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Socio-Economic Prospects and Major Constraints of Vannamei Shrimp Farming in Kerala

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ABSTRACT

Shrimp farming plays a pivotal role in the socio-economic development of the coastal population of India by way of contributing to foreign exchange earnings and livelihood options. In the current study, the culture technique and stocking density are taken into account for investigating the influence of these factors on the production performance and economic feasibility of vannamei shrimp farming in Kerala. Along with the major constraints faced by the Kerala vannamei farmers also undergoing investigation. In recent years, vannamei shrimp farming has been getting excellent responses from shrimp farmers around Kerala due to the attractive and profitable rewards of shrimp farming. Kodungalloor from Thrissur District is a key area in Vannamei shrimp farming in Kerala, more than 60 shrimp farmers are doing Vannamei shrimp farming very enthusiastically and efficiently. But Kerala State still depends on other States to cater to the processing industry which is a highly labour-intensive sector providing the major avocation to thousands of families. Continuous unfavourable weather conditions and delay in the farm registration process led to non-adoption of vannamei shrimp farming in Kerala. Though the State Government support the vannamei shrimp farmers by notifying shrimp farming as an essential activity, our study showed that additional efforts and supports are required to implement solid plans at the ground level.

Keywords: *Vannamei Shrimp Farming; Prospects; Shrimp farmers; Constraints; Kerala.*

INTRODUCTION

Aquaculture is the fastest-growing food production sector in the world, providing almost half of the global fish and shrimp which peaked at about 172.6 million tonnes in 2019, among that aquaculture contributed at 47% of the total and 53% came from capture fisheries (FAO, 2020). Shrimp farming is the face of Indian brackish water aquaculture which plays a crucial role in the socio-economic and nutritional security of the coastal communities and forms a major share in the seafood export earnings of the country. Being a lucrative profession, shrimp culture attracts many progressive farmers to venture into the commercial-scale culture.

Penaeus vannamei was the most widely cultured shrimp in the western hemisphere since long where the species contributes to about 90% of the total shrimp culture (Wurmann et al., 2004) which slowly got popularized to other parts of the world. The species was introduced in India for the first time during 2008 (CAA, 2010) and then

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onwards the production of this species surpassed the production of *P. monodon* owing to its faster growth, compatibility to higher stocking rate, less disease risk, euryhaline as well as eurythermic nature, lower dietary protein requirement and lower feed conversion ratio (FCR).

Heterotrophic Auto-recycling Aquaculture Technology (HAAT) developed in the farmers' field is an environment-friendly shrimp culture technique consisting of selectively reared SPF zooplankton (*Brachionus* spp.) and probiotic bacteria that have a huge potential to enhance yields of *P. vannamei*. Maintaining the transparency level at 25 cm for the better growth of zooplankton is a specialty of the HAAT system. The natural HAAT system was developed by the application of fermented wheat bran juice. The HAAT system has been proved to be a very efficient and cost-effective natural system. It is reported to have significantly improved the total production of shrimp in many trials. This system got emerged as a popular one among the farmers of Kerala since a few years. The present study was undertaken to evaluate the efficacy of Vannamei shrimp farming in Kerala encompassing the socio-Economic characteristics, production and economic performance and the major problems faced by the farmers towards providing valuable suggestions for further improvement.

METHODOLOGY

For the purpose of the study, the State of Kerala, India was geographically divided into three zones viz., North, Central and South. The study was confined to four Districts selected purposively to represent each of the zones. The present investigation has carried out in brackish water shrimp farms at Ernakulam, Thrissur, Kollam and Kannur Districts. More than 70 shrimp farmers were found to be actively doing Vannamei culture in Kerala. They undertake shrimp farming two crops per year continuously because of its profitability and economic sustainability.

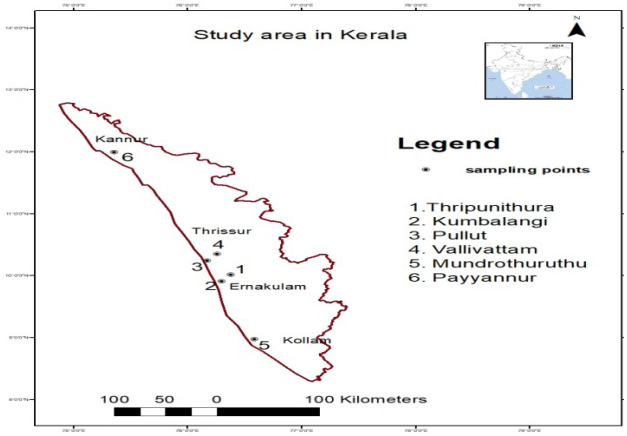

Figure 1. Location Map of Research area

A detailed survey schedule was designed based on the objective of the research and used for the collection of data from Vannamei shrimp farmers those were actively participated in shrimp farming more than five years. Among them, a total of 72 vannamei shrimp farmers selected purposively. The Vannamei shrimp farmers were contacted directly and the objectives of the study were explained to them before commencing the research study to ensure their cooperation. The present investigation was carried out in brackish water shrimp farms at Ernakulum, Thrissur, Kollam, and Kannur Districts of Kerala State (Fig. 1). The investigation had been carried out during the period from October 2018 to February 2021 and all the crops were taken in varying-sized ponds (0.40-1.011 ha) with a water depth of 1.2-1.5 m.

There are four types of farming techniques adopted by the vannamei farmers in Kerala. They are Autotrophic system, Natural HAAT system, HAAT system, Autotrophic and Heterotrophic intermittent culture system with a stocking density of 15, 25, 30, 40, 50 and 60 m-2. Farmers in Trissur District prepare the Autotrophic system using 'Naulgi'- a patented product for

diatom enhancement. The culture ponds were stocked with Pacific white shrimp (Vannamei) Post larvae (PL) that had been transported from a CAA-approved hatchery and acclimated directly into the pond environment very slowly. The application of the first dose of probiotic was made 3-4 days before stocking. After stocking, shrimps were fed with a good quality commercial pellet feed four to six times a day until the harvest. Farm management included pond preparation (drying), having an effective filtration system, adequate pond water preparation, pre-biotic media preparation, ensuring the best bio-security, providing adequate aeration, optimizing stocking density, water quality management, adequate water topping up, health management and recording the crop details.

Garrett's ranking technique was employed to find out the critical constraints faced by the Vannamei shrimp farmers in the study area. It was calculated as a percentage score and the scale value was obtained by applying the Scale Conversion Table given by Garret and Woodworth (1969).

The percentage score is calculated using the following formula:

$$\text{Percentage score} = \frac{100(R_{ij}-0.5)}{N_j}$$

Where,

Rij = Rank given for i^{th} item by j^{th} individual.

Nj = Number of items ranked by j^{th} individual.

For each constraint, the scores of individual respondents were added and divided by the total number of respondents. These mean scores for all the constraints were ranked in order to identify the critical constraints.

FINDINGS AND DISCUSSION

The Vannamei farmers in Kerala are found to be adopting the emerging technologies and innovative practices in the aquaculture value chain coupled with digital extension activities which can enhance productivity and accelerate production area thereby, ensuring their economic stability. The culture performance of vannamei shrimp farming in Kerala are given in table 1. In the present culture trial, the Vannamei farmers in Kerala maintained the better FCR values which are ranged from 0.79 to 1.60 due to the promotion of natural productivity by proper fertilization regime, quality probiotic application and efficient feed management. A farmer from Kodungaloor reported that adopting innovative culture techniques like the 'HAAT' system helped him to reduce feed utilization by 75%. Valderrama and Engle (2002) found FCR values ranging from 1.42 to 4.07 in the semi-intensive rearing of *P. vannamei*. Garza de Yta, Rouse and Avis (2004) registered FCR from 1.97 to 2.12 for *P.vannamei* cultured at densities of 10, 20 and 30 shrimp/ m^2. As it is well known, the feed cost constitutes the major share of the production cost of shrimp. Normally, the feed cost ranges from Rs. 80 to 100/ kg shrimp in all types of shrimp farming practiced in Kerala. Feed Management Cost is the cost of the feed to produce 1 kg shrimp. Feed Management Cost is comparatively very less in Trichur Districts might be due to adoption HAAT system, which promotes natural productivity through the effective utilization of zooplankton like selectively reared rotifer species.

Table 1. The Culture Performance of Vannamei Shrimp Farming in Kerala

Sl. No	Parameters	Ernakulam	Thrissur	Kannur	Kollam
1.	Area (ha)	.49-1.01	.40-1.01	.61-1.01	.81-1.01
2.	Stocking Density	15-30	30-50	40-60	30-40
3.	Initial stocking	100000-150000	250000-400000	400000-500000	250000-400000
4.	DOC	90-120	120-130	110-130	110-135
5.	Probiotics	Detrodigest	Detrodigest	PRO-B-AQUA	OptiBact
6.	FCR	1.20-1.30	.79-1.34	1.35-1.60	1.30-1.44
7.	Survival (%)	80-85	80-85	75-80	80-85
8.	Feed Management Cost (Rs.)	90-100	65-100	110-120	110-120
9.	Total production (kg)	4000-5000	6000-10000	6000-10000	6000-8000
10.	Total variable cost (Lakh)	4-7	9-12	10-15	10-12
11.	Total fixed cost (Lakh)	5-7	10-12	10-15	10-12
12.	Total cost (Lakh)	10-15	20-30	20-35	20-30
13.	Gross returns (Lakh)	20-25	35-50	40-60	35-50
14.	Net Profit (Lakh)	10-15	15-30	15-35	15-30

Shrimp feed constitutes 55 to 60% of the production cost in shrimp farming and it is one of the critical factors which determine the profitability of a crop. The Vannamei farmers in Kerala used very practical and pond specific feeding protocols and the feeding regime was arrived as per stocking density and survival of the shrimp in that particular pond. The majority of the shrimp farmers were using CP and Avanti commercial pellet feeds followed by Blanca, Grower and Vannamei plus shrimp feeds. The farmers used feed attractants and Vitamin C, adding these to the feed with the help of a binder. They were also used zeolite mixed with commercially available probiotics @ 15 Kg/ha applied once in 10-15 days depending upon the requirement. The frequency of feeding varied four to six times depending on the environmental conditions. As it is well known, the feed cost was the major share in the production cost per kg with an average of Rs 80/kg in all the categories of shrimp farmers in Kerala. The profitability of any aquaculture farm is directly related to feed management costs. Feed management cost is the cost required to produce 1 kg shrimp. The Vannamei farmers could efficiently reduce the feed management cost to the tune of Rs. 67 to 121 by the promotion of natural products through continuous and effective use of fertilization regime, good quality water and addition of soil and gut probiotics. Some farmers reported that the incorporation of garlic paste along with feed would help to increase the digestibility of shrimp. Kumar et al. (2016) reported that the feed cost was high in the total variable cost representing 38.20%. Balakrishnan et al. (2011) also reported

that feed cost was the major share in the production cost representing 50.39% and the net profit was 78.56/kg of shrimp. Between the Vannamei farmers in Kerala, the HAAT system is an effective culture technique that promotes natural productivity through the effective utilization of zooplankton like selectively reared rotifer species has been proved to be a very efficient and cost-effective natural system, which would help the farmers to reduce the feed management cost-efficiently. Several farms here have upgraded their facilities adding shrimp toilets, better aeration and blowers. Farmers in Kerala have maintaining low density after 60 days of culture and adopt controlled feeding to avoid white faeces problem.

Water quality management has been considered as the most significant component that determines the profitability of pond aquaculture, but in recent years, the management of pond bottom has received less attention. There is increasing evidence that the condition of pond bottom and the exchange of substances between soil and water strongly influence water quality. The Vannamei farmers in Kerala keep all the water and soil quality parameters within the favourable range required for the growth of white-legged shrimp farming due to the continuous and effective use of good quality water and soil probiotics and minerals. The findings of this study reveal that *P.vannamei* culture is successful in the brackish water environment in Kerala due to the effective farm management and technical efficiency of the farmer acquired by experience attained through various training programmes by KUFOS and other organizations. Effective extension tools always help to have sustainable aquaculture operations.

The Vannamei farmers in Kerala used the best quality probiotics at regular intervals and optimum dosage depending on the potency of the product. The majority of the Vannamei farmers in Kerala used probiotics named 'Detrodigest' a patented product developed by CUSAT followed by 'OptiBact', a unique blend of optimal aquaculture strain probiotics and 'PRO-B-AQUA', a TATA product of multistrain probiotics for soil and water. The regular and optimum use of these quality probiotics would help them to maintain optimum water and soil quality parameters improve beneficial phytoplankton quantity and also help to maintain a good nitrogen cycle in shrimp ponds.

Socio-Economic indicators like occupation, education, and technical skill are shown very crucial roles in enhancing production and productivity. The Socio-Economic characteristics are shown in Table 2. The age of the farmers plays a critical role in being enthusiastic and their technical Expertise enhances the production performance of Kerala vannamei shrimp farming. Around 61% of farmers were between 30-50 years of age with well- experienced and improved technical knowledge in shrimp farming activities. (51%). Most of the farmers from Ernakulam (50%) Trichur. Kannur and Kollam with a percentage of 66.67 have an educational background of High School. One farmer from Kodungallor, Thrissur Districts is a well expert and knowledgeable person who made a registered society for vannamei farmers in his District and also gave advice to vannamei shrimp farmers in all Districts. Most of the farmers from the study area gained technical knowledge from their own experience through participation in various seminars, workshops, and training conducted by various fisheries Institutions (51.25%). Through participating in such training and workshops, the farmers acquired knowledge of farming protocols and effective feed management.

Table 2. Socio-Economic Characteristics of Vannamei Shrimp Farmers in Kerala

Sl. No	Process	Indicators	Ernakulam (%)	Trichur (%)	Kannur (%)	Kollam (%)	Mean Value
1.	Age	20-30	33.33	8.33	0.00	33.33	18.75
		31-50	33.33	80.00	66.67	66.67	61.68
		50-60	33.33	11.67	33.33	0.00	19.58
2.	Occupation	Only shrimp farming	33.33	50	33.33	66.67	45.83
		Other aquaculture activities	33.33	33.33	66.67	33.33	41.67
		Employed in other firms	16.67	11.67	0.00	0.00	7.09
		Other business	16.67	5	0.00	0.00	5.42
3.	Education	Primary School (class 1-5)	0.00	5	0.00	0.00	1.25
		Secondary School (6-9)	16.67	18.33	0.00	0.00	8.75
		High School (class 10-12)	50	66.67	66.67	66.67	62.50
		Graduate	33.33	10	33.33	33.33	27.50
4.	Technical skill obtained	Own experience	0.00	3.33	0.00	0.00	0.83
		Govt. Workshops	16.67	8.33	33.33	33.33	22.92
		Own experience & workshops	66.67	38.33	66.67	33.33	51.25
		Shared information from others	16.67	50	0.00	33.33	25.00
6.	Annual income from the shrimp sale	Rs. 100000- 500000	16.67	3.33	0.00	0.00	5.00
		Rs.500001- 1000000	33.33	43.33	33.33	66.67	44.17
		Rs.1000001- 2000000	33.33	33.33	33.33	33.33	33.33
		Rs.2000001- 5000000	16.67	16.67	33.33	0.00	16.67
		? Rs. 5000000	0.00	3.33	0.00	0.00	.83

Major Problems faced by Vannamei Farmers

Though there are a large number of enthusiastic and technical efficient shrimp farmers who have been doing Vannamei culture very progressively in the State, the farmers were facing a number of constraints during their culture period. The various constraints experienced by the selected Vannamei shrimp farmer respondents are detailed in Table 3.

Table 3. Major Constraints faced by the Kerala Vannamei Shrimp Farmers

Sl. No	Constraints	Garret Score	Garret Mean Score	Rank
1	High production cost	81	74.1	I
2	Despite unfavourable weather conditions	70	69.19	II
3	Delay in farm registration license processing.	63	67.9	III
4	Market issues & slumping prices	58	56.13	IV
5	Lack of adequate support from the Govt.Sector	52	54.37	V
6	Inadequate awareness of new production technologies	48	46.64	VI
7	Lack of Credit facilities & Insurance	42	42.31	VII
8	Emerging diseases	37	37.99	VIII
9	Poor Coordination among the farmers	29	25.36	IX
10	Inadequate consultation & meeting with Govt. Officials	18	22.51	X

The most important and severe constraint reported by the Vannamei shrimp farmers in Kerala was the highest production cost with a Garret Mean Score of 74.7. It is a big challenge faced by them because all kinds of inputs for shrimp farming are comparatively more expensive in Kerala. This might be due to the fact that the State is still depending on the supply of seed, feed and other healthcare products to other States. Also, due to climate change there are frequent cyclones leading to irregularities in rainfall and resulting in bad weather conditions like floods and raised or overflowed water levels. These cause huge damages and panic harvesting which leads to the huge losses to the shrimp farmers and this is the next major constraint reported by the farmers. The delay in getting the licence for the Vannamei shrimp farming was another critical constraint with Garret Mean Scores of 67.9. Fast completion of the CAA licensing formalities may help the farmers significantly to start the operation quicker. This would encourage and support them to do start shrimp farming and engage more efficiently and dedicatedly to the business which will help to attract more younger and technically efficient farmers to Vannamei culture and thereby, increasing the productivity and area under cultivation.

Similarly, the market issues, slumping prices (56.13) and lack of adequate support from the Govt. Sector (54.37) were observed as the other major constraints. Inadequate awareness of new production technologies and lack of credit facilities and Insurance were reported as the other constraints with a Garret Mean Score of 46.64 and 42.31 respectively. Some of the farmers from Thrissur and Ernakulam Districts have adopted the new technology like the HAAT system which was proved to be a very effective. Hence, the Fisheries Universities and other Aquaculture related Institutions conduct research experiments on the efficacies of these new technologies. The emerging disease outbreak

was considered as the 8th major constraint by Kerala farmers while Srinivas and Venkatrayalu (2016) reported that the disease outbreak is the main constraint in the Vannamei shrimp farmers from Godavari District of Andhra Pradesh. In the present study, the Vannamei farmers in Kerala adopted strict biosecurity protocols given by CAA and also each biosecurity step and tools were redesigned, implemented, audited on a regular basis and maintained after each crop to keep the disease at bay. Poor coordination among the farmers (25.36) and inadequate consultation and meeting with Govt. Officials (22.51) were the least constraints reported by the Vannamei shrimp farmers from Kerala.

CONCLUSION

In recent years, Vannamei farmers in Kerala managed to register a substantial increase in farm production of shrimp. The production efficiency and productivity in most farms increased substantially during this period. Even though the vannamei shrimp farmers faced lot of constraints in shrimp farming. The most important and severe constraint reported by the Vannamei shrimp farmers in Kerala was the highest production cost. This might be due to the fact that the State is still depending on the supply of seed, feed and other healthcare products to other States. The continuous bad weather conditions caused huge damages and panic harvesting led to lose in vannamei shrimp farming. The delay in getting the farm registration licence is also another critical constraint. Fast completion of the CAA licensing formalities would help the farmers to doing the shrimp farming more efficiently. The Socio-Economic variables such as age and technical skills obtained from various Govt. workshops and the shared information from the experienced farmers and the other technical experts helped more young enthusiastic farmers entered into the Kerala vannamei shrimp farming. In the Investigation study, the maximum production, productivity and better Feed Management Cost were observed from Trichur Districts where the farmers adopting a newly developed HAAT system may have the potential to address all of these concerns and should be investigated more thoroughly by conducting research culture trials in this line. As supplementary feed plays a major role in the operational cost of Vannamei shrimp farming, efforts have to be made by the State Govt. to establish the feed production plants and provide the feed at a subsidized rate to the shrimp farmers. Production credit should be made available to the farmers by the financial institutions as well as by the State Government with subsidies which would encourage them to do Vannamei culture more efficiently.

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