AN ECONOMIC ANALYSIS OF SHRIMP FARMING IN THE COASTAL DISTRICTS OF MAHARASHTRA

Nakul A. Sadafule[1], Shyam S. Salim[2*] and S.K. Pandey[3]

ABSTRACT

Among the different shrimp species cultured in India, Tiger shrimp, *Peneaus monodon* is the most popular and commands considerable demand all over India, including Maharashtra. In India, there exists about 1.2 million hectare of potential area suitable for shrimp farming. It has been estimated that about 1.45 lakh tonnes of shrimp were produced during the year 2006. Shrimp farming has helped to generate employment opportunities due to increase production, better transport facilities, improved processing, marketing techniques and export trade. However, the industry suffered various shocks including white spot disease, price fluctuation at international level and threat of antidumping by USA, which resulted in greater risk in production and marketing. All these issues have direct bearing on the profitability and economics of shrimp farming operations. The present study is based on economic analysis of shrimp farming in the coastal Maharashtra viz., Thane, Raigad, Ratnagiri and Sindhudurg. The data on shrimp farming was collected from a total sample size of 110 farmers, using a pretested questionnaire. The technical efficiency was estimated using 'Cobb Douglas Production Function'. The results revealed that the water spread area, stocking density per hectare, and fertilizer used were the most important factors for determining the production of shrimp in the State of Maharashtra. The cost of seed, quantity of feed, and culture period were the most pertinent factors for determining the production of shrimp in Thane District. The culture period and quantity of feed were the most important factors for determining the production of shrimp in Raigad District. Stocking density, cost of medicines and feed required were the most important factors for determining the production of shrimp in Ratnagiri and Sindhudurg Districts. The study suggests the need for the concerted efforts in developing a disease management plan and evolving a viable marketing strategy for augmenting the production and realising a higher unit value for shrimp production.

Key words: shrimp farming, economics, coastal districts, Maharashtra

I. INTRODUCTION

Fisheries play an instrumental role in the socio-economic development of the country, as it is a valuable source of livelihood for a huge section of economically backward population. Among the different fisheries enterprises, aquaculture is the fastest growing food sector in the world. Over the last few decades, aquaculture has taken off in India from a mere subsistence to a profitable commercial

[1] Secretary (Centre for Fisheries and Rural Development); Director - Ambition Group (Fish and Fisheries Business and Consultancy), Panvel, Dist. Raigad – 410 218 Maharashtra, India

[2] Senior Scientist, SEETTD, Central Marine Fisheries Research Institute (ICAR), Cochin – 682 018 Kerala, India. *Corresponding author

[3] Sr. Technical Officer, Central Institute of Fisheries Education (ICAR), Mumbai – 400 061 Maharashtra, India.

enterprise. In India, there exists about 1.2 million hectare of potential area suitable for shrimp farming, of which an area of about 1.57 lakh hectare is under actual farming. It has been estimated that about 1.45 lakh tonnes of shrimps were produced during 2010-11. The average productivity has been estimated at 660 kg/hectare per year. The cultured shrimps contribute about 50 per cent of the total shrimp exports from India. Shrimp farming provides direct employment to about 0.3 million people and ancillary units provide employment to 0.6–0.7 million people (FAO, 2010).

Maharashtra, the third largest state in the country in terms of area and population, with a coastline of 720 km and continental shelf area of over 0.11 million sq km, offers rich resources for marine fish production. Maharashtra has about 80 thousand hectare of brackish water area suitable for shrimp farming. At present, approximately 12,445 ha land is suitable for brackish water culture in Maharashtra, out of which 1,056 ha area is developed.

For the past two decades or so, development of aquaculture has been one of the most outstanding features of fisheries sector in the country including Maharashtra State. It is one of the major reasons for doubling the shrimp production not only from Maharashtra State, but also from the whole country. The coastal districts of Maharashtra viz., Greater Mumbai, Thane, Raigad, Ratnagiri, and Sindhudurg are the areas suitable for shrimp culture (State Fisheries Dept., 2010).

Problem Focus

Over-exploitation of marine fish, lower catch per unit effort and lower price realization compounds the problem of the primary stakeholders viz., the fishermen. There is a scarcity of fish to meet the ever-growing demand in the market. Shrimp is the highly demanded species in the international market, due to which it fetches a good price and foreign exchange. Therefore, shrimp farming is the best alternative to increase the fish production. In addition, utilization of vast areas, which are not suitable, can be a way to augment fish production in the state and country. Shrimp farming can be done in controlled conditions, but it has some technical and economical problems. Shrimp farmers are facing a lot of threats like white spot disease, other viral diseases, low rate for produce, high cost of production, natural disasters, flood problems, poaching of shrimps and other accessories, lack of quality seed, high price of seed, etc. Huge capital investment is required to be made in brackish water shrimp farms for construction of bunds, sluice gates and equipment; during initial years. However, the industry suffered various shocks including white spot disease, price fluctuation at international level and threat of antidumping by USA, which resulted in increased risk in production and marketing. All these issues have direct bearing on the profitability and economics of shrimp farming operations. As such, development of shrimp farming industry is at very slow pace in Maharashtra as compared to other states of India. In view of these, the present study on technical efficiency of shrimp farming in coastal

Maharashtra was undertaken with the following objectives.

Objectives of the Study:

The overall objective of the study is to analyze the status of shrimp farming in the different coastal districts of Maharashtra viz., Thane, Raigad, Ratnagiri and Sindhudurg.

However the specific objectives are to

1. estimate profitability of shrimp farming across different coastal districts
2. deduce the different problems faced by shrimp farmers
3. suggest policy guidelines for augmenting shrimp production in the state

II. DATA COLLECTION AND METHODOLOGY

The study was done in the coastal districts of Maharashtra viz. Thane, Raigad, Ratnagiri and Sindhudurg were purposively selected for the present study. These four districts play a very important role in brackish water fisheries in Maharashtra, as they are situated in the coast of Arabian Sea and have plenty of brackish water resources. The farmers were highly encouraged to undertake adoption of improved practices in shrimp farming to increase the yield of shrimp. Based on the probability proportional sampling method and taking into consideration the area under shrimp farming and shrimp production; out of the total sample of 110 respondents, 44 were allotted to Thane District, 33 were allotted to Raigad District, and 33 to Ratnagiri and Sindhudurg Districts. The sampling design of the selected respondents list is furnished in Figure 1. The study is based on primary and secondary data. Primary data was collected from the sample respondents, in the selected four study areas, by personal interview method. The personal interviews were conducted with the help of a pre-structured, comprehensive questionnaire (interview schedule), which was pre-tested with a reconnaissance study.

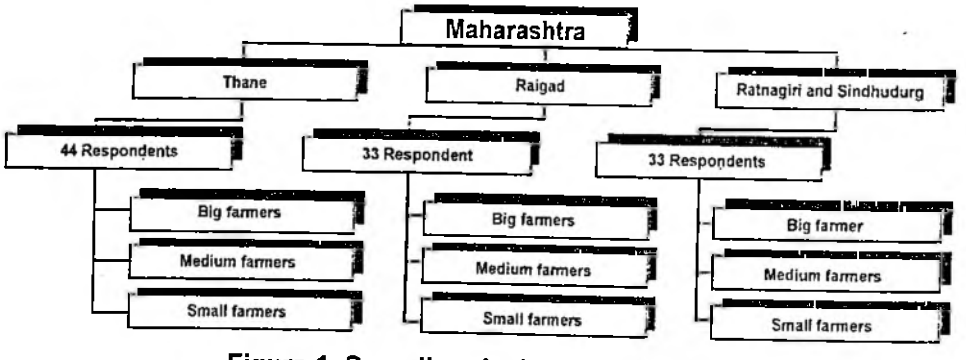

Figure 1. Sampling design of respondents

Methodology:

The study used the average and percentage analysis to present the facts in a cogent manner, to draw meaningful conclusions and to generalize the technical efficiency and marketing pattern of shrimp farming.

The Garette Ranking Technique was employed to rank the problems in production of shrimp, marketing of shrimp, disease problems and technical problems. The order of merit given by the consumers was translated into scores. For converting the scores assigned by the consumers towards a particular problem, percent position was worked out using the formulae (Garette, 1969):

Percent position = 100 (Rij - 0.5) / Nj

Where, Rij = rank given for the ith problem by the jth respondents
Nj = number of attributes

III. RESULTS AND DISCUSSION

Input-wise and operation-wise costs incurred in the coastal districts of Maharashtra

In shrimp farming, different costs are incurred, which can be categorised into input-wise and operation-wise expenditure. The input cost is the actual cost of the inputs, which are used in farming. And the operation-wise expenditure is the cost used for performing that activity.

Input-wise expenditure of the respondents in the coastal districts of Maharashtra

The results of input-wise expenditure of the respondents are given below in Table 1.

Table 1. Input-wise expenditure in the coastal districts of Maharashtra (lakh/ha/crop)

Cost	Ratnagiri	Sindhudurg	Raigad	Thane	Maharashtra
Seed	0.21	0.31	0.33	0.25	0.28
Feed	0.71	0.95	0.89	0.89	0.87
Medicine	0.02	0.08	0.08	0.08	0.08
Electricity	0.5	0.57	0.59	0.65	0.55
Fertilizer	0.01	0.04	0.05	0.05	0.05
Labour	0.14	0.16	0.14	0.2	0.17
Other	0.26	0.37	0.39	0.32	0.34
Total	**1.85**	**2.48**	**2.47**	**2.44**	**2.34**

There are different inputs required in shrimp farming viz, seed, feed, medicine, electricity, fertilizer, labour, and other inputs. These inputs are used as per their

requirements. The requirements depend on the factors like stocking density, weather conditions, management practices, feeding, location of the farm, pond construction, etc. Collected data was further analyzed for estimation of the economics of shrimp farming in sample districts. The cost of different activities in Rs./lakh is shown in the Table 5.

In Ratnagiri District, the input-wise expenditure was analyzed and it has been seen that, feed, seed and electricity were the major costs incurred. 11 per cent of the total expenditure was used for the seed. 38 per cent of the total cost, which was Rs. 71 thousand were used for feed purpose. 27 per cent that means Rs. 50 thousand were used for electricity.

In case of Sindhudurg District, seed, feed, electricity and medicine were the main costs incurred in culture. 13 per cent of the total cost was incurred for the seed purpose. 38 per cent of the total cost that means Rs. 95 thousand were incurred for feed. 3 per cent cost of the total cost was used for medicines. Rs. 57 thousand that means 23 per cent of the total cost was used for electricity purpose.

In case with Raigad District, it was found that, seed, feed and electricity were the major costs incurred in culture. The cost of seed used in culture was Rs. 33 thousand that means 13 per cent of the total cost. Feed is one of the major cost i.e. Rs. 89 thousand, it means that 36 per cent of the total cost was incurred for feed purpose.

When Thane District was analysed for the different costing incurred in culture, it was seen that, 37 per cent of the total cost of inputs was incurred for feed. So, feed was one of the major costs in farming in Thane District. 10 per cent cost for seed and 27 per cent cost for electricity was used from the total cost incurred.

In all over coastal districts of Maharashtra, it has been seen that seed, feed and electricity were the major costs incurred in the culture. The cost incurred for the seed was 12 per cent, which means Rs. 28 thousand were used for the seed purpose from the total cost in culture. 37 per cent cost of the feed was incurred for the culture from the total cost. Electricity was also one of the major costs, and it costed around 24 per cent, which meant Rs. 55 thousand were incurred on electricity in one hectare farm in coastal Maharashtra.

Operation-wise Expenditure in one ha Shrimp Farm in Sample Districts:

The operation-wise expenditure in one ha shrimp farm in sample districts were analysed and indicated in Table 2.

Table 2. Operation-wise expenditure in shrimp farming (Rs in lakhs)

Activity	Ratnagiri	Sindhudurg	Raigad	Thane	Maharashtra
Pond preparation	0.07	0.12	0.11	0.10	0.10
Stocking	0.25	0.36	0.38	0.3	0.33
WQM	0.56	0.66	0.67	0.71	0.64
Feeding	0.78	1.03	0.97	0.96	0.94
Disease control	0.02	0.08	0.08	0.08	0.08
Harvesting	0.10	0.14	0.16	0.14	0.13
Other	0.07	0.09	0.10	0.15	0.12
Total	**1.85**	**2.48**	**2.47**	**2.44**	**2.34**

Operation-wise expenditure of the farms in coastal districts of Maharashtra was analysed. There are different operations in shrimp farming and those were categorized into seven viz, disease control, stocking, water quality management, feeding, harvesting, pond preparation and other. Operation-wise expenditure includes cost of input and labour charges to do that activity. So, the description of different operation costs is described as follows.

In Ratnagiri District, it has been seen that feeding, stocking and water quality management were the major operation-wise expenditure. 30 per cent of the total operation-wise expenditure was used for the water quality management. 42 per cent of the total operation-wise expenditure was used for the feeding purpose. Stocking was also one of the major activities in Ratnagiri District. 14 per cent of the total operation-wise expenditure was incurred on culture in Ratnagiri District.

Different inputs and activities were analysed to obtain the operation-wise expenditure. From the operation-wise expenditures of Sindhudurg District, it has been seen that stocking, water quality management and feeding were the major costs incurred in the shrimp culture.15 per cent of the cost from total operation-wise expenditure was required for stocking purpose. For water quality management, 26 per cent of the total operation-wise expenditure was incurred. The major operation-wise expenditure in Sindhudurg was the feeding and it required 41 per cent of the total operation-wise expenditure.

In Raigad District, it has been reported that stocking, water quality management, feeding and harvesting were the major operation-wise expenditures. 15 per cent of the operation-wise expenditure was incurred on stocking. 28 per cent of the total operation-wise expenditure was required for the water quality management. 4 per cent was required for pond preparation and a major amount that 40 per cent of total operation-wise expenditure was incurred on

the feeding purpose.

In Thane District, it has been seen that stocking, water quality management, feeding and disease control were the major activities. 12 per cent of the total operation-wise expenditure was required for the stocking. 29 per cent of the total operation-wise expenditure was incurred on the water quality management. 40 per cent of the total operation-wise expenditure was incurred on the feeding purpose. Another major operation-wise expenditure reported in Thane District was disease control i.e. 6 per cent of the total operation-wise expenditure.

In all over Maharashtra, it has been seen that stocking, water quality management, pond preparation and feeding were the major operation-wise expenditures. 14 per cent of the total operation-wise expenditure was incurred on the stocking purpose. 27 per cent of the total operation-wise expenditure was incurred on the water quality management, 41 per cent of the total operation-wise expenditure was incurred on the feeding purpose and 4 per cent of the total operation-wise expenditure was incurred on the pond preparation.

Economics of the Shrimp Farming:

The economics of the shrimp farming per ha is illustrated in Table 3.

Table 3. Economics of shrimp farming in coastal districts of Maharashtra (per ha)

	Ratnagiri	Sindhudurg	Raigad	Thane	Maharashtra
Yield (tonnes)	1.02	1.28	1.17	1.09	1.14
Expenditure(lakh)	1.85	2.48	2.47	2.44	2.31
Profit (lakh)	0.31	0.48	0.33	0.52	0.42
Cost of Production (Rs/kg)	181.37	193.75	211.11	223.85	202.52

Four economic aspects viz. average yield in tonnes, average expenditure in Rs. lakh, average profit in Rs. lakh, and average cost of production in Rs. lakh were studied in the economics of shrimp farming in coastal Maharashtra.

The analysis of Ratnagiri District revealed that, average yield was 1.02 tonnes per hectare. The average expenditure i.e. total input cost was Rs. 1.85 lakh per ha. The average profit earned by the respondents was Rs. 31 thousand and the average cost of production was Rs. 181 per kilogram of the shrimp. The analysis of Sindhudurg District indicated that, average yield was 1.28 tonnes per hectare. The average expenditure i.e. total input cost was Rs. 2.48 lakh per ha. The average profit earned by the respondents was Rs. 48 thousand and the average cost of production was Rs. 193 per kilogram of the shrimp. The analysis of Raigad District

revealed that, average yield was 1.17 tonnes per hectare. The average expenditure i.e. total input cost was Rs. 2.47 lakh per ha. The average profit earned by the respondents was Rs. 33 thousand and the average cost of production was Rs. 211 per kilogram of the shrimp. The analysis of Thane District indicated that; average yield was 1.09 tonnes per hectare. The average expenditure i.e. total input cost was Rs. 2.44 lakh per ha. The average profit earned by the respondents was Rs. 52 thousand and the average cost of production was Rs. 223 per kilogram of the shrimp.

The analysis of total Maharashtra revealed that, average yield was 1.14 tonnes per hectare. The average expenditure i.e. total input cost was Rs. 2.31 lakh per ha. The average profit earned by the respondents was Rs. 42 thousand and the average cost of production was Rs. 202 per kilogram of the shrimp.

Garette Ranking Analysis:

In order to study the problems faced in shrimp farming, 110 respondents were interviewed using pre-structured questionnaires. The questionnaire consisted of different problems faced for shrimp farming. Respondents ranked the problems as per their perception and on the basis of the rank assigned. Garette Ranking Technique was used to analyze the problems. analysis of technical problems using Garette Ranking Technique for coastal Maharashtra is furnished in Table 4.

Table 4. Analysis of technical problems – Garette Ranking Technique: Coastal Maharashtra

Sl. No.	Problem	Ratnagiri	Sindhudurg	Raigad	Thane
1	Low Dissolved Oxygen	97.57(I)	69.36(I)	43.27(IV)	73.36(I)
2	Sedimentation	93.14(II)	62.41(III)	62.55(I)	60.61(III)
3	Plankton problems	90.29(III)	52.50(IV)	49.21(III)	50.73(IV)
4	Water shortage	81.00(IV)	63.86(II)	62.27(II)	63.09(II)
5	Seepage	71.00(V)	34.77(VI)	32.64(VI)	38.45(VI)
6	High turbidity	57.86(VI)	36.91(V)	37.61(V)	43.84(V)
7	Acidity	45.00(VII)	29.55(VII)	29.52(VII)	27.77(VII)

It is clear from the Table 4 that the major ranked problems faced by the respondents from the Ratnagiri District are low dissolved oxygen, sedimentation, water shortage, etc. Due to high stocking density and bad management practices, the chances of occurrence of such type of problems are more. The respondents cited the low ranked problems viz. seepage, high turbidity, and acidity. So, from the Table, it is clear that in Ratnagirl District, technical knowledge is not sufficient.

The major problems ranked by the 22 respondents were low dissolved oxygen. Following that, major problem was water shortage and sedimentation and such problems were due to lack of scientific knowledge and bad management practices.

Plankton problem, high turbidity, seepage and acidity were the least ranked problems by the respondents.

Sedimentation was the major problem ranked by the respondents. After that, water shortage and plankton problem were the major problems in Raigad District. Respondents cited low dissolved oxygen, high turbidity, seepage and acidity as low ranked problems. Water shortage is due to the industrial area in Raigad District and many of the times there were the chances of water pollution. Sedimentation problem was mainly because of excessive use of feed.

When the 44 sample respondents were asked to rank the technical problems, which they were facing; they ranked low dissolved oxygen as the first problem. It is due to high stocking density and bad management practices. After that, they ranked the second problem as water shortage, because there is an industrial area in vicinity. Sedimentation was also one of the major problems they ranked. Plankton problem, high turbidity, acidity, seepage were the problems which they cited as low ranked problems.

The analysis of the general by Garette Ranking Techniques is shown in Table 5. Flood problem in Ratnagiri was the dominant problem faced by the 11 respondents in Ratnagiri District. Some of the other major problems in shrimp farming in Ratnagiri area were low price for product, high input cost, high cost of water, etc.

Recently within three to four years, there was heavy rainfall in the Ratnagiri area. And mostly the farms were situated near the coasts, so at the time of high tide respondents were facing the problems of flood. As the rate of US Dollar has been decreasing, the price of shrimp also decreased. That was the reason for getting low price for their produce. As farmers were practicing high stocking density, which needs high water exchange and aeration, there were high input cost and high water cost. The respondents cited high price of feed, poaching, market information, poaching, and difficulty in getting credit as a low ranked problems. This indicates that they were technically and financially rather strong but climatic conditions were not suitable in the respective areas.

Disease problem in Sindhudurg was the dominant problem faced by the 22 respondents. Some of the other major problems of shrimp farming in Sindhudurg District were high price of feed, low price for end product, high cost of water, etc. As farmers were practicing high stoking density, they needed high water exchange and aeration. If particular requirements are not fulfilled in shrimp farming, shrimp get affected by different diseases. Feed price is increasing day by day. Processors were offering very less price for the shrimps. The respondents cited technical, high input cost, difficulty in getting credit, poaching, inadequate market information, and the last one flood as a low ranked problems. The scenario indicates that the respondents were technically not stronger, therefore they faced different problems. And flood is not a major problem here.

From Raigad, 33 sample respondents were interviewed. It is clear from the Table that majority of the respondents gave highest score for the problem of difficulty in getting credit, followed by flood as another major problem. The respondents in Raigad District felt that they are not able to get perfect market information. Respondents cited the low price of end product, high cost of water, high input cost, high price of feed, and the last one disease problem as low ranked problems. As the average size of farm is bigger in Raigad District, the respondents needed to order the inputs in huge quantity. The input companies were not able to give them credit for the products which they were taking. The region between Raigad and Ratnagiri boundaries is known as heavy rainfall area, since last three-four years; so respondents in Raigad District face the problems of floods, as in Ratnagiri. Low price for the end product is the major problem in the districts of Ratnagiri and Sindhudurg, but in Raigad District the case was not similar. Mainly, processors were located at Mumbai and Mumbai is nearer to Raigad, so the respondents had easy access to processing plants and could market their product with bargain.

Table 5. Analysis of general problems – Garette Ranking Technique: Coastal Maharashtra

Problem	Ratnagiri	Sindhudurg	Ratnagiri	Thane
Flood	82(I)	43.06(X)	63.58(II)	58.14(III)
Low price for end product	75.6(II)	79.56(III)	59.70(IV)	73.14(I)
High input cost	63.8(III)	66.88(VI)	39.55(VII)	55.41(V)
High cost of water	60.5(IV)	76.94(IV)	41.79(VI)	44.86(VI)
Disease	58.3(V)	86.31(I)	31.58(IX)	68.02(II)
High price of feed	53.5(VI)	80.88(II)	33.30(VIII)	56.43(IV)
Poaching	51.3(VII)	57.75(VIII)	28.34(X)	39.98(VII)
Inadequate market Information	36.5(VIII)	49.00(IX)	60.24(III)	27.86(X)
Technical	35.6(IX)	68.38(V)	42.67(V)	38.57(VIII)
Difficulty in getting credit	33.6(X)	66.63(VII)	74.12(I)	36.05(IX)

There were 44 sample respondents interviewed in Thane District and they ranked first problem as low price for their produce. Mumbai is the nearer market for selling their product, but because of high cost of production, the price which they were getting was not sufficient as a profit. They further ranked disease problem and flood problem. There is highly polluted water in Thane District, so, cultured shrimps were affected by it. The respondents cited the problems like high input cost, high cost of water, poaching, technical problems, and difficulty in getting credit and at last inadequate market information; as low ranked problems respectively.

The intensity of the different disease problems as perceived by respondents are given in Table 6.

Table 6. Analysis of disease problems – Garette Ranking Technique: Coastal Maharashtra.

Sl. No.	Disease Problem	Ratnagiri	Sindhudurg	Raigad	Thane
1	Viral	65.64(I)	66.91(I)	68.15(I)	69.64(I)
2	Fungal	48.36(II)	47.64(II)	45.12(III)	43.11(III)
3	Bacteria	46.55(III)	44.36(III)	56.33(II)	56.14(II)
4	Parasitic	32.36(IV)	30.09(IV)	31.12(IV)	31.36(IV)

It is clear from the Table that the respondents in the Ratnagiri District were mainly facing the problem of viral diseases. White spot disease was the major threat in all over India. Respondents also cited the fugal, bacteria, and parasitic diseases as low ranked problems because the respondents were able to control these diseases. But the viral disease could not be controlled by the respondents.

The respondents from the Ratnagiri District were facing major ranked problems like low dissolved oxygen, sedimentation, water shortage, etc. Due to high stocking density and bad management practice, the chances of occurrence of such type of problems were more. The respondents cited the low ranked problems viz. seepage, high turbidity, and acidity. So, from the Table, it is clear that in Ratnagiri District, the shrimp farmers lacked sufficient technical knowledge.

Viral disease was the dominant disease in the district of Sindhudurg. Following that, fungal disease was one of the major diseases as per the respondents' perception. The respondents cited bacterial and parasitic diseases, as low ranked problems. Amongst viral diseases, mainly white spot disease was witnessed at the respondents' shrimp farms. In Ratnagiri and Sindhudurg Districts, the respondents ranked viral disease as the major disease problem. Then bacterial, fungal and last ranked problem was the parasitic disease. Similar to the other coastal districts of Maharashtra, viral disease problem was the low ranked problem when 44 sample respondents were interviewed. As per the respondents' ranking, the problems were bacterial disease, fungal disease, and the lowest ranked disease was parasitic disease.

IV. RECOMMENDATIONS AND POLICY SUGGESTIONS

□ The area analysis indicated that there exists a minimal area under shrimp farming in Maharashtra. In order to augment production, there is a need to have

horizontal integration by ploughing in more areas; as only 2 per cent of the brackish water area is exploited.

- The hatcheries in Maharashtra are non-operational leading to high costing of seed, which basically stems from high cost of transportation and disease occurrence stock. Thus, there is an immediate need for governmental intervention in this regard.

- The feed cost accounts for 40 to 45 per cent of the total cost, as the feed is imported from South East Asian countries. There is also a need to develop low cost feed, harnessing the indigenous technical knowledge.

- Mostly, farmers are facing the problems of viral diseases like WSSV. Farmers should take initiative to prevent spread of the destructive viral diseases. Government should provide consultancy to the farmers about site selection, pond construction and better management practices, to avoid losses due to floods, etc.

- As there is huge economical loss due to diseases and other technical problems; farmers should get crop insurance.

- Government should tie-up with private extension providers to increase the efficiency of extension service. There should be regular extension programmes to increase awareness about innovative practices in fisheries.

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