

DFM Report

Mapping the Dried Fish Markets of Karnataka

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This work draws on research supported by the Social Sciences and Humanities Research Council of Canada.

Abstract

In this report we present the findings from an exploratory analysis of some of these major issues in the context of dried fish markets in the Karnataka state on the southwest coast of India. The study was conducted as part of the Karnataka component of the Dried Fish Matters project. Two principal criteria determined our selection and exploration of the markets, namely the vertical and the horizontal or spatial flow of dried fish products. The vertical chain tracks markets in terms of the product flow along the different nodes of the supply chain, including the production, wholesale, retail, consumer markets, and also the integrated production-and-consumption market a feature observed in coastal dried fish markets. The horizontal chain follows the flow of products in terms of the geographical location of markets. Specifically, we explore characteristics of dried fish markets in the coastal areas and the hinterlands of Karnataka. The hinterland serves as a reference point for comparing the coastal regions with respect to the consumers of dried fish; their preference for species; seasonality of demand; source of fish; affordability and price differences. In this report, we attempt to understand some of these aspects through a market mapping exercise and value chain analysis of several coastal and hinterland markets. While our market mapping exercise may not be comprehensive, at least to the authors' knowledge it is the only substantial studies on the Karnataka dried fish market.

Synopsis

Dried fish is a traditionally important component of the seafood [1] value chain of Karnataka. Dried fish are consumed especially by the weaker sections of the society, serving as a vital source of nutrients. Yet, there are not many formal detailed studies on the markets for, and consumption of, dried fish in Karnataka. Thus, neither the functioning of this market is understood well, nor is its contribution to the food and nutritional security in the society appreciated. A systematic study of this market can help understand several important characteristics, including: the product flow, i.e., origins, intermediate markets and final destination of dried fish products; dried fish pricing and selling mechanisms and hence their affordability; dried fish varieties available and preferred in different geographical markets and their seasonality; the nuances in processing; the market actors, nature of their trade and transactions; and the history, continuity, and changes in the market structure, conduct, and performance.

In this report we present the findings from an exploratory analysis of some of these major issues in the context of dried fish markets in the Karnataka state on the southwest coast of India. The study was conducted as part of the Karnataka component of the Dried Fish Matters project. Two principal criteria determined our selection and exploration of the markets, namely the vertical and the horizontal or spatial flow of dried fish products. The vertical chain tracks markets in terms of the product flow along the different nodes of the supply chain, including the production, wholesale, retail, consumer markets, and also the integrated production-and-consumption market a feature observed in coastal dried fish markets. The horizontal chain follows the flow of products in terms of the geographical location of markets. Specifically, we explore characteristics of dried fish markets in the coastal areas and the hinterlands of Karnataka. The hinterland serves as a reference point for comparing the coastal regions with respect to the consumers of dried fish; their preference for species; seasonality of demand; source of fish; affordability and price differences. In this report, we attempt to understand some of these aspects through a market mapping exercise and value chain analysis of several coastal and hinterland markets. While our market mapping exercise

may not be comprehensive, at least to the authors' knowledge it is the only substantial studies on the Karnataka dried fish market [2].

Given the severe lack of information on dried fish markets of Karnataka, this scoping study involved gathering important qualitative and quantitative information on the markets and market actors. In this report, the data is augmented with available secondary information on closely related markets to develop a clearer picture of the dried fish markets of the state.

Context of the Study

A Profile of the Coastal Districts of Karnataka and their Fisheries

Fisheries resources of Karnataka consist of 313.02 km long coastline, 87000 sq. km out of Indian Exclusive Economic Zone (EEZ), 27,000 sq. km of continental shelf area, 8000 hectares of brackish water areas, and 565,000 hectares of inland water resources. The marine fisheries resource potential of Karnataka is estimated to be 425,000 metric tons. 225,000 metric tons of those catch came from inshore areas, and the remaining 200,000 metric tons from the offshore or deep-sea.

Karnataka occupies fourth position in marine fish production and 11th position in inland fish production in India [3]. As shown in Table 1, marine fish production has a dominant share of well over 60 percent in the total fish production of the state. Compared to the average fish production of about 200,000 metric tons during the 1980s, substantially more fish is produced in the state in the recent years. Literature (e.g., [4]; [5]) reveals that technological advances in fishing, ever-increasing demand for seafood in the domestic and export markets, and governmental policy support including the provision of subsidized inputs are some of the major factors associated with increased marine capture fisheries supply. Table 1. Fish production in Karnataka: 2014-15 to 2019-2020.

Year	Marine fisheries production	Inland fisheries production	Total fish production	Share of marine fisheries in total fish production (%)
2014-15	389,822	223,419	613,241	63.6
2015-16	411,762	168,828	580,590	70.9
2016-17	399,000	158,000	557,000	71.6
2017-18	414,348	188,174	602,522	68.8
2018-19	389,491	197,921	587,412	66.3
2019-20	403,368	228,633	632,001	63.8

Production measured in metric tons.

Data source: [6] and [7].

There are an estimated 961,000 fishers in Karnataka, of whom 328,000 are in marine fisheries and 633,000 are in inland fisheries [8]. Of the total of 22,915 fishing fleet operating in Karnataka, 4,576 are mechanized, 9,266 are motorized, and 9,073 are non-motorized traditional boats [9] [10]. Karnataka has three maritime districts, namely Dakshina Kannada in the southern end with a 62km coastline, Udupi district in the middle with 98km coastline, and Uttara Kannada in the northern end with 160km coastline. As per [11], there are 8 fishing harbors or ports, 16 fish landing centers and jetties, and 91 beach landing centers along the Karnataka coast [12]. Figure 1 shows the nine major fish landing centers of coastal Karnataka and their share in combined fish landings over the sample duration. Malpe (in Udupi district) and Mangaluru (in Dakshina Kannada district) are by far the largest landing centers in the state, accounting for about 80 percent of the cumulative catch of the nine landing centers [13].

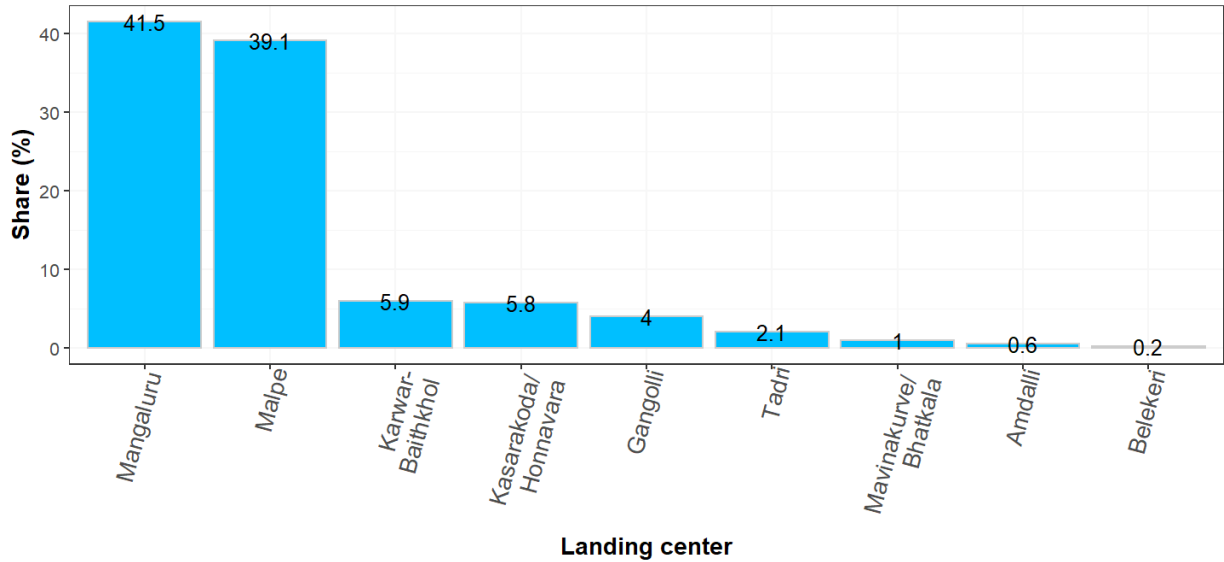


Figure 1. Major fishing harbors of Karnataka and their share in combined fish landings. Data provided by NETFISH Karnataka and analyzed by authors.

Figure 2 shows the top-20 fish species or product categories, based on the authors' analysis of NETFISH Karnataka data, in terms of quantities landed aggregated across all nine landing centers. Sardines and mackerel occupy the top two ranks. Further descriptive analysis by the authors showed that smaller landing centers such as Amdalli and Belekeri tend to show more landings of small coastal pelagic fish such as scads, anchovies and sardines, compared to demersal fish types.

Table 2 shows the socioeconomic profile of the three coastal districts and also for the state. While the State itself ranks seventh in India in terms of position in the Human Development Index, the three coastal districts fare better in terms of ranking among districts within the state. The Net Income from Fishing line in Table 2 show the dominant role played by the three coastal districts in terms of generation of fishing-related income for the state. Fishing also contributes more to total income in the three coastal districts compared to the corresponding contribution for the state. Dakshina Kannada district has the lowest percentage contribution from fishing to total income among the three districts, indicating that there are bigger contributions from other sectors such as industries to the total income of the district [14].

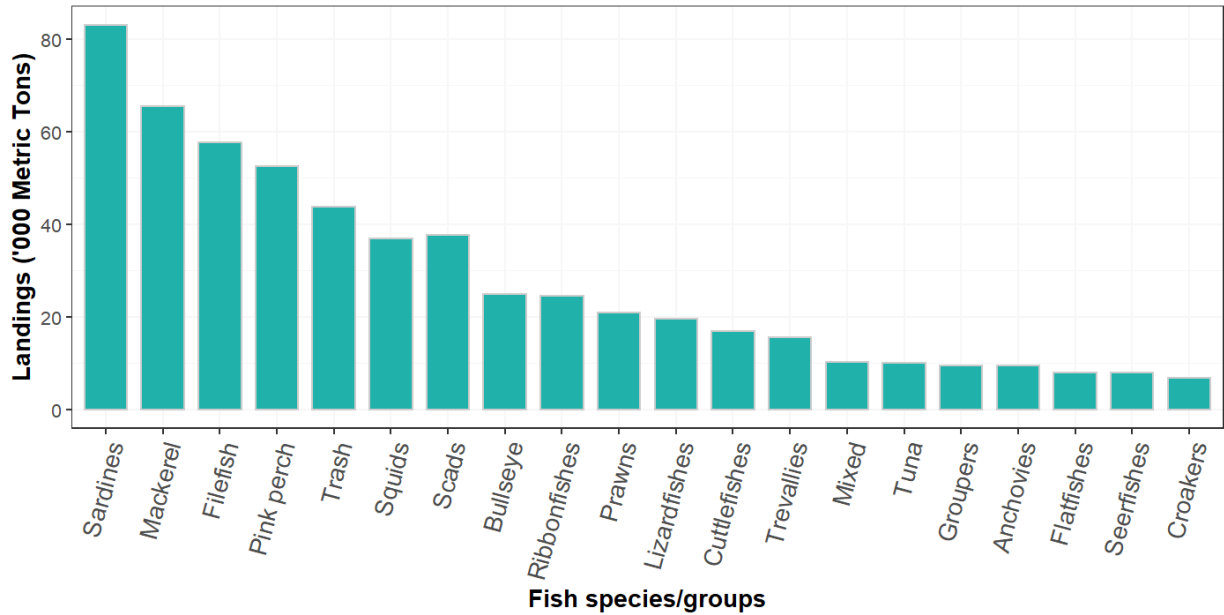


Figure 2. Top-20 fish species or product categories landed, in terms of cumulative landings between 2017 and 2020. Data provided by NETFISH Karnataka and analyzed by authors.

Table 3. shows the total number of fisher families in the three coastal districts, the number and share of Below Poverty Line (BPL) families, for the years 2010 and 2016. The decreased contribution of fisheries in Dakshina Kannada's total income (Table 2) may explain the decrease in the number of fisher families in the district. In the other two districts, the number of fisher families has increased. However, in all three years, there is a substantial increase in the share of families under the BPL, particularly in Dakshina Kannada and Udupi. A probable factor influencing this decreasing income among fisher families could be the overexploitation of fishery resources [15]. Table 2. A socioeconomic profile of the Karnataka state and its three coastal districts.

Variable	Karnataka	Dakshina Kan- nada	Udupi	Uttara Kan- nada
Total population (Millions)	61.131	2.085	1.178	1.440
Decadal population growth rate (percent)	15.67	9.80	5.90	9.20
Area (in sq. km)	1,91,791	4,866	3,575	10,291
Population Density (persons per sq. km)	319	457	287	240
Rank based on Human Development Index	7	2	3	5
Literacy level (percent)	75.60	88.62	86.29	70
Ratio of workers to total population	44.3	50.0	44.0	40
Net District total income 2007-08 (in million ₹) at current price	2,116,625.3	96,998.4	47,392.2	56,050.3
Per capita income (in ₹) 2017-2018 (at constant price 1999-2000)	36,945	47,151	39,307	36,243
Net income from fishing 2017-18 (in million ₹) at constant price	7977.3	2253.4	2052.9	1974.3
Percentage contribution of fishing to total income	0.38	2.32	4.33	4.2

Data source: Various publications of Government of Karnataka.

Karnataka's rank among India's states in terms of the Human Development Index; the three coastal districts' ranking among districts of Karnataka.

Fish utilization in Karnataka

[16] compiled data on marine fish utilization in Karnataka, by type of fish processing, for selected years between 1970 and 2009. There are three major modes of marine fish utilization in Karnataka- fresh, frozen and dried. Consumption in fresh form has the largest share and is increasing over the time. The share of harvested fish utilized in the fresh form in 2009 was about 68 percent, compared to 45 percent in 1970. The frozen fish are mainly for export markets. The data show a proliferation of ice plants and freezing or frozen storage plants over the years. Support from the government since the 1950s has played a crucial role in the development of value chains of fresh and frozen fish products in the state. The establishment of ice-making plants and freezing and frozen storage plants facilitated increased consumption of fish in fresh and frozen form. The share of fish used for producing dried products declined substantially from a peak of about 36 percent in 1980 to about 11 percent in 2009 and marginally improved thereafter [17]. This may indicate a lack of support for developing the value chains of a traditionally important product such as dried fish. Apart from changes in seafood supply in the Karnataka coast, changes in consumers' preferences along with socioeconomic and demographic changes could also have driven such changes in utilization patterns.

Even as the share of fish utilized for production of dried products decreased, there was a substantial increase in the capacity for fishmeal production in the state. While there is no record of any fishmeal plants existing in 1970, there were 10 in 1987 (with a combined production capacity of 129.5 tons per day), 18 in 1997 (184 tons per day capacity), and 20 in 2008-09 with a 414.5 tons per day capacity. More recently, [18] find that Karnataka has 23 fishmeal plants that produce 58,000 tons of fishmeal and 30,500 metric tons of fish oil [19]. [20] note that about 50 percent of the total number of fishmeal plants operating in India are based in Karnataka. Compared to 1970s, the production capacity of these plants, and the exports of fishmeal, have almost

doubled. Mushrooming of fishmeal production plants is likely in response to increased derived demand for fishmeal in the global aquaculture or livestock markets as a feed ingredient. As the marine fisheries sector of Karnataka began relying on mechanization and motorization for fish harvesting, substantial quantities of trash fish [21] appeared in the catches. This is as evident in Figure 2 which shows trash fish to be the fifth most landed type of fish in Karnataka. Fishmeal companies are some of the major buyers of such trash fish, juveniles, and smaller fish. Therefore, increase in fishmeal production could have impacted the availability of fish for alternative fish utilization avenues such as the drying of fish [22].

Table 3. Fisher population and poverty levels in the three coastal districts: 2010 vs. 2016.

	Year	Total No. households	No. of BPL families	Share of BPL fisher families	Percentage change between 2010 and 2016	
In the total number of fisher families	In the share of BPL fisher families					
Dakshina Kannada	2010	4570	1485	32.5	-21.0	11.2
	2016	3610	1304	36.1		
Udupi	2010	9907	7650	77.2	20.9	9.8
	2016	11976	10150	84.8		
Uttara Kannada	2010	16236	14489	89.2	4.0	5.2
	2016	16893	15858	93.9		
Total	2010	30713	23624	76.9	5.8	9.3
	2016	32479	27312	84.1		

Data source: The 2005, 2010, and 2016 rounds of the Marine Fisheries Census conducted by the Central Marine Fisheries Research Institute (CMFRI).

Despite these adverse developments in the market and lack of policy support, the dried fish sector is still an important component of India's seafood value chain. Drying is one of the least expensive methods of processing and preservation of aquatic products and requires no specialized storage facilities after drying ([23]; [24]. Dried fish production and business create livelihoods for vulnerable sections such as small-scale fisherwomen in coastal areas and hinterland. Dried fish are vital sources of critical nutrients for weaker population segments in many South and Southeast Asian countries

[25]. However, given the lack of recognition of the importance of dried fish sector by policymakers and academics alike, the competing uses for fish (food vs. feed; domestic vs. exports), and increasing pressure on Karnataka's coastal resources, the long-term viability of drying is under serious threat. The present report brings out some of the fundamental details about the dried fish supply chain of Karnataka. The overarching goal of this report is to describe the link between the production and distribution channels of dried fish supply chain in Karnataka, and to map the network of activities and actors in the chain. Specific objectives of the market mapping study are:

1. To describe the continuity and changes over time in the functioning of dried fish markets in Karnataka;
2. To understand the key actors in the dried fish supply chain in Karnataka and the linkages among them as the products flow from the production (i.e., upstream markets) through to the consumption (downstream markets) end of the supply chain; and,
3. To analyze the structure, conduct and performance characteristics of dried fish markets in the coastal and hinterland areas of Karnataka.

Methodology

Given the severe lack of secondary data and publications on dried fish markets of Karnataka, collecting primary data was an obvious choice for the purposes of this study. Primary data were collected through multiple methods, namely, interviews with market actors, market observations, and transect walks. Both qualitative and quantitative information were collected. Table 4 shows the data collection procedures carried out at individual markets.

7. Appendices

Appendix 1 provides the schedule used in the surveys and interviews with market participants. Table 4. Summary of data collection procedures carried out at dried fish markets.

No	Market	District	Number of samples		
Market Observations	Transect Walk	Interview			
1	Karawara	Uttara Kannada	12	Yes	20
2	Tadadi	Uttara Kannada	4	Yes	8
3	Honnagara	Uttara Kannada	15	Yes	10
4	Sirsi	Uttara Kannada	1	Yes	4
5	Katapady	Udupi	1	Yes	1
6	Kundapura/Gangolli	Udupi	1	Yes	9
7	Malpe	Udupi	13	Yes	15
8	Mangaluru	Dakshina Kannada	18	Yes	25
9	Puthuru	Dakshina Kannada	1	Yes	6
10	Sullia	Dakshina Kannada	1	Yes	5
11	Hunasuru	Mysuru	1	Yes	1
12	Piriyapattana	Mysuru	1	Yes	1
13	Gonikoppa	Kodagu	3	Yes	3
14	Kushalnagara	Kodagu	1	Yes	1
15	Madikeri	Kodagu	1	Yes	3
16	Virajpet	Kodagu	1	Yes	4
17	Balehonnuru	Chikkamagaluru	1	Yes	2
18	Koppa	Chikkamagaluru	1	Yes	3
19	Sagara	Shivamogga	10	Yes	5
20	Shikaripura	Shivamogga	1	Yes	1
21	Soraba	Shivamogga	1	Yes	1
22	Hubballi	Dharwad	1	Yes	2
23	Hamsabhavi	Haveri	1	Yes	1
24	Belagavi	Belagavi	1	Yes	3

A total of 24 geographical markets spread across 10 districts of Karnataka were covered in the primary data collection phase. These markets were chosen purposively so as to cover major production centers, wholesale markets, and consumption centers in the state. The markets covered in the study are classifiable into two groups based on their location as the coastal and the hinterland markets. Figure 3 shows the location of the markets, by district and by location (coastal and hinterland), on the map of Karnataka.

1. The six coastal markets are production-and-consumption centers since they each have at least one landing center and are populous enough to be considered important dried fish consuming areas. As production centers, these exhibit wide variations in terms of size (production quantity) and the species or product categories of fish landed, which influence their functioning as dried fish production centers. While Mangaluru and Malpe are by far the largest landing centers of Karnataka, in comparison Kundapura/Gangolli, Karawara and Honnavara are medium-sized centers, while Tadadi is a smaller center (see Figure 1). Fish landings in Mangaluru and Malpe are dominated by catches from large mechanized boats and hence have larger shares of demersal fish. In comparison, fish landings in smaller landing centers show relatively larger shares of small, pelagic, coastal fish types such as anchovies and scads.
2. The hinterland markets are located within a distance of 200 km from the coast (nearest coastal landing center). Some of these hinterland markets, viz Sullia and Puthur, are in the coastal district of Dakshina Kannada, but away from the coast by over 50km. Thus, the hinterland markets do not have substantial dried fish production capacity of their own, and hence can be considered to be consumption markets receiving dried fish products from the coastal markets.

For objective (3), information on the market structure, conduct and performance were collected. In economics, these terms have specific meaning, and detailed discussions on these terms can be found in texts such as [26] and [27]. The term market structure refers to a description of the number and size distribution of firms (participants) in a market, vertical integration, the degree of entry and exit barriers, and whether or not the products are differentiated. The term conduct describes the key choice variables of firms, including price, output, advertising, and product design. The term performance describes whether the market performs well from society's perspective. Market efficiency, equity, and stability are some of the performance-related economic attributes. Classical use of a market's structure, conduct and performance in economics is in gaining a better understanding of their implications for welfare. In this report we use these measures in a less ambitious scope, in

the sense that we do not trace the distribution of output, costs, and profits at different nodes of the supply chain; we are more interested in getting an overview of the organization of dried fish market in coastal and hinterland areas of Karnataka.

The collected data were used in creating a supply chain map of the dried fish markets in the coastal and hinterland areas of Karnataka. Flow of the material and the prices of products at different stages of the market were analyzed descriptively. Dried fish production, distribution and consumption are dependent on the season, competition from other fish utilization industries (such as fishmeal production), weather conditions and economic shocks induced by incidence such as the COVID-19 pandemic. Therefore, the findings from the data collected in this study need to be conditioned on these factors.

Results and Discussion

Historical developments in the dried fish markets of Karnataka

Discussions with fishers of coastal Karnataka revealed that drying of fish has been a popular method of preservation for centuries in the region. Older members of the fisher community recalled that some fish curing yards were established in 1917 by Sir Frederick Nicholson, the then Director of Fisheries of the erstwhile Madras Presidency [28]. He was instrumental in the setting up of several fish preservation units for improving the keeping quality of fish in the presidency [29]; [30) [31]. This may be among the rare instances when the fish curing or drying sector in the state received direct support from policymakers.

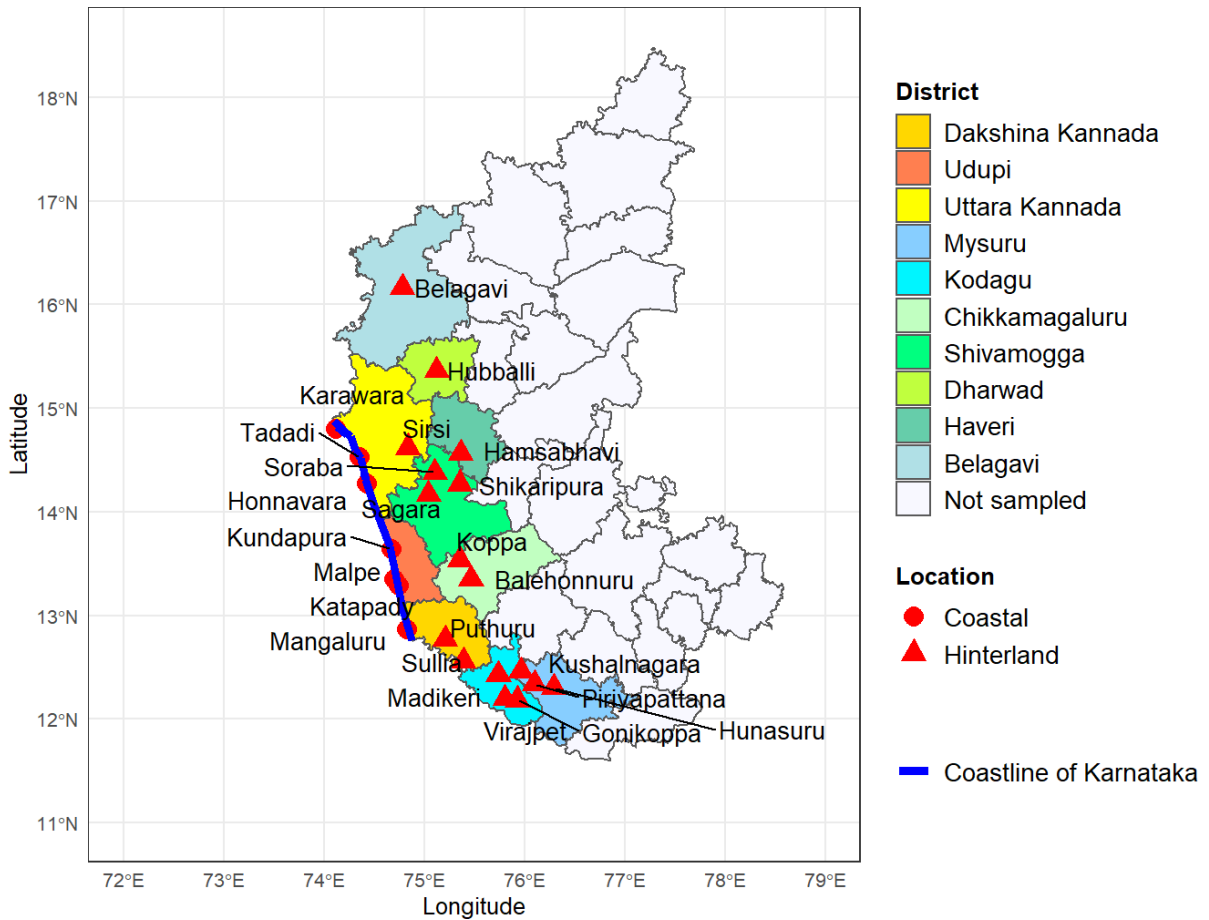


Figure 3. The coastal and hinterland dried fish markets sampled in Karnataka, by district.

[32] mentions several commercially important dried fish products in India. These included the Indian oil sardine (*Sardinella longiceps*), the Indian mackerel (*Rastrelliger kanagurta*), different shark species, varieties of anchovies (*Stolephorus* spp.), the Bombay Duck (*Harpadon nehereus*), ribbonfishes, marine catfishes, seerfishes, croakers or jewfishes, trevallies, perches, flatfishes, silverbellies, and immature fry of fishes etc. However, market observations and discussions with market participants indicated that currently there are lesser number of species being dried. According to fishers at Mangaluru and Malpe fishing harbors, many fishes - such as silverbellies, trevallies, false trevallies, marine catfishes, mullets, flatfishes, croakers, white sardines, white pomfrets and the Brown shrimp *Metapenaeus dobsoni* - were earlier available in ample quantities for drying at these harbors but have become harder to procure in recent decades. As will be discussed in a

later section, not only the diversity of dried fish types, but even the number of processors in Karnataka has reduced substantially over the years.

There are primarily three techniques of producing dried fish: Salted and dried; Drying without initial salting (mainly for anchovies); and, salted wet fish. Fermented fish products, which are often clumped with dried fish, are not produced in Karnataka, at least during the field study period. Some of the fish drying techniques, such as the pit-curing method, which were once popular have now become less common in Karnataka coast [33]. Pit-curing was especially employed in preserving large harvests that resulted when beach seines such as the Rampani were operated. Pits were dug in the beach and fish were stored there in salt water after initial washing and cleaning. Compared to sun-drying, this method needs less space. The pits are now either abandoned or are occasionally leased out to outsiders who bring fish from outside of the state to produce pit-cured fish.

A major change in the dried fish market of India has been the decline in exports of dried fish products over time. Figure 4. shows the share of the quantity of dried fish exports out of the total seafood quantity exported from India annually for the years 1976-2019. The data are taken from the (FAO) [34] platform. The FAO Fisheries and Aquaculture Statistics platform, through the FAO Global Fish Trade Statistics database, provides annual time-series statistics of country-wise seafood trade from 1976 onwards. The data show a large decline in the share of dried fish exports after peaking in the 1990s. Going further back in time, literature shows that dried products were the dominant form of seafood exports from India with a share of about 80 percent until the 1950s, before the exports of frozen seafood products started and gained momentum in the country [35]. In fact, seafood exports from India during the colonial period consisted only of dried products [36]. Given that export markets have played a key role in the development of fresh and frozen seafood value chain in the country, it may be pertinent to analyze export markets for the dried seafood products to understand the factors that led to the growth in dried fish exports in the 1990s and the causes of decline, subsequently. Export-oriented production of dried fish may have positive implications on technology, quality assurance, and supply chain performance thereby improving the overall performance of the dried fish sector.

Of late, fishmeal companies have started procuring dried fish of low quality for use in manufacturing fishmeal. A large fishmeal company in Bhatkala and some fishmeal companies from even Andhra Pradesh purchase such dried fish of low quality. Even mixed fish varieties and non-edible fishes such as Squilla are utilized for production of dried products. Fishmeal companies are reported to pay ₹100-150 per kg for these inferior quality dried fish.

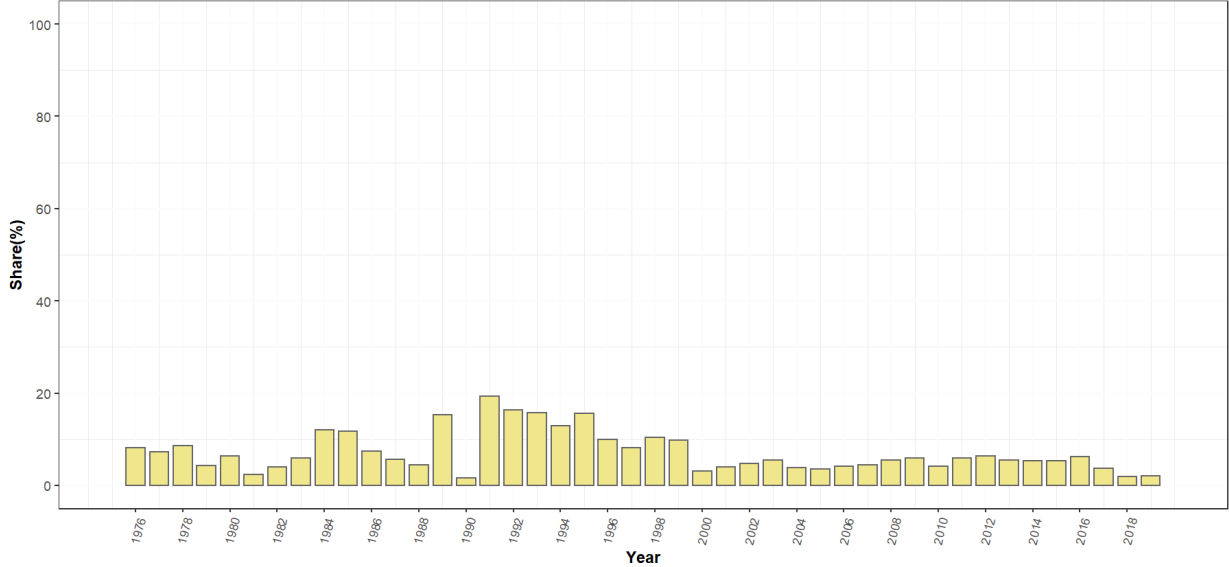


Figure 4. Share of dried seafood export quantities in total seafood exports of India: 1976-2019. Source: Authors’ calculations using the FAO Global Fish Trade Statistics database.

Description of the coastal dried fish markets

Discussions in this section follow from the structural characteristics of the markets presented in Table 5 and the supply chain map of dried fish provided in Figure 4. Production of dried fish takes place in the coastal area, and the product moves along to wholesale markets, also in coastal areas, and some in inland areas such as Belagavi, and then to the retail markets before reaching the final consumer. Retailing of dried fish is done in shops as well as by mobile vendors who sell it on vehicles, taking the product to distant rural markets. In some cases, markets play dual roles: processors of dried fish in coastal areas in most cases also sell to final consumers; retailers in hinterland areas act as wholesalers or distributors of dried fish to smaller vendors. In this section, markets along the dried fish supply chain are described in terms of their structure and functioning, along with findings from the mapping exercise.

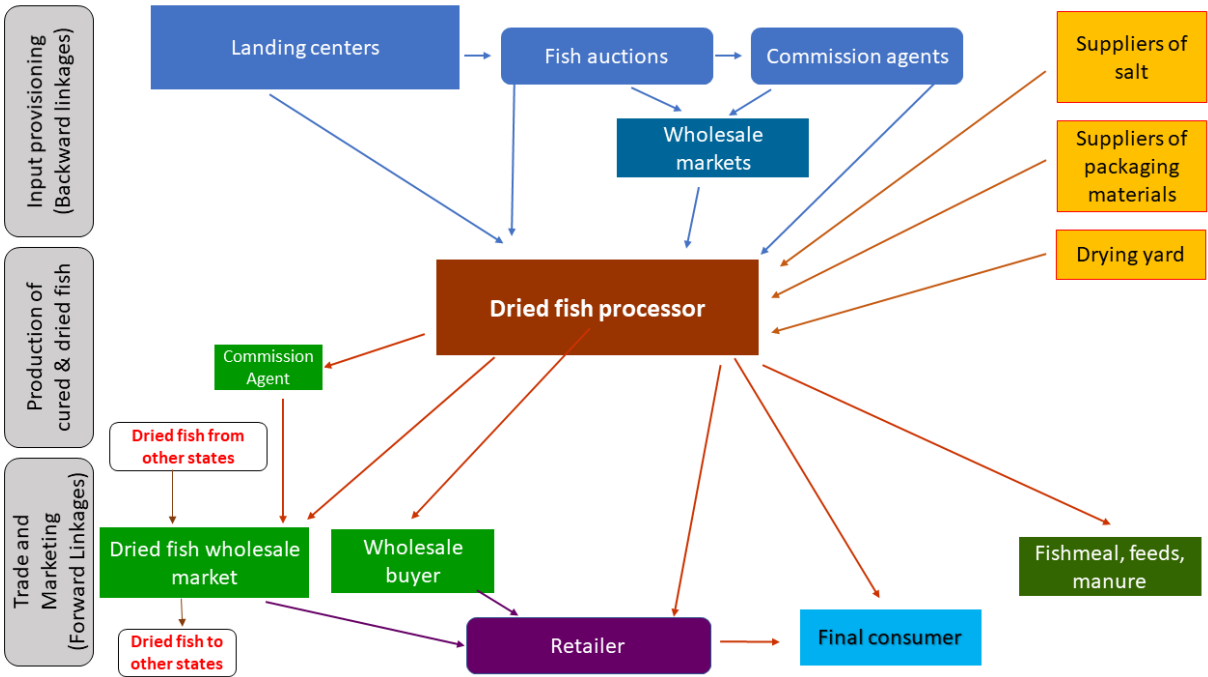


Figure 5. Supply chain map of dried fish markets of Karnataka.

Mangaluru

Mangaluru has been a center of dried fish trade for a long time, with many dried fish merchants who specialize in trading with other districts, states, as well as the Lakshadweep islands [37]. It continues to be a major hub of dried fish trade and is by far the largest dried fish market of Karnataka in terms of the number of species traded in the market (Table 5). Therefore, a more detailed description of this market is warranted.

Dried fish processing in Mangaluru: Bengre, Hoige Bazar, and Kudroli are some of the major dried fish producing areas in Mangaluru town. Bengre is an island (a Sand Spit) formed by the Arabian Sea and the Netravathi and Gurupura rivers, and fishers depend on boats for ferrying materials to or from the island. Production of dried fish goes on except in the monsoon fishing ban period (June and July). Most of the processors buy raw material (wet fish) at the Mangaluru Fishing Harbor through commission agents, while some of them buy it directly from fishers or at the auctions. Most of the time, the transaction between processors and boat owners or commission agents is based on credit such that the processors purchase fish on credit and sell their product on credit to wholesalers. Boat owners and commission agents will be paid back once processors are paid by wholesalers. Of the fish landed by multiday trawlers and purse-seiners at the landing center, the best quality fish are sent to auction halls for exports and domestic consumption as fresh, iced, or chilled fish; the intermediate quality fish go for fish drying; while the lowest quality fish end up in the fishmeal, manure, or feed industry. Thus, fish used for dried fish production would change depending on the fish landings. Mackerel, anchovies, seerfish, lizardfish, ponyfish, and ribbonfish are some of the fish that are dried in Mangaluru. Most dried fish producers sell their products in the wholesale market in Mangaluru. They also engage in direct marketing to consumers via the retail marketplace. Salt for curing purposes is received from Tamil Nadu via Kerala. Water for cleaning and other purposes is drawn from the Netravathi river.

Table 5 shows that the number of processors has declined substantially over the last decade or so. Current group of processors identify the declining availability of raw material (fish) as one of the main contributing factors in

the exit of processors from the business. Competition with other subsectors of industrial fisheries may have diminished the fish available for drying purposes. There is an association of dried fish processors in Mangaluru. This association was set up with intentions of supporting processors on issues such as getting credit from financial institutions, and in protecting the processors' privileges over the drying yard. A better functioning association or collective would help processors to safeguard their interests. The fish drying yards in Mangaluru are reasonably well connected by roads to the urban centers. However, water supply for curing operations simply does not exist. Processors use water from the jetty for washing and cleaning the fish, which is not a hygienic practice [38]. This probably shows the lack of awareness among processors about the safety and hygiene guidelines, and about the impacts of unhygienic practices on consumer health.

Mangaluru dried fish wholesale market: The Mangaluru wholesale dried fish market consists of 12 shops. The market is called *bandasaale* (literal meaning, a warehouse) in the local language Tulu. It was constructed by the Mangaluru City Corporation and then handed over to the Mogaveera fish processors. Mangaluru is the only place in Karnataka with a dedicated market for wholesaling of dried fish. While most shops receive dried fish from outside the state also (particularly Gujarat), one shop sources its products from only local processors. The Mangaluru wholesale market is the destination for dried fish produced at processors from across coastal Karnataka. The actual transactions take place mostly on a credit system and trust between buyers and sellers. The wholesaler purchases dried fish from processors at prevailing market price, usually on credit. Figure 6 shows prices of some important dried fish products in different months at the Mangaluru wholesale market. In turn, the wholesaler sells the product to buyers on credit, and the processors will be paid once wholesalers get paid typically after a week or two. Sometimes, wholesalers also act as guarantors on behalf of processors to ensure that boat owners or commission agents do not block the supply of raw fish to processors for not repaying the credit owed. Moreover, processors would also need information from wholesalers on the latest market demand to decide what type of fish to buy for drying and how much to buy for the next batch of dried fish processing. Thus, wholesalers are a vital link ensur-

ing proper flow of goods and information in this market. By religion, 11 shops are owned by Muslims and 1 Hindu. Wholesalers cut a commission of seven to eight percent for selling the products of dried fish producers. There are no women wholesalers in Mangaluru. The number of wholesalers has come down from about 20 about a decade ago to 10-11 now [39]. There is an association of dried fish wholesalers, which mostly acts on matters related to taxation (the Goods and Services Tax, GST) on the products, but not on matters related to pricing.

Buyers from many hinterland markets of Karnataka and also from Kerala come here to procure dried fish. Dried fish are typically packed in bamboo baskets, which are purchased from Bhadravathi in Shivamogga district. Cost of packaging material is included in the final selling price of fish. Dried fish from here are distributed to inland markets within Karnataka and other states such as Kerala, Goa, Andhra Pradesh, Tamil Nadu, and Lakshadweep. The highest transactions usually take place on Mondays and Fridays. It would be interesting to understand, why specific days have peak transactions, though we could not find specific attributes explaining this during our scoping exercise.

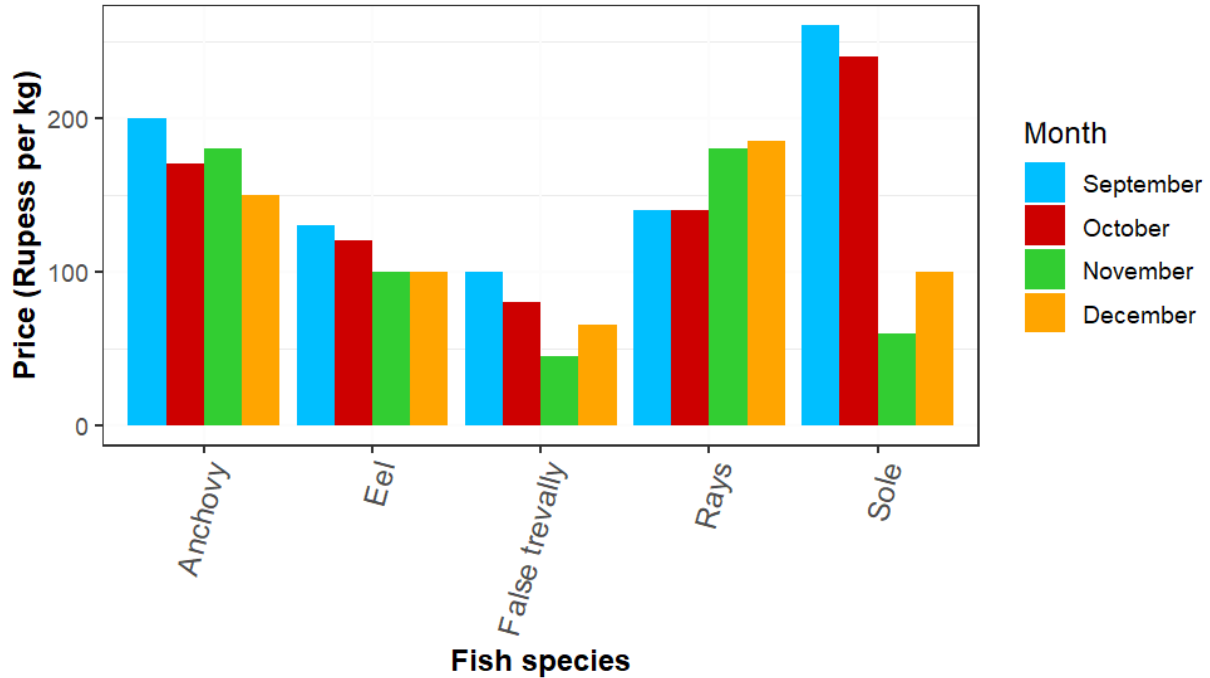


Figure 6. Monthly wholesale prices of selected dried fish products in Mangaluru: September 2020 to December 2020.

Retailing of dried fish in Mangaluru A large dried fish retail market is located near the terminal private bus stand in Mangaluru, i.e., the State Bank bus stand. The market building, with a total capacity of 78 shops, was built by the government and rented out to fisherwomen at a reasonable daily rent of ₹10 per shop per day [40]. Currently only about half the shops are open due to the economic slowdown caused by the coronavirus (COVID-19) pandemic. The sellers at the market are fisherwomen from different parts of the Mangaluru town such as Bokkapattana, Bengre, Ullala, Boluru, Hoige Bazar, and Kudroli. They get dried fish from two sources: their own production; and, purchased at the wholesale market, usually on credit. The retailers bring fresh batch of dried fish usually on Mondays and Fridays. The sellers dry the purchased dried fish again, usually in open spaces available close to the shop, to remove moisture and increase shelf-life. They also grade the dried fish to discard any damaged or spoiled fish. Thus, price of fish at the retail market is higher. Moreover, prices have increased following the COVID-19 outbreak. At prevailing market prices, Bombil (the Bombay Duck), Rays, and anchovies are among the more expensive dried fish (sell-

ing for ₹300 per kg or more); the Indian mackerel, oil sardine, sharks are among the mid-priced dried fish (about ₹250 per kg); and flatfish, croakers, and ponyfish are among the least expensive dried fish priced at about ₹200 per kg. Buyers here include many visitors from outside the district (from hinterland Karnataka and from Kerala). Two fairly recent developments have increased competition in the business for these sellers [41]: fish vendors (men, mostly Muslims) carrying dried fish on their motorbike and selling at the doors of customers; and stores in malls that sell packaged dried fish. Prevailing prices for a pack of 100g at stores in the malls are ₹35 for silverbellies, ₹50 for anchovies, ₹55 for sole (flatfish), ₹70 for shark cubes, and ₹80 for shrimps. When these prices compared on a per-kg basis, dried fish sold at malls appear to cost substantially more compared to the Mangaluru dried fish retail market.

Women play an important role particularly in processing and retailing of dried fish in Mangaluru. Among laborers, men do the loading and unloading of fish, while women are involved in washing, cleaning, curing and drying of fish. At places like Hoige Bazar, men and women laborers are roughly equal in numbers. Local fisherwomen are mostly business owners [42], and migrant women work mostly as laborers with some exceptions. Over 90 percent of processors are women. Processing is done by members of the local fisher community (the Mogaveeras), as well as migrants from Tamil Nadu. The processors at Bengre are utilizing a stretch of government-owned land for drying [43], and are anxious about the fate of the land- given the coastal Blue Economy initiatives of the government, expensive real-estate in Mangaluru, and its rapid urbanization. Local women processors are getting older and are not sure about the continuity of their profession since their children are educated who may end up in other professions. Given the age of these women processors, their health is not in the best condition. Since younger generation in the local fisher community is not involved in dried fish operations, younger laborers (mostly immigrants) who have worked under the current generation of owners will likely be the future of the dried fish processing sector in Mangaluru.

Malpe

Dried fish production: Malpe is another major dried fish processing center of Karnataka along with Mangaluru. The fish drying yard at Malpe is located about 100m away from the Malpe Fisheries Harbor. The drying yard is about 5.5 acres in area, and the land is owned by an individual who has rented it out to fisherwomen for ₹5 per square-foot and a leasing period of 11 months. All the dried fish processors (business owners) are women and are from the local fisherwomen community (the Mogaveeras). Some decades back, these women used to work by themselves or used family labor in dried fish operations, but in recent decades large-scale migration from northern districts of Karnataka has made available to them relatively cheaper labor. Thus, local fisherwomen are more into management of operations than physical labor itself. While large-scale processors procure raw fish directly from boats at the Malpe Fishing Harbor, smaller processors rely on middlemen or agents who charge ₹2-₹3 per kg raw fish as commission. Like Mangaluru, processing stops during the monsoon fishing ban period (June and July) in Malpe.

Compared to Mangaluru, lesser number of species are traded at Malpe, even though Malpe has substantially greater number of processors (Table 5). This could be because Mangaluru is the major destination market for dried fish produced in the Karnataka coast (including Malpe) and other coastal states. There is some wholesaling of dried fish in Malpe, but at a much lower scale than Mangaluru- some buyers from hinterland Karnataka markets such as Shivamogga and Hubballi directly approach dried fish processors in Malpe and make commitments of purchase. However, by far the largest share of Malpe's dried fish production is destined for the Mangaluru wholesale market. The processors sell their products, mostly on credit, directly to wholesale buyers or through agents on a commission basis. The rest of the product goes for retailing in towns around Udupi (Malpe is only about 6km from Udupi).

There is a Malpe Fisherwomen's Cooperative Society established in 1977, currently with a membership of around 2500 of whom about 250 are in fish curing and drying operations. The society was established to provide organizational support to processors. Its activities included leasing of land from the

Port or Harbor authority and subleasing to processors for drying or curing activities; providing inputs such as salt; and supporting the members in obtaining credit.

Kundapura/Gangolli

The Gangolli harbor is geographically close to Kundapura town, the two being separated by the Panchagangavali river. Interviews during market surveys indicated that there are currently about 10-15 dried fish processors in Gangolli, whereas a decade ago there were 100-120 processors. In terms of number of species processed, Gangolli is the smallest market since only one type of fish, i.e., anchovies, are processed mostly (Table 5). They sometimes process fish such as flatfishes, mackerel and trevallies. Many of the processors sell their products to local traders. Market for dried fish produced at Gangolli is also limited: most of the dried fish produced here is consumed within Kundapura taluk; and only a negligible quantity of dried product goes outside of the taluk. Compared to Mangaluru and Malpe, the proportion of salt used is low here [44]. The processors also work as laborers and involve themselves in loading or unloading and cleaning of fish. They are anxious about losing the land currently being used as drying yard, the management of is by the Department of Fisheries of Government of Karnataka. As indicated in Table 5, many processors have exited from the dried fish business. The processors use water from the jetty, which is not a hygienic practice. Processors mainly belong to the local fisher community called the Kharvi, also known as Konkan Kharvi.

Honnavara

A dried fish processing yard is located very close to the harbor in Kasarakode village of Honnavara, on the banks of the Sharavati river. The harbor is about 4km away from Honnavara town. Currently there are about 150 dried fish processors in Kasarakode, a substantial drop from about 500 processors that were in the business about a decade ago (Table 5). Honnavara dried fish processors sell their products at different market outlets including direct sales to consumers, selling to hinterland traders, and to local traders. These processors recently established contact with buyers from Vijayawada in Andhra Pradesh. There are about 11-13 different fish varieties that are processed and traded at Kasarakode. Water for processing comes from the jetty. In Honnavara, dried fish processors are from the Hindu castes Kharvi and Gabit, and also Christians and Muslims.

Tadadi

The Tadadi harbor is located on the banks of river Aghanashini, the only free-flowing river of the Western Ghats. There is a fish drying yard very close to the harbor. The Karnataka Fisheries Development Corporation (KFDC) has constructed a fish drying yard, made of 41 plots [45]. These plots are auctioned, and the winning bidder gets the plot for three years for use in fish drying operations. After the first year, the lease amount increases by 10 percent. The processors collectively bid for the plots and pay the amount based on the area they require. The drying yard is about 23km away from Kumta, the nearest major consumer market.

There are about 20 processors now in Tadadi, whereas a decade back there were about 100-150 processors (Table 5). They process about 6-8 species or product categories of fish. There are some first-generation dried fish processors, but many have been doing it for generations. Dried fish processors in Tadadi mostly belong to the Hindu fisher communities Gabita and Kharvi. The processors sell their products directly to local consumers, sell to local traders and to traders from inland markets. They sometimes take the services of commission agents from Mangaluru who help sell products to buyers in the Mangaluru wholesale market. Dried fish processors also carry the prod-

ucts, especially dried mackerel, to Karwar to sell directly to consumers. Consumers in Goa have high preference for dried mackerel, and Karwar, which is very close to the Goa border, offers a good price for good quality dried mackerel.

Karawara

Karwar, also known as Karawara, is the administrative center and the largest city of Uttara Kannada district. It is just 14km south of the neighboring Goa state border. Many fishers have been displaced or impacted from massive projects such as the Seabird naval base. People from around India reside in Karwar working in these projects. The city is also a major tourist destination. Thus, Karwar offers a large market for seafood, not only from the local areas but also from the neighboring Goa.

Karawara has a vibrant market of dried fish, in terms of production, wholesaling and retailing. It is arguably the largest dried fish market in Uttara Kannada. Dried fish production takes place in areas around the Baithkhol landing center, the Tagore Beach, and Majali. There are about 12-16 fish varieties that are processed or dried here (Table 5). Dried mackerel is in great demand in this market, especially among Goan consumers [46]. Dried Bombay Duck, and marine shrimp are shipped from Maharashtra for sale in local markets. Currently there are about 50 processors, and about a decade back there were around 75 processors. As in all other dried fish production centers of Karnataka, processing is mostly done by women. Fish harvesting, processing and merchandizing are integrated in the family in many cases. The husband hands over the harvested fish to the wife, who decides how much of it to sell as fresh fish and what quantity of fish to process into dried fish [47]. Dried fish production is done only by local fisher communities, particularly the Konkan Kharvis.

Table 5. Structure and pricing of dried fish markets of coastal Karnataka.

Particulars	Mangaluru	Malpe/Udupi	Kundapura/Gangolli	Honnavara	Tadadi	Karawara Tagore Beach
No. of fishes traded	25-30	10-12	1-3	11-13	6-8	12-16
No. of wholesale processors and sellers	17	150-200	10-15	150	20	50
No. of processors about a decade back	50-60	350	100-120	500	100-150	Over 75
No. of retailers	35		10-15	10	40	100
No. of wholesale shops	11	25	NA	NA	NA	50
Distance to nearest major consumer market	2 km	3 km	4 km	4 km	23 km	2 km
Mackerel price (₹/kg)	75-80	120	120	200	180-200	140-180
Anchovies price (₹/kg)	120-200	200	150	220	200-240	180
Lizard-fish price (₹/kg)	100	90	120	160	120	100-120
Croaker price (₹/kg)	70	70	140	120-180	160-180	140-160
Ribbon-fish price (₹/kg)	90	100	NA	150-200	NA	180
No. of dried fish processing techniques	3	2	1	2	2	1

Dried fish processing techniques	* ♦Salted and dried Drying without initial salting (Anchovies) Huli uppina meenu dried (earlier) • Salted wet fish (Halage)	Salted and dried fish with various % of moisture content Drying without initial salting (Anchovies)	Salted and dried (2Kg salt /30Kg of fish)	Salted and dried with different % of moisture content Drying without initial salting	Salted and dried Drying without initial salting Drying with various % of moisture content	Salted and dried
Major fish types dried	Mackerel, Soles, Anchovies, Yellowtail Scad, Croakers, Halagi, Indian scad, Ribbonfish.	Lizardfish, Anchovies, Mackerel, Croaker, Yellowtail Scad	Anchovies	Anchovies, Ribbonfish, Catfish	Lizardfish, Yellowtail Scad, ribbonfish, ponyfish, Anchovies, Mackerel	Mackerel, Common ponyfish, Halagi, Yellowtail Scad, Anchovies, Thryssa, Croakers

There is a Sunday Bazar which is a weekly wholesale market for dried fish. The Sunday Bazar plays an important role in providing a platform for transactions among buyers and sellers of varying sizes and capacities from different parts of the country. Retailers are often from Karawara town and neighboring areas. They purchase dried fish at the Sunday Market from wholesalers, mostly on trade credits, with the repayment happening mostly on the next weekend. The retail dried fish market here is competitive with new entrants and producers coming regularly into the market. Retailers sell their products around residential areas, villages, designated marketplaces, and weekly markets. It is also easy to exit from retailing business once the outstanding credits have been cleared. Consumers of dried fish come to Karwar from the neighboring Goa state, often for bulk purchases, since Karawara offers price advantage and the quality of dried fish here is perceived to be better. Karawara is a major market for buyers from inland parts of Karnataka such as Shirasi, Haveri, Siddhapura, Hubballi, and Yallapura.

Migrant workers in the fish drying operations

Discussions with processors indicated that migrant laborers have been playing an important role in fish drying operations at Mangaluru and Malpe harbors for the last two or three decades. Workers involved in the dried fish operations are migrant women from northern Karnataka districts such as Bagalakote, Koppala, Raichur etc. In their native villages they are dependent on rain-fed farming, and due to insufficient rainfall in most years, they migrate to the coastal districts of Udupi and Dakshina Kannada where wages are substantially higher. At Malpe, they are mainly involved in activities such as loading and unloading of fish from or to the drying yard, and fish cleaning (gutting, washing). Their wages are based on the type of activity (carrying a basket of fish fetches ₹20, while cleaning a basket of mackerel fetches ₹200) and, overall, their earnings range between ₹500 and ₹1500 a day. New migrant laborers keep entering the workforce and there is also attrition. Unlike Mangaluru, there are no business owners among migrants in Malpe.

Description of the hinterland dried fish markets

Table 6 shows some of the characteristics of the dried fish markets in the hinterlands of Karnataka. Based on estimated quantities of dried fish sold in a day, these markets could be divided into large (daily sales of over 1000kg), medium (daily sales of 501kg to 1000kg), and small (daily sales of less 500kg or less). Three of these markets are large (Gonikoppa, Koppa, and Sagara); five medium-sized markets (Balehonnuru, Madikeri, Puthuru, Sullia, and Virajpet); and nine small markets (Soraba town, Hamsabavi, Hubballi, Hunasuru, Kanle in Sagara, Katpadi, Kusahlnagara, Piriypattana, Ulvi in Soraba).

Table 6. Some structural characteristics of the hinterland dried fish markets.

Place	Market size	Number of shops	Fish varieties available
Sagara	Large	12	Grouper, Mackerel, Barracuda, Sardine, Croaker, Needle-scaled queenfish, Ribbonfish, Malabar Trevally, Flatheads, Shark, Torpedo scad, Anchovies, Marine shrimp, Bombay Duck, Common pony fish, Pomfret, Tank goby, Rays.
Soraba	Small	01	Shark, Malabar Trevally, Anchovies, Flatheads, Mackerel.
Ulvi (Soraba)	Small	01	Needle-scaled queenfish, Mackerel, Malabar Trevally, Anchovies.
Hamsabhavi	Small	03	Mackerel, Malabar Trevally, Seerfish, Ray, Anchovies, Marine shrimp, Ribbonfish, Flatheads, Lizardfish.
Kanle (Sagara)	Small	01	Pedi, Lizard fish, Malabar Trevally, Swarlu, Ribbon fish, Kaddi jabbu (Salt & without salt), Marine shrimp, Mackerel, Barracuda, Common ponyfish, Croaker, False trevally, Rays.
Balehon-nuru	Medium	03	Ribbonfish, Croaker, shrimp, Yellowtail Scads, Needle-scaled queenfish, Sharks, Rays, Mackerel, Anchovy, Marine catfish, Flatheads, Gold-spotted grenadier anchovy, soles.
Koppa	Large	05	Soles, Indian scad, Anchovy, Shark, Lizardfish, Mullu meenu, Ribbonfish, Shrimp, Needle-scaled queenfish, Sardine.
Go-nikoppa	Large	03	Shark, Indian river scad, Anchovy, False trevally, Bombay Duck, Gold-spotted grenadier anchovy,
Kusahl-nagara	Small	01	Masmin, Sardine, Rays, Shark, Indian scad, Common ponyfish, Mackerel, Yellowtail Scad, Marine catfish, Baale meenu (catfish Wallago attu), lizardfish, Swadi, Indian scad, Gold-spotted grenadier anchovy, False trevally, Croaker, Soles, White pomfret, Black pomfret, Ribbonfish, Barracuda.
Virajpet	Medium	05	Marine catfish, shark, Sardine, Yellowtail Scad, Marine shrimp, anchovy, Croaker, Rays, Common ponyfish, Soles, Needle-scaled queenfish, Lizardfish, Mackerel, Gold-spotted grenadier anchovy, Indian river scad.
Madikeri	Medium	03	Masmin, Sardine, Anchovies, Soles, Indian scad, Barracuda, Croaker, False trevally, Common ponyfish, Gold-spotted grenadier, Lizardfish, Marine shrimp, Ribbonfish, Ray, shark.
Piriyapat-tana	Small	01	Indian river scad, Anchovies, False trevally, Bombay Duck, Mackerel, Marine shrimp.
Huansuru	Small	01	
Sullia	Medium	5	False trevally, Mackerel, Indian scad, Barracuda, Lizardfish, Croaker, Soles, Gold-spotted grenadier anchovy, Common ponyfish, Yellowtail Scad, Needle-scaled queenfish, Ray, Shark, Sardine, Marine shrimp, Bombay Duck, Masmin, Ribbonfish.
Puthuru	medium	7	Common ponyfish, anchovy, Soles, Needle-scaled queenfish, Croaker, Ribbonfish, False trevally, Lizardfish, Shark, Sardinella gibbosa, Arol, Barracuda, Marine shrimp, Mackerel, Indian scad, Gold-spotted grenadier anchovy.
Katapady	Small	3	Marine shrimp, croaker, Common ponyfish, Soles, Mackerel, Anchovy, False trevally, Shark.
Hubballi	Small	2	Bombay Duck, Mackerel, Anchovies, shrimp, Shark, pomfret, Catfish.

Large market- over 1 ton of dried fish sold daily; Medium-sized market- 500kg to 1 ton; Small market 50- 500 kg.

Retailers in these hinterland markets are mostly Muslims, but there are some from other religions (Hindus and Christians). Unlike the coastal markets, there are very few women retailers of dried fish in hinterland. Among Hindu retailers, many sellers trace their origins to the coastal districts, as their ancestors migrated to hinterland areas. Similarly, there are substantial number of consumers who trace their origins to the coastal districts. Hinterland retail markets do business year-round, but the peak season is October to February, while April to June is considered as moderate, and the other months have low business. There are many vendors who buy dried fish from the retailers and sell in rural markets by carrying the fish on bicycles or bikes (i.e., secondary marketing). These mobile vendors of dried fish play an important role in meeting the demand for the product in remote or rural areas with less infrastructure. Thus, retailers in hinterland also act as wholesalers or distributors of dried fish. Species availability and prices of dried fish in the hinterland market are dependent on the supply from coastal markets, and hence are tied to the landings at the harbors. Retailers from the large hinterland markets mentioned earlier purchase dried fish from any coastal market, even directly from processors, depending on species available and other factors. However, retailers from most other hinterland markets depend on the wholesale market in Mangaluru for their supplies. Most of the transactions between hinterland retailers and coastal processors or wholesalers are based on trade credit, with repayment happening during the next week or next visit. Some limited varieties of freshwater fish such as the Indian river shad (*Gudusia chapra*, locally called Kiski) and the helicopter catfish (*Wallago attu*, baaley meenu) are also sold in dried form in some of these markets. Many of the interviewed retailers in hinterland markets perceive that the younger generation does not want to consume dried fish, preferring to eat fresh fish or meat. This may constrain the long-run sustainability of dried fish business in terms of its marketability in hinterland areas. The COVID-19 pandemic and the subsequent economic slowdown have impacted the dried fish business. Even though there was demand from consumers, finding reliable transportation and storage facilities for a prolonged period became difficult for the retailers.

Details of the hinterland markets are provided in the next subsections by the districts they belong to.

Dried fish markets in the Kodagu and Mysuru districts

Dried fish markets in Kodagu receive most of their products from Mangaluru, but sometimes from Kerala as well. These retailers mostly visit Mangaluru every week by themselves, or sometimes may depend on agents to purchase dried fish. About 10 to 15 metric tons of dried fish are sold in Gonikoppa markets in about a week or ten-days period. Many vendors purchase fish in bulk from these larger inland markets for selling in interior rural markets on motor vehicles. Workers in coffee plantations of Kodagu are major consumers of marine dried fish with more preference for fish such as marine catfish, croakers, anchovies. Most of these workers are migrant laborers from Assam, a landlocked state in Northeast India, and have higher preference for marine fish such as catfishes, croakers, anchovies, and shrimps. Since the estates are located in distant areas with limited connectivity, dried fish with its longer shelf-life is in demand. Tribals of Mysuru, such as the Jenukurubas who mostly live in Piriya-pattana and Hunasuru taluks, regularly consume dried fish. Anchovies are in greater demand in tribal areas. Thus, dried fish serves as an important component in the diets of poor and marginalized communities. Communities such as the Kodavas, Goudas, Kurubas and Muslims also consume dried fish regularly.

Dried fish markets in the Chikkamagaluru and Shivamogga districts

The dried fish market in Koppa town in Chikkamagaluru district is a big market. Other surrounding markets of Koppa such as Balehonnuru [48], Narasimharaja Pura, Kalasa, Horanadu, Kuduremukha, Shringeri, Thirthahalli get their dried fish supplies from Koppa. Like in Kodagu, workers in coffee plantations of Chikkamagaluru are major consumers of marine dried fish in Chikkamagaluru. Chikkamagaluru and Shivamogga districts also have significant number of people who trace their origins to the coastal districts of Karnataka. These coastal-origin consumers have still retained their traditional dietary habits of coastal Karnataka even though they are born and brought up in hinterland areas.

Sagara (in Shivamogga district) dried fish market is one of the largest in Karnataka. It is located within the premises of the weekly market has permanent shops built by the municipal authorities [49]. Retailers take the services of local agents to buy fish from Mangaluru and in transporting to Sagara. Sagara market acts as a nodal point for distribution to other markets such as Soraba. Retailers in many hinterland markets, including Sagara, redry the dried fish after purchasing from the coastal markets. This helps in improving the shelf-life of the product. They adjust the price of the final product taking into account the cost involved in redrying, the weight loss due to redrying, and the profit margin.

Dried fish markets in the Dharawada, Haveri, and Belagavi districts

Hubballi is a commercial centre of northern Karnataka. The Hubballi market is more dependent on Maharashtra than Karnataka for sourcing of fish. Proportion of fish consumers in this town is relatively low, thus overall demand for dried fish is also low. Local retailers in Hubballi collect unsold fresh fish for drying purposes, similar to Karawara.

There is a large wholesale dried fish market in the Kasaigalli area of Belagavi, operated mostly by Muslim traders but also some Christians. This market receives dried fish mainly from the Mangaluru wholesale market, from

Ratnagiri in Maharashtra, and from Gujarat (via Mangaluru [50]). It could be the second largest dried fish market in the state. It acts as redistribution center for other regional markets such as other taluks of Belagavi, Bijapur/Vijayapura, Hubballi-Dharawada, Haveri, and even parts of Maharashtra such as Solapur and Savanwadi. Consumers in Belagavi have higher preference for salt-cured fish (i.e., no drying after salting).

Conclusions

This scoping study is the only detailed study on Karnataka's dried fish markets. The present study maps the flow of dried fish products from the landing centers in the coast to the final consumers in the coastal and hinterlands of Karnataka. The dried fish markets of Karnataka encompass the coastal production and processing markets from where dried products move to wholesale markets and then to retail markets before reaching the final consumer. The production market is dominated by women processors. Women from fisher communities of coastal Karnataka manage the processing of dried fish in most cases, whereas the physical labor (as explained in section 4.2.7) is performed by women migrants from northern districts of Karnataka. Compared to a decade ago, there has been substantial decline in the number of dried fish processors. The Mangaluru wholesale dried fish market is the largest market in the State that acts as the focal point for collection of dried products from not only the harbors along the Karnataka coast, but also from Lakshadweep, Gujarat and Maharashtra. Most hinterland markets depend on the Mangaluru wholesale market for procurement of dried fish. Retailers in hinterland markets often act as distributors or wholesalers of dried fish, selling the products to the final consumers, as well as to vendors who take the products further along the supply chain to interior and rural markets. These vendors are an important link in the dried fish supply chain.

Dried fish is a regular component in the diets of many sections of the society in Karnataka cutting across geographical (coastal, hinterland) and socio-economic (rich, poor, minorities, tribals, migrants, laborers) strata. However, there are also challenges such as changing tastes and preferences that come with generational shift in consumers. Therefore, the dried fish segment of Karnataka's fisheries sector needs to be promoted for achieving food and nutritional security. The dried fish segment of the seafood sector of Karnataka has long been severely neglected by policymakers and academicians. Scanty literature, especially on the social-economy of dried fish, and minimal mention or neglect of dried fish segments in policy documents suggest this apathy. Compared to the fresh or frozen seafood segment, the dried fish segment

receives negligible budgetary allocations, with only sporadic favorable policy provisions. This apathy is visible through the constraints faced by the segment. Land for curing and drying is one such major constraint. There is an acute shortage of land at the major harbors, and dried fish processors at almost every harbor are apprehensive about losing the drying yard. Since processors do not own the land on which fish are dried, at least in the major fishing harbors, they find it difficult or impossible to access formal financial instruments such as bank loans for business operations. Dried fish processing units lack basic facilities such as clean water facilities for cleaning. Hence, policymakers need to consider creating clusters of dried fish production units along the Karnataka coast, where adequate facilities for land, water and market connectivity are available. Such clusters could be setup even around smaller landing centers. Our analysis of the NETFISH data on fish landings (refer to section 2.1) shows that landings at smaller harbors are composed of substantial quantities of fish varieties that are traditionally important for drying operations.

There is a concern among retailers, especially in hinterland areas, that younger generation is not interested in consumption of dried fish. Substitution of dried fish with fresh fish and meat could be higher among the younger generations. A promotional campaign aimed at increasing the consumption of dried fish could be taken up by KFDC.

Trash fish production in Karnataka, most of which is reduced to fishmeal, is a major concern. Trash fish are mainly brought in by industrial fishing vessels that bring their catch to larger fishing harbors. This introduces uncertainty in the supplies of fresh fish for small-scale operators, i.e., at fishing villages around beach landing centers for local consumption and for drying purposes. Moreover, larger buyers at large fishing harbors outcompete smaller buyers such as dried fish processors on price. Thus, instead of being able to buy fish directly from boats, dried fish processors are forced to rely on commission agents. This lengthens the supply chain, increasing the cost of procurement. The increased share of trash fish also raises questions about sustainability of fish stocks and the long-term viability of fishing.

Given that the current cohort of processors is ageing, and the younger generations of local fisher communities are not taking up the dried fish business,

the future of the dried fish segment is likely to be linked to migrants. There is preliminary evidence from the field study indicating reduction in the number of dried fish processors over time at almost all major production markets. To ensure that the dried fish segment successfully navigates this major transition period, measures along multiple fronts are necessary. These include: gearing marine fisheries management towards sustainability especially by reducing trash fish landings; favorable treatment for fish utilization methods such as the drying-curing of fish that promote dietary diversity, and food and nutritional security, as against production of fishmeal for farming of a few fish types; and, institutional support- such as training, fostering collective action, and financial assistance for dried fish processors and other actors in the value chain. Such measures should consider specific needs based on gender and social background (e.g., migrants, landless) of the value chain actors. The quality of dried fish products needs to be improved through awareness campaigns and development of training modules by Extension agencies.

On the academic side, there is limited research on the value chain, gendered roles in processing and marketing, the magnitude of the economy of dried fish processing and trading, and the socio-ecological and geographical aspects of dried fish. Also, the culinary aspects, consumption preferences by communities, nutritional values and importance are among the many aspects of neglected areas in dried fish research. Most of the studies on new technologies of fish drying are based on laboratory-scale systems that overlook frugal technologies used by communities and therefore risk undermining them. Inadequate quality of dried fish is a major hindrance attributable to poor hygiene and sanitation practices prevalent among processors in traditional fish drying operations. Academic studies need to identify the underlying causes for guiding policy and actions. These social, economic, ecological, and technological insights could help improve the acceptability of dried fish among consumers in terms of perception of food safety and quality. More attention is also needed to the subsistence dried fish segment for own consumption by households especially in fishing villages around beach landing centers. This subsistence production caters directly the food and nutritional needs. Hence, the actual and potential contributions of dried fish con-

sumption in terms of food and nutritional security and health impacts need to be analyzed in greater detail.

Appendices

Appendix 1: Schedule of Dried Fish Market Surveys and Interviews.

Individual interview (Retailer).

1. For how long have you been involved in this job (years)?
2. Do you belong to a fishing community?
3. How many new retailers have entered this business in the last 2-3 years?
4. How many people exited from the business in the past 2-3 years?
5. Are there any rules to get into this business? How easy is it to enter this business?
6. Is it your permanent space for selling? How much you have to pay? To whom?
7. Do you process dried fish?

Supply Chain

1. #7 If yes How much quantity you prepare for a year? What species? How do you procure the raw material? Are your family members involved in fishing? Are your family members involved in fish drying? Are you a member of any Self-help Group (SHG)? Do you help each other to run the business? How? Have you received any technical training regarding hygienic fish drying?
2. >If yes
3. From where? How long?
4. Have you got any financial assistance for this business?
5. >If yes
6. *From Where and How much?
7. #7 If not Where do you procure the dried fish from? How much? Do you have a regular wholesale provider of dried fish? How do you par-

ticipate in the auction of dried fish? Is it always through the auction process?

8. H) Which species are in high demand this year? Which species are most preferred by the consumer?

9. J) Do you have credit relationship with buyer or sellers? Whom do you give credit to? Where do you get credit from?

Value chain

1. How do you purchase the raw material? At what rate?

2. How many days are required to dry the fish?

3. How many workers are required for a box of fresh fish to be converted into dried fish?

4. What would be the wage of one worker?

5. What are the inputs involved to prepare dried fish & its cost?

6. How much do you spend on transporting dried fish from the wholesale market?

7. Have you done any value addition/grading after purchase?

8. What percentage you will get after grading?

9. How price differs for graded and non-graded dried fish? Pick 3 or 4 important species price.

10. How do you transport the fish to the market?

11. What is your daily expenses at market?

12. How do you fix the price?

13. How do you deal with bulk buyer of dried fish? What happens to the price?

14. How do you decide the floor price?

Market observations

1. How old is that market? Is the market only a retail market or doubled up as wholesale market?

2. Has the market shifted its place in the past?
3. From which all places the fish is procured and sold in this market?
4. To whom the dried fish is sold? Consumer: who are they, mostly belonging to which places, which communities, high/middle or low income groups; traders: from which places they come from? What varieties they prefer most? Which communities they belong to?
5. For both: which seasons are good for dried fish trade? Which seasons are not good?
6. Is the price generally stable or fluctuates a lot?
7. What varieties of fish are found in the market?
8. At what price are the dried fish sold?
9. Who decides the price of dried fish? On what basis?
10. How do they measure the fish?
11. Do they think it is sustainable nowadays?
12. What are the difficulties they faced during COVID-19?
13. Is COVID-19 a boon or bane for the dried fish business? How?
14. Proportion of women in the business?
15. Which fish fetches high price in the market?
16. Which fishes dominate the market in terms of quantity?
17. Other quality aspects?

Others social factors

1. Is there any particular community that has a hold on the dried fish market? Observe fishing or non-fishing communities. Also see Hindu, Muslim and Christian traders in the market.
2. Role of fishing and non-fishing communities in the dried fish operations.

Appendix 2: Photographs from some coastal and inland dried fish markets.



Photo 1. Fishers involved in the drying of fish at Bengre village in Mangaluru town. Date: 21/12/2020.



Photo 2. Migrant workers engaged in the drying of fish at Hoige Bazar in Mangaluru town. Date: 22/12/2020.



Photo 3. A wholesale shop for dried fish at Bamboo Bazar in Mangaluru town that exclusively sells dried fish produced by local fish processors. Date: 28/12/2020.



Photo 4. A wholesale shop for dried fish in Bamboo Bazar in Mangaluru that sells locally produced dried fish as well as products imported from other states of India. Date: 28/12/2020.



Photo 5. A retail marketplace for dried fish, near the State Bank terminal private bus stand, Mangaluru. Date: 27/12/2020.



Photo 6. Packaged dried fish on shelves at a supermarket in Mangaluru. Date: 27/12/2020.



Photo 7. Fish drying yard at Malpe Fishing Harbor. 11/01/2021.



Photo 8. Fisherwomen at Gangolli involved in drying fish. Date: 24/09/2021.



Photo 9. Fish drying activities near the Honnavara fishing harbor. Date 30/10/2021.



Photo 10. Pre-processing of fish at Tadadi for curing and drying. Date: 31/10/2021.



Photo 11. Women fishers at the Tagore Beach in Karwar collecting dried fish from the drying mats for selling at the Sunday Bazar. Date: 03/12/2020.



Photo 12. A view of the Sunday Bazar in Karwar, with consumers and women retailers. Date: 19/12/2021.



Photo 13. A shop selling dried fish in Shivamogga's Sagara town, one of the major inland dried fish markets of Karnataka. Date: 16/12/2020.



Photo 14. A dried fish retailer in Balehonnuru, Chikkamagaluru. Date: 19/02/2021.



Photo 15. A dried fish retailer in Gonikoppa, Kodagu. Date: 07/03/2021.



Photo 16. A woman dried fish seller in Hubballi. Date 06/02/2021.

- 1.
- 2.

Notes

1. † The term seafood is used in this report to represent all edible fish and shellfish.
2. † There are some studies such as and that have analyzed the profile of the seafood sector of Karnataka, including the dried fish segment. However, this report takes a different approach by focusing solely on the dried fish segment. †
3. † Government of Karnataka, “Economic Survey of Karnataka 2020-21”
4. † Hornby et al., “Reconstruction of India’s Marine Fish Catch from 1950-2010.”
5. † Bhathal, “Historical Reconstruction of Indian Marine Fisheries Catches, 1950-2000, as a Basis for Testing the Marine Trophic Index [R”]
6. † Government of Karnataka, “Economic Survey of Karnataka 2019-20”
7. † Government of Karnataka, “Economic Survey of Karnataka 2020-21”
8. † Government of Karnataka, “Economic Survey of Karnataka 2019-20”
9. † Mechanized fishing boats are those whose engines are permanently fixed to the hull for propulsion and fishing; Motorized fishing boats are those fitted with motors for propulsion only; and non-motorized/traditional boats are those maneuvered in the water by paddling, poling or sailing for propulsion and fishing.
10. † Government of Karnataka, “Economic Survey of Karnataka 2019-20”
11. † Government of Karnataka, “Notification Regard to Fishing Harbours, Landing Centers and Beach Landing Centers along Coast of Karnataka. Order Number AHF/51/SFS/2015 Dated 15/09/2016.”

12. † A beach landing center is a designated place on the beach, devoid of any paved jetties or wharfs, where boats returning from a fishing trip are hauled on to. Boats are hauled manually, though there are some isolated attempts to make the hauling process more mechanical by introducing the use of winches.
13. † The NETFISH database covers the fish landings at the eight major fishing harbors listed in and also the Amdalli Fishing Harbor. For some of the landing centers the share is zero in some years, which is due to data being unavailable for those centers in those years.
14. † Dakshina Kannada, and to a lesser extent Udupi, have industrialized rapidly over the previous 2-3 decades. and provide a detailed description of the major investments that have occurred over time in the coastal districts of Karnataka and their environmental and the socio-economic impacts. The two studies also contain excellent discussion on the implications of the Blue Economy initiatives for coastal Karnataka.
15. † However, there could be a multitude of factors that influence the income levels among fisher communities, as explained by studies such as and . Some of these factors are- a lack of access to markets, inadequate infrastructure, social exclusion, lack of access to resources, and lack of formal education.
16. † Viswanatha et al., “An Overview of Marine Fisheries Infrastructure and Fish Utilization Pattern in Karnataka, India.”
17. † Fish utilization patterns in Karnataka closely follow that for India reported by , who found that 67 percent of total fish produced to be utilized in fresh form, 16 percent in processed and dried forms, 6 percent for fishmeal, and 1% for canned. According to , about 32 percent of total fish catch in India was utilized in dried form.
18. † Ponnusamy, Ambasankar, and Ponniah, “Production and Marketing of Fish Meal in India-a Study”
19. † In comparison, Kerala has two fishmeal plants that produce 6000 tons of fishmeal and 3000 tons of fish oil; and, Tamil Nadu has three fishmeal plants with a combined production capacity of 1000 tons of

fishmeal and 500 tons of fish oil. Thus, Karnataka is by far the largest producer among the three states.

20. ↑ Scholtens, Karuppiah, and Jyotishi, “India: Fishmeal- a Twisted Trajectory”
21. ↑ The term trash fish is loosely used and can be described as fish species caught as bycatch that are generally smaller-sized low-value fish species with weak preference among consumers . However, in recent years instead of being bycatch, there has been a shift towards targeted catching of such fishes to cater to the increasing demand from the fishmeal industry
22. ↑ There is a vast literature on the conflicts in the use of fish as a feed ingredient (through fishmeal) versus fish as a source of human food (for example, ;).
23. ↑ Gopakumar, “Salted Dried Fish in India: A Review of Methods and Quality Control”
24. ↑ Wang, Zhang, and Mujumdar, “Trends in Processing Technologies for Dried Aquatic Products”
25. ↑ Siddhnath et al., “Dry Fish and Its Contribution towards Food and Nutritional Security.”
26. ↑ Reardon et al., “The Quiet Revolution in Staple Food Value Chains: Enter the Dragon, the Elephant, and the Tiger”
27. ↑ Tremblay and Tremblay, “New Perspectives on Industrial Organization: With Contributions from Behavioral Economics and Game Theory”
28. ↑ The erstwhile South Canara district, comprised of the present day Dakshina Kannada and Udupi districts, was a part of the Madras Presidency.
29. ↑ Silas, “History and Development of Fisheries Research in India”
30. ↑ Ravichandra, “Remembering Father of Coop Movement”
31. ↑ Sir Frederick Nicholson is credited with the establishing of a separate department for fisheries (specifically the Bureau of Fisheries) in

the Madras Presidency in 1907. He is also credited with the creation of the first fisheries cooperative in India and is considered to be one of the pioneers of the cooperative movement in India (; .

32. ↑ Gopakumar, “Salted Dried Fish in India: A Review of Methods and Quality Control”
33. ↑ A pit-curing method called the Colombo Curing was in practice in coastal Karnataka until the 1990s in which pelagic fish such as the mackerel were pickled for 3-4 months in salt. A sour fruit named *Garcinia cambogia* would be placed in the cleaned fish belly during pickling. This product was mainly for exporting to Sri Lanka .
34. ↑ FAO Fisheries and Aquaculture Statistics, “FAO Fisheries and Aquaculture Statistics”
35. ↑ <https://niti.gov.in/planningcommission.gov.in/docs/plans/plan-rel/fiveyr/2nd/2planch14.html>
36. ↑ Major importing countries of dried fish from India included Myanmar (Burma), Sri Lanka, Hong Kong, Taiwan, Singapore and Malaysia.
37. ↑ Historically, Lakshadweep was part of the Mangaluru administration under the British rule until 1928. Thus, over the years, because of the port facilities and the proximity to the islands, availability of food supplies and institutional infrastructure, Mangaluru remained a main trading center for Lakshadweep. Even today, Mangaluru receives large quantities of Masmin, i.e., heavily smoked hard-dried tuna, from Lakshadweep and acts as a nodal point for redistribution to hinterland markets.
38. ↑ The Bureau of Indian Standards (BIS) has specified the quality standards for “dried and dry-salted” fish products under the Indian Standard (IS) 14950. The Code of Practice for Processing and Storage of Cured Fish and Fishery Products (IS 14516) provides the technological and hygiene requirements for producing dried products. Technical requirements for the water and ice used in fish processing industry are specified in IS 14517. These guidelines can be accessed from

39. ↑ However, the limited scope of this exploratory market study does not allow us to determine whether the reduction in the number of dried fish processors translates into consolidation of production or it is an absolute decline in the size of the processing industry.
40. ↑ Thus, the rent per shop is around ₹36,500 per year. To put this figure in context, the per capita annual income of Karnataka at market price in 2018-19 was ₹207,062.
41. ↑ A survey of dried fish processors at major fishing harbors of Karnataka revealed that they do not perceive much potential in online retailing of dried fish products. Only 14 out of the 270 respondents replied positively to a question asking if they saw any potential in selling dried fish online.
42. ↑ This hinders the processors' ability to avail loans from formal financial institutions such as the banks that ask for legal documents as proof of ownership. This exposes them to informal financial market agents such as lenders.
43. ↑ The local Hindu fisher caste (like many other non-Brahmin Hindu caste/communities of Dakshina Kannada and Udupi districts) followed a matrilineal system of succession called the Aliyakattu or Aliya Santhana (the word Aliya means nephew). The practice of this system can be traced back to at least 10th century AD. In this system, the property of the mother would be divided such that the daughters get a major share, while the father was free to divide his property as he wished (; ;). This inheritance system may explain the substantial presence/ownership by women in fishing-related businesses.
44. ↑ This low use of salt is probably because the species used in Gangolli, mostly anchovies, do not require a lot of salt (or any salt). They are just sun dried, with no prior salting.
45. ↑ This is one of the very few instances of support from the government for the dried fish sector.
46. ↑ The dried mackerel supply chain of Karawara has innovated in raw material procurement. A buyback system is in place wherein fresh mackerel not sold in various retail shops is bought back by designated

agents who then sell it for drying purposes. Demand for the product might have led to this innovation in the mackerel supply chain.

47. ↑ Thus, women play a central role in the financial and material transactions in the dried fish business here. This practice is fairly common in the small-scale fisher families of Uttara Kannada. This has been the tradition in the fisher community.
48. ↑ Balehonnuru used to directly receive products from Mangaluru, but due to lack of demand in recent years retailers here have started procuring from Koppa. Competition from small chicken stalls that have sprung across the rural landscape, as well as lack of demand from younger generation have caused an overall decline in the market demand here.
49. ↑ There are plans by KFDC to expand this market by demolishing the old shops. However, retailers are apprehensive about the increase in rent and uncertainties in project implementation.
50. ↑ Compared to Mangaluru, Belagavi is closer to Gujarat. However, dried fish from Gujarat first comes to Mangaluru and then gets redistributed to Belagavi.

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