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Marketing channels in trawler bycatch utilisation at Veraval fishing harbour, northwestern coast of India

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Original Article

Abstract

Marketing is essential for distributing goods from producers to consumers. Despite steady growth in fish production, India's fish marketing infrastructure remains underdeveloped and inefficient. This study examines the marketing channels for by-catch utilisation in Veraval, Gujarat, involving 169 stakeholders (fishermen, auctioneers, suppliers, processors and exporters). Primary data were collected through structured interviews, revealing nine distinct marketing channels. The most preferred channel involved direct sales to purchasers, offering higher profitability for fishermen. Key constraints included poor handling, inadequate storage, and insufficient drainage facilities. The study recommends establishing modern auction halls with cold storage facilities to optimise supply chain efficiency, minimise post-harvest losses, and enhance fisher incomes.

Keywords: *Intermediaries, stakeholders, supply chain, post-harvest losses, Veraval fisheries*

Introduction

The marine fisheries sector is one of the largest employment generators in India. The estimated marine fish landings in 2023 were 3.53 million tonnes, a 1.2% increase compared to the landings in 2022. In India, Gujarat with its extensive coastline of 2,340.62 Km (Survey of India, 2024), 280 marine fishing villages, 107 marine fish landing centres, 3,54,992 fisherfolk population (Gir Somnath accounts for 23.5% of it) (CMFRI, 2020) stood first with fish landings of 8.23 lakh tonnes with a noticeable 64% rise in marine fish landings over the previous year (CMFRI, 2024). Gir Somnath district, with Veraval harbour, contributed 51% (4.18 lakh tonnes) of the total catch in Gujarat. The marine fish landings in Gujarat, during the period, were dominated by pelagic resources 3.60 lakh tonnes (44%), demersal resources 1.97 lakh tonnes (24%), crustacean resources 2.05 lakh tonnes (25%), and molluscan resources 0.57 lakh tonnes (7%) (CMFRI, 2024). In export also, Veraval Port contributed 9.0 metric tonnes, valued at 0.50 crores (0.06 US$ million) in 2023–24 (MPEDA, 2025).

Trawlers, recorded the largest landings in the mechanized sector, with a total of 4.29 lakh tonnes (CMFRI, 2024). Although trawl net is the most common fishing gear used in marine fisheries globally as well as in India, due to their non-selectivity and high percentage of bycatch generation, it is very detrimental to aquatic life. From 2017 to 2019, LVB (Low-value bycatch) accounted for 30–60% of trawl landings in India, with the majority being directed towards fishmeal production (Dineshbabu *et al*., 2022). Although trawl bycatch is responsible for the economic enhancement of local fisherfolk, trawling captures non-target species, juveniles, marine mammals, *etc*., which may disrupt ecological balance. The National Policy on Marine Fisheries (NPMF, 2017), promotes the sustainable utilisation of marine biodiversity, emphasising the importance of bycatch reduction strategies. This is to be achieved through rigorous governance mechanisms and adherence to international frameworks such as the FAO's Code of Conduct for Responsible Fisheries (CMFRI, 2012;2017).

The trawler landings include commercial fish, elasmobranchs, squids, shrimps, cuttlefishes, lobsters, *etc*. Landings also include by-catch comprising juveniles of quality fishes, crabs, squilla, small-sized shrimp, *etc*. (Pravin and Manohardoss, 1996). According to Eayrs (2007), bycatch includes all non-target animals and non-living materials (debris) that are caught while fishing. Azeez *et al*. (2021) stated that by-catch of multiday trawlers at Veraval comprises 123 species with teleosts (62.09 %), cephalopods (35.88 %), crustaceans (1.47 %),

and elasmobranches (0.56 %). Dineshbabu *et al.* (2022) estimated LVB and species composition, identifying 298 species from LVB landings from multiday trawlers in Veraval and Mangrol landing centres.

Aswathy *et al.* (2014) examined the structure of marine fish marketing within the state of Kerala, focusing on the efficiency of various marketing channels. The study's findings indicated that marketing efficiency was notably higher for commercially valuable species, such as seerfish. Furthermore, the analysis revealed that intermediaries in the supply chain captured a substantial portion of the consumer's expenditure, highlighting inefficiencies in the distribution system. Roul *et al.* (2024) found that the price of marine fish is influenced by various factors, including quality, size, weight, seasonality, market structure, and supply and demand dynamics. Additionally, the marketing channels employed for different finfish vary from each other.

The present study was conducted at one of the most active fish landing centres of Gujarat, *i.e.*, Veraval fishing harbour, from December 2023 to November 2024. The above study area was selected based on the dominance of the multi-day trawler and the availability of an extensive bycatch marketing chain employed here. The study gathered the information through a simple random sampling survey among fishermen, suppliers, auctioneers, cutting plants, surimi manufacturers, and commission agents. The total sample size of the study was 169, which included 80 fishermen, 31 auctioneers, 29 suppliers, 10 fish cutting plants and 12 purchase men, 3 surimi manufacturers, and 4 fish meal plants. The fishers were interviewed on their boats, suppliers at the auction halls (locally called *dangas*), and the fish meal producers at their plants. The interviews focused on the movement of marine fish through the market channel, price fluctuation, quality of catch, and marketing constraints. Before this study, stakeholder meetings and field visits were made to fish landing centres, local fish markets, surimi plants, and fish drying plants in Veraval.

Material and methods

Primary data were collected using a personal interview method with a semi-structured questionnaire. A combination of quantitative and qualitative methods was used for data collection. The secondary data were collected from the institute library books, periodicals, and various online resources such as the Department of Fisheries, research papers. The key roles in the marketing channels of the trawler bycatch of the Veraval fishing harbour were identified, *viz.*, fishers, suppliers, and fish meal manufacturing plants. Rapid Market Appraisal (RMA) is a research method employed for the quick collection and analysis of market-related information within a commodity sub-sector (Holtzman, 2003). The method is designed to provide actionable insights to inform policy-making, program development, and strategic interventions aimed at improving the functioning of the market or commodity value chain. A questionnaire survey is an essential tool for systematically collecting primary data from market participants in various sectors. For studies focused on the marine fish distribution and marketing system, this method typically involves interviews with a diverse range of market operators, such as fishermen, assemblers, wholesalers, and retailers. The questionnaire is designed to extract detailed information on several critical areas that influence the operation and efficiency of the marketing system. Cross-check interviews were conducted with stakeholders involved in the marketing chain; 20 processing plant owners and 19 boat owners were interviewed. Some sample questions used for interviews were (i) To whom do you sell the catch, and at what price? (ii) How much profit do you earn? (iii) Which fish brought in the highest earnings for you?

Results and discussion

Marketing channels

The marketing systems were operated through many intermediaries performing their role in the market chain formation from producers to final consumers (Fig.1A).

Marketing channels existing in Veraval for low-valued food fishes and trash fishes are:

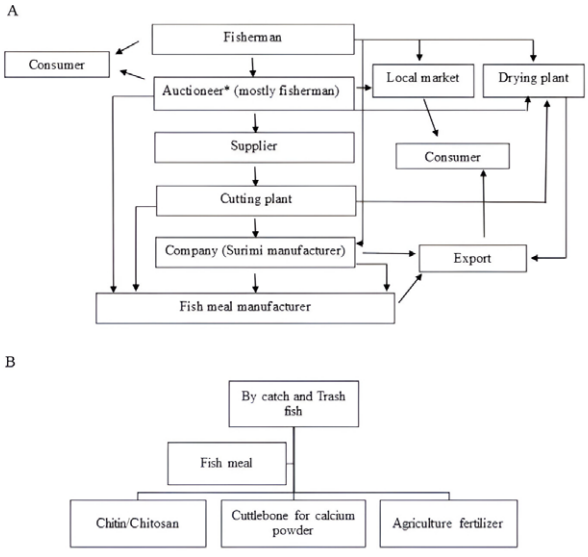

Fig. 1. Flow chart representing, A) marketing channels of trawlers bycatch at Veraval, B) utilization of fish waste produced from cutting plants

Table 1. Production status of fish, fish meal, and dried fish in Gujarat

Year	Total fish production in Gujarat (in Metric Tonnes, MT)	Fish meal (in MT)	Dried fish (in MT)
2017–18	7,00,743	20,175	13,910
2018–19	6,99,230	23,601	19,567
2019–20	7,00,809	22,542	20,688
2020–21	6,19,720	21,635	17,078
2021–22	6,88,272	22,100	19,171

(Source: commissioner of Fisheries, 2022)

Auctioneer (mostly fisherman) - Supplier – Fish cutting plant- Surimi manufacturers - Export.

Auctioneer - (commission agent) - Supplier – Fish cutting plants - Surimi manufacturers -Export.

Auctioneer - Supplier – Fish cutting plant – Fish drying plant - Export.

Auctioneer (mostly a fisherman) - Local market - Consumer.

Auctioneer - Purchase man - Local market - Consumer.

Auctioneer - Drying plants - Consumer.

Auctioneer - Supplier - Processing plants - Export.

Auctioneer - Supplier - Cutting plant - Surimi manufacturer - Fish meal manufacturer - Export.

Auctioneer - Supplier – Fish cutting plant - Fish meal manufacturer.

Marketing intermediaries

Veraval fishers, who own multiday trawlers, borrow money from suppliers for diesel, ice, boat maintenance, and the salaries of the boat's workers." According to a type of 'MoU', after completing the fishing, they sell all their fish catch to the supplier for their 2 or 3 fishing trips or until their debt is paid. The condition of the fisher is critical in this market chain. Major communities of fishers in Veraval include Kharva, Moila, and Machara (Zynudheen *et al*., 2003). After the fishing trip, the catch is landed at the jetty in Bandar. Very few fishermen also use mechanized gill netters for up to 7 days of a trip.

Auctioneer: There are about 300 auction halls (locally called danga) around Veraval fishing harbour (Fig. 2A). Mostly, fishermen have their dangas for landing the catch, and they act as auctioneers. Some owners rent their dangas also. In another chain, fishermen sell their whole catch or

Fig. 2. A) Auction halls, B) Suppliers inspecting the quality of the catch at the auction hall, C) Cutting plant, women engaged in fish processing; D) Local fish market, Kharakuva near Veraval Fishing Harbour, Gujarat

low-valued fish to a purchase man, who auctions the whole catch, or if the catch is highly valued (cephalopods- squid, cuttlefish, *etc.*), they sort the catch by grade and sell to processing plants via suppliers/purchasers. The catch is brought to auction halls via fishing carrier vehicles in plastic crates. Efforts are taken by the stakeholders to sell the high-value catch like *Trichiurus lepturus* (locally "bagga"), groupers—*Epinephelus diacanthus*, *E. epistictus* (vekhala), squid—*Uroteuthis duvaucelii* (narshinga), cuttlefish—*Sepia pharaonis, Sepiella inermis* (makool/dedka), *etc.* fast before its quality deteriorates. Following their sale, comparatively low-valued fish are sorted by size, quality, and value in the market (Fig. 2A and B). Some commercially important bycatch species traded in the survey are shown in Table 2.

Commission agent: The commission agent, locally called the purchase man, at Veraval purchases the catch from the boatman and sells it to the supplier earning a commission of ₹ 3 to 5 according to his profit margin. This type of market chain is also seen in Veraval. At times the purchase man enters into an agreement with fishermen and makes an advance payment for their expenditure and gets their catch from 2 to 3 trips until their debt is paid. Some purchase low-value bycatch and sell it to suppliers/ local markets. The benefit of this chain is that the entire catch is sold, with fishermen not having to keep an eye on the quality of the catch and the selling process. The disadvantage is that he faces a price constraint. Most surimi plants also have their purchasing person.

Supplier: Suppliers form the main link between fishermen and fish cutting plants. The plants provide an advance payment to suppliers who, in turn, make advance payments to boatmen for expenses like diesel, worker salaries, *etc.* The entire fish is directly sold to the supplier till the debt is paid. They get the commission (around ₹ 5 to 10) from fish-cutting plants

Table 2. Commercially important bycatch species traded in Veraval

Local name	Scientific name	Price* (₹/kg)	
		Good quality	Poor quality
High-value catch			
Vekhala	*Epinephelus diacanthus, E. epistictus*	300–350	100–120
Vam	*Muraenesox bagio, M. cinereus, Congresox talabonoides*	250–350	120–150
Bagga	*Trichiurus lepturus, Lepturacanthus savala*	150–250	100–150
Rani fish	*Nemipterus japonicus*	70–80	20–40
Nariyella	*Atropus atropos*	60–120	30–35
Dhoma	*Otolithes cuvieri*	40–80	30–40
Khagi	*Arius maculatus*	60–100	25–40
Lal dola	*Priacanthus hamrur*	35–45	15–20
Chandaliyo	*Mene maculata*	30–45	15–20
Bhunger/chor bumla	*Saurida tumbil, S. undosquamis*	25–50	10–15
Pili Patti	*Upeneus moluccensis*	30–40	15–20
Gokhan	*Grammoplites suppositus*	20–40	10–15
Mendali	*Coilia dussumieri*	30–40	10–15
Low-valued catch (locally 'chillar')			
Telas	*Dussumieria acuta*	15–25	5–10
Popacha	*Cyclichthys orbicularis, Diodon holocanthus, Lagocephalus guentheri, L. lunaris*	10–15	5–10
Jawala	*Acetes indicus*	10–20	5

*Price of the fish varies according to its quality, availability, and demand in the market.

and boatmen. Most processing, surimi, and fish drying plants have suppliers who visit the cutting plants to check the quality of the catch and provide the raw material to the fish cutting plants (Fig. 2B).

Fish cutting plants: In Veraval, there are more than 20 fish-cutting plants that purchase low-value bycatch from fishermen via suppliers/purchasers (Fig. 2C). They both visit the auction halls, check the quality of the catch manually by smell, touch, and texture of the fish. After procuring raw fish, its pre-processing, which includes beheading, removal of scales, viscera, and washing, is undertaken by women workers. Plants send the pre-processed fish to surimi manufacturers and get an advance payment from them. Surimi maker decides the prices of fish, based on which the plants charge around a 10-rupee margin (commission) for fulfilling the needs of workers' salaries and other expenditures. The fluctuation in fish prices depends on the availability of raw materials and their demand in surimi plants. Prices may even fluctuate daily. The fish head removed during pre-processing is used as bait in longline fishing. The fish waste generated is sold to fish meal manufacturers at very low prices and converted into protein-rich fish meal.

Low-value fishes like *Priacanthus hamrur* (locally called Lal dola), *Saurida tumbil* (bhunger), *Upeneus moluccensis* (pili patti), *Mene maculata* (chandaliyo), *Grammoplites suppositus* (gokhan), *etc.*, are sold to fish cutting plants. Fish such as small groupers (vekhalu), *Rastrelliger kanagurta* (bangdi), *Acetes indicus* (jawala), are not suitable for surimi making and hence not preferred by fish cutting plants. Fresh fishes like eel-*Muraenesox* sp. (vam), *Pampus argenteus* (paplet), *Parastromateus niger* (halwa), *etc.,* are sold to the local market Kharakuva and *Atropus Atropos* (nariyella), large sized *Nemipterus japonicus* (rani fish) to local villages. In the cutting plants, the catches were handled with poor quality (Fig. 2C).

Fishes such as *P. hamrur*, *N. japonicus*, *S. tumbil*, *Lepturacanthus savala, E. diacanthus*, *E. epistictus, etc.,* processed in fish cutting plants and also high-valued swimbladder (locally, 'pota') of fishes like *Arius maculatus*, *Osteogeneiosus militaris* (khagi), *Otolithoides biauritus* (goyni), and *Otolithes cuvieri* (dhoma) were sold to Kolkata and Kashmir via their suppliers.

During peak fishing seasons, the fish-cutting plants produce 20 to 22 tonnes (t) of pre-processed fish, generating a massive amount of fish waste, approximately 20–25% of total fish weight, depending on the species being processed. Availability

of raw material (bycatch fish) is maximum from August to November. The waste resulting from processing activities is transported to adjacent fish meal plants. The majority of fish-cutting plants generally remain operational for 8 months per year, depending on the seasonal availability of raw materials.

In Veraval, each fish-cutting plant employs 70 (on average) women. They typically squat down and use a sickle to cut the fish and can process 800 kg to 1 ton of fish per day, for which they are paid at a rate of ₹ 1.5–2.0/kg.

Local market: Fresh fish or sometimes rejected fish from the auction halls are sold at the Kharakuva fish market. The fish sellers are mostly women, and the fish market opens in the evening. The traders in the markets pack the fresh fish in the tea chests with ice and dispatch them to designated markets in metro cities (Mumbai mainly). While small-sized and poor-quality fish are sold to retail fish vendors (Fig. 2D).

Fish drying plants: Fish drying plants purchase low-value fish from fishermen, auctioneers, and fish-cutting plants. Mostly wet salting is done, followed by rack drying (racks made up of coir rope) and sun drying. Dried fish are packed in jute sacks. Fishes like *Harpadon nehereus* (locally, Bumla), *T. lepturus*, *S. longiceps*, *A. maculatus* (Khitali), *G. suppositus, etc.*, were dried. The dried fish were generally exported to Nepal, Bangladesh, Sri Lanka, *etc*. Even though the people of Veraval mostly prefer to consume fresh fish over dry fish, several favour dried Bombay duck compared to other dried fish.

Processing plants: Processing plants purchase raw materials from auctioneers via their suppliers/purchasers. The plants, after pre-processing the fish and sorting based on size and weight, were frozen in a blast freezer and a plate freezer. High-value fishes like *Eleutheronema tetradactylum*, *P. argenteus*, *P. niger*, *L. savala*, *Lutjanus* sp., *etc*., shrimps (mostly *Litopenaeus vannamei*, *Metapenaeus* sp, *Penaeus monodon*, *etc*.), cuttlefish (mainly *S. pharaonis*, *Sepiella inermis*) and Squid (mainly *Uroteuthis duvaucelii*) are processed and exported. Frozen fish, frozen raw shrimp products (frozen PUD shrimp blocks, IQF PD shrimp blocks, IQF headless shrimp, *etc*.), and frozen raw cephalopod products (SWC- Squid Whole Cleaned, CT-Cuttlefish Tentacles, SW-Squid Whole, *etc*.) are exported to China, Japan, and the USA.

Surimi manufacturers: The Surimi manufacturers make advance payments to suppliers as they purchase the catch from fish-cutting plants after checking the quality of the fish. Only a few species are suitable for surimi making, like *N. japonicus*, *P. hamrur*, *S. tumbil*, *Upeneus moluccensis*, *etc*. Mostly, the headless material from cutting plants is sent to surimi companies. As the Surimi produced is meant for export, stringent hygienic practices are maintained in the plants, with the fish being brought here in a partially pre-processed stage. The export markets for these companies are mainly EU (European Union) countries. In India, Surimi and Surimi Analogue exports, holding the fifth-largest position, reached 1,35,327 metric tons, representing a 4.12% increase in volume, contributing ₹ 2,414.43 crores (US$ 294.43 million) in revenue in 2023–24 (MPEDA, 2024). This export market creates an opportunity for the preparation of high-quality fish paste and other surimi products through the utilisation of fish with low value in domestic markets.

Fish meal manufacturers: The trash fish, fish waste from auction halls, waste from cutting plants, and surimi processing are used for fish meal production. In Veraval, mostly the wet reduction method is followed for fish meal production using bycatch species like *S. tumbil*, *S. longiceps*. While plants also prepare shrimp meal from species such as *Penaeus indicus*, *Metapenaeus monoceros*, *M. dobsoni*, and *A. indicus, etc*.

There are about 10–11 fish meal plants in Veraval. The fish meal produced is marketed to various states and also exported to countries like Malaysia, Thailand, Bangladesh, *etc*. In the marketing of the fish meal, the problem is seen in the buyers, sometimes a change of purchasing behaviour from other manufacturers.

In the study area, wastes from shrimp processing (exoskeleton) are used for chitin and chitosan preparation, while cuttlefish bone is used for preparing calcium powder and agricultural fertiliser (Fig. 1B).

This study shows that fresh and good-quality fish f*etc*h a higher price than less fresh and poor-quality fish. Fresh and medium quality fish are used for surimi plants, fish cutting plants, and the local market, while rejected catch (based on quality) by processing plants and trash fish are utilized by fish meal plants for fish meal production. So, compared to the conventional fish market, the bycatch market f*etc*hes a lower price for fish due to its poor quality. Hence, prices of bycatch fluctuate quality-wise at different intermediary levels.

Conclusion

Marketing of the bycatch is a lucrative business in the study area as suppliers (around ₹ 3-9), purchase men (salaried), and fish-cutting plants (around ₹ 9-12), receive a commission from the marketing chain. Additionally, cutting plants and processing plants provide direct employment to fisherfolk (mainly women) for cutting and pre-processing fish. Also, in the value chain, non-edible catch and waste are utilised

for the preparation of protein-rich fish meal, which is further used for aqua and poultry feed preparation. The fish meal manufacturers and surimi plants are indirectly facilitated to boost the export earnings of the country from fisheries. Nine marketing channels were identified in the utilisation of bycatch in the study area. According to respondents, channels II, IV, and V were most preferred, as these provide them the desired price for their catch. In other channels, the practice of fixing the price between the fishermen and the supplier in advance ensures the fishermen a support price, but they may not benefit from positive market fluctuations and enhanced earnings. To overcome the marketing constraints, the construction of a cold storage facility in the harbour area would help in preventing high marketing fluctuations in demand for short periods. The government should provide loans (at low interest) to fishermen for fishing trips and subsidies for diesel costs. In addition, policies that incentivise sustainable bycatch management, such as subsidies for utilising bycatch in product manufacturing or supporting eco-label certifications, can facilitate market access for bycatch-derived products.

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Author contributions

Conceptualisation: RJV, SR; Methodology: RJV, SR; Data Collection: RJV, SR; Data Analysis: RJV, SR; Writing Original Draft: RJV, SR; Writing Review and Editing: SR, DTV; Supervision: DTV.

Data availability

All relevant datasets supporting the conclusions of this article are included within the article.

Conflict of interest

The authors declare that they have no conflict of financial or non-financial interests that could have influenced the outcome or interpretation of the results.

Ethical Statement

No ethical approval is required as the study does not include activities that require ethical approval or involve protected organisms/ human subjects/ collection of samples/ protected environments.

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