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Price fluctuations and species diversity across fish markets in Kerala

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ABSTRACT

The fish marketing system of Kerala deserves to be highly efficient as compared to that of the country. The demand-supply gap is ironed by the fish arrivals from the other states and there exists huge price variations of fish identified among the landing centres, wholesale and retail markets of Kerala. The study analysed the price volatilities and species diversity, across different markets. Results of the study suggest that the supply side constraints and the monopsony conditions of the fish markets are the major factors responsible for the high price instability. The prices of low value fish species have not been stable for several reasons and the prices varied depending on species, seasons and abundance of other fish and fishery products. The study suggests that the development of a Fish Market Price Information System (FMPIS) to act as a decision support system would ensure fish market and price information dissemination about availability, accessibility and affordability of fish which also enables different stakeholders, mainly fishers in identifying target prices or markets; consumers with rational choices about fish availability and traders with inputs for better marketing efficiency.

Keywords: Market diversity, Marketing efficiency, Price stability, Species diversity

Introduction

Fisheries is a fast-growing sector in India, contributing to nutrition and food security of a large population of the country, as well as providing income and employment to fishermen and fish farmers. India, being the second largest producer of fish in the world, contributes about 6.5% of the global fish production. The Indian marine fisheries sector contributes enormously to the economy in terms of food security, direct employment and foreign exchange earnings (Shyam *et al.,* 2015). The demand for fish and fish products is on the rise and being sought as a preferred alternative to other animal protein, owing to its taste, preference and proven health benefits (Maeve *et al.,* 2017). The supply side is often curbed with many disquieting factors leading to wide-ranging variations in marine fish landings, which might have serious impacts on the economy of the country (Pierce *et al,* 1977; Ravallion *et al.,* 1986). With changing consumption pattern, emerging market forces and technological developments, the fisheries sector has assumed added importance in India and is undergoing a rapid transformation (Kavussanos *et al.,* 2002). The present fish production is 13.7 million t with a contribution of 3.49 million t from marine sector and 10.21 million t from inland sector. (CMFRI, 2018). Amidst decrease in landings, the valuation of fish has considerably increased due to increase in consumption of fish followed by movement of fish from non-consumption areas to consumption areas generating higher prices in addition to phenomenal increase in export earnings. The sector is undergoing fast transformation, from subsistence level to a multimillion industry. Fish has become an integral constituent in the food basket of Indians as it is considered to be a healthy food with high level of cheaper edible protein (CMFRI, 2013). On one side, fish could be a poor man's protein (low-value fishes) ensuring food security and on the other, a delicacy offered at huge prices and comparable with other protein sources (high-value species like shrimps, pomfrets and seer fishes).

The international trade of fish, yields substantial foreign-exchange earning to India's exchequer and hence are accorded utmost priority (Antony *et al.,*1973). Unlike the export sector, the domestic fish marketing system in India is handicapped with poor value addition and quality constraints amidst catering to more than 85% of the total fish distribution. The fish consumption pattern across pan India varied in terms of species preference, size range, type of fish, seasons and traditions (CMFRI, 2011). Kerala continues to be one of the major states in India where the demand and supply pattern shows limited volatilities. The consumption studies of Kerala have proved that the average *per capita* consumption of the state itself is about 27-30 kg (Shyam *et al.,* 2019; 2020). Therefore, the development of a cohesive and efficient marketing system within the country is highly inevitable so that the significant fish production is effectively delivered with the twin objectives of giving fair price to fishers and affordable prices to the consumers. The marketing strategy should be aimed at improved efficiency thereby ensuring lower price spread and better penetration of fish supplies to the different market types.

An efficient marketing system is capable of moving goods from producer to consumer at the lowest cost, consistent with the provision of the services that consumers demand (Vassdal *et al.,* 1994). Marine fish marketing in India is characterised by uncertainties in supply, assembling of fish from too many landing centres, different types of varieties and demand patterns, number of marketing channels, intermediaries and price fluctuations (Sathiadhas, 1997; 1998). Unlike other agricultural commodities, where demand decides the price, marine fisheries supply plays a major role in price determination (Bjorndal *et al.*, 2014). Price is determined by the interaction of demand and supply at both producing centre (primary markets) and consumer markets (Sims *et al.,* 1972). Analysis of price behaviour at landing centres and retail markets helps to assess the efficiency of marketing system (Aswathy and Abdussamad, 2013).

Essentially, an efficient marketing system is one where there is a perfect market integration and full price transmission, with an instantaneous price adjustment to changes from within or outside the system (Squires *et al.,* 1986). Such a system would enable the producers, middlemen and consumers in the marketing chain to derive maximum gains. It would also help in elimination of unprofitable arbitrage and isolation of spatially differentiated markets and would ensure that efficient allocation of resources across space and time is achieved (Sathiadhas *et al.,* 2011).

The price of fish fluctuates far higher due to the changes in supply, variations in the price ranges, uncertainty of fish production, availability, affordability, accessibility and perishability of the fish species. In the fish marketing system, price movements in different markets depend to a large extent on the cross-market movement of available catch, which in turn, is governed by the demand and supply factors. The extent of price transmission from one market to the other and its direction are the important aspects to be looked into, as these would provide valuable information on the degree of integration and in turn, the efficiency of these markets. The price behaviour of fish is characterised by wide fluctuations at all the stages of transactions in the supply chain. There is no proper grading, weighing and quality control at any level of domestic fish marketing (Shinoj, 2008). In this backdrop, the present study aims to assess the diversity of the species and markets across the state. The study also analyses the degree of price stability for the commercially traded fish species across the major markets in Kerala. The overall objective of the proposed study is to analyse the fish price stability across the different markets of Kerala. However, the specific objectives are to estimate the species and market diversity of the major fish markets, identify the performance and behaviour of fish prices through marketing margins realised across the different markets and to analyse the price fluctuations of the fish species in different markets.

Materials and methods

The study was based on the primary data collected from 98 markets including landing centres, retail and wholesale markets across Kerala (Fig. 1). The study was carried out to analyse the scenario of the fish marketing system across the 14 districts of Kerala during the period of March-May 2019. The data were collected through regular and systematic primary surveys conducted as a part of the study. As a part of the study, identified 98 different markets representing four different zones *viz.,* North, Central, South and Highland, based on their geographical vicinity. Table 1 represents the market locations based on the four different zones. All the markets were directly visited and purposive simple random technique was employed for collecting the species, price and market information data. The price details of around 60 fish species which are traded in the state have been collected for the study. Different statistical and econometric tools such as diversity index, instability matrix analysis, percentage analysis and marketing efficiency assessment were deployed for analysing the data.

Analytical tools

Simpson diversity index (SID)

The diversification and concentration of markets was measured using the Simpson index of diversity (SID). The

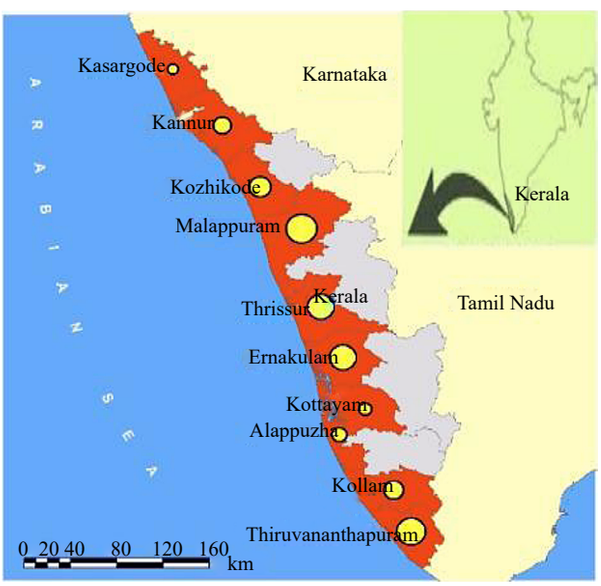

Fig. 1. Map showing the study areas

Table 1. Zonal classification of study area

South	Central	Highland	North
Thiruvananthapuram	Kottayam	Idukki	Palakkad
Kollam	Ernakulam	Pathanamthitta	Kozhikode
Alappuzha	Thrissur	Wayanad	Kannur
	Malappuram		Kasargode

index ranges between 0-1, tend towards zero when there is specialisation and towards one when there is complete diversification (Joshy *et al.,* 2003). SID was calculated using the following equation:

$$SID = 1 - \sum_{i=1}^{n} W_i^2 \text{ and } W_i = \frac{X_i}{\sum_{i=1}^{n} X_i^2}$$

where X_i = Value of i^{th} commodity and W_i = Proportionate value of i^{th} commodity out of total quantity

Marketing efficiency index (MEI)

Marketing efficiency was worked out using Shepherd's Index (Chole *et al*., 2003):

Index of marketing efficiency (MEI) = V/I

where V= Value of goods sold (retail price) and I=Total marketing costs and margins

Coefficient of variation (CV)

The fluctuations in prices were estimated by measuring Coefficient of variation (CV):

$$CV = \frac{\text{Standard Deviation}}{\text{Mean}} * 100$$

Coppock's instability index

Coppock's instability index, the widely used measure of instability was used to evaluate the price instability of different fishes, which can be used to compare any fluctuating variables.

$$Vlog = \frac{\sum_{i=1}^{n} (\frac{\log X_{t+1}}{X_t} - m)^2}{N} \quad \text{.....(1)}$$

$$\text{The instability index} = (\text{antilog } \sqrt{V \log} - 1) \times 100 \quad \text{.....(2)}$$

where, X_t = Price of fish in week t, N = Number of weeks, m = The arithmetic means of the difference between the logs of X_t and X_{t+1} *etc*, V log = Logarithmic variance of the series.

Results and discussion

Market diversity analysis

The fish marketing system of Kerala is one of the most dynamic and vibrant marketing systems in India. The study identified 98 well-structured domestic fish markets across Kerala State which is categorised into three, based on their geographical settings *viz*., Coastal-region markets; Non-coastal region markets and High-range markets. Based on the marketing functionaries and the market linkages, the markets are classified as: Wholesale, Retail and Landing centre markets. The total number of markets surveyed from each district is presented in Fig. 2. In total, the highest number of markets were covered from two districts, Malappuram (11 markets) and Ernakulam (10 markets). About 56% of the markets surveyed are wholesale, 37% are retail and 7% are landing centre markets (Fig. 2). These markets sell both marine and inland fish species through multiple marketing chains of wholesale, major, minor retailers and auctioneers. In the recent years, balanced fish distribution systems to the remote areas are reasonable due to the improved storage infrastructures and transportation potentials empowered by the marketing functionaries.

The price spread and diversity of the species leading a prominent role, highlights the need for analysing the market and species diversity of the selected study areas. In order to identify the diversity, price behaviour and price fluctuations, the wholesale, retail and landing centre markets were again classified into four different zones *viz*., North, Central, South and Highland based on their geographical vicinity and are indicated in Fig. 3.

The results indicate that based on the geographical destinations, Central zone has the highest number of wholesale and retail markets (32%) followed by North zone (26%), South zone (24%) and Highland (18%). The zonal classification enables to analyse the market diversity and price variations in a varied context. The study identified that marine fish consumption is predominant in the Central zone as the number of fish markets are high in this region when compared to other zones. Apart from

Fig. 2. Fish market types selected for the study

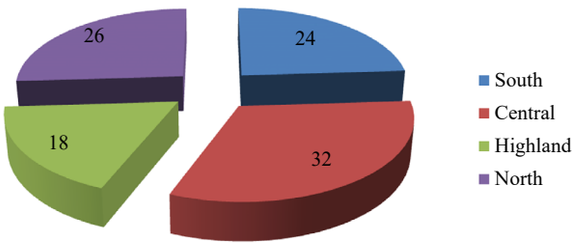

Fig.3. Geographical spread of fish markets

other zones, the demand for fish in the highland regions are largely met through the inland and freshwater species. Also, short stint night markets are found to operate mostly in these areas and offers considerable fish trade.

Diversity assessment

Fish market prices are the economic drivers that affect fishers' behaviour and in particular, the selection of target species. The Kerala fisheries sector is highly diversified with various marine and inland species and majority of these fishes are traded according to the consumer preferences, fish availability and affordability as well as diversified dimensions of fish trade. The extent of diversification was quantified both species-wise and market-wise using Simpson index of diversity and indices are furnished in Tables 2 and 3. The diversity assessment was derived based on the species availability across and within markets. Accordingly, market diversity indicates the number of species available/traded in a particular market and it ranges from 0 to 1. Similarly, the species diversity indicates the spatial distribution of a particular species across markets and it ranges from 0 to 1. High market diversity index, indicates more species traded within a market and similarly high species diversity index indicates more spatial spread of a particular species across markets.

The market diversity assesses the fish species diversity within the markets in terms of species availability and accessibility. The average market diversity index was found to be 0.52 which means that, of the 60 species traded, 52% are available in different markets of Kerala. Of the 100 markets selected it was found that, Nadakkav market and Vadakara market has the highest diversity of 0.77 which indicated that among the 59 species traded, 77% are available and accessible in Nadakkav and Vadakara markets. Thus, the market with high indices trades many species offering better trading opportunities.

Similarly, the species diversity assesses the geographical spread of the species in terms of its availability, accessibility across the markets and consumers. The average species diversity of the different markets of Kerala was found to be 0.52. Of the 59 species traded across the different markets, it was found that among the identified species, sardine has the highest diversity of 0.98 and tilapia is the second most with diversity index 0.95 followed by pearl spot (0.93) and mackerel (0.92) which indicated that among the 98 markets selected, sardine was traded in 98% of the markets, tilapia 95%, pearl spot 93% and Mackerel 92%, making these four as the most available and accessible fish across the markets. All the markets found sardine, tilapia, pearl spot and mackerel as the species which have huge trading opportunities (Table 2).

The diversity indices also indicate that sardine, mackerel, tilapia and pearl spot are the most consuming fish species and has got huge significance in the economy of Kerala. The nutritional values of mackerel as well as

Table 2. Species diversity index

Species	Index	Species	Index
Sardines	0.98	Squids	0.57
Tilapia	0.95	Dolphin fish	0.54
Mackerel	0.93	Other carangids	0.52
Pearl spot	0.93	Octopus	0.51
Anchovies	0.92	Penaeid shrimps	0.49
Threadfin breams	0.90	Perches	0.43
Clam	0.90	Mullets	0.41
Tunnies	0.89	Flat fishes	0.41
Silverbellies	0.88	Dolphin fish	0.37
Sharks	0.83	Half beaks and full beaks	0.34
Croakers	0.83	Ribbon fishes	0.31
Crabs	0.83	Lobster	0.31
Seer fishes	0.82	Wolf herring	0.27
Cat fishes	0.82	Oyster	0.22
Cobia	0.81	Cold water species	0.20
Lizard fishes	0.80	Non-penaeid shrimps	0.18
Rays	0.76	Bulls eye	0.17
Mussels	0.76	Goat fish	0.16
Barracudas	0.73	Big-jawed jumper	0.14
Pearl spot	0.72	Pompano	0.13
Tilapia	0.72	Grey mullet	0.12
Scads	0.72	Eels	0.07
Catfishes	0.71	Flying fishes	0.07
Pig-face breams	0.69	Flat heads	0.07
Moon fish	0.69	Murrels	0.07
Cuttlefishes	0.65	Skates	0.05
Milk fish	0.64	Threadfins	0.05
Pomfrets	0.63	Shad	0.01
Carps	0.63		
Rock cods	0.58		
Bill fishes	0.57		

Table 3. Market diversity index

Market	Market diversity index	Market	Market diversity index
Nadakave RT	0.77	Kannur WS	0.53
Vadakara WS	0.77	Alapuzha WS	0.53
Vadakara RT	0.75	Adoor RT	0.53
Kavanad WS	0.75	Thalassery WS	0.52
Kavanad RS	0.75	Thalassery RT	0.52
Thoppumpady RT	0.73	Malapuram WS	0.48
Balarampuram RT	0.73	Kannur RT	0.48
Kollam RT	0.72	Chalakudy WS	0.47
Payippadu WS	0.72	Chalakudy RT	0.47
Broadway RT	0.72	Nedumangad RT	0.47
Chambakara WS	0.68	Chenganoor RT	0.46
Chambakara RT	0.68	Malapuram RT	0.45
Vadanappaly RT	0.67	Kalavoor retail	0.45
Thaliparambu WS	0.65	Chenganoor WS	0.45
Chandiroor WS	0.65	Erattupetta WS	0.45
Thiroor WS	0.63	Erattupetta RT	0.45
Thiroor RT	0.63	Changanassery WS	0.43
Trichur WS	0.63	Changanassery RT	0.43
Trichur RT	0.63	Pala WS	0.43
Thodupuzha WS	0.63	Kumbala WS	0.42
Punnapra WS	0.63	Kumbala RT	0.42
Kozhikode Central market	0.62	Palaghat WS	0.42
Chandiroor RT	0.62	Aroor WS	0.42
Cherthala RT	0.62	Aroor RT	0.42
Ettumanoor WS	0.62	Kalavoor WS	0.42
Ettumanoor RT	0.62	Pala RT	0.42
Thodupuzha RT	0.62	Kalpetta WS	0.40
Varapuzha WS	0.62	Palaghat RT	0.40
Varapuzha RT	0.62	Kalpetta RT	0.38
Chalai RT	0.62	Perinthalmanna WS	0.37
Palayam WS	0.62	Perinthalmanna RT	0.37
Varkala RT	0.62	Cheruvathur WS	0.37
Central market RT	0.60	Cheruvathur RT	0.37
Kasargod WS	0.60	Nilamboor WS	0.35
Kasargod RT	0.60	Nilamboor RT	0.35
Pangode WS	0.60	Betheri WS	0.33
Venjaramood RT	0.60	Manjeswaram WS	0.32
Valancherry WS	0.58	Betheri RT	0.32
Angamali WS	0.58	Manjeswaram RT	0.30
Angamali RT	0.58	Mananthavadi WS	0.30
Cherthala WS	0.58	Mananthavadi RT	0.30
Alapuzha RT	0.58	Mahe RT	0.30
Kottayam RT	0.58	Mahe WS	0.29
Kottakkal WS	0.57	Kanjangadu WS	0.28
Kottakkal RT	0.57	Kanjangadu RT	0.28
Thaliparambu RT	0.57	Vandiperiyar WS	0.25
Kottayam RT	0.56	Vandiperiyar RT	0.25
Kadappakada Kollam WS	0.55	Mundakayam WS	0.23
Vadanappaly RT	0.53	Mundakayam RT	0.23

the tradition in eating sardine are the major reasons for the high consumption levels of mackerel and sardine. There exists a very clear-cut demand and supply pattern for these fish species. In addition, the supply pattern of sardine are met from the fish arrivals from the neighbouring states of Tamil Nadu, Karnataka, Maharashtra and Goa. Also, the use of plastic crates had made the transport of sardine to and from the state much more convenient.

Behaviour of fish prices

The efficiency of a market highly depends on the price fluctuations and market integrations. The price of fish fluctuates far higher than any other agricultural commodity due to the changes in supply, prices of other marine fish varieties, uncertainty in fish production and perishability. The price of fish is determined by the interaction of demand and supply at both the producing centres and the consuming markets. The price behaviour of fish is characterised by wide fluctuations at all the stages of transactions in the supply chain.

External forces such as weather conditions, regulated fishing seasons and consumption patterns determine the volatility in fish production and thereby fish price. The trend of fish prices across the different zones analysed are indicated in Table 4. The study found that the major species dealt with the different markets are sardine, seer fish, mackerel, threadfin breams, shrimps, squid, anchovies, crabs, pomfrets, tuna, red snapper and rohu The price ranges from ₹200- 300 for the low value fishes and around ₹450- 800 for the high value fishes.

Highlands have the highest marketing efficiency of 19.38 and north zone has the lowest marketing efficiency of 15.51. The coefficient of variation (CV) of the price series of the retail and wholesale markets were found to be, north (52.98%, 56.73%), central (51.95%, 58.80%), south (53.51%, 59.99%) and highlands (55.61%, 59.89%) respectively. Within the different zones there exists a slight variability ranging from 0.4-0.7% in the movement of the fish prices across the retail and whole sale markets accounting for a similar variation of fish prices across the different zones. The results points out that highlands holds high variability and central zone accounts for low variability of price among the retail markets and south zone has high variability and north zone has low variability of price among the whole sale markets. The study indicates that the fish availability and accessibility determine the affordability across the consumers. The price spread increases on account of the fish movement from the production to consumption centres.

The behaviour of the fish prices in Fig. 4 indicates that as the fish moves from the region of supply to the region of demand, the marketing efficiency reduces, making the middlemen role more prominent. The retail and whole sale prices of the different destinations were estimated as: North - ₹262.01 per kg and ₹221.38 per kg; Central - ₹267.63 per kg and ₹221.04 per kg, South - ₹284.68 per kg and ₹236.48 per kg; Highlands - ₹294.36 per kg and ₹237.81 per kg, respectively. Among the different fish species, seer fish is the most high value

Table 4. Average fish prices and marketing efficiency in Kerala

Markets	North		Central		South		Highlands	
	Mean	CV (%)	Mean	CV (%)	Mean	CV (%)	Mean	CV (%)
Wholesale (WS)	221.4	56.73	221	58.8	236.5	59.99	237.8	59.89
Retail (RT)	262	52.98	267.6	51.95	284.7	53.51	295	55.61
Marketing efficiency index (MEI)	15.51	18.35	17.41	21.08	16.93	20.38	19.38	24.03

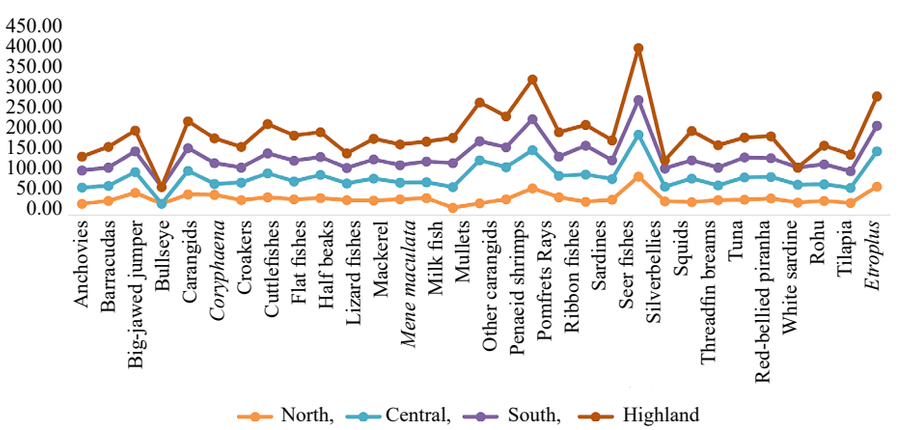

Fig. 4. Behaviour of fish price across different zones

fish sold from the four regions. The results of the trend analysis also highlight that other than price, demand is the real driving factor for fish consumption and thereby the marketing activities. The demand of the species determines the price among the different markets.

Price fluctuations of species among different markets

A single market alone does not determine the price of a fish species. The market actions are always influenced by the price signals from other markets (Salayo, 2006). The marketing efficiency of fish market and species and the buyer-seller transactions are wholly dependent on these price signals and hence price information dissemination is very essential for the marketing activities of the fish markets. The price information dissemination could be done in a more precise manner by analysing the price fluctuations of the different species within the regions. The changes in consumer preferences of different varieties, quality, quantity, availability as well as affordability are attributed as the major reasons for the change in fish prices. The price fluctuations of the major 30 different species within the four regions of the study are analysed and the results are indicated in Table 5.

The results point out that among the whole sale markets of the four different zones, threadfin breams (41.59%) showed the highest price fluctuations and silver bellies (34.54%) the lowest. Carangids (33.41%) had the highest price fluctuation and flat fishes (26.76%) the lowest, among the retail markets of the four different zones selected for the study. Moreover, among the different zones, silverbellies recorded the highest price fluctuation in whole sale (34.54%) and retail (31.72%) markets and big-jawed jumper had the lowest fluctuation in whole sale (7.20%) and retail (6.39%) markets with in the North zone. In the Central region, threadfin breams (41.59%), showed the highest and big-jawed jumper (4.88%), the

Table 5. Price fluctuations of different species within the zones

Varieties (Common name)	Scientific names	North (CV %)		Central (CV %)		South (CV %)		Highland (CV %)	
		WM	RM	WM	RM	WM	RM	WM	RM
Anchovies	*Stolephorus indicus*	27.62	22.74	29.79	19.44	19.63	12.09	10.19	8.50
Barracudas	*Sphyraena* sp.	23.97	20.86	26.36	21.09	21.20	18.83	8.32	9.09
Big-jawed jumper	*Lactarius lactarius*	7.20	6.39	4.88	5.88	0.00	0.00	0.00	0.00
Bulls eye	*Cookeolus japonicus*	19.42	15.29			0.00	0.00	0.00	0.00
Carangids	*Carangoides equula*	18.06	15.81	40.24	33.41	24.98	24.17	5.81	2.33
Croakers	*Johnius dussumieri*	26.79	24.58	36.81	27.86	12.94	12.26	0.00	0.00
Cuttle fishes	*Sepia* sp.	13.49	12.48	11.73	10.37	5.50	7.10	4.88	5.56
Dolphin fish	*Coryphaena hippurus*	22.50	20.98	7.62	6.67	5.89	3.45	0.00	0.00
Flat fishes	*Cynoglossus macrolepidotus*	28.99	25.18	26.77	24.07	41.18	26.76	0.00	0.00
Lizard fishes	*Synodus indicus*	24.54	18.98	17.48	14.36	10.04	7.28	6.15	6.67
Mackerel	*Rastrelliger kanagurta*	9.31	7.53	23.31	23.90		5.35	8.90	5.89
Moon fish	*Mene maculata*	27.06	18.98	20.41	22.90	7.42	4.56	0.00	0.00
Milk fish	*Chanos chanos*	29.41	25.66	35.97	25.16	7.30	5.77	10.53	10.62
Mullets	*Mugil cephalus*	18.06	13.98	33.01	29.83	3.04	6.82	0.00	0.00
Other carangids	*Carangoides malabaricus*	29.42	27.06	35.63	17.75	18.96	15.86	4.56	4.17
Penaeid shrimps	*Penaeus monodon*	10.27	8.96	7.53	8.70	5.82	4.98	22.15	14.29
Pomfrets	*Pampus argenteus*	12.69	10.26	15.06	8.30	20.56	20.00	14.32	13.15
Rays	*Himantura* sp.	21.04	18.69	17.48	13.54	22.28	19.81	38.57	31.42
Ribbon fishes	*Lepturacanthus savala*	29.87	24.70	21.35	13.97	27.92	1.91	0.00	0.00
Sardines	*Sardinella longiceps*	18.44	14.30	17.72	10.96	5.58	7.28	19.02	20.94
Seer fishes	*Scomberomorus guttatus*	11.98	11.28	10.65	6.32	11.45	9.13	7.51	2.99
Silver bellies	*Leiognathus* spp.	34.54	31.72	12.86	3.45	17.10	12.96	0.00	0.00
Squids	*Uroteuthis duvaucelii*	27.20	25.68	24.76	18.33	9.10	7.60	0.00	0.00
Threadfin breams	*Nemipterus japonicus*	20.84	18.98	41.59	29.79	19.55	15.60	6.67	9.61
Tuna	*Euthynnus affinis, Auxis rochei*	19.41	20.23	36.13	19.69	12.25	9.83	15.01	11.95
Red-bellied piranha	*Pygocentrus nattereri*	19.52	16.91	20.13	15.31	12.80	9.45	15.30	9.45
White sardine	*Escualosa thoracata*	17.41	15.67	20.40	11.31	21.30	15.94	0.00	0.00
Rohu	*Labeo rohita*	20.68	17.20	16.93	12.25	20.78	15.71	19.34	14.04
Tilapia	*Oreochromis mossambicus*	15.89	15.18	16.26	10.16	14.21	9.52	22.65	17.65
Pearl spot	*Etroplus suratensis*	10.74	13.74	16.43	13.32	7.66	7.77	0.00	0.00

lowest variations among the whole sale markets, whereas in retail markets, carangids (33.51%) and silverbellies (3.45%) had highest and lowest price fluctuations respectively. Flat fishes in the whole sale (41.18%) and retail (26.76%) markets showed the highest price variations, whereas mullets (3.04%) of whole sale and ribbon fish (1.91%) of retail markets showed the lowest variation among the different species in the South zone. Within the highlands, rays recorded the highest price variation in the whole sale (38.57%) and retail (31.42%) markets. The study identified that the prices were highly volatile and varied between different zones. The price fluctuations were due to the uncertain nature of the fish harvest, perishability and variations in short run supply.

Price instability matrix

Assessment of the fish price volatility is highly important as the volatile fish prices could result in higher fish price instability and increase in the fish food insecurity creating demand-supply dilemma. The price volatilities might lead to the price shocks which affect not only the consumers but also all the intermediaries involved in fishing as well as the marketing channels. This could lead to the collapse of market economy and hence the fish price instability assessment assumes significance. The price instability assessment was done using the Coppock's instability index method and species having high/medium/low values in and across different zones and markets are indicated in the instability matrices (Table 6 and 7). The price range for high, medium and low was categorised as: ₹350-900, ₹180-350 and ₹120-180 and the instability categorised as: 2-2.5, 1.5-2 and 1-1.5 representing high, medium and low respectively.

The results point out that retail market prices are less stable than the whole sale market prices. High value species were found to be having stable prices compared to the low value species. Low value species showed greater price instability in the retail markets throughout the period. The study points out that categorisation of the species according to the price instability will be of more advantage in decision making of fish demand-supply mismatch in the fish markets and for developing government interventions in regulating fishing business. Moreover, the consumption pattern, changing consumer preferences and purchasing competencies of the consumers could be also easily recognised and concerted efforts could be made so that the fish will be available in the markets at affordable prices, thereby ensuring fish food security for consumers.

The study identified that the supply side constraints and the monopsony conditions of the fish markets are the major factors responsible for the high price instability of the fish markets. Furthermore, the study designate that all marine fish species showed a very high range of price fluctuations in all the four different zones. The prices of low value fish species have not been stable for several reasons and the prices varied depending on species, seasons and abundance of other fish and fishery products. During glut seasons, many species earned a lower price and thus fell into the low value category. It is not the quantity of fishes

Table 6. Price instability matrix - Retail markets

Price instability → ↓	High	Medium	Low
High		Mullets, Rays, Flat fishes, Pearl spot, Dolphin fish, Tuna, Croakers Barracudas, Ribbon fishes	Sardine, Mackerel
Medium	Red bellied piranha, Penaeid shrimps, Silverbellies, Threadfin breams, Milkfish, Moon fish		
Low	Carangids, Other carangids, Pomfrets, Seer fishes, Squids		

Table 7. Price instability matrix - Whole sale markets

Price instability → ↓	High	Medium	Low
High		Rays, Flat fishes, *Etroplus*, Dolphin fish	Sardine, Mackerel
Medium	Red bellied piranha, Penaeid shrimps, Silverbellies, Threadfin breams, Milk fish	Milkfish, Moon fish, Tuna, Croakers Barracudas, Ribbon fishes	
Low	Carangids, Seer fishes, Squids, Mullets, Other carangids, Pomfrets		

landed but the value of the fishes landed that is important as it could offer breathing space to the fishermen if they fail to catch adequate quantity.

The soaring fish prices in domestic market leads to issues of fish availability, accessibility and affordability for the consumers. The domestic fish market is growing significantly with population and income growth rates, changes in food habits, increasing awareness on nutritional qualities of fish, improvements in transportation, storage and processing facilities and access to quality fish. There exists huge demand for fish even at a higher price. The poor supply of fish to the domestic fish market will lead to a situation wherein the domestic consumers will be devoid of fish in the market at affordable prices. The current innumerable hassles in export of fish are also coupled with inefficient domestic marketing system and it is important to integrate domestic and international markets to ensure sustainability of fisheries trade. The different stakeholders (fishers, traders, consumers, exporters and policy makers) need to be made aware about the market and price of fishes for evolving efficient marketing systems and supporting infrastructure that would lead to better quality and prices.

The development of a Fish Market Price Information System (FMPIS) to act as a decision support system would ensure fish market and price information dissemination about availability, accessibility and affordability of fish. The FMPIS enables different stakeholders mainly fishers in identifying target prices / markets; consumers with rational choices about fish availability and traders with inputs for better marketing efficiency. It could overcome the concerns of exorbitant prices, climate change, increasing exports, higher domestic demand that have resulted in limited fish availability, and several constraints at production, distribution and consumption levels. Moreover, the fish market information system could provide virtual price and market platform and elements in developing domestic fish marketing policies for future.

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