UTILISATION AND PROCESSING OF FISH BY-PRODUCTS IN BANGLADESH: VALUABLE TREASURES, NOT TRASH

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A five-country study conducted by FAO and INFOFISH in 2024 revealed that fishery by-products, previously discarded as trash, can be valued treasures attracting substantial local and international market demand. Through processing, these by-products are transformed into high value-added co-products such as collagen, chitin and chitosan, fishmeal and fish oil.[1,2,3]. These biomaterials can then be used in the pharmaceutical, nutraceutical, cosmeceutical, feed, bioplastics and biofertiliser industries, contributing to circular economies and minimising environmental hazards. This article is a partial outcome of the study, focusing on the key fish by-products (fish scales and skins, pituitary glands, shrimp shells, fish maws, fishmeal and fish oil, sharkfins and rays) available in Bangladesh, along with their valorisation potential.

Fish processing facilities generate a significant amount of fish by-products (co-products) that could be an important source of energy, food, fertilizer or industrial feedstock.

According to the Food and Agriculture Organization of the United Nations (FAO), fish by-products are the side streams from processes such as fish processing, where fillets are the main product, i.e. by-products are secondary materials. Fish heads, skins, bones and viscera are examples of such fish by-products.

However, some by-products can gain added value through further processing and be converted into marketable new products known as co-products. Fishmeal (made from fish heads, tails, fins and discarded whole fishes not used for human consumption); fish oil (viscera, intestines and gill rakes are used as raw materials); gelatin and collagen (from fish scales, skins and bone frames), chitin and chitosan (crustacean shell wastes) are examples of such co-products.

Fish scales and skin

Between 40 and 55% of fish scales contains organic components such as collagen and lecithin.

[1] *Islam, M.J., and Omar, R.P., 2021. Seafood Waste Management Status in Bangladesh and Potential for Silage Production. Sustainability 2021, 13(4), 2372; https://www.mdpi.com/2071-1050/13/4/2372*

[2] *Islam, J., Yap, E.E.S., Krongpong, L., Toppe, J. and Peñarubia, O.R. 2021. Fish waste management – An assessment of the potential production and utilization of fish silage in Bangladesh, Philippines and Thailand. FAO Fisheries and Aquaculture Circular No. 1216. Rome. https://doi.org/10.4060/cb3694en*

[3] *FAO and INFOFISH 2024. Compilation of Value-Added Products with Materials Originated from Aquatic Resources. A study on fish by-products conducted in Bangladesh, Malaysia, Indonesia, Philippines and Thailand. 82 pages (To be published).*

Among the fish by-products, fish scales stand out for their economic promise, driven by their rich collagen content which is essential for gelatin industry. Fish scales were previously discarded but are now carefully collected and sold for an average price of BDT 70 (USD 0.60) per kilogram in Bangladesh. Large fish scales command higher prices, while smaller ones fetch lower prices. According to the Export Promotion Bureau (EPB), Bangladesh exports fish scales worth BDT 200 crore (USD 17.02 million) annually. During the 2023–2024 fiscal year, 2 874 tonnes of scales were exported, with the country earning BDT 80 crore (USD 6.8 million) as foreign exchange. The price per kg of scales varies from BDT 5 to BDT 20–30 during the wet and dry stages respectively. Furthermore, depending on the species, the quality, size and moisture content of the scales may vary, resulting in export prices ranging between USD 1 400–2 000 per tonne.

Fish skins (derived from *Pangasius* and other catfish) are also major sources of collagen. Since freshwater fish skins constitute 3–5% of the raw material, Bangladesh has the potential to accumulate approximately 4 000 tonnes (1 438–7 190 tonnes) of skins from freshwater fishes, which is enormous. But the fish skins are usually not collected or processed in the country, becoming waste in the process (Table 1).

Table 1: Species/group-wise annual fish production from inland fisheries, 2022–23

Major freshwater fish species	Production 2022–23 (in tonnes)	Production of fish by-products (in tonnes)
Major carps (*Labeo rohita, Catla catla* and *Cirrhinus mrigala*)	1 084 397	108 440–325 319
Other carps (*Labeo calbasu, L. bata* and *L. gonia*)	144 584	14 458–43 375
Exotic carps (*Hypophthalmichthys molitrix, Ctenopharyngodon Idella, Cyprinus carpio, Hypophthalmichthys nobilis, Mylopharyngodon piceus*)	545 141	54 514–163 542
Tilapia (*Oreochromis niloticus*)	421 191	126 357–42 119
Sarpunti (*Systomus sarana*)	112 280	33 684–11 228
Pangas (*Pangasianodon hyphophthalmus*)	403 283	40 328–120 985
Other catfish (*Wallago attu, Sperata aor, Rita rita*)	76 000	7 600–22 800
Total freshwater fish by-products (estimated)		**385 381–706 568**

Source: Yearbook of Fisheries Statistics, Bangladesh.[4] Note: Snakehead (shoal, gozar, taki); live indigenous fish (koi, shing, magur); and marine water fishes are not included in this Table. Fish by-products were estimated at 10–30% of the raw fish weight.

The value chain for fish scales includes various intermediaries such as fish dressers, local vendors, traders and exporters. Local vendors generally collect scales from the dressers at the wet markets and sell them to the local traders or exporters who wash them to remove oily substances. Once washed, the wet fish scales are sun-dried (or mechanically with the help of a dryer during rainy days) to maintain the best quality. Dust particles are carefully removed with the help of a sieve and the dried fish scales (a valuable and natural source of collagen) are packed in 25 kg or 50 kg sacks and finally shipped by exporters to international markets. Details on the processing and utilization of fish scales in Bangladesh can be found here and here.

Pituitary glands

The pituitary glands (PGs) of fish produce, accumulate and store gonadotropic hormones which play a decisive role in reproduction. Situated on the ventral side of the brain below the hypothalamus, the gland serves as an intermediary between the central nervous system and gonads. The collection of PGs on a commercial scale is possible only when fish are of suitable size (above 1kg), i.e. sufficiently mature and with gonadal development.

After collecting, the PGs are taken to the laboratory for processing which includes cleaning, followed by a dehydration procedure with acetone treatment to preserve and prepare the glands for use (Best practices of PG collection and processing). Finally, the product is dried, weighed, and packaged in bottles designed to meet export quality standards. The unit price of PGs varies from Tk 4-6 (USD 0.03-0.45) to Tk 10 -15 (USD 0.08-0.012) during the wet and dry stages respectively, and between USD 10 to USD 100 per gram of final product, depending on their quality, size and efficacy.

Collected and preserved pituitary glands from fish are important as a source of gonadotropic hormones to induce reproduction.

The annual demand for PGs in Bangladesh ranges from 40–50 kg. United Agro Fisheries, one of the leading PG collectors in the country, supplied 6 kilograms of dried PGs to various districts last year (which was 10 percent of the national demand) and the rest was exported to other countries, including the Russian Federation, Brazil, Ukraine, Iraq, Venezuela, Malaysia, Portugal, Kazakhstan, Egypt, United Arab Emirates, United States, Togo, China, Japan, Singapore, Germany, Poland, India, Colombia, Ecuador, Iran,

[4] *Yearbook of Fisheries Statistics of Bangladesh 2022-23, Fisheries Resources Survey System, Department of Fisheries, Ministry of Fisheries and Livestock, Govt. of the People's republic of Bangladesh. Pages 124. 2024-07-08-03-59-c335f1d6908e7427417e8bc610142b63.pdf*

Argentina, Jordan, Bulgaria and the United Kingdom. The natural glands marketed by United Agro Fisheries are widely accepted by hatchery operators for their superior quality compared to synthetic alternatives. The revival of natural PG collection and processing exemplifies the existence of a niche market for aquaculture products which contribute significantly to both local and national economies. If PGs were not being collected, they would have been wasted.

Shrimp shells

Due to the rise in global shrimp consumption, the production of shrimp shells and head wastes by processing plants has also increased (Table 2). Generally discarded, these wastes have emerged as a valuable resource for the fishery sector. By converting them into valuable products, industries can mitigate the environmental impacts and unlock economic opportunities substantially.

Dried shrimp shells are rich in chitin, proteins and calcium carbonate, which is useful for industries like pharmaceuticals and cosmetics.

Table 2: Species/group wise annual fish production of inland fisheries in 2022–23

Major shrimp/crab species	Production in 2022–23 (tonnes)	Production of wastes in tonnes (Estimated by Islam et al, 2021)
Shrimp/prawn	224 539	78 589–112 270
Crabs	12 881	4 508–6 441
Total shrimp waste		**83 097–118 711**

Source: Yearbook of Fisheries Statistics, Bangladesh5

5 Yearbook of Fisheries Statistics of Bangladesh 2022-23, Fisheries Resources Survey System, Department of Fisheries, Ministry of Fisheries and Livestock, Govt. of the People's republic of Bangladesh. Pages 124. 2024-07-08-03-59-c335f1d6908e7427417e8bc610142b63.pdf

In Bangladesh, export data on fish scales and shrimp shells are combined under the same HS Code category, presenting a challenge to quantify them separately. The export of fish scales and shrimp shells was recorded at 1 881.28 tonnes worth USD 1 822 641.59 in 2020–2021. In the following year, the export of shrimp shells was recorded as 3 022.62 tonnes, valued at USD 3 658 425. There is no doubt that if the Department of Fisheries were to take the initiative to collect, process and utilise shrimp and other crustacean shells in the country, it would benefit the sector economically and reduce environmental pollution in the long run.

Currently, a significant amount of shrimp shells and appendages (both spoiled and fresh) are collected by local contractors. After that comes the sorting out of unwanted particles and packing in 25kg or 50kg sacks; and finally, the finished packs are exported to China, Republic of Korea, Thailand and Indonesia as raw materials for the pharmaceutical and cosmetic industry. (Shrimp by-product utilization in Bangladesh). Lastly, the spoiled shrimp shells go for landfilling. A targeted processing, utilisation and value chain development plan for the industry in Bangladesh can result in substantial economic returns for these by-products.

The price of each kg of shrimp shells varies from Tk 2–5 to Tk 5–10 (USD 0.016–0.041 to 0.041–0.082) during the wet and dry stages respectively. Export price fluctuations may also occur depending on the quality, presence of dust particles and moisture content of the shells. Comparatively, the export price of fish scales is between USD 700–1400 per tonne, depending on the species, size and quality of the raw material.

Fish maws

Drying fish maws by applying different techniques.

Fish maws derived from the swim bladders of fish, are valued for their high collagen content and nutritional benefits, leading to significant market demand, especially in Asia.[6] The Bangladesh Fish Maw Business Association reported that the trade has gained substantial popularity particularly in Chattogram, where 40 enterprises from the Fishery Ghat

6 Xing et al., 2025. Species authentication and conservation challenges in Chinese fish maw market using Mini-DNA barcoding. Food Control. Volume 167, https://doi.org/10.1016/j.foodcont.2024.110779

area near Karnaphuli River employ some 300 people for the collection and processing of fish maws.

Generally, fish maws are collected by fish dressers at the local wet markets. They are cleaned thoroughly with freshwater and sun-dried by using various techniques and finally packed for export. These by-products are used in popular Chinese dishes like fish maw soups and fish maw stews. They are also used to produce high-value surgical sutures in addition to being a good source of collagen and fibre. The key steps in the collection, processing and utilisation of the fish maws from wet market to exporter level in Bangladesh are outlined here. (Best practices for collection and processing of fish maws in Bangladesh)

Dried fish maw is a lucrative fishery commodity; for instance, one kilogram of swim bladders from *Johinus coiter,* locally known as Datina koral, and white grunter *(Pomadasys hasta),* sold for BDT 400 000–500 000 (USD 3 404–4 256) during the study period. Similarly, the swim bladders from Indian salmon also commanded high prices, selling at BDT 100 000 per kg (USD 851). Pike eel *(Muraenesox bagio)* swim bladders sold for BDT 25 000–40 000 per kg, whereas those from eel, rui *(Labeo rohita),* pangasius *(Pangasius hypophthalmus),* catla *(Catla catla),* boal-catfish *(Wallago attu),* lakkha *(Leptomelanosoma indicum),* lambo (Joe-fish) and other whitefish sold at BDT 5 000–6 000 per kg (USD 43–52).

The export of fish maws and fins from Bangladesh to countries such as China (including Hong Kong SAR), United Arab Emirates and Vietnam has gained momentum, driven by the high demand for these products.

Fishmeal and fish oil

As the country's fish production has increased substantially, the volume of by-products, including heads, gill rakes, viscera and entrails has also risen. Fishmeal and fish oil can be extracted from by-products, which will not only add value to the processing industry, but will also contribute to environmental sustainability by reducing waste.

There is no official record of fishmeal and fish oil production in Bangladesh. According to a study by WorldFish/USAID, about 1 million tonnes of commercial feed and 0.3–0.4 million tonnes of farm-made feed were produced in 2012.[7] Currently, the commercial pellet feed production in the country is estimated at about 1.6 million tonnes per year, while the amount of farm-made feed has reduced drastically due to the introduction of extruded feed (floating feed). Almost all the fishmeal and fish oil required to produce fish feed is imported. Considering the inclusion of fishmeal and fish oil at 10kg and 1 litre respectively in the manufacture of commercial feed per tonne, the demand for fishmeal and fish oil is approximately 16 000 tonnes and 16 000 litres per year, which is huge. By converting local fish by-products into valuable fishmeal and fish oil, imports can be reduced. Moreover, the fish oil can be used in various sectors such as nutraceuticals, pharmaceuticals, cosmetics and animal feeds.

Collection of fish entails, roes and viscera.

[7] *Improving Aquaculture Feed in Bangladesh: From Feed Ingredients to Farmer Profit to Safe Consumption. An article published in The Fish Site.com. https://thefishsite.com/articles/improving-aquaculture-feed-in-bangladesh-from-feed-ingredients-to-farmer-profit-to-safe-consumption*

Sharks and rays

Although the netting of nine genera and 52 species of marine fish, including whales, dolphins, sharks and rays is prohibited in Bangladesh, the hunting of sharks and rays continues unabated, as reported in The *Business Standard, October 2023).* Furthermore, despite a ban on the trade of sharkfins in several countries during 2010–2012, the illegal export of shark products, particularly to Myanmar, continued. According to Government statistics, up to 2 000 tonnes of dried sharkfins are exported from Bangladesh each year, earning over a million USD as foreign exchange.[8] In 2020–21, the quantity traded was 64.15 tonnes valued at USD 67 750. The following year, 2021–22, the quantity jumped to 79.27 tonnes, with a corresponding price rise to USD 210 507. However, the fiscal year 2022–23 witnessed a sharp decline in the quantity traded, dropping to 5.02 tonnes and a significantly decreased value of USD 54 421. This decline indicates that regulatory changes, conservation efforts, and reduced demand have impacted the global trade of sharkfins.

Major challenges and recommendations

The main challenges in by-product processing and utilisation in Bangladesh are listed below:

- The stakeholders involved in the fish scale value and supply chain are still using traditional collection and processing methods.
- There is a lack of competitiveness in the domestic market and access to potential export markets.
- Dearth of knowledge and information at the competent authority level and among other stakeholders regarding the gathering of data on fish by-products and their utilisation.
- No/limited capacity building or training conducted by the relevant agencies to manage, utilise and process the fish by-products, with only the private sector being aware of the market potential.
- Huge amounts of shrimp and crab shells constitute a public nuisance and cause environmental pollution especially during the peak season when they are discarded in landfills.
- Inadequate financial support for young and new entrepreneurs; as well as insufficient facilities to further process fish by-products into co-products.
- Limited or no R&D activities to improve processing and utilisation.
- A lack of a national conservation strategy and plan of action for endangered sharks and rays in Bangladesh to protect them from extinction.

The following recommendations are highlighted to address the above challenges:

- The country needs cutting-edge technologies and improved processing facilities to enhance efficiency and quality, product innovation and better utilisation of by-products.
- Competent authorities should work to reduce trade barriers and enable broader market access.
- Training and capacity-building for industry stakeholders should be emphasised to realise the full potential of the by-product value chains and to facilitate trade and market access.
- More financial assistance is necessary to spearhead innovative technologies, including greater access to interest-free loans to improve processing facilities.
- Initiate more R&D and Innovative projects to strengthen public-private partnerships.
- Formulate a national conservation strategy and plan of actions for sharks and rays; and implement the existing laws aimed at species and fisheries biodiversity conservation.

Conclusion

The processing and utilisation of by-products originating from aquatic resources hold substantial promise for economic growth and environmental sustainability in Bangladesh. By capitalising on the abundant fisheries resources and improving processing techniques, the country can significantly boost its exports and generate revenue. However, to harness the potential and address practical challenges, coordinated efforts from the government, industry stakeholders, and researchers are important. With targeted interventions and strategic planning, the processing and utilisation of by-products can contribute to sustainable fisheries development while adding value to the circular economy of Bangladesh.

Being a highly motivated aquaculture professional, ***Sujit Krishna Das*** *has more than 16 years of experience in fisheries and aquaculture value chains at regional and international levels. His areas of expertise include aquaculture value chains, commercial breeding and reproduction of tropical fishes and shrimps, intensive nursing and farming operations, formulation of species-specific feed and nutrition, biosecurity, certification and welfare of aquatic animals. With a Master's degree in Marine Science (Major in Aquaculture), he started his career as a Research Assistant with the DFID (UK)-funded SUFER project and over time, he took up various key technical positions in national and multinational organisations. As the Technical Advisory Officer at INFOFISH, Malaysia (https://v4.infofish.org), since 2019, he is responsible for providing Technical and Policy Advisory Support to the INFOFISH Member States, keeping abreast of technological developments, dealing with the projects and consultancies; organising training, workshops and international conferences. He regularly writes articles for the INFOFISH International as a contributing editor. He is also responsible for publishing the Fishing Technology Digest and Fish Inspector newsletters (quarterly) as a technical editor. Sujit Das also advocates the Blue Transformation Strategy declared by FAO and is passionate about contributing to regenerative permaculture and responsible 'blue food' production systems.*

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[8] *Checking illegal trade of marine life in Bangladesh: A long way to go | The Business Standard*
The artificial propagation of warm-water finfishes A manual for extension