled Services.
- 50% of income derived from export is exempted from tax.
- Tax exemption on royalties, technical knowhow and technical assistance fees and facilities for their repatriation.
- Tax exemption on interest paid on foreign loan.

Accelerated depreciation:
Accelerated depreciation for machinery and plants.

Exemption on import duties:
- Exemption of customs duties on capital machineries.
- Exemption of import duties on raw material used for producing export goods.

Tariff refund:
Tariff (if paid) refund on import of raw materials for export.

Double taxation prevention:
Benefits for countries with double taxation avoidance treaty.

Bonded warehousing facilities:
- For export-oriented industries.
- For large import for local selling in certain items.

Ownership:
100% ownership is allowed.

Repatriation of invested capital and dividend:
Full repatriation of capital invested from foreign sources will be allowed. Similarly, profits and dividend accruing to foreign investment may be transferred in full. If foreign investors reinvest their dividends and or retained earnings, those will be treated as new investment.

Others:
- No restrictions on issuance of work permits to project related foreign nationals and employees.
- Facilities for repatriation of invested capital, profits and dividends.
- Provision of transfer of shares held by foreign shareholders to local investors.
- Reinvestment of remittable dividends would be treated as new investment.
- Remittance of royalty, technical know-how and technical assistance fees.
- The Foreign Private Investment (Promotion & Protection) Act. 1980 ensures legal protection to foreign investment in Bangladesh against nationalization and expropriation.
- Equal treatment of both local and foreign investment.
- Bilateral and multilateral investment agreements ensure protection of investment.
- 100% FDI, Joint Ventures, Partnerships, PPPs, Non-equity mode (Technology transfer, licensing Franchising, contracting etc.), and Foreign Lending are allowed.
- 100% FDI or Joint Venture FDIs are allowed to participate in the primary and secondary stock markets.
- Foreign Investors are allowed to have access to local banks for working capital requirements.
- Intellectual Property right is protected by Law.

Source: Bangladesh Investment Development Authority (BIDA)

Annex V: Incentives for Economic Zones

Setting up a business in an Economic Zone in Bangladesh

- An Economic Zone (EZ) is an area including underdeveloped zones that provides numerous incentives to investors to encourage rapid economic development through the increase in number of different kinds of industries, employment, export and production.
- A public/government economic zone are approved by and invested in by the government. A government-to-government (G2G) economic zone is designated for investors of a particular country. Private EZs are those owned and developed by the private sector.

- A total of 10 years of income tax incentive will be given; 100% for the first 3 years, 80% for the 4th year, 70% for the 5th year, 60% for the 6th year, 50% for the year 7th year, 40% for the 8th year, 30% for the 9th year, 20% for the 10th year.
- 100% income tax exemption for 10 years.
- 100% income tax exemption on capital gains from transfer of shares for 10 years.
- 100% income tax exemption on royalties, technical know-how and technical assistance fees etc. for 10 years.
- 50% exemption from income tax on the income of expatriate for 3 years.
- Exemption from double taxation subject to the existence of double taxation agreement.
- Duty free import of capital machinery and construction material.
- Entire EZ has been declared as Warehousing Station.
- All the unit investors in EZs are entitled to Home Consumption & Other Bond Facilities, Warehouse Operator.
- Dedicated Customs Procedure (Economic Zone).
- 20% sale of finished product to Domestic Tariff Area (DTA).
- Sub-contracting with Domestic Tariff Area (DTA).
- Exemption of Customs Duty, Regulatory Duty, VAT, Supplementary Duty for import of vehicles (up to 2000 cc, one sedan car and one microbus/pick up van/ double cabin pick up).
- 100% duty exemption on export.
- 100% exemption from VAT on Utility services related to production of goods.
- 100% land development tax exemption.
- 50% exemption of stamp duty on lease registration.
- 100% exemption from tax sub tax, rate, toll, fees etc. imposed 100% exception from tax sub tax, rate, toll, fees etc. imposed.
- 100% exemption from tax on transferring immovable property imposed.
- EZ investors are waived from Board of Investment Act, 1989.
- Regulatory framework of foreign exchange transactions of enterprises operating in EZs.
- No restrictions except few sectors on foreign investment in Bangladesh including EZs.
- No ceiling of FDI.
- 100% repatriation of dividend earned against the investment.
- 100% loan from external sources.
- Repatriation of Royalty, Technical Know-how& Technical Assistance Fees.
- No limit on Telephonic Transfer (TT).
- FC Accounts for EZ enterprises.
- FC Accounts for foreign nationals working in EZ enterprises.
- 75 % of current income remitting of foreign nationals working in EZs.
- Industries operating in Domestic Processing Area (DPA) of EZs can meet their foreign payment obligation on account of Royalty, Technical Know-how& Technical Assistance Fees from their Taka Account.
- 100% Backward Linkages of raw materials to sell for export-oriented industries.
- Formation of Joint Venture Industries.
- Special cash incentives against export of textile goods including readymade garments.
- Issuance of work permit to foreigners is allowed (Up to 5% of total officers/employees of an industrial unit).
- Resident visa for investment of USD 75,000 or above.
- Citizenship for investment of USD 1,000,000 or above.

Source: Bangladesh Economic Zone Authority (BEZA)

Annex V: Incentives for Export Processing Zones

Setting up a business in an Export Processing Zone

- An Export Processing Zone (EPZ) is a territorial zone where goods may be imported and manufactured and then reshipped with minimum to zero custom interference. EPZs are fully export-oriented and investors receive benefits when manufacturing in EPZs.

Fiscal Benefits at EPZs:

- A total of 7 years of tax exemption for Uttara, Ishwardi and Mongla EPZ; 100% for the first 3 years, 50% for the next 3 years, and 25% for the last 1 year.
- A total of 5 years of tax exemption for Chattogram, Dhaka, Cumilla, Adamjee and Karnaphuli EPZ; 100% for the first 2 years, 50% for the next 2 years, and 25% for the last 1 year.
- Duty free import of construction materials.
- Duty free import of machineries, office equipment and spare parts etc.
- Duty free import and export of raw materials and finished goods.
- Relief from double taxation.
- Exemption from tax dividend.
- GSP facility available.
- Accelerated depreciation on machinery or plant allowed.
- Remittance of royalty, technical & consultancy fees allowed.
- Duty & quota free access to European Union, Canada, Norway, Australia etc.

Non-Fiscal Benefits at EPZs:

- No ceiling on foreign and local investment.
- 100% foreign ownership is possible.
- GSP benefits from European Union countries, Japan, Australia, Canada.
- Foreign currency loan from abroad under Off-Shore Banking Unite (OBU) facilities.
- Medium to long term external borrowing facilities.
- Non-Resident Foreign Currency Deposit (NFCD) allowed for 'A' Type industries.
- Operation of Foreign Currency (FC) account by 'B' and 'C' Type industries allowed.
- 100% backward linkage, raw materials and accessories are allowed to sell for export-oriented industries inside and outside EPZs.
- 10% sale of finished products except garments; sale of defective finished goods and surplus raw materials to Domestic Tariff Area (DTA) is allowed.
- Intra/ Inter zone Sub-contracting and transfer of goods allowed.
- Sub-contracting with export-oriented industries inside and outside EPZ allowed.
- No UD (Utilization Declaration), IRC (Import Registration Certificate) and ERC (Export Registration Certificate) is required.
- Export and import based on Cost of Making (CM), Cut-Make-Pack (CMP) and Cut-Make-Trim (CMT) is allowed.

Annex V: Specific taxation policies

H.S. Code	Description	Unit	Statutory rate of import duty	Statutory rate of export duty
0301.11.00- 0301.99.90	Live fish	kg	25%	Free
	Fry	kg	0%	Free
0302.11.10-0302.99.90	Fish, fresh or chilled, excluding fish fillets and other fish meat of heading 03.04	kg	25%	Free
0303.11.10-0303.99.90	Fish, frozen, excluding fish fillets and other fish meat of heading 03.04.	kg	25%	Free
0304.31.10- 0301.99.90	Fish fillets and other fish meat (whether or not minced), fresh, chilled or frozen.	kg	25%	Free
0305.10.10- 0305.79.90	Fish, dried, salted or in brine: smoked fish, whether cooked before or during the smoking process; flours, meals and pellets of fish, fit for human consumption.	kg	25%	Free
0306.11.00- 0306.99.90	Crustaceans, whether in shell or not, live, fresh, chilled, frozen, dried, salted or in brine; smoked crustaceans, whether in shell or not, whether or not cooked before or during the smoking process; crustaceans, in shell, cooked by steaming or by boiling in water, whether or not chilled, frozen, dried, salted or in brine; flours, meals and pellets of crustaceans, fit for human consumption.	kg	25%	Free
	Fry	kg	0%	Free
0307.11.10- 0307.99.90	Molluscs, whether in shell or not, live, fresh, chilled, frozen, dried, salted or in brine; smoked molluscs, whether in shell or not, whether or not cooked before or during the smoking process; flours, meals and pellets of molluscs, fit for human consumption.	kg	25%	Free
0308.11.10- 0308.90.90	Aquatic invertebrates other than crustaceans and molluscs, live, fresh, chilled, frozen, dried, salted or in brine; smoked aquatic invertebrates other than crustaceans and molluscs, whether cooked before or during the smoking process; flours, meals and pellets of aquatic invertebrates other than crustaceans and molluscs, fit for human consumption.	kg	25%	Free
1603.00.00	Extracts and juices of meat, fish or crustaceans, molluscs or other aquatic invertebrates.	kg	25%	Free
	Prepared or preserved fish; caviar and caviar substitutes prepared from fish eggs.	kg	25%	Free
1605.10.00- 1605.69.00	Crustaceans, molluscs and other aquatic invertebrates prepared or preserved.	kg	25%	Free
2301.10.90	Flours, meals and pellets, of fish or of crustaceans, molluscs or other aquatic invertebrates	kg	0%	Free
8436.10.00	Machinery for preparing animal feeding stuffs	item	1%	Free

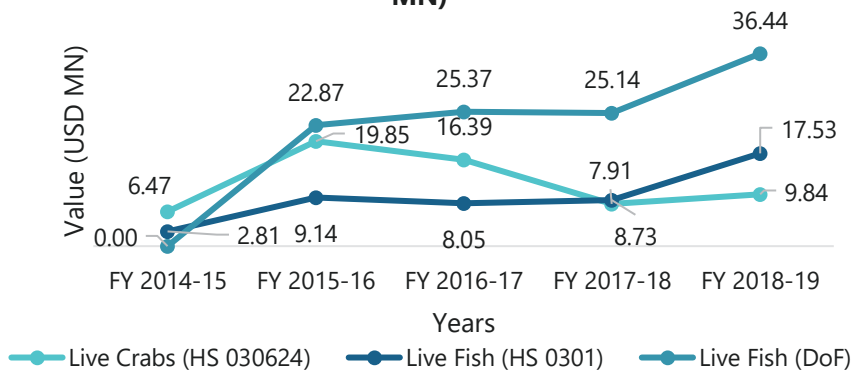
Source: Bangladesh Customs Tariff

Annex V: Live fish exports

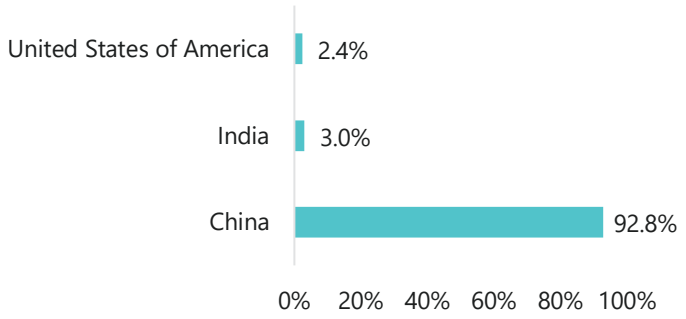
Eel remains the largest export live fish, although COVID-19 drastically reduced exports

- Since 2018, the export of live fish has overtaken the export of live crabs. Prior to this, crabs accounted for the large majority of live fish and seafood exports.
- Live fish exports are predominantly eels, which had accounted for 96.5% and 99.3% of live fish exports in 2019 and 2020, respectively.
- Live fish and live crab exports have been in decline since 2019, with Covid-19 further exacerbating the performance of the sector in 2020.
- Live crab exports were hit particularly hard, dropping to zero in 2020, primarily due to demand impacts from lockdown and imposition of stringent quality restrictions on product imports because of to Covid-19 in key markets such as China.
- Since the products are exported in live and/or chilled form and not frozen, they are exported to nearby regions. Export destinations for other species are Singapore, Kuwait, Qatar, Saudi Arabia, Taiwan, Malaysia, China and Thailand. China is the largest importer of crabs from Bangladesh. Depending on the export destinations, exporter collect licenses provided by the Department of Fisheries.
- Anjum International and Surma Seafood are among some notable pure-play live fish exporters. They export mostly eels and crabs.

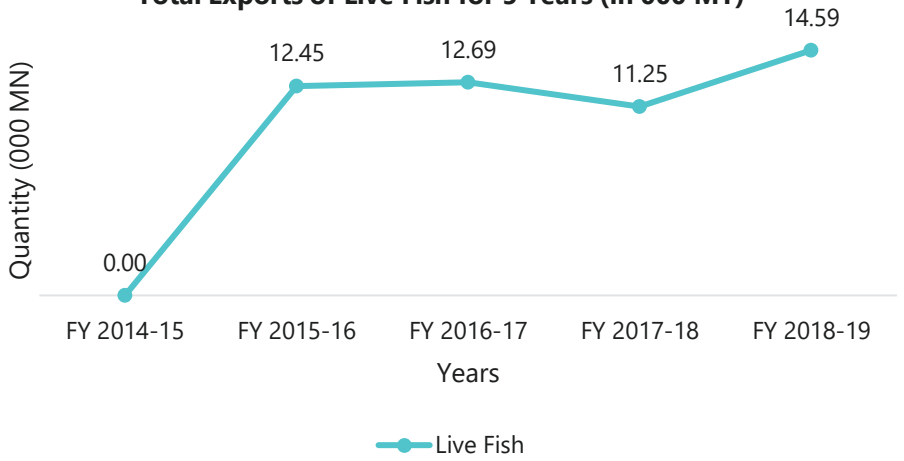
Total Exports of Live Fish and Live Crabs for 5 Years (in USD MN)[2]



Total Exports of Live Fish by Country in 2019 (%)[1]



Total Exports of Live Fish for 5 Years (in 000 MT)[3]



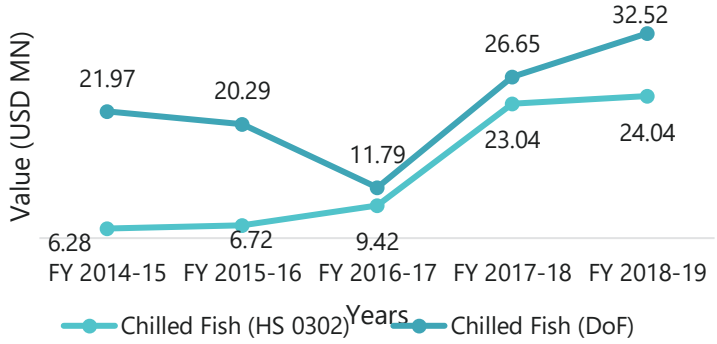
[1]Source: International Trade Center
[2]Source: Export Promotion Bureau, Department of Fisheries
[3]Source: Department of Fisheries

Annex V: Chilled finfish exports

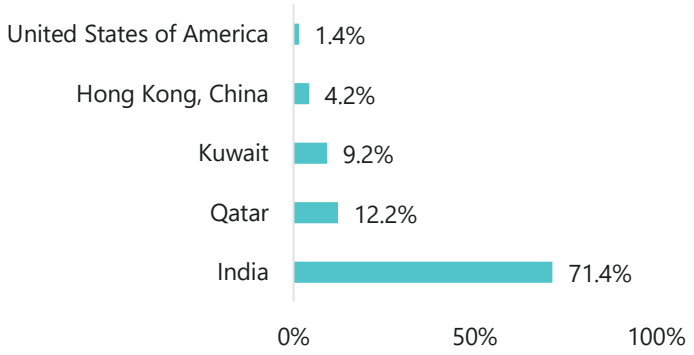
India is the largest importer of Bangladeshi chilled finfish

- The Bangladesh live and chilled food exporters association (BLCFEA) has 216 listed members who are engaged in the export of live and chilled fish and crabs.
- Among them, there are approximately 60 companies involved in the processing/packaging and export of live and chilled fish. These companies are located around the Uttara zone of Dhaka city in order to take advantage of the proximity to the Hazrat Shahjalal International Airport, which is essential for the export of fresh fish and crabs.
- Chilled Hilsha is only authorized to be exported to India.
- Chilled fish are typically packed into Styrofoam boxes with lining of ice.
- The mortality rate is very high owing to lack of proper temperature control. Bangladesh also lacks in providing sufficient capacity for packaging plants. Additionally, owing to urbanizations, these plants are shifting further away from the airports which results in longer transport time.
- Ocean Trade International and MM Enterprise (b) are some notable pure-play chilled finfish exporters.
- Orchid Trading Corp, Suman International, MM Enterprise (a) and SR Traders some notable live and chilled finfish exporters.

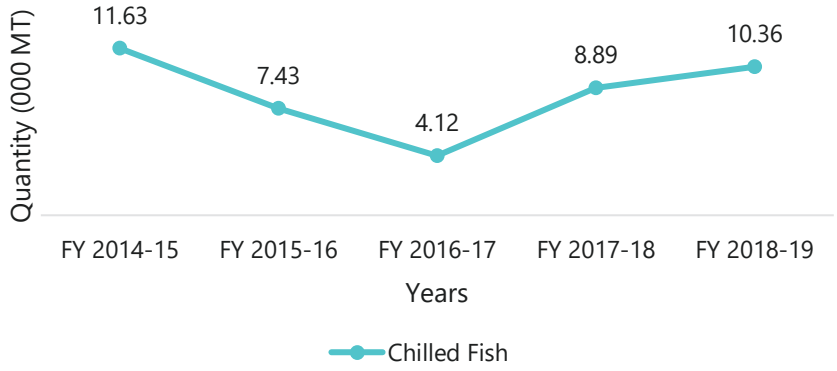
Total Exports of Chilled Fish for 5 Years (in USD MN)[3]



Total Exports of Chilled Fish by Country in 2019 (%)[1]



Total Exports of Chilled Fish for 5 Years (in 1,000 MT)[2]



[1]Source: International Trade Center
[2]Source: International Trade Center
[3]Source: Export Promotion Bureau, Department of FIsheries

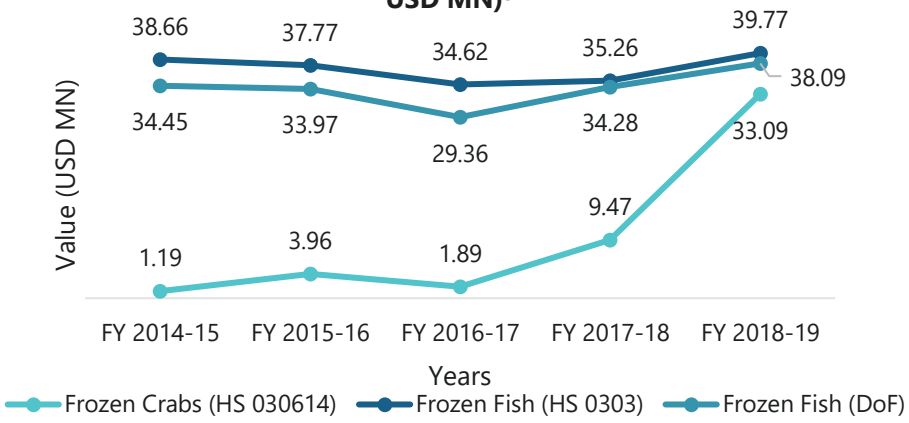
Source: Department of Fisheries

Annex V: Frozen finfish exports

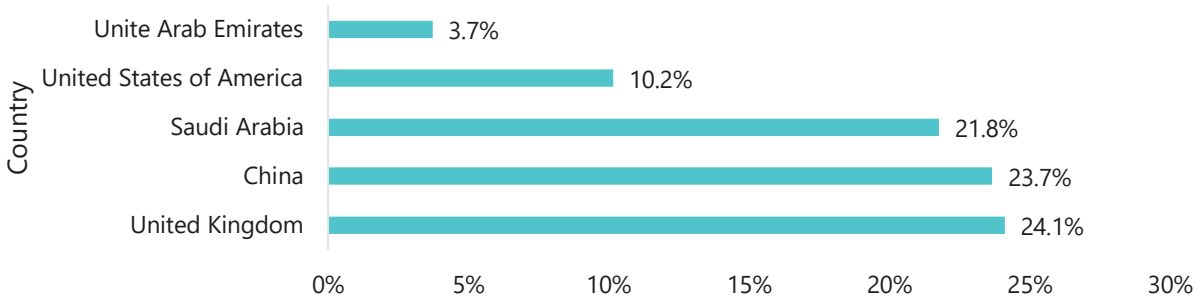
UK and the Middle East are the main importers of frozen finfish, with COVID-19 heavily impacting export

- Frozen Fish and Frozen Fish exports from Bangladesh together accounted for USD 55.48 MN 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.
- Key frozen fish exports include cut and dressed hilsa and carp varieties that are predominantly exported to the UK and certain destinations in the Middle East, which host a large diaspora of Bangladeshis. 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. This would suggest that Bangladesh finfish processors have not been able to capture the international palate for sea-based finfish as it has done with shrimp exports.
- Processed finfish exporters receive a cash incentive from the GoB amounting to 5% of the invoice value, up to a ceiling price of USD 1.97 per KG. This compares to a cash incentive of 10% for the export of frozen shrimp, up to a ceiling price of USD 4.90 per KG.
- As with shrimp processing and export, some processors have their own buyers and export directly, whereas other supply through agents. In addition, it is common for many agents/parties who do not have their own production facilities to lease factories, bring in their own RM supplies and pay storage & processing charges to the factory for processing their export orders. They are known as Non-Packers.

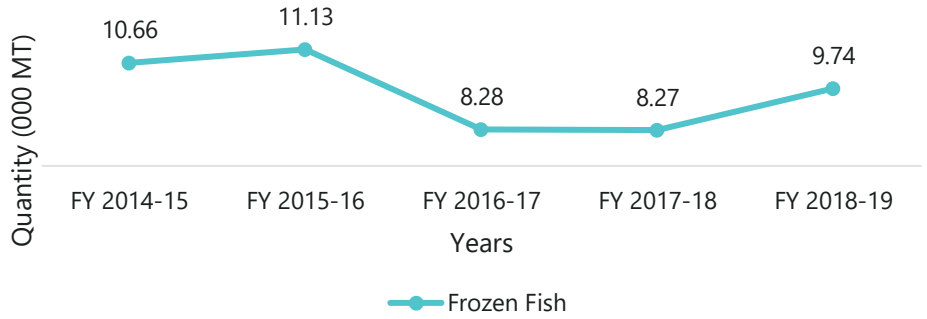
Total Exports of Frozen Fish and Frozen Crabs for 5 Years (in USD MN)[3]



Total Exports of Frozen Fish by Country in 2019 (%)[1]



Total Exports of Frozen Fish for 5 Years (in 000 MT)[2]



[1]Source: International Trade Center
[2]Source: Department of Fisheries
[3]Source: Export Promotion Bureau, Department of Fisheries

Annex V: Top frozen finfish exporters

Players	Location	Production Capacity/ Annual Sales	Major Species	Type of Processing		Notes on companies
BD Sea Food	Chittagong	19,000 sq. ft. refrigerated/freezing warehouse space; 33,000 sq. ft. processing area and 100,000+ sq. ft. factory floor space	Ayer, Asian Sea Bass, Bashpata and Bozuri Tengra, Bacha, Baila, Bata, Batashi, Boal, Bozuri, Chela Pata, Chapila, Puti, Datina, Echuri Mola, Kalibaush, Gulsha, Gutum, Hilsha, Star Baim, Tengra, Tilapia, Taki, Shoil			Part of the BD Group conglomerate. Approval and endorsements of the European Union and USFDA. SGS and UKAS certified.
Seven Star Processing	Pabna		Carps			
Virgo Fish & Agro Process	Mymensingh (Trishal)		pangasius, Tilapia	Whole Fish, Gutless Fish, Head off Gutless Tail off Fish (HGT), Fish Steaks, Fish Skewers, Fish Fillet		
Seven Oceans Group	Mymensingh (Trishal)	Freezing capacity of 15 MT daily including Blast, Plate freezers and IQF Spiral freezers – and two storage of 350 MT of storage facility each.	pangasius, Tilapia, Basa, Salmon, Sea Bass, Mackerel, Scallops, Crabs, Oysters, Lobsters, Mussels and Squids. Local fish varieties such as Pabda, Tengra, Taki, Shol, Shing Magur, Rui, Pabda, Kechki, Katla, Hilsa, Chital, Boal, Bele	Whole Fish (gutted & grilled), Fish Fillet, Breaded Fish Fillet, Fish Chops, Fish Balls, Fish Skewers, Fish Fingers, Caviar		They are almost predominantly focused on pangasius processing and exports. Clientele includes five-star hotels, industrial caterers, restaurants, hyper markets, and supermarkets across the Asian Continent, European Continent and South American Continent. plants confirm to high standards of quality that are ensured and monitored through the highly effective HACCP, ISO, EU and USFDA Quality System.
Anraj Fish Products Industries	Chittagong		Tailla, Taposi, Squid, Cuttle Fish, Chinese Pomfret, Silver Pomfret, Black Pomfret, Datina Koral, Red Snapper, Spanish Mackerel, Lakka			Export markets are USA, UAE, Australia, Canada, Germany, Italy, Qatar, Kuwait, Bahrain, Korea and India. Use imported White Chokori Fish Hilsha Cat Fish Black Pomfret Silver Pomfret Sardine Chinese Pomfret Telepia Indian Mackerel from Pakistan, Vietnam, UAE, India, Japan and Malaysia. Adheres to HACCP.
Mashud Fish Processing & Ice Complex	Chittagong	Plate Freezer 1000 Kg/ Load of 1.45 To 2.00 hrs; 2 (Two) Flake Ice Machine 20 MT/ day; 3X Air Blast freezer 10×3 MT/ load; Spiral freezer 500 kg / Hr.; Steam Cooker 500 kg/ Hr.; Batch Cooker (For Blanch) 400 kg /Hr; 4X (Four) Cold Storage Capacity:-1500 M.T	White Fish – Tengra, Tilapia, Taki, Star Baim, Shoil, Kalibaush, Hilsa, Gutum, Gulsha, Echuri Mola, Datina, Puti, Chela Pata, Chapila, Buzuri, Buzuri Tengra, Boal, Batashi, Bata, Bash Pata, Baila, Bacha, Koral, Ayre.			EU Approval (CTG-100). 100% export oriented company.

Annex V: Competition in the international export market

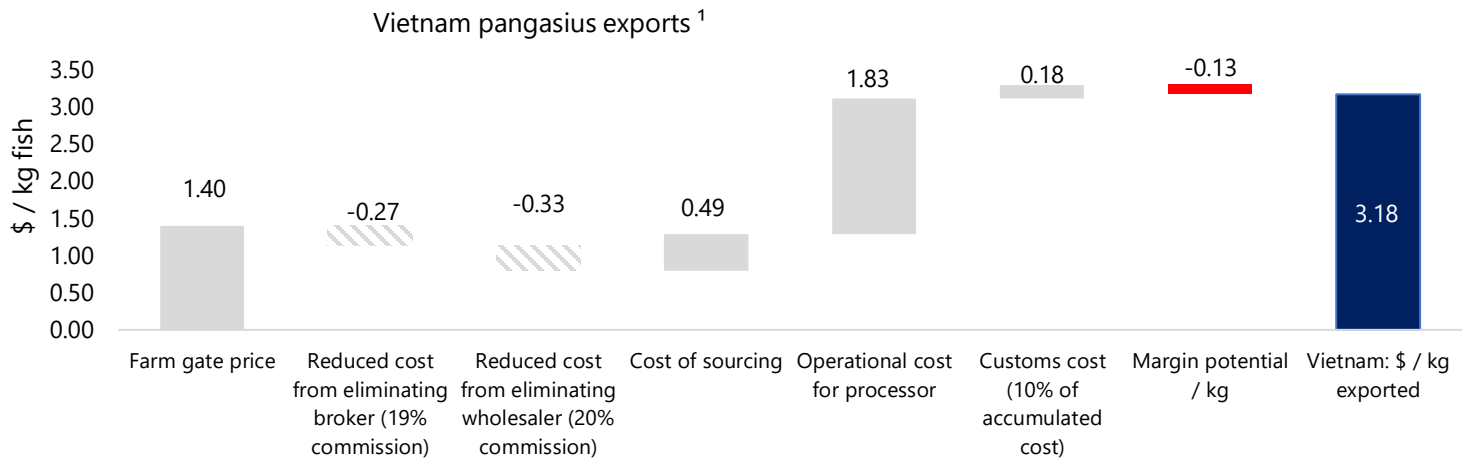
Improving productivity, practices and supply chains can improve the Bangladeshi aquaculture sector

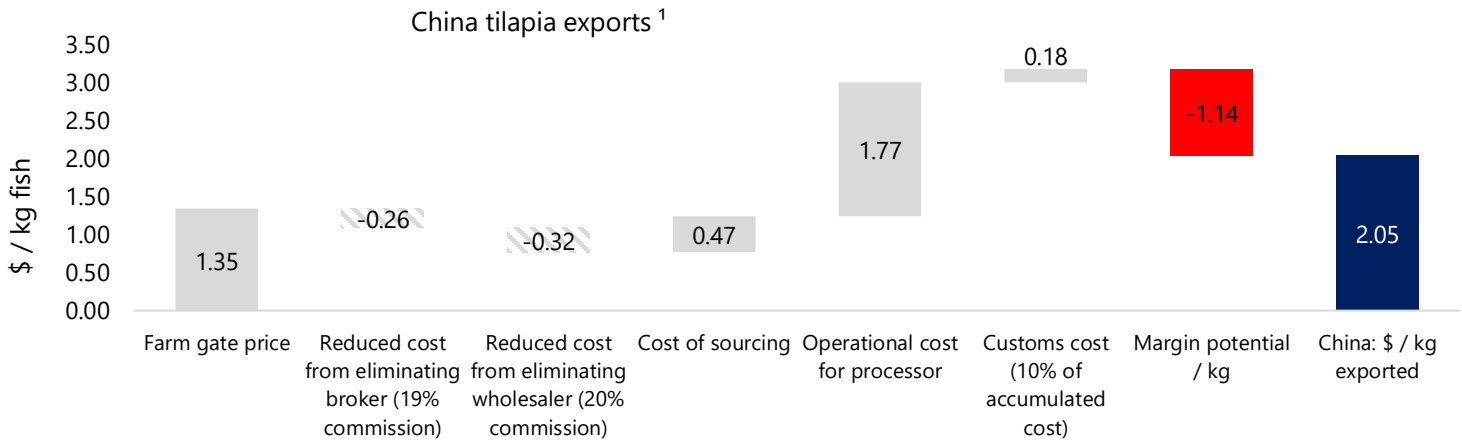
A large share of shrimp production is exported. For fish, the pattern is reversed. While Bangladesh ranks top-5 in aquaculture production in the world, fish exports fall significantly behind when taken as a share of fish production. Exports as a share of fish production amounted to 1.8% in FY18-19, seeing an insignificant increase of 0.01% point from FY13-14.

Even when Bangladesh realizes a shorter fish supply chain where margins charged by brokers and wholesalers are circumvented, likely lowering the sourcing cost for processors, together with adequate hygiene and production in place to participate in export markets, Bangladesh will likely remain uncompetitive against Vietnam and China, being leaders in the pangasius and tilapia market, respectively.

The pangasius export markets in Vietnam and China are often driven by single large, sometimes integrated producers, who are efficient in terms of production, processing and distribution. Bangladesh is expected to experience difficulties in competing with these countries. There are some processors, such as Virgo Fish and Agro Process Limited, who have successfully set up processing infrastructure in the proximity of farm clusters (such as Mymensingh) with short and efficient supply chains to target the export market. However, the scattered nature of Bangladesh farmers and inefficiencies akin to the value chains and processing, points at the cultured fish industry not being ready for large-scale exports, considering the competition Bangladesh will face in international markets.

While often regarded as a superfluous actor in the value chain, which it may be, intermediaries do support farmers with financing and fulfill an important role in connecting farms and processors. Changing these longstanding relationships is often difficult, given that these interactions are often deeply entrenched in the business behavior of both. This makes realizing efficient and short value chain challenging as well.





Source: ITC trade map (2020), LightCastle primary interviews. Note: [1] Farm gates prices originate from 2016 and are estimated using inflation rates. Export prices of pangasius (tilapia) of Vietnam (China) are derived from ITC data by dividing the export value by the volume. The share of operational cost for a fish processor as a share of the farm gate price is assumed to mimic the operations for shrimp. The customs cost of 10% are assumed. Given the estimations, numbers remain indicative.

Annex V: Types of fish marketplaces

1. **Arat/ Wholesale Markets:**

- The arat is a meeting place that connects mohoajons and Paikars/retailers via commission agents. Here mahajans, fishermen and Faria/Bepari bring in the day's catch for sale. Paikars and Retailers come here in search of fish to purchase for reselling. The commission agent acts as the intermediary between the two parties and prices are determined by the day's market. The commission agent sells incoming fish in batches through an auction process, shouting the bid value and responding to any further price offers. Fish is sold only at bulk at arats (usually starting from 5KG) and can offer considerable savings over retail prices. Arats are only open for a few hours every morning, and arats in Dhaka begin operating as early as 4AM.


An arat at peak hour (left) and another (right) after closing of sales

2. **Local Wet Markets:**

- Local fish markets connect retailers with individual consumers. The typical local fish market is located in a corner of a larger food market. Consumers visiting the fish market during their weekly grocery purchase walk through the fish market on their way in or out of the market. This type of fish market is designed for convenience and caters to the communities living in close proximity to the market, lying within 2-3 km distance from consumer residence. Some fish markets can simply be a congregation of street sellers next to the pavement, with no support infrastructure at all. Transactions in these markets are informal, and no receipts are exchanged at purchase. Local fish markets are usually open from early morning and remain open throughout the day, closing in late evening.


A typical fish market (right) and an open-air market (left)

3. **Supermarkets:**

- Supermarkets are complete shopping destinations offering their customers a range of items under one roof. There are a three major supermarket chains (Shwapno/ACI, Meena Bazaar and Agora) in Bangladesh, and their branches are mostly concentrated in Dhaka and Chittagong city. The typical supermarket offers air-conditioning for a smooth customer experience, and being a one-stop shop, offers most grocery and food items in addition to basic cosmetics, garments and even utensils. The major supermarket stores even offer live fish which are on display for customers to choose from. Customer visiting pay higher prices than they would in their local markets, but it is much more convenient for them. Hence, supermarkets are most popular among the middle and high-income consumers.


Fish Station at Local Supermarkets

Annex V: Locally-sold processed fish

- Processed fish products are consumed mainly by a fast-growing urban middle class and upper middle class consumer base. Such products are stocked mainly by supermarkets and larger grocery stores that have the refrigeration facilities required for preserving these ultra-processed foods. There are several processors who process fish to several degrees:

1) Cutting and Dressing:

- Cutting and dressing refers to the process of de-scaling, gutting and cutting the fish into fillets or steak cuts.
- Cutting and dressing services are offered post-sale at most retail point of sales in Bangladesh including wet markets and supermarkets.

Fish Station at Local Supermarkets, where cutting and dressing are provided after purchase

2) Chilling and Freezing:

- Apart from ultra-processed foods, some companies such as Bengal Meat are also offering chilled marinated fish as Ready-to-Cook solutions for shoppers.

Pre-Processed (Chilled) Fish

Processed and Frozen Fish Fillets

Annex V: Locally-sold processed fish

3) **Ready-to-Cook Products:**

- **Seasoned/ Marinated:** Apart from ultra-processed foods, some companies such as Bengal Meat are also offering chilled marinated fish as Ready-to-Cook solutions for shoppers.
- **Ultra-processed:** There are multiple players based in Bangladesh who are catering to the demand for ultra-processed fish products in the local market. Key ultra-processed fish product categories include fish fingers, fish balls, fish fillets, fish tofus, fish curry, fish cakes etc. These are all sold frozen.

Fish Sticks and Seafood Tofu by Sea Natural Food and EON Foods

4) **Ready-to-Eat Products:**

- A very limited number of players are into the Ready-to-Eat (RTE) segment. Chilled RTE products are highly perishable (with a typical shelf life of a few days) and examples include smoked fish by Bengal Meat.

Ready-to-Eat (Smoked) Fish by Bengal Meat

5) **Dried Fish Products:**

- Many formal processors are also entering into the dried fish segment (locally called "*shutki*"), which was traditionally the domain of smaller local informal processors who typically processed the dried fish in unhygienic conditions.

Dried Fish by Kazi Farms

Annex VI: Investments and divestments in shrimp processing

Recent investments

- Due to the low-capacity utilization and lower profitability, there have not been any significant investments into new capacities in shrimp processing in recent years. Recent capacity additions include:

Company	Ownership	Year of investment	Location	Approximate Investment Value
ACI Seafood	Domestically owned	2019	Satkhira	BDT 150 MN (USD 1.76MN)
Primus Seafood	Domestically owned	2018	Bagerhat	BDT 200 MN (USD 2.35MN)
Alpha Seafood	Domestically owned	2018	Khulna	BDT 300 MN (USD 3.53 MN)
Unipex	Domestically owned	2021	Sylhet	Not Known

- On the flip side, divestment is also common in the processing industry; factory sales by Jalalabad /Jahanabad Seafood and Salam Seafood in Khulna are prominent recent examples.

Source: Industry Insider and Expert Interviews (LightCastle Primary Data)

Annex VI: Top local processed fish players

Players	Location	Ready to Eat Products	Ready to Cook Products	Frozen Fish Items	Chilled Fish	Dried Fish	Notes on companies
EON Foods Ltd, (Ocean Ria Brand)	Tejgaon (Dhaka)			Fish Balls, Seafood Tofu, Fish Cakes			Uses mostly imported fish. They are now trialling use of locally produced carp on a limited pilot basis in partnership with World Fish.
Sea Natural Food Ltd,	Sonarga, Dhaka/Rangs Group			Fish Sticks, Fish Curry			
Bengal Meat	Pabna	Smoked Fish	Marinated Fish	Fish Fillets, Breaded Fillets, Fish Fingers, Fish Balls	Carps etc.		Predominantly a meat processor. They were the first to set up an international-standard abattoir in Bangladesh. Although fish products form only a very small portion of Bengal Meat's portfolio, they do have a number of fish product SKUs and are working with WorldFish to introduce fish products based on locally-produced carps (as opposed to caught and marine fish).
Golden Harvest	Gazipur			Fish Fingers			
Kazi Farms	Savar (Dhaka)					Dried Shrimp, Kechki and Bombay Duck	

Annex VI: Examples of Dutch players active in aquaculture

Segment	Organisation	Website
Genetics	Hendrix Genetics	www.hendrix-genetics.com
Genetics	Til Aqua	www.til-aqua.com
Feed / ingredients	Nutreco/Skretting	www.nutreco.com
Feed / ingredients	De Heus	www.deheus.com
Feed / ingredients	Bioseutica	http://www.bioseutica.com/
Feed equipment manufacturing	Almex	www.almex.nl
Feed equipment manufacturing	Ottevanger Milling Systems	www.ottevanger.com
Feed equipment manufacturing	Van Aarsen	www.aarsen.com
Packaging material	Solidpack / Smart Packaging Solutions	www.smart-packaging-solutions.com
Farming systems, engineering	De Lange Plastics	www.dlplastics.nl
Farming systems, engineering	Buwatec	www.buwatec.com
Farming systems, engineering	Fleuren & Nooijen	www.fleuren-nooijen.nl
Farming systems, engineering	Viqon	www.viqon.com
Sourcing	Klaas Puul	www.klaaspuul.com
Sourcing	ANOVA Seafood	www.anovaseafood.com
Sourcing	Primstar (Cornelis Vrolijk)	www.primstar.com
Sourcing	Seafood Connection	www.seafoodconnection.nl

Annex VI: Examples of Dutch players active in aquaculture

Segment	Organisation	Website
Sourcing	Fisherman's Choice	www.fishermanschoice.nl
Sourcing	Foppen	www.foppenseafood.com
Sourcing	Parlevliet van de Pas	www.seafoodparlevliet.nl
Processing and cold storage equipment	Innotec	www.innotec.nl
Processing and cold storage equipment	Kramer Machines	www.kramermachines.nl
Processing and cold storage equipment	GEA Food Solutions	www.gea.com
Processing and cold storage equipment	MPS Aqua	www.mps-aqua.nl/en
Processing and cold storage equipment	Nijhuis Industries	www.nijhuisindustries.com
Processing and cold storage equipment	GEA Refrigeration	www.gea.com
Consultancy, farming systems, engineering	Aquaculture Experience	www.aquaculture-experience.com
Consultancy, farming systems, engineering	ACE	www.ace4all.com
Consultancy, farming systems, engineering	Holland Aqua	www.hollandaqua.nl
Consultancy, farming systems, engineering	COSTA	www.dutch-aquaculture-experts.com/profiel/17
Consultancy, farming systems, engineering	Kamstra Consult	www.dutch-aquaculture-experts.com/profiel/20
Consultancy, farming systems, engineering	Leon Klaasen	
Knowledge institutes	Wageningen UR	www.wur.nl
Knowledge institutes	HZ Vlissingen	www.hz.nl

Annex VI: Examples of Dutch players active in aquaculture

Segment	Organisation	Website
Finance	Rabobank	www.rabobank.nl
Finance	Aqua-Spark	www.aqua-spark.nl
Civil Society	Solidaridad	www.solidaridad.nl
Business intelligence	STIP (part of Kontali)	www.seafood-tip.com
Business intelligence, market entry advisory	Larive	www.larive.com

Annex VI: Dutch Government instruments

Available RVO instruments for Private Sector Development

RVO instruments	Description
PSD Toolkit	The PSD Toolkit is a set of instruments available to the Embassy and RVO to develop small projects such as sector studies, small training programmes or for the formation of Public-Private Partnerships.
SDGP facility	The SGDP facility supports Public Private Partnerships that contribute to achieving the SDGs through a grant subsidy. This partnership should have at least one Dutch partner. The instrument is temporarily closed for applications.
Impact Cluster	The Impact Cluster is a RVO tool available for the development of integrated value chain clusters. An Impact Cluster is mutually designed by an Embassy, a consortium of Dutch and local businesses and RVO.
DHI	The demonstration projects, feasibility studies and investment preparation studies (DHI) is a subsidy for SMEs with international ambitions in emerging markets. Dutch companies can apply for subsidy for demonstration projects, feasibility studies or investment preparation projects.
FVO	The Fund for Responsible Business supports Dutch partnerships that wish to address the underlying causes of Responsible Business Conduct risks and misconduct in their value chains and implement measures to address them.
PIB	Partners for International Business (PIB) is a programme that allows Dutch businesses to enter into a public-private partnership to realise their international ambitions. This is primarily focussed on matchmaking, networking and economic diplomacy.
DGGF	The Dutch Good Growth Fund (DGGF) is set up to help Dutch entrepreneurs realise their international ambitions in emerging markets and developing countries (DGGF countries). The fund supports investment, import, export and investment funds.
Develop2Build	Develop2Build (D2B) is a Government-to-Government programme offering governments in 37 developing countries and emerging markets direct assistance in setting up infrastructural projects.
DRIVE	DRIVE facilitates investments in infrastructural projects that contribute towards a good business climate and entrepreneurship in the priority sectors: water, climate, food security, and sexual and reproductive health and rights (SRHR). Public infrastructure projects that have a high development relevance in other sectors also can apply for DRIVE support.
SIB vouchers	SIB vouchers can be used by Dutch businesses, to hire a consultant for market studies, participate in a trade mission or to hire an international lawyer.

Annex VI: Dutch Government instruments

Other Dutch organizations and tools

Other Dutch (funded) organizations or initiatives	Description
PUM	PUM is a volunteer organization of Dutch experts supporting businesses worldwide. 180 PUM representatives are spread over 35 countries across the globe, with 1700 experts being active in 45 sectors.
NUFFIC OKP	The Knowledge Programme offers scholarships, training and institutional partnerships between education institutions in Technical and Vocational Education and Training (TVET) and higher education, in fields related to the priority themes of the Dutch government: • Food and nutrition security • Water, energy and climate • Sexual and reproductive health and rights • Security and the rule of law This is implemented through a number of calls, published on the website of NUFFIC.
YEP Program	The Young Expert Programme allows young experts, both Dutch and local, in the Agro&Food sector to gain experience in an intercultural environment an work on a specific project related to either Water, Agrofood and/or Renewable Energy. Up to 50% of the salary of this young expert is subsidized by the Dutch Ministry of Foreign Affairs.
CBI	The CBI supports entrepreneurs to become successful exporters to the European market through export coaching projects.
Atradius Dutch State Business	Atradius Dutch State Business offers a wide range of insurance and guarantee products for Dutch exporters of capital goods, their financiers and/or investors. It also assist in finding other funding through the Dutch Good Growth Fund.
FMO	FMO is the Dutch entrepreneurial development bank. FMO manages funds for the Ministries of Foreign Affairs and Economic Affairs of the Dutch government to maximize the development impact of private sector investments.

Annex VII: Challenges in breeding

Shortage of high-quality seeds causes serious challenges throughout the value chain

Shortage of high-quality seed

- The Bangladeshi shrimp value chain faces several production bottlenecks, most notably in acquiring quality shrimp seeds. Most broodstock is still caught through wild collection and less than 2% of PL are SPF PL. Over-fishing of mother shrimp from the wild has led to rapid depletion of Monodon mother brood stock, which had a knock-on effect and has reduced the production of Monodon PL in recent years. In the fish sector, smaller hatcheries source broodstocks from local wet markets and ponds.

- Also, the fish sector experiences this problem. Many fish hatcheries do not replace their broodstocks on a regular basis and there is heavy in-breeding. The majority (60-70%) of fish fry/hatchlings are from hatcheries that do not have their own broodstock and are dependent on government hatcheries to collect broods or otherwise collect broodstock/roe collection from local farmers and wet markets without disease screening.

- All of these culminate in low productivity and low resistance to diseases for both shrimp and fish. Poorer farmers opt for cheaper low-quality seeds as the prices are often 30% - 50% lower - and as a result there is perpetually low productivity until the entire hatchery sector shifts to standard production practices.

- Limited seed supply had its impact in the forward segments through inflating the price of inputs for farmers. A large share of genetics is prone genetics, implying that the genetics that are available can also lead to poor survival rates. For some farmers, due to limited supply, the price burden of genetics has become too high. This has led to the closure of farms. The lack of inputs in upstream segments of the value chain also affected processors and exporters. Limited raw material (shrimp) causes them to utilize half of their installed capacities. The production of SPF PL, which is a key ingredient for semi-intensive shrimp farming, remains very low in Bangladesh (<5% of total Monodon production). Consequently, even semi-intensive farmers are sometimes forced to use diseased seeds spawned from wild-caught broodstock. Increased supply of SPF broodstock can not only deliver a positive supply effect, the broodstock will also yield more PL per unit of broodstock.

Annex VII: Challenges in feed

Low availability of quality feed is especially urgent for shrimp, to a lesser extent also for fish

Low market penetration of high-quality shrimp feed

A variety of factors contribute to the sales and production of quality commercial shrimp feed to be low. Suboptimal and inefficient farming conditions and a weak bargaining power of farmers depresses farm profitability, causing farmers to opt for cheaper inputs. Farmers, especially extensive farmers, tend to prefer relying on cheaper alternatives of commercial feed or choose to mix feed themselves. The high-quality standard for feed ingredients and finished produce (policy constraints) is difficult for farmers to meet. Farmers lack financial means and are commonly experiencing rising production costs. The lower quality and cheaper feed alternatives are supplied by producers that rely on unreliable power and for whom quality inputs are hard to acquire.

However, in certain cases, the production of feed of cheaper feeds is a deliberate decision. Feed suppliers anticipate the demand for cheap alternatives and try to market lower quality feeds, for which the production usually involves lower costs, as a good quality alternative.

This market situation is reflected by the positioning of for example Quality Feed; one of the few local shrimp feed manufacturers. It has invested in a dedicated shrimp feed production line, which utilizes pulverizing technology and gives the feed a higher binding capacity compared to competitors. However, the grade of their shrimp feed remains inferior to global standards. This is a deliberate decision in order to keep prices lower, despite the technical capability to produce higher-grade feed. Players with low-grade shrimp feed are occupying the market by providing feed on credit for longer credit cycles and relatively cheap feeds that farmers are sensitive to due to the riskiness of their business operations. Since the market is mostly credit driven where cheap feed alternatives are high in demand, players with large amounts of working capital and efficient operations focused on affordable products can grow over time. This also creates a challenge for feed producers with smaller working capital. This challenge is particularly an issue when the feed producers with low working capital reserves are the ones focusing on the production and sales of high-quality feed.

Unaffordability of quality feeds and limited awareness about the benefits of quality feeds

Volatile prices of raw materials

- Supply of raw materials needed for feed production is seasonal and can be unpredictable, which can lead to volatile prices of inputs. Negative supply shocks tend to depress the profitability of a feed miller. Raw material prices tend to be reflected in the end price of feed farmers incur. The shrimp and fish feed markets are therefore volatile as it fluctuates according to price of other feed inputs. For certain inputs, domestic supply does not fulfill what feed millers demand, leading to a portion of inputs being imported, further putting upward pressure on feed prices. High feed prices further reduce the ability of farmers to purchase high quality feed which would otherwise positively contributes to more sustainable production and the quality of produce. To mitigate the uncertainty of future input prices, volatile feed prices tend to induce farmers to opt for feed alternatives, such as pulse and rice grains.

Unfavorable regulations for feed producers

- Feed manufacturers face regulatory bottlenecks and encounter costs such as port and customs demurrage when importing raw materials. At present, the incidence of Advance Tax (AT), Advance Income Tax (AIT), import duties, supplementary duties and a host of other taxes lead to an overall tax incidence of around 35% on raw material imports for local manufacturers. With increasing regulations, the cost of producing feed increases, generally leading to higher feed prices and reducing the affordability of quality feed.

Annex VII: Challenges in farming

There is a lack of professional training and techniques, while climate changes poses increased risks

Financial vulnerability and low purchasing power limiting investments in quality inputs and technology needed for safe, efficient and monitorable farming

Fish and shrimp farmers, requiring finance to cover up-front investments, have weak bargaining power, forcing them to comply with the terms set by intermediaries, such as *arathdars*. Financing is traded for guaranteed sale to intermediaries at a price lower than the price that would be realized in open markets without involvement of intermediaries. Compared to prices earned in open markets, the sale to intermediaries leads to farmers running less profitable operations. Less profitable operations increase the risk of defaults, which not only affects farmers themselves, but also other stakeholders trading with farmers, such as feed millers, or those that are dependent on farmers for supply, such as processors. This causes them to be less able to invest in quality inputs, training and infrastructure that positively contribute to long run profitability and sustainable output. Depressed market prices are discouraging some farmers, such as monodon shrimp farmers to diversify. However, sunk costs and a lack of knowledge in aquaculture of other species mean farmers cannot diversify their production readily. An expansion of finance availabilities to farmers can enable resource-poor farmers to pursue intensified fish and shrimp farming and decrease reliance on middlemen, improving their bargaining power.

Weather and natural risks
Farmers are faced with several weather and natural risks such as:

- Premature depletion of pond water due to gradually extending dry season;
- Saltwater intrusion due to flooding and natural events.

These weather risk pose financial risks for farmers, depending on the resilience of the farm's infrastructural design. Financial risk is especially high due to the up-front investment farmers incur and revenues materializing at the end of the harvest cycle. While the Bangladeshi government significantly supports the agricultural sector, provision of financial support (e.g. insurance) to the aquaculture sector remains very low.

Lack of qualified farmers and technicians
Few qualified technicians being active at the breeding- and farm level limit the development of sustainable hatchery and farm practices, both in the export and domestic chain. The lack of local specialists in intensive/semi-intensive (shrimp, does this apply also to fish?) culture in Bangladesh meant that several semi-intensive farms had to employ less skilled aquaculture experts, who are not always qualified to react to water quality management and bio-security issues arising from (shrimp, does this apply also to fish?) aquaculture. The lack of qualified technicians therefore impedes development of good farming practices and hinders transfer of adequate knowledge among fish and shrimp actors.

Although training of fish and shrimp farmers is not uncommon, most farmers still face a knowledge gap. Antibiotics are a common choice to treat diseases preventively, though are not an adequate long-term option. Informing farmers about the benefits of probiotics can be one of the starting points for increasing awareness about proper input usage and fostering good farming practices. Probiotics can increase disease resistance, foster growth of fish and shrimp and improve feed efficiency, and is considered a good alternative for antibiotics. Usage of probiotic, minerals & medicines are uncommon among extensive farmers and gradually increasing among semi-intensive farmers. As extensive farmers account for majority of production, application of probiotics is limited.

Annex VII: Challenges in farming

In shrimp farming, the growth of intensive farming systems is lacking

Development of more efficient farming systems lagging behind

Most shrimp is produced in semi-intensive and extensive farm systems. These systems are characterized by suboptimal biosecurity standards, where the risk of pathogens affecting fish and shrimp stock is above what is desired. Desired biosecurity standards are not attained due to several internal factors that are related to farm infrastructure and operations, including suboptimal water treatment practices and entrance of pathogens from external environments (nearby rivers e.g.) due to open farm systems. If diseases such as White spot disease strike, it can lead to massive decimation of stocks. Setara farming, the largest semi-intensive farmer in Bangladesh, has in recent years lost major stocks of shrimp due to disease.

Furthermore, a lack of competent and experienced shrimp farming specialists (particularly as related to bio-security and water quality management) and the non-suitability of smallholder lands for large-scale efficient farming equally have limited the development of more efficient farming.

Limited growth of efficient farming contribute to low post-larvae survival at farms, which has a direct impact on the profitability of a farmer. Inefficient production is especially common among the less intensive producers. The survival rate for PL for extensive shrimp farmers is thought to be between 33% and 50% due to improper bio-security measures, scarcity of quality PL and limited usage and availability of nutrition that positively contribute to PL survival. Spread of diseases such as White spot disease for Monodon and antenna rot for Rosenbergii inhibit farmers from achieving high yields. Spread of diseases is particularly threatening for semi-intensive farmers due to the congested nature of semi-intensive farming.

Extensive nature of shrimp farming as the prevailing production method

Majority of shrimp farmers are extensive farmers practicing polyculture without fertilisation and feed with PL of suboptimal quality.[1] Little attention is devoted to maintaining water quality. Productivity is low with relatively low survival rates, increasing the average cost of a kg of produce and weakening the competitive position in international markets. How fish and shrimp are treated in ponds, riverbodies and other cultured water is the type of behavior that most farmers have internalized which can be hard to change without intervention.

Although extensively farmed shrimp, when successfully being certified, are priced at a premium in export markets, extensive farmers are characterized by their small scale and disorganized production with suboptimal biosecurity standards, increasing the likelihood of diseases, and making it more difficult to secure international certification for access to premium markets. Implementation of standardized and verifiable practices and making farming less prone to diseases in a biosecure way contributes to making a larger share of production eligible for export to more profitable markets. Semi-intensive shrimp farming, despite modestly, has grown in Bangladesh and improved survival and productivity rates and increased profitability of those active in the sector.

Although a myriad of factors contributes to the extensive system being the most prevalent system, two causes are believed to be major causes: knowledge gaps and a weak bargaining power of farmers.

Notes: [1] Polyculture is often practices with silver, common and grass carps. Polyculture is often associated with parasitic infections that can cause diseases (FAO – article Jiang Yulin 1996).

Annex VII: Challenges in farming

Animal health is a concern in hatcheries and farms. Limited traceability causes problems throughout the value chain

Disease spread in hatcheries and on farms

The rapid spread of fish disease affects about 30% of fish farms. In Bangladesh, pop eye, ventral reddening, tail and fin rot, haemorrhagic lesion over body surface, dropsy, gill rot, white spot and EUS are recurring signs of disease. Spreading diseases, negatively affecting fish health and yield, affect about 30% of fish nurseries and farmers. While disease spread among species and different types of diseases have distinct causes, a number of recurring circumstances can be identified that increase the chance of a disease outbreak. The broodstock, PL/fry stocked are prone to diseases and can be caused by inadequate input handling and desired biosecurity conditions not being maintained. Disease infectants can also come from abroad.[1] The lack of awareness about fish disease among farmers lead to a lack of preventive and control measures.

Rosenbergii shrimp hatcheries are facing massive technical difficulties resulting in the loss of PL stock due to suspected bacterial/viral infections or PL nutrition issues. In the past 10 years, none of the Rosenbergii hatcheries have had good PL yield in successive years, forcing many Rosenbergii hatcheries to cease operations. Furthermore, SPF hatcheries have not been able to meet the desired quality and survival rates and have struggled which has prevented them from gaining widespread market traction, especially among extensive smallholder farmers. In Rosenbergii breeding, in the best-case scenario, 50% of hatched PL will survive, causing pressure on wild-caught broodstock supply and prices.

Social conflicts among farmers

Social conflicts constrain productivity. These conflicts express themselves in multiple farmers having ownership over farm which involves coordination as to farm ownership and bearing the cost for inputs. Poor coordination and the resulting poor management of farms contributes to the prevalence of extensive farms using low-inputs. In densely populated aquaculture districts, the practice of poisoning ponds is sometimes carried out by other farmers when competition is fierce, as well as the poaching of farms.

Limited assurance of traceability and compliance with food safety and hygiene regulations

On-farm behavior and the organization of the supply chain is usually not in line with what is required for receiving certification that would enable access to premium export markets. Downstream players sometimes mix products from various suppliers which makes ensuring traceability, as one of the export requirements difficult.

Certain farmers are inclined to apply antibiotics or feed containing antibiotics excessively. Application of antibiotics is common and are sometimes used inappropriately, posing serious threats for human health through antibiotics resistance. The European food market set clear boundaries for antibiotic concentrations, in particular for organically produced seafood.

The disorganized supply chain entails that the produce switches ownership many times and increases the risk of infectants entering the fish and shrimp after it has passed the farm gate. Due to the complex supply chain, keeping within boundaries of the maximum residue levels of contaminants demanded by the European food market can not always be guaranteed.

In other shrimp producing countries, such as Vietnam, the farmers that are BAP and ASC certified are commonly corporate farms or those organized in cooperatives. The small size of the farmers and individualistic nature of farmers in Bangladesh makes certification complicated. Standardizing the farming practices of farmers cooperative is more cost-efficient than training farmers individually and facilitates knowledge spill-over. Encouraging farmers to organize themselves into cooperatives can therefore make attaining certification in a more feasible.

Annex VII: Challenges in end-markets

The export market is hampered by lack of certification due to a fragmented market

Acquiring export certification for fish exports

Bangladesh has not reached the full potential its aquacultural export market has. According to industry experts, there are several factors contributing to the decline in exports over the years. The inability to achieve the needed export certification for part of Bangladesh's fish production prevents access to Western markets, which would otherwise lead to an influx of economic gains. Inaccessibility to export markets comes forth out of both unmet certification at the farm- and processor level. Key requirements to be met as an aquacultural produce exporter include the implementation of the hazard analysis and critical control points (HACCP) standards and being able to trace your products back to registered aquaculture farms. The farms supplying exporters must possess sustainable certifications (ASC as the most common for aquaculture). A small share of farms posses ASC certification, enabling the processors tied to these farms to have access to profitable markets. The extensive nature of farming, due to their small scale and disorganized production, contributes to difficulties in achieving international certification that could have facilitated exports to more premium markets. Characteristics innate to the Bangladeshi aquacultural supply chain, such as several layers of middlemen active between farm and processors and infrastructural weakness that limit systematic registration of transported products make ensuring traceability challenging. Limited supply of aquacultural produce that can be exported negatively affects the attractiveness of investing in fish processing for the export market, though significant efforts to make the production practices of farmers export-ready can reverse this trend and unleash export opportunities.

Relatively weak competitive position of the shrimp export market of Bangladesh

Fluctuation of shrimp prices in international markets and the failure to leverage the extensive farming brand for entry into premium segments weakens Bangladesh export position versus (international) export markets. Vannamei shrimp, grown in most Asian countries except Bangladesh and some Latin American countries, dominate the world market because of its low prices compared to black tiger and freshwater prawn. This is exacerbated by the growth of the (semi-)intensive shrimp farming segment in competitive Asian countries. In Bangladesh, extensive shrimp farming prevails. Factors that contribute to the relatively high production cost include the availability of land and the low production per ha of shrimp farming area, with the latter being low compared to other countries producing with Vannamei shrimp.

In order to achieve better prices for its products, Bangladesh will need to create access to better markets such as retail or higher-end food service markets. This will require a significant improvement of the image of Bangladeshi shrimp, starting with safer and more efficient production practices and leading to certification and traceability. Limited efforts devoted to ensuring safe and efficient farming is expected to be the bottleneck. The benefits from allocating resources to provide training are twofold. More efficient farming makes the sector more cost efficient through improved survival rates, and healthier and faster-grown shrimp and can create access to more profitable markets.

Annex VII: Challenges throughout the sector

Throughout the sector, transport difficulties and disease outbreaks cause great disrupt

Lack of cold chain facilities and inefficient road infrastructure

The distribution chain of the Bangladeshi aquaculture sector is characterized by inefficiencies related to the preservation of produce, transportation infrastructure and trading practices. These inefficiencies impede Bangladesh from increasing the sector's profitability and realizing its full potential in the export sector. Many companies employ agents or accountholders who act as the middleman between depots, processors/exporters and retailers serving the domestic market. Procurement through such traditional value chain intermediaries is characterized with transportation without cold chain facilities, deteriorating the condition of shrimp and fish. If cooled, fish and shrimp is often transported in containers with ice. Usage of specialized refrigerated vehicles is limited. Limited cold chain facilities between farm and factory contribute to food loss in this section of the value chain. Many layers of middlemen combined with inefficient road infrastructure, increasing the time between farm and processor, exacerbate the effect a lack of cold-chain facilities has on fish and shrimp preservation, and makes ensuring traceability challenging as well. The nascent stage of the cold chain management system can help to explain the proximity of processors to fish and shrimp farmers as it decreases the need for cold-chain. To reduce wastage of aquacultural produce to a minimum, expanding cold-chain storage and transportation for perishable fish and shrimp products is required. The expansion should address the limited unavailability of icing and cold-storage facilities at places nearby the farmers' harvest sites, which would decrease discarded production and benefit hygiene practices. Improved road transport furthermore reduces the negative impact of missing cold-chain facilities but can also reduce the farmer's dependency on distributors.

Lack of investments in infrastructure and cold-chain

Investments in cold-chain infrastructure are often deemed not profitable due to too costly applications for which the cost must be born by an individual actor or due to the price needed for large scale cold facility service providers being above what actors are willing to pay.

Long and complex supply chains call for locations with multiple cold-chain. Shortening supply chains require fewer cold-chain facility hotspots and can make the investment more profitable considering the benefits through improved preservation of produce and fulfilling part of the requirements to enter premium export markets when hygienic cold-storage conditions are in place.

Although low-cost solutions are widely developed, improving the investment pay off is required by making applications even more energy efficient and cheaper due to the usage of innovative materials.

Due to the individualistic nature of farmers and middlemen, investments usually should be covered by individuals, who tend to lack the resources and collateral to make an investment with own or borrowed money, respectively. Joint investments by farmer groups are more feasible due given the shared financial responsibility and it makes it more attractive for collectors to source from such cold-chain facility due to the possibility to source high-quality produce in bulk.

Investments are too often considered from a single-crop perspective. Business opportunities may exist in large-scale provision of cold-chain facilities located at strategic routes where supply chains of multiple crops intersect that simultaneously allow for shortened supply chains and decreasing involvement of intermediaries.

Annex VIII: Opportunities for quality genetics

Capitalizing on the low availability of high-quality shrimp seed can accelerate semi-intensive farming

Increasing the availability of quality shrimp genetics to fill the supply gap of shrimp broodstock and PL

The apparent low survival rates in Bengali shrimp farming raise the needed to transform production with disease prone inputs to production with disease resilient input. A major component in the survival rate equation is the quality of PL. Most of PL used in shrimp farming is collected in the wild in the Cox's Bazar and surrounding districts. Not only puts this pressure on wild broodstock reserves, but the genetics are also weak, and a large share will not make it to fully grown shrimp compared to professionally developed broodstock.

Supplying SPF broodstock will improve productivity and is desired for export to the EU, which requires antibiotic free produce. A higher price for SPF broodstock may be partially offset by improved survival rates. An increased supply of SPF broodstock, which is currently accounted for by the only two SPF broodstock suppliers in Bangladesh, being MKA Hatchery, Desh Bangla SPF, Hatchery and Fishtec SPF Hatchery, will likely be absorbed given the projected shortage of wild broods over the next few years.

Supplying high quality broodstock is one part of the story. Proper product handling and creating transparency into what products are being sold contributes to higher survival rates and an improved understanding of the quality of input that is being traded upon point of sale, respectively.

The usage of SPF broodstock can help accelerate the development of semi-intensive farming, or vice versa. A growth in semi-intensive production systems can help Bangladesh combat the rising production costs given the more efficient characteristics of the type of production. Integrating the usage of quality inputs into production is paramount for semi-intensive shrimp production to grow.

Potential interventions

(Future) establishment of breeding multiplication centers (BMCs)
A BMC localizes the production of genetics based on a parent stock. In a BMC, parent broodstock is converted to first generation genetics, which is then distributed to hatcheries. A BMC is typically geared towards the domestic market, increasing the availability of high quality broodstock.

Establishment of nurseries[1]
Putting PL into a nursery aids in the acclimatization the PL and improves survival rates. Some existing nurseries in Satkhira are profitable and there is potential to establish new nurseries in Khulna, Satkhira and Bagerhat districts.

Successfulness of setting up a nursey depends on the capacity of the organization, possibly in cooperation with NGOs, to break through the regular supply chains patterns where middlemen control the interaction between fry collectors and farmers. Farmers setting up small nursery areas within their ponds and ghers can help with acclimatize genetics and improving survival rates.

Investment in educational resources can encourage farmers to so utilize nurseries. Successful private sector involvement would require a strong collaboration between the ones interested in investing in nurseries, (clusters of) farmers and broodstock suppliers.

Source: LightCastle-Larive primary interviews, analysis, FAO – 'An assessment of impacts from shrimp aquaculture in Bangladesh and prospects for improvement (2017)'
Notes: [1]A nursery is an intermediary step between the hatching of genetics and farming.

Annex VIII: Opportunities for quality genetics

Improving the quality of fish genetics through integrated solutions and local breeding programs

Fish genetics – development of a local breeding program

A growing industry, low quality fish genetics and pressure on the stock of wild broodstock signifies a possible opportunity to supply high-quality fish genetics locally.

The common practice hatchery operators adopt is the sourcing broodstock at wet markets where the seed is in live form collected from the mother fish. The majority of the 1,000+ hatcheries relies wild-caught broodstock. A small number of hatcheries, mostly integrated, such as Nourish and Quality, source broodstock from foreign countries (e.g., China). Genetics is often homogeneous causing limited adaptability in different environments and disease prone (genetics screening/assessment is not performed in hatcheries). Due to the inexistence of an in-house breeding program, the supply of genetics is volatile and resulting prices similarly.

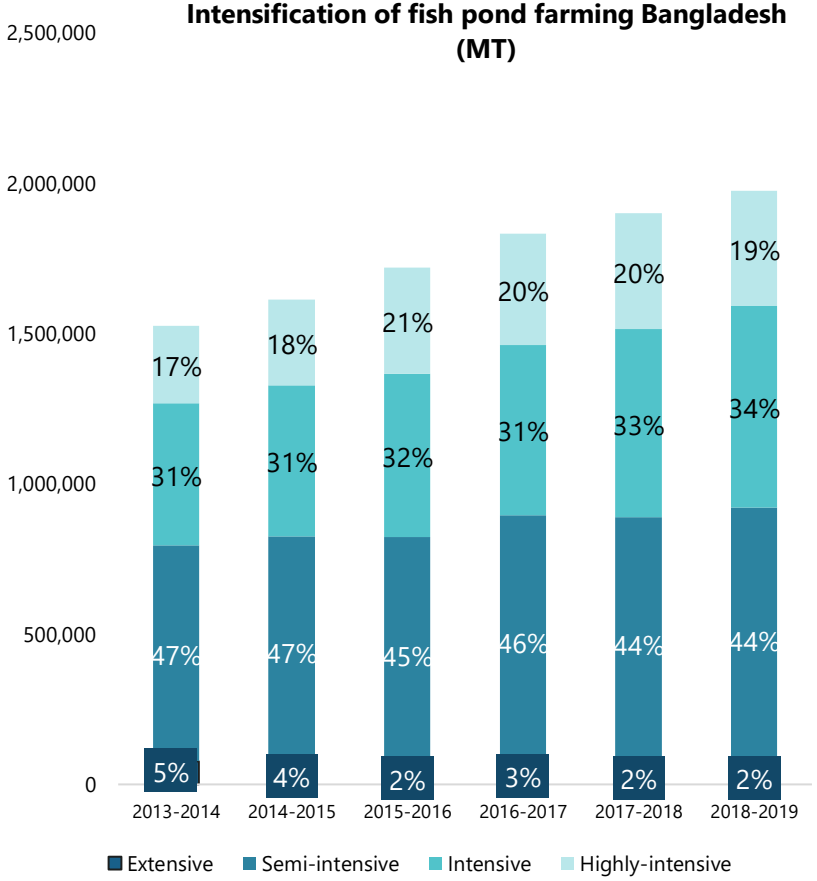
Given the challenges that local supply of quality genetics can overcome, the development of a local breeding program can be an opportunity. The opportunity is contingent on increased supply creating traction among fish farmers. Whether broodstock end-users in Bangladesh will adopt high-quality genetics depends on a myriad of factors. These include whether end-users will undergo the required behavioral changes to shift towards alternative broodstock and adopt new related buying procedures, whether end-users are willing to pay a certain premium and whether the quality of locally supplied broodstock will meet desired standards of end-users, provided a certain price.

Farmers may be willing to pay a premium, though local suppliers must set up operations in a way that ensures remaining competitive to suppliers of wild-caught broodstock. The use wild-caught broodstock characterizes the industry and will require significant effort to change this deeply embedded behavior and preferences. Setting prices at a point that improves cost-efficiency of end-users, where they in theory should buy the product, will not guarantee offtake.

The volatile supply and poor quality of genetics combined with an industry whose demand for broodstock will grow in parallel with the overall industry will inevitably require a shift in how broodstock is supplied currently. Further research is required to determine more accurately any untapped potential for the supply of quality fish genetics locally and the size of the opportunity.

High demand for quality fish genetics can be accelerated due to future intensification of fish farming (see figure). To ensure that the local breeding program is tailored to local conditions, the initiative would require technical cooperation with Bangladeshi livestock universities, who can support with broodstock development, and development bodies, who can support with implementation and encouraging take-up.

Intensification of fish pond farming Bangladesh (MT)



Annex VIII: Opportunities for inefficient supply chain

Improving efficient and sustainable farming offers opportunities for increased export

Improved production systems and technology

To maintain the organic and 'clean' nature of the Bangladeshi shrimp, productivity improvements should be realized through interventions that cause no farm for the environment with little to no usage of hazardous chemicals.

Improving productivity using the existing cultivation areas contributes to increasing shrimp output and profitability without having to remove additional mangroves which fulfill a paramount role in conserving biodiversity.

Productivity improvements while avoiding adverse side effects can be realized through several ways. Increasing usage of professional hardware at the farming and hatchery level can improve productivity. RAS systems allow for reusing water, mitigates the environment downsides conventional shrimp farming has in countries such as Vietnam through limited release of wastewater into the environment. Additional benefits of RAS farming include the control over water quality and cultivation conditions, allowing for higher stocking densities and lower disease rates.

The investment in professional hardware in Bangladesh is commonly regarded as an investment which cannot be borne by most farmers. Nevertheless, the system has made its introduction in fish farming 2016. Agro Fisheries in Mymensingh and Deshi Fish Farm in Manikganj have adopted RAS culture on a commercial basis. The intensification of shrimp farming in Bangladesh, if getting up to speed, may be paired with the introduction of and demand for new technologies. For Dutch private sector players, which are pioneers in RAD technology, long term sales opportunity can arise.

Assist farms and processors with achieving required quality standards for export for those actors with above basis level of production practices

Currently, Bangladesh does not meet the quality standards of the EU. If NL could help Bangladesh meet standards, this could be interesting. Most value addition by NL can be in farming: making it more efficient/sustainable. If there are sizeable parties, we could think about cooling/processing. Bangladesh could also potentially increase its market by targeting China. Chinese demand for Bangladeshi product has been increasing. If Bangladesh can offer better quality material through shorter supply chains, it will be likely that China is ready to absorb more of Bangladesh's products. Several players are working on increasing sales in China and EU buyers are afraid for Chinese competition.

Annex VIII: Opportunities for inefficient supply chain

High-quality, tailor-made training programs can lift the quality of the entire sector through improved practices

Investing in value-added fish processing to serve the domestic market & capture vast export potential

Majority of inland produced fish is consumed fresh (~ 50%) due to strong consumer preferences. The rapidly rising middle-income affluent urban population of Bangladeshi might effectuate a small yet gradual change in consumer preferences. The number of players in processing is limited. Processors in Bangladesh are usually located in two areas. In western region, processing concerns freezing and chilling for the export market, whereas in the East processing concerns processing for the ready-to-consume segment (e.g., fish fingers). In line with growing demand a limited number of players, there can be untapped potential in the domestic value-added and ready-to-eat fish segment.

Cross-country curriculum development (G2G-K2K)

Improved practices throughout the sector can be achieved through high-quality training programs. The Dutch government and knowledge sector could assist with improving knowledge institutes, developing a nation-wide curriculum, and offering improved education to (future) farmers.

Training to ensure proper production practices to capture potential of high-quality inputs, feed and other inputs

Usage of high-quality genetics being paired with suboptimal production practices does not yield the full potential benefits of the quality PL. The basis for the inputs to provide their added value is proper farming practices and knowledge on how to optimally control the farming environment that can make or break the success of inputs used.

The syllabi should contribute to educating farmers and breeders on disease prevention but also on the actions needed to ensure sustainable production, both in terms of chemical-free outputs and limited harm to the environment.

The intervention to ascertain the full potential benefits of increased SPF-broodstock supply therefore concerns training of the end-users of PL. Using quality inputs should be accompanied by proper farm management. The sector requires more competent and experienced local shrimp farming specialists, particularly as it relates to bio-security and water quality management. Training farmers on these practices and how to ensure optimal survival rates will enlarge the benefits of the quality PL and contribute to making the integration of quality PL more affordable, given the higher survival rates that will likely result from the expanded knowledge of those utilizing quality PL.

Annex VIII: Opportunities for inefficient supply chain

Jointly resolving governance issues

Bangladesh since 1998 has a National Fisheries Policy which encompasses separate policies for inland closed water fish culture and for coastal shrimp and fish culture.

The Policy touches on many contentious issues. For instance, it addresses conflicts over shrimp cultivation and underscores the need for formulation of suitable guidelines. To help conservation efforts, it prescribes a moratorium on further cutting of mangrove for shrimp cultivation. It also supports an integrated culture of fish, shrimp and paddy in paddy fields. In addition, the Policy deals with many other relevant issues such as quality control, industrial pollution and the use of land.

The Netherlands is pioneering in the field of climate-smart agriculture, how to govern industries to adequately incentivize actors on adopting environmentally friendly practices.

The Netherlands has developed numerous effective policies on usage of minerals and manure and pesticide usage, which are adhered to by the majority of the farmers.

Drafting a national guideline for fish farming, informing actors what requirement they need to fulfill in order to participate in the export market, could help to shift the industry from a fully-domestic industry toward a partial export-industry. Bangladesh has secured export certification for shrimp and stakeholders argue that the cultured fish segment has the capability to achieve this similarly.

Public involvement

Organizing and preparing trainings can be costly, and the financial situation of shrimp farmers often does not allow for investments in such training. Actively distributing knowledge across the sector requires commitment, government involvement and a strong cooperation between public and private institutes.

Setting up collaboration with Bangladeshi knowledge institutes, Dutch knowledge institutes, farmer cluster groups and NGOs tied to these farmer cluster groups can be a starting point for facilitating knowledge transfer. The department of fisheries (DoF) aims to expand the number of shrimp farm clusters. In 2025 (2030), the DoF aims to have 1,560 clusters with 39,000 farmers (2,075 clusters with 51,875 farmers). The potential training base is therefor growing.

The centralized nature of farming clusters simultaneously makes these clusters the desired target groups through which adoption of SPF PL can be increased.

Annex: Interview list

Organization	Contact person	Interviewer
Anova Seafood	Koen Verburg, Operations Director	Larive International
ASC	Roy van Daatselaar, Global Lead ASC Improver Programme	Larive International
Fishermen's Choice	Undisclosed	Larive International
Primstar	Jacco Numan, Sr. Project Manager	Larive International
Seafood Connection	Sjoert Moors, Purchase Manager	Larive International
Solidaridad	Moin Uddin Ahmed, Team Leader, SISBP Project at Solidaridad Network Asia	LightCastle Partners
Solidaridad	Selim Reza Hasan, Country Manager- Bangladesh	LightCastle Partners
(BFRI) - Bangladesh Fisheries Research Institute	Dr. Shafik Uz-zoha, Former Principal Scientist	LightCastle Partners
Bangladesh Agricultural University (BAU)	Dr. Abdul Wahab, Professor, Department of Fisheries Management	LightCastle Partners
Spectra Hexa Feeds ltd. (Mega Feeds Ltd.)	Md. Ahsanuzzaman, Director	LightCastle Partners
Agro3 Fishery	A.B.M. Shamsul Alam Badal, Propreitor	LightCastle Partners
Bangladesh Frozen Fish Exporters' Association (BFFEA)	Sheikh Sohel Pervez, Secretary	LightCastle Partners
Bangladesh Live and Chilled Food Exporters' Association (BLCFEA)	Habibur Rahman Shamim Mrida, Secretary	LightCastle Partners

Annex: Interview list Continued

Organization	Contact person	Interviewer
EON Group of Industries	Momin Ud Dowlah, Chairman & Managing Director	LightCastle Partners
WorldFish	Md. Mazharul Islam, Divisional Administrator	LightCastle Partners
Quality	Ihtesham B. Shahjahan, Managing Director	LightCastle Partners
ACI Godrej	Mohi Uddin, Finance Director	LightCastle Partners
M.U. Seafoods (Potential Vannamei)	Shyamal Das, Managing Director	LightCastle Partners
Fahim Seafood	MA Hasan Panna, Founder	LightCastle Partners
ADOF Shrimp Farming	Mr. Humayun, Founder	LightCastle Partners
ACI Agrolink Limited	Ahsan Bappee, Head Of Operation & Marketing	LightCastle Partners
Oriental Fish Farms	Abdul Baki, Owner	LightCastle Partners
Jalalabad seafood industry Ltd.	Md. Shoyeb Mahmud, General Manager	LightCastle Partners

Larive International B.V.
Sparrenheuvel 2
3708 JE Zeist
The Netherlands

Matthias Brienen
Director
Matthias.Brienen@Larive.com
Tel: + 31 30 693322

This is a publication of
Netherlands Enterprise Agency
Prinses Beatrixlaan 2
PO Box 93144 | 2509 AC The Hague
T +31 (0) 88 042 42 42
E klantcontact@rvo.nl
www.rvo.nl

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