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From Fish Waste to Wealth: Unlocking New Opportunities in India's Fisheries Value Chain

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Fish processing waste is an underutilized resource with considerable potential for economic development and environmental sustainability in India. Fish heads, skin, scales, bones, viscera and shrimp shells contain valuable proteins, oils, minerals, collagen and chitin that can be converted into commercially useful products. Fish meal, fish oil, fish silage, collagen, gelatin, chitosan and organic fertilizers are important examples. Recent initiatives by ICAR-CIFT and ICAR-CIBA highlight emerging opportunities in this field. Scientific waste utilization can reduce environmental pollution, improve resource efficiency, generate rural employment and promote sustainable fisheries entrepreneurship.

Keywords: Fish processing waste; Value addition; Fish by-products; Circular economy; Waste utilization; Fisheries entrepreneurship.

Introduction

Fisheries is an important contributor to India's food security, nutrition, employment and rural economy. However, the value of fish does not end with harvesting or selling fresh fish. Considerable quantities of fish materials are generated during cleaning, dressing, filleting, peeling and processing. Fish heads, skin, scales, bones, viscera, shells and trimmings are often discarded or sold at low prices. These materials are commonly called fish processing waste or by-products. They contain valuable proteins, oils, minerals, collagen, gelatin and chitin. With suitable processing technologies, they can be converted into fish meal, fish oil, fish silage, collagen, chitosan, animal feed and organic fertilisers (FAO, 2024; ICAR-CIFT, n.d.). The concept of 'Fish Waste to Wealth' promotes the efficient utilization of valuable fish materials. It supports a circular economy in which resources are recovered, waste generation is reduced and additional income opportunities are created.

India's Fisheries Sector: Why Waste Utilization Matters

India's fish production increased from 95.79 lakh tonnes in 2013–14 to 197.75 lakh tonnes in 2024–25. Inland fisheries and aquaculture contributed 151.60 lakh tonnes, while marine fisheries contributed 46.15 lakh tonnes in 2024–25 (Department of Fisheries, 2026). During 2025–26, India exported 19.72 lakh tonnes of seafood valued at ₹73,890.46 crore. Frozen shrimp contributed ₹49,037.93 crore in export earnings, demonstrating the importance of seafood processing and international markets (Ministry of Commerce and Industry, 2026).

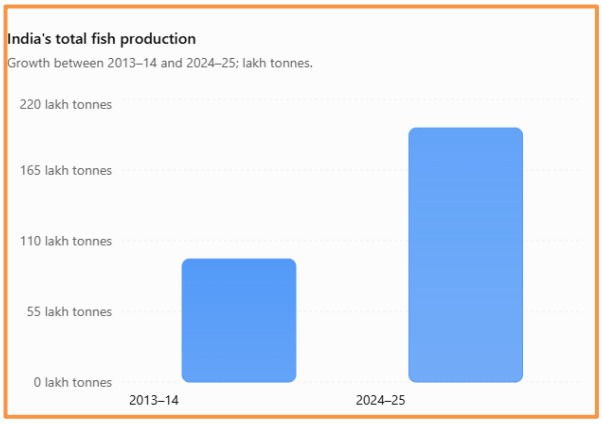

Figure 1. Growth of Indian fish production Source: Department of Fisheries, Government of India (2026).

The growing production and processing sector also increases the need for hygienic handling and scientific utilisation of processing by-products. Recovering useful materials can increase the value obtained from harvested fish while reducing disposal problems.

Major Fish Processing By-products

Fish processing waste refers to the materials remaining after preparation of fish and shellfish for consumption. Their composition varies with species, size and processing method (FAO, 2024). Common by-products include fish heads, which contain proteins and minerals; skin and scales, which are sources of collagen; bones and frames, which contain calcium and phosphorus; viscera, which contain proteins, lipids and digestive enzymes; and shrimp and crab shells, which contain chitin. Fish trimmings contain muscle proteins suitable for minced fish products and protein concentrates. Instead of being discarded, these materials can be collected, segregated and processed into useful products.

Important Value-Added Products from Fish Waste

Fish Meal and Fish Oil: Fish meal is a protein-rich ingredient prepared by cooking, pressing, drying and grinding suitable fish materials. Heads, frames, viscera and trimmings can be used as raw materials when fresh and hygienically handled. Fish meal is used in aquaculture and animal feeds as a source of protein and essential amino acids. Fish oil recovered during processing contains valuable fatty acids, including omega-3 fatty acids such as EPA and DHA (FAO, 2024).

Entrepreneurial opportunity: Small processing units can collect suitable fish residues from markets and supply them to authorized feed manufacturers.

Fish Silage: Fish silage is a liquid or semi-liquid product prepared by preserving ground fish waste through acidification or biological fermentation. It contains soluble proteins, peptides, amino acids and minerals. After suitable quality assessment, it can be used as an ingredient in animal and aquaculture feeds. Its relatively simple production process makes it suitable for decentralised processing units (FAO, 2024).

Collagen and Gelatin from Fish Skin and Scales: Fish skin and scales are valuable sources of collagen, a structural protein used in food, pharmaceutical, cosmetic and biomedical industries. Gelatin is obtained through partial breakdown of collagen and is used in confectionery, food products and pharmaceutical capsules. Commercial production requires controlled extraction, purification and quality testing (ICAR-CIFT, n.d.).

Chitin and Chitosan from Shrimp and Crab Shells: Shrimp and crab shells contain chitin, a natural polysaccharide that can be converted into chitosan through deacetylation. Chitosan has applications in water treatment, biodegradable packaging, agricultural coatings and certain biomedical products. These technologies are particularly relevant to shrimp-processing centers in Andhra Pradesh, Gujarat, Kerala and Tamil Nadu (ICAR-CIFT, 2026).

Fish Powder, Pickles and Ready-to-Cook Products: Fish mince, suitable trimmings and edible portions can be converted into fish powder, cutlets, balls, fingers, crackers, pickles and ready-to-cook products. Fish powder can be incorporated into food preparations to improve their protein content. Proper processing, drying, packaging and storage are essential for maintaining product quality.

Such products offer practical business opportunities for women's self-help groups, fisher cooperatives and rural entrepreneurs (ICAR-CIFT, n.d.).

Fish-Based Organic Manure and Biofertilizers: Fish processing residues contain nitrogen, phosphorus, calcium and other nutrients that can be recovered in agricultural formulations. ICAR-Central Institute of Brackish water Aquaculture (ICAR-CIBA), Chennai, developed two fish-market-waste-based products, CIBA-Plankton Plus and CIBA-Horti Plus, announced in June 2026. These products demonstrate the potential of linking fisheries waste management with agricultural nutrient management (ICAR-CIBA, 2026).

Fish Protein Hydrolysates and Biomedical Products: Fish processing residues can be treated with enzymes to produce fish protein hydrolysates containing smaller peptides and amino acids. They have potential applications in functional foods and animal feeds.

An important Indian development is the ICAR-CIFT research on converting fish scales into hydroxyapatite-based nanofiber graft materials for potential bone and dental applications. This demonstrates how discarded fish scales can become raw materials for specialized biomedical technologies (ICAR-CIFT, 2026a).

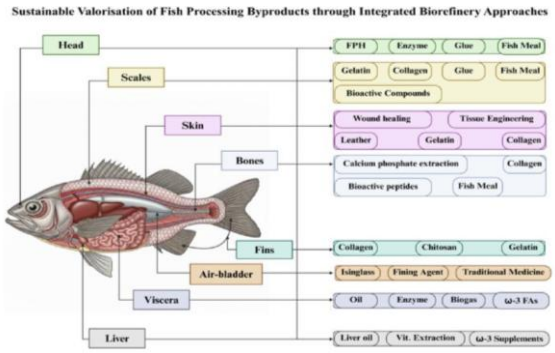

Figure 2: Parts of the fish and their derivatives for making different edible products.

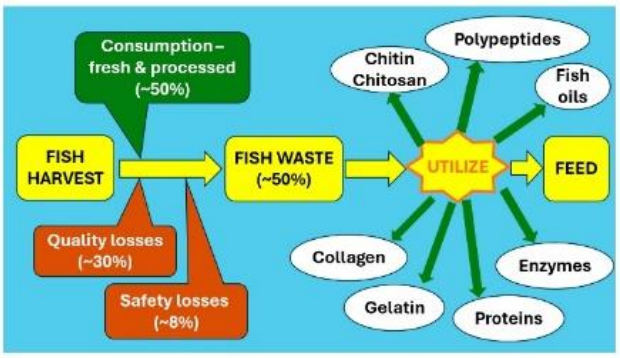

Figure 4: Fish Waste Generation and Its Potential for Value Additio

Figure 3. Different fish and shellfish processing by-products and examples of products obtained through scientific utilisation. (Source: Illustrative photographs; processing products based on FAO and ICAR-CIFT information)

Recent Indian Developments: From Research to Commercial Opportunities

India is moving beyond conventional fish meal production towards scientific utilisation of processing by-products. Some important developments during 2026 include:

- **Fish waste-based agricultural inputs:** ICAR-CIBA introduced CIBA-PlanktonPlus and CIBA-HortiPlus in June 2026 (ICAR-CIBA, 2026).
- **Biomedical applications:** ICAR-CIFT reported a patent for nanofibres incorporating hydroxyapatite derived from fish scales in May 2026 (ICAR-CIFT, 2026a).
- **Shrimp shell utilisation:** ICAR-CIFT transferred shrimp-shell valorisation technologies to a Kerala start-up in June 2026 (ICAR-CIFT, 2026b).
- **Fish fin utilisation:** In October 2026, ICAR-CIFT signed a technology transfer agreement for partially hydrolysed fin collagen concentrate, opening opportunities for functional food, nutraceutical and feed applications (ICAR-CIFT, 2026c).

These developments show that fish by-products can support agriculture, food processing, packaging, nutraceuticals and biomedical industries.

Opportunities for Farmers, Women and Rural Youth

Fish waste utilisation offers business opportunities at different investment levels. Small enterprises can prepare fish pickles, dried fish, fish powder and snacks. Women's self-help groups can produce hygienically processed fish cutlets, balls and packaged products. Medium-scale units can manufacture fish silage, fish meal, fish oil and fish-based fertilisers. Technology-based start-ups can explore collagen, gelatin, chitosan and protein hydrolysates.

For example, a fish market cooperative can establish a collection centre where heads, bones, skin and viscera are separately collected and chilled. Edible portions can be directed towards food processing, while other suitable materials can be supplied to authorised feed, fertiliser or specialised processing units.

Table 1. Fish processing by-products and their potential utilisation

By-product	Valuable component	Potential products
Head and bones	Protein, minerals	Fish meal, fish calcium
Skin and scales	Collagen	Gelatin, collagen peptides
Viscera	Protein, lipids, enzymes	Fish silage, fish oil
Shrimp shells	Chitin	Chitosan
Fish trimmings	Muscle protein	Fish mince, fish powder
Processing residues	Nutrients	Organic manure

Challenges in Fish Waste Utilisation

Despite its potential, several challenges affect commercial utilisation.

- **Rapid spoilage:** Fish waste deteriorates quickly due to microbial activity and enzymatic breakdown. Immediate chilling, hygienic collection and processing are essential.
- **Lack of infrastructure:** Many fish markets lack separate collection facilities, cold storage and processing equipment.
- **High investment:** Collagen extraction and chitosan production require specialised machinery, trained personnel and quality-control facilities.
- **Market and regulatory limitations:** Entrepreneurs need reliable buyers, suitable packaging, product certification and compliance with food safety, feed and environmental regulations. Untreated processing wastewater should not be discharged directly into water bodies (FAO, 2024).

Way Forward: Building a Fish Waste-to-Wealth Economy

Fish landing centres, wholesale markets and processing plants should develop organised systems for collection, segregation, chilling and transportation of by-products. Research institutions such as ICAR-CIFT and ICAR-CIBA can support technology transfer, training and product development. Fisheries departments, cooperatives, self-help groups and start-ups can work together to establish decentralised processing units. Government-supported programmes, including Pradhan Mantri Matsya Sampada Yojana (PMMSY) and relevant processing infrastructure assistance, can support post-harvest facilities and value addition. Entrepreneurs should verify current scheme eligibility and state-specific guidelines before investing (Department of Fisheries, 2026).

Conclusion

Fish waste should no longer be considered merely a disposal problem; it should be recognised as a valuable biological resource. Converting fish heads, skin, scales, bones, viscera and shellfish waste into useful products can improve resource efficiency, reduce environmental pollution and generate additional income for fishing communities. Recent initiatives by ICAR-CIFT and ICAR-CIBA demonstrate India's progress towards scientific waste utilisation and high-value product development. By combining appropriate technologies, entrepreneurship, government support and market linkages, India can transform fisheries waste into a new source of rural employment and economic growth.

Figure 5. Fish waste utilization in agriculture and entrepreneurship: Fish-derived agricultural inputs and small-scale fish processing enterprises offer opportunities for rural livelihoods

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