

Supply Chain in the Fish Processing Sector in Kerala: An Empirical Analysis

ANCY V. P. AND K. V. RAJU

Fish is generally accepted as a solution to the problem of protein-calorie malnutrition faced by the fast-growing population of the world. This study has been structured to capture the process and flow of the supply chain in the fishery sector. Supply and value chain analysis framework was developed to present the real picture of this sector. The study observed that the marine fish marketing in Kerala relies upon various marketing channels for different types of fishery products. The present analysis identified the various costs incurred with the structural innovation. Gravity model is used to examine the market-wise flow of marine product exports from India.

1. Introduction

The fisheries sector in India is contributing significantly to the agricultural export of the country and thereby helping poverty alleviation and generating employment to millions of people in the coastal area. The agro climatic conditions and vast resource potential in the Exclusive Economic Zone of India make it a leading marine fish producing and exporting country in the world. The state of Kerala which is endowed with a rich fish fauna contributes a substantial proportion of the total production and export of marine product of the country. Increased fish and fishery productivity generates a higher income and creates income generating opportunities for fisher folk to come out from the vicious circle of poverty. The share of total fish production exported increased significantly from 25 per cent in the mid-1970s to nearly 40 per cent in 2011, reflecting the sector's growing degree of integration in the global economy (FAO, 2012). Net exports from the developing world are projected to continue through 2020, though at a lower level than present. This is mainly due to rising domestic demand within developing countries for fish because of population growth, income growth and urbanization (Delgado et al., 2003). In recent year's liberalization policies, technological innovations, improvements in processing, packaging and transportation, as well as changes in distribution and marketing have further accelerated this trend, while facilitating the emergence of complex supply chains in which goods often cross national borders several times before final consumption (Sumaila et al., 2014). This paper analyses the supply chain, value chain and the price spread in the fish export processing sector in Kerala.

2. Data and Methodology

The data requisite for the empirical analysis are collected from both primary and secondary sources. Primary data

Dr Ancy V. P., Assistant Professor, Department of Economics, Maharaja's College, Ernakulam, Kerala, India.

Dr K.V. Raju, Associate Professor, Department of Economics, Sacred Heart College, Thevara, Kochi, Kerala, India.

is collected by conducting a survey of seafood export processing sector in Kerala. Secondary data used for this study were collected from the published and unpublished sources of Marine Products Exports Development Authority (Kochi), Exports Inspection Agency (Kochi), Marine Census of CMFRI, Exports Inspection Council, CIFT, Fisheries College, and School of Marine and Industrial Fisheries. This paper presents the estimation of gravity model covering the period of 24 years from 1980 to 2014. In the model trade flows between two countries *i* and *j* are explained by factors that indicate total potential supply of country *i*, total potential demand of country *j* and the resistance factors to trade flow between *i* and *j*. The gravity model is then obtained by the equality of supply and demand. Then the gravity equation is obtained by using market equilibrium clearance.

3. Analysis of Marine Export from India-Gravity Model

The gravity model has been extensively used for analysing the performances of international trade in recent years and can be applied to quantify the trade flows empirically. Timbergen was the first who applied the gravity model to analyse international trade flows in 1962 and many others have followed it up to set up a series of econometric model to analyse bilateral trade flows.

The gravity model estimated in this study has the following form:

$$T_{ij} = A_{ij} / D_{ij} \cdot \text{Log}(EV_{ij}) = C + a \log \text{GDP}_i + b \log \text{GDP}_j + c \log D_{ij} + U_i$$

LogEV_{ij} = Log of Marine Exports from *i* to *j* (*i*=India *j* = import markets), **C** = Constant, **Log GDP_i** = log of India's Gross Domestic Product at constant prices, **Log GDP_j** = log of importing countries Gross Domestic Product at Constant Prices (log of Average Gross Domestic Product at Constant Prices (USA, Japan, EU)), **Log D_{ij}** = log of distance between exporting and importing nations, **U_i** = Error term

The result of the gravity model is given in Table 1 and it shows that the growth in GDP has a positive impact on marine fisheries export trend from India. In the model, the coefficient of the GDP at constant price is positive and highly statistically significant. The distance variable is significant and has the anticipated negative sign, which indicates that India tends to trade, with its neighbouring countries during the period of food safety regulations. This variable is expected to have negative effect on trade, as transport cost increase with the distance between countries. This negative coefficient shows the decline in Indian export and upward trend in the domestic consumption.

Table 1: Gravity Analysis for Marine Exports from India and Importing Countries
Dependent Variable : Log of Marine Products Exports from *i* to *j*

Independent Variable	Coefficient	Standard Error
Constant	-54.1485 (-6.43005)*	8.421165
Log GDP _i	0.710515 (1.676091)***	0.423912
Log GDP _j (Average)	3.95464 (3.732296)*	1.059573
Log D _{ij}	-0.13551(-0.89161)	0.151977
$R^2 = 0.950798$ Adjusted $R^2 = 0.945878$		

Source : Computed from MPEDA Government of Kerala, Kochi., World Bank Database, 1980-2014

Note : * statistically significant at 1 per cent

** Statistically significant at 5 per cent level

*** Statistically significant at 10 per cent level

The result of the gravity model with respect to importing countries reveals that growth in GDP of India and importing countries has a positive influence on the marine fisheries export from India. *Log GDP_j* of importing countries is significant at 1 per cent level. However *Log GDP_i* of India is significant only at 10 per cent level. The value of R^2 and adjusted R^2 are found to be high.

4. Supply Chain and Value Chains in the Fisheries Sector

The term *supply chain* is often used interchangeably with the term *value chain*. Supply chain shows the flow of fish and fishery products from their source to the ultimate user. Supply chain comprises a series of activities in which

products are simply transferred from starting point to an end point. Supply chain involves purchasing, manufacturing, transportation, customer service and waste management. All the parameters in the value chain are as same as in the supply chain, but in the value chain certain values are getting added in each stage. i.e., grading, sorting, packaging or cold storage and repack the products.

Willems et al., (2005) examined the strategies of suppliers from the buyers' perspective and the costs of intervention to assist the various developing country stakeholders to comply with international agro-food standards. Raising the efficiency of supply chains can

help meet the simultaneous challenge of reducing the costs of food to consumers, enhancing sustainability, food safety and nutrition, and increasing the revenue of supply chain participant, including smallholders. (Lem et al., 2014). Food safety forces supply chain actors to collaborate to obtain transparency in the supply chains that will guarantee a safe product for consumption.

Representative fisheries and aquaculture supply chain and value chains are summarized in Figure 1. Value chain is the whole process involved in transferring fish from its point of production, whether by capture or culture, upto its point of consumption.

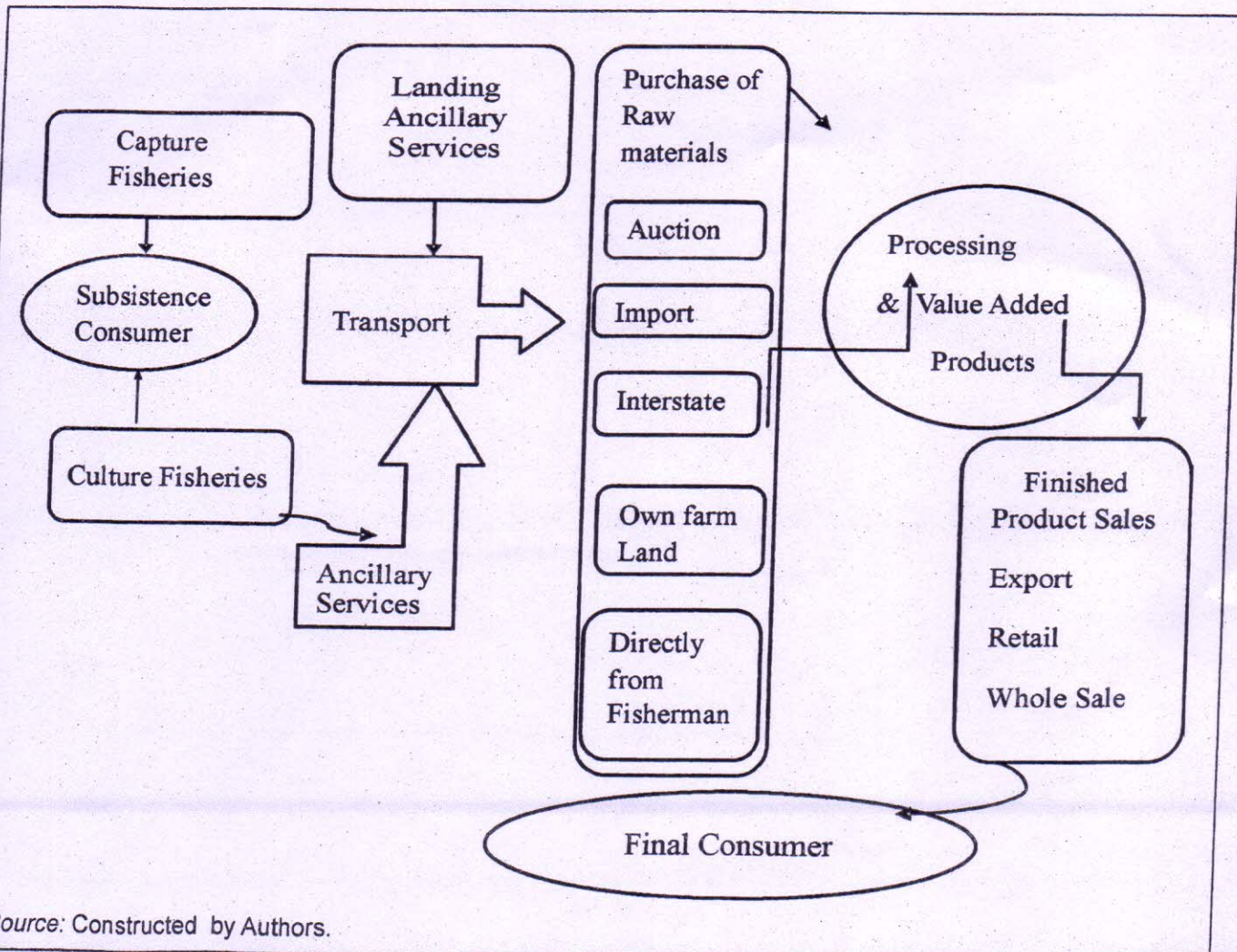


Figure 1. Supply Chain and Value Chain in the Fisheries Sector

Ancillary Services

E.g., Boat Builders, mechanics, fuel sellers, ice makers, gear makers, hatcheries, feed merchants, power companies, etc.

There is bonding relationship between different actors and agencies found along this chain. In the domestic supply chain fish and fishery products are available as either capture fisheries or culture fisheries. During 2012–13, the share of inland fish production to the total fish production of Kerala state was 22 per cent (Economic Review, 2014). A subsistence consumer purchased fish and fishery products from capture or culture fisheries. As per the population census 2011, the fisher folk population in Kerala is 10.02 lakh covering 7.71 lakh in coastal area and 2.31 lakh in inland sector. It is also estimated that about 74,100 people are engaged in fishery-allied activities. The main players in the ancillary services are boat builders, mechanics, fuel sellers, ice makers, gear makers,

hatcheries, feed merchants and power companies.

The main sources of raw materials for seafood export processing units are obtained directly from the fishermen or the farmer, participating in the auction, from their own farmland, supplier agents, interstate agents and importers from other countries. After the purchase of raw materials processors add value through processing and convert the raw materials, into value added products. Finished fish and fishery products are either sold through export or distributed in the retail or whole sale domestic supermarkets and finally reaches, to the ultimate consumer. Table 2 depicts the sources of raw materials, purchased by the seafood processing export units.

Table 2: Sources of Raw Materials Received by Processing Units (Percent)

Directly from Fishermen Agent/Farmers	Participating in Auction	Own Farm Land	Agent	Export from Other Countries	Other State
40	90	15	85	8	35

Source: Survey Data.

The fishermen agent receives fish from the fisherman and grade each type of fish based on the freshness and quality of the fish. Auctioneer is the link between the fishermen agent and the supplier agent. Fishermen agent deals with varieties of fish whereas the supplier agent deals with particular type of products which is demanded by the fish processors. Even though our domestic fish marketing is transparent, artificial scarcity of raw material may fetch higher price which will be more beneficial to the auctioneer and supplier. The study observed that among the supply chain actors, living conditions of the fishermen are the lowest in the supply chain. Recently buyers i.e., importers are the price makers due to economics of information. Buyers have the awareness regarding the price of raw materials and other expenditure met by the exporter and has good bargaining power in the international market with the help of their agents. Agents in between the exporter and importer are the real profit makers without any sacrificing cost. All other supply chain actors are really engaged in these fish and frozen surroundings, their hardship, exploitation and pertinent management maximizes their net revenue. As fish is a most perishable commodity, an appropriate waste management system has to be developed to maintain hygiene and ensure proper sanitary conditions.

Table 3: Cost for Food Safety and Quality Issues in the Supply Chain

Type of Costs	Fish Export Processing Industry
Direct costs	Implementation of standards and advanced technology
	Auditing of standards
	Training and education dtaff
	Food safety/quality staff
	Export health certificate
	Quality system
Indirect costs	Laboratory
	External laboratory costs
	Maintenance of systems
	Visit of importers
	Relationship management
	Reputation problem
Risk	Rejection of shipment
	Political and economic changes
	Changing quality standards
	Trial and error
Hidden costs	Loss of opportunities to sell products
	lack of knowledge, innovation and reliable information
	Loss during transport
	Strike of chain actors

Source: Survey data.

Table 3 shows the different types of cost for food safety and quality issues in the supply chain. Among fish processors, large differences exist with regard to costs. In particular, small-scale producers are not able to invest in technology, quality systems, laboratories, specialized staff, and training and education and depend on traders or cooperatives. Qualitatively, the costs of compliance with food safety can be summarized to unavoidable direct costs, which are tied mainly to heavy investments and higher operating costs. The more intangible hidden costs are reported to be substantial. These include costs encountered due to lack of information, innovation, and learning.

4.1 Impact of intermediaries in the supply chain

The marine fish market in India can be divided into two categories, domestic and export market. The scarcity of raw material reflects an increase in price of marine fish products in the supply chain system. The study observed that fishermen's share in consumer's rupee ranges from 45 to 85 per cent and vary according to the type of the fishery products. The main marketing channels for export oriented items like shrimps, cephalopods and fish are shown below:

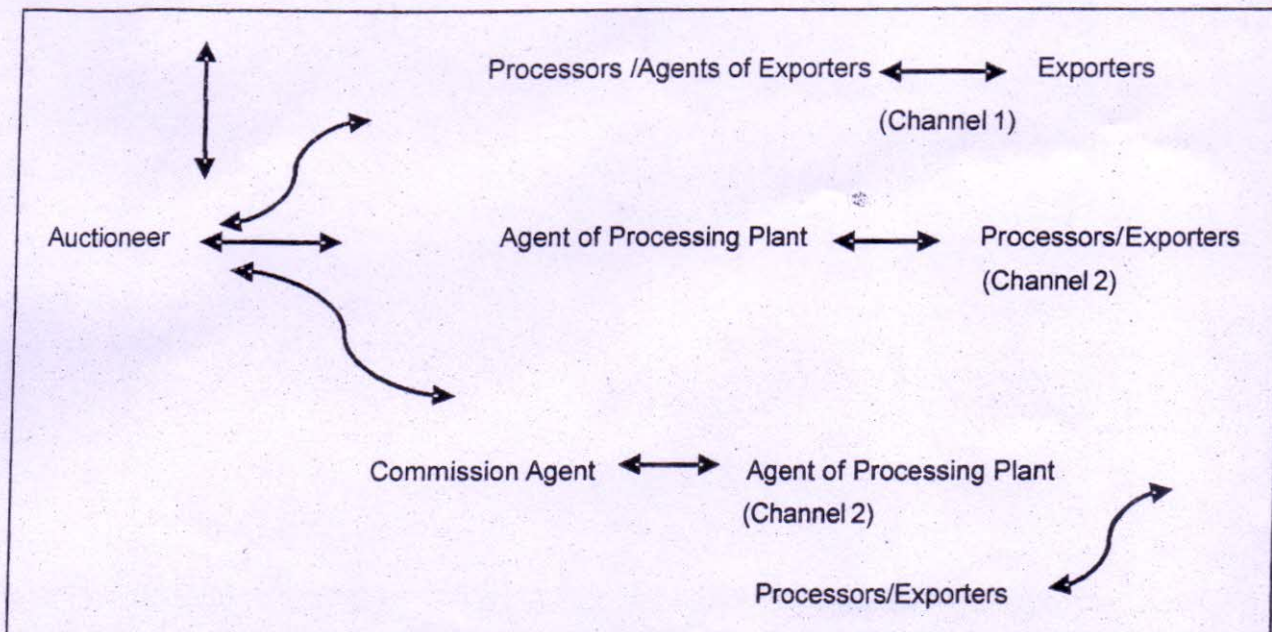


Figure 2. Fisherman

Intermediaries in the supply chain of seafood industry have a dominant role in marine fish marketing (Kulkarni, 2005). The main supply chain intermediaries between fishermen and exporters are auctioneers, commission agents, agents of processing plant and agents of exporters.

4.2 Main functions of supply chain actors

Auctioneers: Marine fish products are sold through auctioning in majority of the coastal landing centres in Kerala. These auctioneers work on commission basis and about 1 to 6 per cent of the catch value is charged as commission from the fishermen. The commission per cent age may vary according to the grading and nature of the fishery products. Auctioneers provide financial assistance to fishermen for their day-to-day operations which automatically create dependency syndrome within the

fishermen. This may be one of the reasons why fishermen are not able to come out from the vicious circle of poverty. The idea pinpointed by Ragner Nurkse's balanced growth theory states that 'A country is poor because it is poor' can be rightly used as 'fishermen are poor because they are poor'.

Commission Agents: The commission agent purchase raw material through auctions or directly from the fishermen. They receive commission from agents of the processors, agents of exporters or wholesalers. They get around 6 per cent of the purchased value as commission from the concerned agents. They work as money lenders and also assist the fishermen in procuring diesel, ice and spare parts. They arrange for packing and transfer of the fishery product to the concerned centres. The commission

agent purchases the fish at 10 to 15 per cent less than the auction price.

Agent of Processors/ Exporters: They receive fish from the commission agents or from auction. Their commission varies between Rs 2 to 3 per kg. They sort fish in grades as per the quality standards requirement of the exporters/processors. They transfer fish to their processing or pre-processing units and negotiate price with the processor/exporters.

Exporter: The exporter or the manufacturer receives fish and fishery products as raw materials from the agents. Quality control technologist of the concerned processing unit test the raw material through sampling method process using the Hazard Analysis and Critical Control Point procedures and ensure the quality of the raw materials. If the test result is positive, they accept the raw material and go ahead with other processing activities. The company performs the export procedures to dispatch the raw material and negotiate the price directly with importers or indirectly through importers agent and this negotiated price with the importer may vary with season or quality and it range between 30 and 75 per cent of the export value. The agent of importer receives around 5 per cent of the negotiated value.

4.3 Efficiency in the supply chain mechanism

Transformation of production and consumption patterns of fisheries sector will impact the long-term economic growth and contribute to the reduction in inequalities among the various fisheries clusters (Ancy and Raju, 2014). The survey observed that the marine fish marketing in Kerala rely upon various marketing channels for different types of fish and fishery products. In each channel, there exist a number of intermediaries between the fishermen and the ultimate consumer, depending upon the volume of landing, sorting, storing, grading and transportation. These factors determines the cost of marketing, which finally decides the price spread or Gross Marketing Margin(GMM), Per cent age Share of Fishermen in Consumer Rupee (PSFCR) and Per cent age share of Marketing Margin in Consumer Rupee (PMMCR).

The GMM or price spread is the difference between the price received by the producer and the price paid by the consumer for any given commodity at any point of time in a market. Price spread is significant in the marine fish export marketing due to freezing cost, additional processing and value addition measures involved. The PSFCR is an important indicator of the marketing efficiency.

It indicates the per cent age share received by the fishermen. The higher the share fishermen receive, the more efficient is the supply chain system due to lesser involvement of the intermediaries. The PMMCR is another important indicator of the efficiency of supply chain system. It indicates the proportion of consumer's rupee that meets the cost of marketing, profit margins by the traders and other expenses involved in the marketing channel by the intermediaries. A high marketing margin indicates more number of intermediaries involved in the system and points out less efficient supply chain mechanism.

An efficient supply chain mechanism occurs when the primary producer get maximum benefit, incurring minimum marketing cost (Sathiadhas et al. 2012). The efficiency of the marketing can be calculated by the following equation:

1. The GMM

$$GMM = RP - LP$$

2. The PSFCR

$$PSFCR = LP/RP \times 100$$

3. The PMMCR

$$PMMCR = (RP - LP)/RP \times 100$$

Where *RP* is the retail price

LP is the landing centre price

The observed data of price spread, PSFCR, PMMCR of shrimp, cephalopods and fish are shown in the Table. 4.

Table 4: Price Spread of Different Species of Marine Fish in Kerala (1Kg/Unit)

Type	LP Rs/Kg	RP Rs/Kg	GMM	PSFCR	PMMCR
Shrimp	375	625	250	60	40
Cephalopods	130	225	95	57	42
Fish	65	175	110	37	63

Source: Survey data.

Shrimp price spread is greater than other varieties of fishery products and at the same time PSFCR share is greater in shrimp as its demand is high in the importing countries. Fish products have higher PMMCR and it shows that huge margin is taken by intermediaries and indicates less efficiency in the supply chain system.

Price spread varies with grades of fish products and due to the higher processing and transportation cost incurred by the intermediaries. Price spread is an important indicator of the efficiency of marketing system. The marine fish pricing mechanism entirely depended upon the cartels formed by intermediaries and traders. Higher price spread indicates that more number of intermediaries are involved in the supply chain and it also revealed a less efficient supply chain mechanism. Kerala has comparatively better supply chain system than other states. The supply of fish is highly inelastic in nature and this may lead to a price hike in future.

5. Conclusion

Fish and fishery product exports can be an engine of economic growth in India and Kerala. An efficient supply chain mechanism is essential for minimizing the manipulation by intermediaries in the fish and fishery marketing channels. The food safety and quality issues related to market requirements lead to more competitiveness in the fishery trade due to lack of supply and value chain management. It is also necessary to create a proper institutional support mechanism for fishing and marketing activities as well as creation of adequate infrastructural facilities for storage and processing for improving the efficiency of trade. The main objective of both value and supply chains is to maximize their net revenue. Supply chain and value chain issues pertain to low level of mechanization, use of unscientific method of fishing, low productivity, varying quality, safety and hygiene and are affected by the structure of the seafood export processing industry.

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Money is like manure. You have to spread it around or it smells.

—J. Paul Getty