

Production, price spread and marketing efficiency of farmed shrimp in Thane District of Maharashtra

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ABSTRACT

Maharashtra is the largest producer of fish in India in terms of marine fish landings next to Kerala and Gujarat. But overall performance of Maharashtra in inland fish production is only 4% of the total inland fish production of 5 million t. Only 18% of the brackishwater area has been developed for shrimp farming in Maharashtra. This is restricted to Thane, Raigad, Ratnagiri, Sindudurg and Mumbai districts. Brackishwater aquaculture shrimp production in Maharashtra stood at 0.009 lakh million t in 2009 which was less than one percent of the total fish production in Maharashtra. The present study pertains to the Thane District in respect of government leased out, private and cooperative shrimp farms as the ultimate unit. The proportionate probability sampling technique has been used to select 69 farmers from three villages. The present study makes an attempt to study the production input-output relationships, existing marketing channels for shrimp and evaluate the price spread and marketing efficiency of different channels. The effects of variation in the consumer price of the farmer, processor, liaison agent and hyper market are also identified.

Keywords: Maharashtra, Marketing efficiency, Price spread, Shrimp, Thane

Introduction

India is the second largest producer of fish, producing 8.29 million t (2010-11) and is also the second largest in aquaculture production in the world. During 2009-10, the value of output from fisheries sector is ₹ 67,913 crore (US\$ 9 billion) and the export earnings from seafood stood at ₹ 12,901 crores by value (US\$ 2.8 billion) and 8,13,091 t by volume. The fisheries sector in India is reportedly growing at 6% annually (Bhatt, 2011). Fisheries contribute 1.07% of national GDP, 4.54% of agricultural GDP and 14% of total agricultural exports (Solanke, 2012).

Maharashtra contributes 14% of the 2.99 million t of fish produced in India. In inland fish production, Maharashtra lags behind. It produces only 4% of the total inland fish production of 5.30 million t in the country (2009-10). West Bengal (29%) and Andhra Pradesh (20%) are the leaders in inland fish production. The contribution of Maharashtra fisheries GDP to total GDP has remained constant around 0.30% to 0.37% between the years 1992-2008. The present study makes an attempt to analyse the marketing system in terms of production, marketing channels, price spread and marketing efficiency. The specific objectives of the study were to estimate the economics of shrimp culture operations in Thane District

and to identify the marketing channels of shrimps in Thane District.

Materials and methods

The present study was conducted in Thane District of Maharashtra and the population of active shrimp farms in the district was surveyed. Three villages *viz.*, Dhanau, Palghar and Thane were identified for selection of shrimp farms. Stratified random sampling was adopted for studying the shrimp production and marketing and the proportionate probability sampling technique was used to select 66 shrimp farmers from the three villages.

Field investigations were carried out from August to October 2011, which was the harvest season of shrimp in the study area. Data collection pertains to the agricultural year 2011-12. Twenty two farmers from private shrimp farms, 44 farmers from leased out farms in the three villages of Thane District were selected making the total sample size of 66 shrimp farmers. Descriptive analysis was used for the costs and returns structure as well as for deriving the input-output relationships in brackishwater shrimp farming. Functional analysis captures the input-output relationship in brackishwater aquaculture in Thane District.

Cobb-Douglas production function was fitted to the data to study the resource efficiency in the area. In spite of

some restrictive features such as constant elasticity substitution throughout input-output ranges and unitary elasticity substitution among the inputs, this function was chosen in the study since the elasticity coefficients are free from unit of measurement and factor ratio, and there is economy in the use of degrees of freedom. In addition, this function is preferred because of the computational ease and theoretical fitness to agricultural data. The specification of the function in logarithmic terms is given below:

$$Y = AX_1^{b_1} \dots \dots \dots (1)$$

$$\text{Log } Y = \log \beta_0 + \beta_1 \log S + \beta_2 \log F + \beta_3 \log E + \beta_4 \log L + \beta_5 \log W \dots \dots \dots (2)$$

where,

Y = Aggregated value of gross returns from sale of harvested shrimp at the farm gate.

S = expenditure on seed

F = expenditure on feed

E = expenditure on energy

L = expenditure on (own) + hired labour

W = expenditure on other operating costs

W (operating cost) included value of those other items not covered by the other four variables (Solanke, 2012). This was done to conserve the degrees of freedom and get a good fit. The farm specific variables have been studied separately (Kumaran *et al.*, 1999).

The data was analysed village-wise (2 numbers) and also pooled for the district level (1 each).

Separate interview schedules were prepared to collect the required information from the market intermediaries namely the commission agent, processing cum exporter of shrimps. Particulars regarding the method of purchase, cost of marketing, commissions and price paid and received were collected from 20 traders (5 each from commission agent, processor, processing cum exporter, intermediate value addition segment, liaison agent and hyper market)

Shepherd's (1965) formula and Acharya and Agarwal's (2001) formula were used along with the composite index method to assess the marketing efficiency of the various marketing channels. The marketing efficiency is measured with the help of the following formula given by Shepherd:

$$ME = V/I - 1 \dots \dots \dots (3)$$

where,

ME = Index of marketing efficiency

V = Value of shrimp sold or consumer price

I = Total marketing cost

In the present study, only the consumer price and marketing cost per kg of shrimp are taken into account to estimate the marketing efficiency of the various channels. The marketing efficiency is measured by using the following formula given by Acharya and Agarwal (2001).

$$E = (O/I) \times 100 \dots \dots \dots (4)$$

where,

E = Marketing efficiency

O = Output of marketing system (value added, that is, difference between consumer's price and producer's price)

I = Input used in the marketing process (marketing cost)

Price spread analysis works out the share of different market intermediaries in the consumer rupee and would often facilitate to understand the relative efficiency of alternative channels of marketing. Price spread is measured by using concurrent margin method where margin was derived as the difference between the price paid by the ultimate consumer and the price received by the shrimp farmer.

Results and discussion

The general characteristics of shrimp farms in Thane District is given in Table 1. Of the total area, 15-56% of the total available land was under shrimp farming in Thane District. The lands under shrimp farming were primarily waste lands and non-arable lands. Pond size ranged from 0.3 to 1.2 ha. Forty eight percent of the farms were owner operated in Palghar and only 17% and 23% were leased in Dhanua and Vasai villages respectively. In Dhanua, 83% 51% in Palghar and 76% in Vasai respectively were leased. Water levels in ponds ranged from 1 m depth in the dry season to 1.25-1.45 m in the wet season. Farmers resided at a distance of 6-15 km from the farms.

The shrimp farming practices in the villages under study in Thane District is shown in Table 2. Brackishwater species *Penaeus monodon* was the main species for culture. Ninety six percent of the farmers in Dhanua and 73% ,and 100% in Palghar and Vasai villages respectively used monoculture of shrimp. Size at stocking ranged from PL 15-20. Post-larvae were purchased from Andhra Pradesh hatcheries and cost was approximately ₹300- 400 per thousand depending upon demand. Culture period ranged from 120-150 days for *P. monodon* and was 90 days for *Litopenaeus vannamei* culture. Size at harvest ranged around 30 counts per kg.

Table 1. General characteristics of shrimp farms in selected villages of Thane District

Items	Dhanua	Palghar	Vasai
Crop land (%)			
Shrimp farms (%)	29.48	55.93	14.59
Size of shrimp pond (ha)	0.7- 1.2	0.8 – 1	0.3- 0.8
Shrimp farm by tenure (%)			
Owned (%)	16-67	48.38	23.08
Leased (%)	83.33	51.62	76.92
Water depth (m)			
Dry season (low)	1	1	1
Wet season (high)	1.25	1.45	1.30
Distance of shrimp farm from residences (km)	8-9	10-15	6-7

Table 2. Shrimp farming practices in the selected villages of Thane District

Items	Dhanua	Palghar	Vasai
Types of culture (%)			
Monoculture (shrimp)	96.14	73.33	100
<i>L. vannamei</i>	3.86	26.67	-
Size of shrimp stocking (PL)	15-18	18-20	15-20
Culture duration (days)	120-150	120-150	120-150
<i>L. vannamei</i> (days)	90	90	90

Table 3 indicates that 1 -13% of the farms in Thane District were marginal holdings of less than 1 ha, 1- 16% of the farms were in the small size category of 1-2 ha while 61- 98% were medium farms in Thane District. Ten percent of farms were in large size group. The small farms were owned by beneficiaries of the land pattas given to the SC/ST for shrimp farming. The medium range farms were owner operated while the large farms were farmed by private companies.

Table 3. Shrimp farms by size of land holdings in the selected villages of Thane District (%)

Items	Dhanua	Palghar	Vasai
< 1 ha	0.83	12.90	
1-2 ha	0.83	16.12	15.38
2-5 ha	98.34	61.29	84.62
>5 ha		9.90	

Table 4 gives the details of shrimp farms in Thane District by size of land holdings. About 17-48% of the farms were owner operated in Thane District. Owing to the lucrative nature of the crop and also because of the necessity of close supervision to prevent poaching and to enable good management, shrimp farming is attractive enough for owners to operate the farms themselves. The average output per hectare ranged from 1600-1800 kg in the three villages selected for the study. Besides, more than the quantity, the

size of the shrimp at the time of harvest determines the revenue generated. The table only gives the variable range of the output. Farms have been reported to be producing more than 1.5 t ha⁻¹ on regular basis under close supervision and management.

Table 4. Shrimp farms by the type of land holdings (ha) in selected villages of Thane District

Items	Dhanua	Palghar	Vasai
Share of farms owned (%)	16.67	48.38	32.08
Share of land leased (%)	83.33	48.38	76.92
Share of co-operative land (%)	—	3.24	—

The range of returns from shrimp farming in terms of the size of the shrimp at the time of the harvest is given in Table 5. In Thane District, the farm harvest price of 30 counts a kilogram shrimp ranged from 340-350 per kg. The price of 40 counts a kg was less ranging from 260-270. The price of 20 counts a kg was highest ranging from 420-430 a kg.

Table 5. Farm harvest price of shrimp by size in the selected villages of Thane District (kg⁻¹)

Counts (per kg)	Dhanua	Palghar	Vasai
30	340	350	340
40	260	270	260
20	420	430	420

Table 6 gives the estimated production function for three types of farming situations. In Thane District of Maharashtra, the three different types of farming situations are private farms (n = 22) leased out farms (n = 44) and pooled data (n = 66). The function has given a good fit to the data. Based on the R² value, the overall fit is acceptable and hence the functional form described the response of dependant variables (gross income) to the changes in independent variable by 84%, 94% and 91% respectively in the three farming situations as listed above across the three villages of Palghar, Dhanua and Vasai in Thane District.

Feed has emerged as the most significant variable among the independent variables in the functional fit for large private farms indicating that the use of quality feed is a significant variable in the process of production of shrimp. It may be noted that feed remained significant at 1% level in the pooled data series. Among private shrimp farms, with one rupee increase in outlay for feed, the output increases by 0.47% and in case of pooled data, it increases by 0.73%. This indicated the important role played by quality feed in shrimp production.

As far as the leased out farms are concerned, energy use efficiency has emerged as significant at 5% level. Therefore the high R² obtained in the functional fit of the data across the three scenarios of farming systems indicated

Table 6. Estimated production function for shrimp farming in Thane District of Maharashtra

Significant variables	Constant	Seed	Feed	Energy	Labour	Operating cost	R ²	F
Private shrimp farms	5.5159** (4.2693)	0.1342* (2.662)	0.4668** (4.884)	-0.02535 (-0.2902)	-0.0177 (-0.3075)	0.0928 (0.9554)	0.8498	18.11**
Leased out Government shrimp farms	2.3749* (3.6479)	-0.01957 (-0.3615)	0.6330 (5.0859)	0.2090* (0.1263)	0.0163 (0.7944)	0.1292 (0.0598)	0.9400	119.17**
Pooled shrimp farms	2.7876* (5.9710)	-0.00331 (0.9302)	0.73389** (4.0993)	0.0909 (0.1739)	-0.0153 (0.7210)	0.0848 (0.0177)	0.9192	136.65**

*Significant at 5% level **significant at 1% level. Figures in brackets are 't' values

that there is good synergy of input-output relationship in shrimp farming across three villages of Thane District.

Marketable surplus is defined as the estimated quantity marketed by the farmer after providing some percentage of the total output for various items of retention. But in the case of shrimp, the marketable surplus is practically the entire output *i.e.*, harvested at the end of the crop season. This is basically because shrimp being a high value product which is not an item of consumption by the farmer himself, there is only minimal percentage of output that is not sold outright at the time of harvest. Therefore only negligible quantity could be taken as the portion retained and does not form the bulk of marketable surplus, which was less than one per cent of the total farm output in all the three villages.

Marketing channels

The marketing channels are combinations of agencies through which the seller who is often, though not necessarily a manufacturer, markets his product to the ultimate consumer. Acharya and Agrwal (2001) defined market channel as distributor that is involved in direct and indirect transfer of title to product as it moves from producer to consumer or processing industries. In the present study, marketing channels refers to the collection of agencies and movements associated with the exchange of shrimp from shrimp farmer to the ultimate consumer.

The farmed shrimps in Thane District are sold through various intermediaries namely commission agent, processing cum exporter liaison agent and hyper market. The marketing channels identified are:

- Channel I : Farmer-commission agent-processor-exporter-liaison agent (in importing country)-hyper markets-consumer
- Channel II : Farmer-processing cum exporter-liaison agent-hyper market-consumer
- Channel III : Farmer-processing cum exporter-intermediate value addition segment (foreign country)-liaison agent-hyper market-consumer

Price spread and marketing efficiency

Price spread is the difference between the actual price received by farmer/producers, the price paid by the consumers, cost incurred and margins earned by the various market intermediaries in the marketing of shrimps. The net price received by the farmers, total marketing costs and margins were analysed (Table 7) to evaluate the marketing efficiency of different marketing channels.

The marketing costs incurred by the different segments of the marketing channel I were: shrimp farmer (2.93%), commission agent (1.04%), processor (0.74%), intermediate value addition segment (20.74%), liaison agent (2.09%) and hyper market (1.30). The marketing agents and margins were commission agent (0.74%), processor (1.04%), intermediate value addition segment (3.3%), liaison agent (7.92%) and hyper market (8.42%) respectively.

The percentages of marketing cost of consumer's price in channel II were: shrimp farmer (3.29%), intermediate value segment (15.37%), liaison agent (2.09%) and hyper market (1.38%) respectively. The marketing margins to consumer's price are intermediate value addition segment (61.44%), liaison agent (21%) and hyper market (5%) respectively.

In channel III, the percentage of marketing cost to consumers price were for farmer (2%), processor (0.50%), processor cum exporter (7.33%), intermediate value addition segment (16.02%), liaison agent (10.08%) and hyper market (2.97%) respectively, while percentage of marketing margin were to processor (0.75%), processing cum exporter (5.22%), intermediate value addition segment (6.46%), liaison agent (8.64%) and hyper market (2.02%) respectively.

In the analysis above, channel II which is the shortest yields the maximum share of the consumer rupee to the farmer. As much as 62% of the consumer rupee is obtained by the farmer which makes it the most economically viable channel.

Table 7. Marketing costs and marketing margins of farmed shrimp in Thane District (per kg)

Net price received / Marketing costs / Marketing margins	Channels					
	I		II		III	
	Amount (₹)	% within each segment	Amount (₹)	% within each segment	Amount (₹)	% within each segment
Shrimp farmer						
I) Net price received	323	56.07	361	62.67	304	38.00
II) Marketing cost	17	2.93	19	3.29	16	2.0
III) Gross price received or paid by the commission agent	340				320	
Commission agent/collection agent						
I) Marketing cost	6	1.04				
II) Marketing margin	4	0.74				
III) Price received or paid by the processor	350					
Processor						
I) Marketing cost	4	0.74			4	0.50
II) Marketing margin	6	1.04			6	0.75
III) Price received or paid by the processing cum exporter	360		380		330	
Processing cum Exporter						
I) Marketing cost					58.23	7.33
II) Marketing margin					41.77	5.22
III) Price received or paid by intermediate value addition segment					430	
Intermediate value addition segment						
I) Marketing cost	120.67	20.94	88.56	15.37	128.25	16.02
II) Marketing margin	59.33	10.30	61.44	10.69s	51.75	6.46
III) Price received or paid by the liaison agent	540		530		610	
Liaison agent						
I) Marketing cost	12.08	2.09	12	2.09	80.65	10.08
II) Marketing margin	7.92	1.37	21	3.65	69.35	8.64
III) Price received or paid by the hypermarket	560		563		760	
Hypermarket						
I) Marketing cost	7.58	1.30	8	1.38	23.78	2.97
II) Marketing margin	8.42	1.42	5	0.87	16.22	2.02
III) Price received or paid by the consumer	576	100.00	576	100.00	800	100.00

Price spread of farmed shrimp in Thane District

The results of price spread of shrimp in Table 8 reveals that the net price received by the farmer was a maximum in channel II which is 361 per kg compared to 323 and 304 per kg in channel I and channel II respectively. The net price received by the farmer in the consumers price is 56.07% , 62.67% and 38.00% in channels I, II and III respectively.

Table 8. Price spread of farmed shrimp in Thane District (₹ per kg)

Particulars	Marketing channels		
	I	II	III
Producer net price	323	361	304
Marketing margin	85.67	87.44	185.09
Marketing cost	167.33	127.56	238.91
Consumers price	576	576	800
Price spread	253	215	496

Price spread analysis shows producers price, marketing margins, marketing cost and consumer price in the three marketing channels. The higher price spread means higher marketing cost and margins obtained by the intermediaries and *vice versa*. Since the standard size at harvest across three villages, Palghar, Vasai and Dhanua was 30 count kg⁻¹, the price paid at the farm gate for the assessment of the price spread is taken as ₹ 340 per kg and the final price paid by the consumer in the importing country was on an average ₹ 576. This range is being taken as a bench mark to determine the price spread (marketing cost and margins) across the three channels.

It may be noted that in the case of channel III, owing to value addition (breaded shrimp/battered shrimp) the price range lies between ₹ 340 per kg for the fresh farmed shrimp to ₹ 800 per kg of value added shrimp products paid by the final consumer in the destination country on an average. Therefore in this channel price spread is ₹ 540 per kg (₹ 800-340)

Table 9 gives the marketing costs and margins of farmed shrimp in Thane District. In channel I, the gross price received by the shrimp farmer was ₹ 340 and subtracting the marketing (harvesting) cost that includes additional labour engaged for harvesting and other minor items such as provision of nets for harvesting placed in the sluice gates. Marketing (harvesting cost) also includes fuel charges for operating the pump sets for draining of the water. This worked out to ₹ 17 per kg of shrimp harvested in channel I in Thane District. Therefore, effectively, the shrimp farmer received a net price of ₹ 323 kg of shrimp harvested.

The price paid by the processor to the commission agent in channel I worked out to ₹ 350 per kg of shrimp. Therefore the marketing cost was ₹ 6 per kg and marketing margin in this segment was ₹ 4 per kg. It can also be observed that 56% of consumer rupee is obtained by the farmer and balance 44% is shared between the various other intermediaries in channel I like the processor, exporter, liaison agent and the hyper market (Sarada *et al.*, 2006).

In the channel II, it may be noted that 63% of the consumer price is obtained by the farmer. It may also be noted that in channel II, owing to the absence of commission agent, the processor cum exporter who procures the farmed

shrimp directly from the farmer, pays as much as ₹ 380 per kg. Therefore between channel I and II, the gross increase in the price obtained by the farmer in channel II is as much as ₹ 38. Therefore it may be seen that as the number of intermediaries in the marketing channels reduces, the proportion of share of the farmer in the consumer rupee increases.

In channel III, it can be observed that despite the fact that the final price paid by the consumer for the value added product is as much as 2.65 times the price received by the farmer, in absolute terms the net price received by the farmer in channel III is the lowest when compared to other two channels.

In channel III, the process of value addition happens in intermediate country and the final value added product is sold in the third country which is the destination market. This indicates that value addition does not necessarily mean a higher share of consumer rupee for the farmer. It also indicates that value addition in shrimp could mean generation of additional avenues for employment and income thereby contributing to growth in the industry and overall contribution of the aquaculture/fisheries sector to agricultural GDP.

In channel I, the price spread is as much as ₹ 253, in channel II ₹ 215 and channel III ₹ 496 per kg. There is direct relationship in terms of proportions attributed to marketing margins and marketing cost with price spread. It means that as the price spread increases the proportion of marketing margin and cost decreases. Marketing margins and cost are highest in channel III which involves value addition to the primary product (Jebakumar, 1979).

Marketing efficiency

Marketing is said to be efficient, if the total marketing margin is reduced for a given marketing cost. In other words, among the marketing margins of the different channels, that with the lowest value would reveal a channel to be efficient. In the present study, marketing efficiency was examined for the three different channels for shrimp farmers of Thane District (Table 9).

The marketing cost, marketing margins (Table 8) and efficiency indices (Table 9) for the three different channels were estimated. It can be observed that the marketing

Table 9. Marketing efficiency index of farmed shrimp in Thane District (kg⁻¹)

Marketing channel	Marketing cost (MC) (₹)	Marketing margin (MM) (₹)	Efficiency index = 1+MM/MC
I	167.33	85.67	1.51
II	127.56	87.44	1.68
III	238.91	185.9	1.77

efficiency in channel I is better than channel II and III. The higher marketing cost in channel I than channel II has not impaired the efficiency of channel I. The relatively absolute lower marketing cost in channel II does not necessarily indicate greater efficiency. The lower absolute marketing cost in channel II may be attributed to the absence of two segments in this channel compared to channel I. Therefore, given the number of intermediaries in channel II, the marketing cost is practically higher as compared to channel I. It is clear that value addition that happens in channel III contributes a larger part of the marketing cost and marketing margin resulting in lower efficiency compared to other two channels (Karla *et al.*, 2000).

Shrimp farming is in developing stages in Maharashtra and not much of area suitable for aquaculture has been lost to shrimp diseases like it happened in other states of India like Andhra Pradesh during its first phase of development between 1992 and 2000. The marketing channels, price spread and marketing efficiency give standard indications in respect of shrimp market margins as is seen in other markets. The efficiency of the market indicated relative percentage share of the consumer rupee received by the farmer. The greater the portion that goes to the farmer, the higher is the efficiency of the market. Farmed shrimp market in India is still unorganised. Despite the fact that cooperatives have played a role in shrimp farming, the organisational structure of cooperatives have prevented it to become a great success. In Maharashtra there is a great opportunity for higher market efficiency since the sector is almost virgin. Since its initial days, if the government could promote the right supply chain models in the state like contract farming and producer companies, there are good chances for this sector in the state to make a significant impact in terms of production and market efficiency.

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