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The impact of the first wave of COVID-19 on the production indices pertaining to Vannamei shrimp farming in Kerala, India

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Abstract

Since the outbreak of the Coronavirus influenza in the world, we have seen an unprecedented situation that has put the entire world on red alert to prevent its further spread. The countries have been going through different phases of lockdown and the entire mankind is going through a challenging situation that affects our regular lives. In the aquaculture sector, the sales, value addition, export and movement of goods are seen badly affected. This paper presents a case study of the impact of the first wave of the pandemic on shrimp farming in Kerala pertaining to selected Vannamei shrimp farms. Present-day shrimp culture is a culmination of continuous up-gradation in farming practices and protocols over the years. In recent years, Vannamei farming has received an excellent response from the farmers due to the availability of high-quality SPF seed, amenability of the species to high stocking density and achievability of high production rates. Scarcity of seed, feed, and the availability of labour force has adversely affected Vannamei farming in the State. In contrast, some farmers have reported that this adverse situation was favouring their business due to the increased demand in the domestic market especially for lower counts like 60-100. No apparent variation on shrimp growth and survival reported in Kerala during this period, the increased feed cost and seed transportation cost coupled with difficulty in accessing service has led to decreased profitability from shrimp farming. Though the central and state governments support the farmers by notifying aquaculture as an essential activity our study shows that additional efforts are required to implement solid plans at the ground level.

Keywords: COVID pandemic, vannamei farming, cost of production, farm gate price, market demand

1. Introduction

The outbreak of Coronavirus disease 2019 (COVID-19) first reported from Wuhan, China ^[1] in December 2019 has been declared as a Public Health Emergency of International Concern (PHEIC) and the virus has spread to almost all the countries ^[2]. On March 25th, India initiated a strict 21-day lockdown, later extended until May 3rd and May 17th. During the nationwide lockdown, the schools, colleges, public transport and businesses remained closed and there were also major restrictions on public gatherings, intercity and interstate travel and bans on all transportation and logistics services except for the movement of essential goods and services. The primary estimates shows that the shrimp farmers in Kerala have suffered a loss of Rs 308 crore due to the COVID-induced lockdown. Shrimp aquaculture is a vibrant agri-business sector in India with a production of 0.7 Million Tonnes (MT), most of which (90%) is exported to the United States of America (USA), South East Asia, European Union (EU), China and Japan earning a substantial amount of foreign exchange to the tune of 5 billion USD ^[3].

White-legged shrimp (*Penaeus vannamei* Boone, 1931), also known as Pacific white shrimp, is a native of the eastern Pacific Ocean, commonly caught from the wild or farmed for food. In India, the Ministry of Agriculture permitted the commercial culture of *P.vannamei* in 2009 and since then the culture of this species has spread all over India^[4]. Vannamei farming has already received an admirable response from the farmers due to the availability of high-quality SPF seed, amenability of the species to high stocking density and achievability of high production rates.

In the backdrop of COVID-19 pandemic, the present study has been undertaken to evaluate the effect of this pandemic and pandemic induced lockdown on the shrimp growth, production

cost, farm gate price, and market demand from the selected vannamei shrimp farmers in Kerala and also check the options to overcome this verse situation.

2. Materials and methods

2.1 Study area

The present survey has been carried out in brackish water

vannamei shrimp farms at Ernakulum, Thrissur, Kollam and Kannur districts of Kerala, India. Three crop cycles of varying stocking densities (SD), areas and crop durations were undertaken during the period from September 2019 to February 2021 and all the crops were taken in varying sized ponds (0.40-2.011 ha) with a water depth of 1.2- 1.5 m.

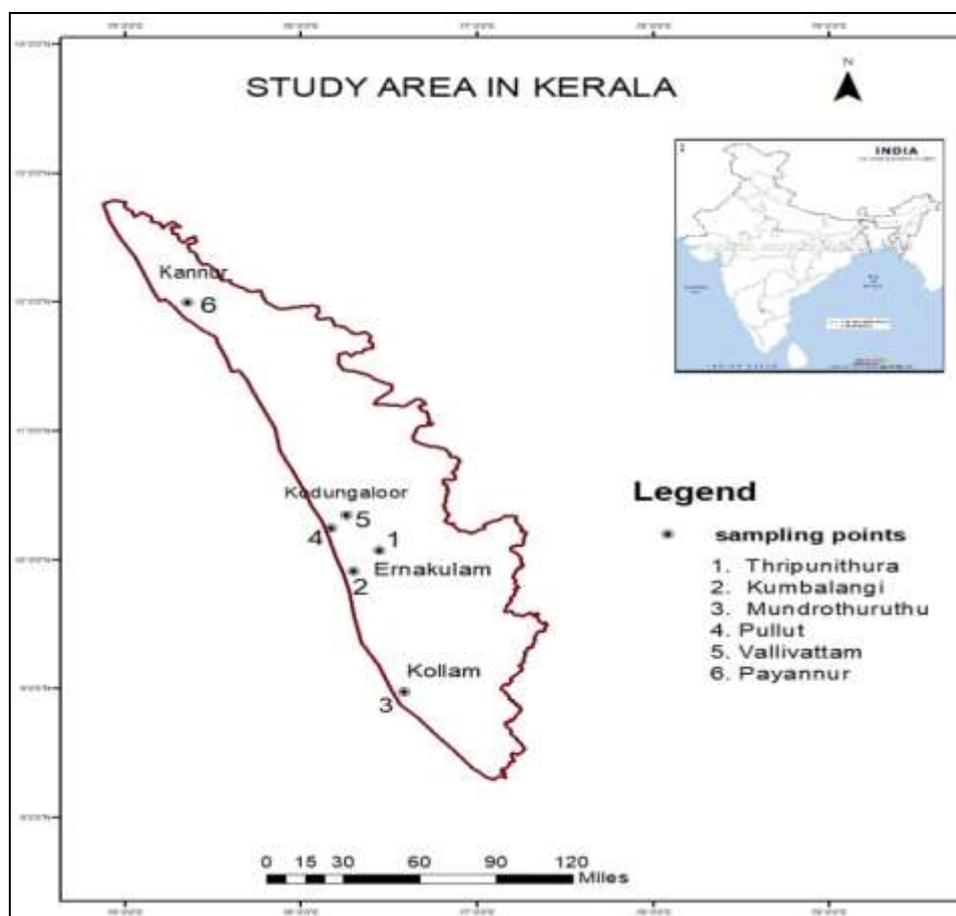


Fig 1: Location map of research area

2.2 Data collection

Since the country was in complete lockdown, an online survey was carried out as it is one of the efficient data collection methods to obtain data in a short time frame as done in previous studies [5, 6]. This study based on the field survey where primary data were collected from 70 vannamei shrimp farmers who were involved in shrimp farming for more than five years. The mode of data collection includes interviewing respondents and accessing the records kept by the respondents. A questionnaire was developed for key information (KI) interviews. All information and data gathered from the field were combined and summarized.

2.3. Garrett ranking analysis

Garrett's ranking technique was employed to find out the critical constraints faced by the Vannamei shrimp farmers in Kerala. It was calculated as percentage score and the scale value was obtained by applying Scale Conversion Table [7]. The percentage score is calculated using the following formula:

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

Where,

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

N_j = 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 means cores for all the constraints were ranked in order to identify the critical constraints.

3. Results and Discussion

The COVID-19 pandemic has negatively affected shrimp farming activities in the Indian state of Kerala, incurring losses for farmers, disrupting production, forcing “panic harvesting,” and creating job losses in the sector in this region. According to recent estimates [8], the nationwide lockdown would result in a sharp rise in the cost of shrimp seeds by 15-30% due to a reduction in hatchery seed production by 40%, fall in the market price of shrimp by 30%, fall in shrimp export performance by 30% and loss of employment in shrimp culture sector by 30-40% during the current season.

3.1 Impact on Vannamei shrimp farming

Table 1: Impact of COVID-19 lockdown on Vannamei shrimp farming in Kerala (n=70).

Sl. No	Impact on vannamei shrimp farming	Garret Mean Score	Rank
1.	Non-availability of pond preparation equipments	28.21	9
2.	Difficulty in transportation to the farm	57.63	5
3.	Non-availability of seed	72.79	1
4.	Non-supply of feed & healthcare products	44.7	6
5.	Labour force shortage	63.29	3
6.	Diagnostic labs	41.97	7
7.	Reduction in shrimp farming area	38.31	8
8.	Increase transportation cost of feed & seed	69.13	2
9.	Drop in shrimp export market	60.86	4
10.	Water quality monitoring kits& supplements	21.91	10

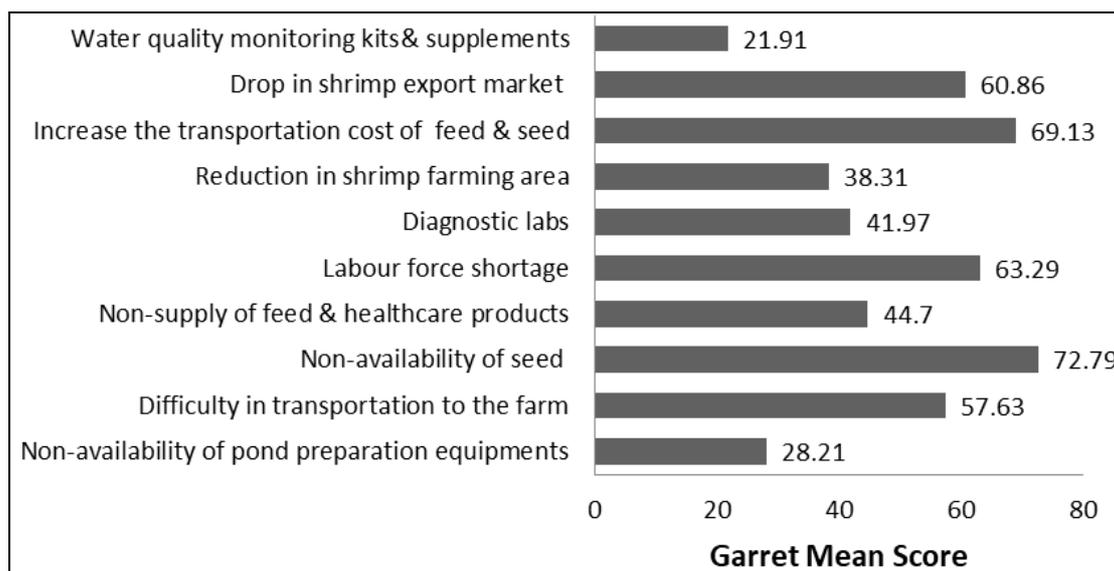


Fig 2: Impact of COVID-19 lockdown on Vannamei shrimp farming in Kerala (n= 70)

The constraints experienced by the Vannamei shrimp farmers during the lockdown are detailed in Table 1 and Figure 2. Non-availability of seed for stocking and increased transportation cost of feed and seed were reported as severe constraints with Garret Mean Scores of 72.79 and 69.13 respectively. Similarly, Labour force shortage (63.29) and Drop-in shrimp export market (60.86) were observed as the other major constraints. [9] Schmidhuber *et al.* reported that labour availability for agricultural supply chains has become a near-ubiquitous problem, such deficits were caused by domestic labour supply disruptions, as well as by shortage of seasonal and migrant workers. The availability of migrant labourers was one of the major constraints due to the nationwide lockdown. [10] Bennet *et al.* reported such a similar scenario that farmers experienced as ‘twin disaster’, which was characterized by reduced demand and attendant collapse of price during the pandemic.

Screening of water and soil samples at weekly intervals is a vital prerequisite to manage the optimum water quality parameters and this has a direct bearing on the health of the farmed shrimp. The least constraint (21.91) reported was the availability of water quality monitoring kits and supplements. The majority of the vannamei farmers had prepared their ponds for the summer crop and were waiting for seed stocking. Hence Non-availability of pond preparation equipment and a significant reduction in the farming area was also reported as the least constraint with Garret Mean Scores of 28.21 and 38.31 respectively. About 27% of farmers who had prepared their ponds for stocking did not do so because of

the difficulty in obtaining quality seed, uncertainty over continuous supply of other inputs and the unpredictable market conditions. About 25% of the farms were in Phase-I with less than 30 days of culture (DOC), 34% were in phase-II with 30 to 80 DOC, and about 14% were in the category above 80 DOC (Phase-III). The DOC reflected the financial impact on the farmer, wherein farmers in phase I and II may not, realize their investment, while those in phase III, could make breakeven or get small profits albeit with production risks and increased expenditure as highlighted by the FAO [11].

In the freshwater aquaculture sector, it is evident that unsold produce results in increased live fish stocks and therefore, increased costs of feeding as well as the risk of mortalities. The culture duration has increased due to delayed harvesting in the lockdown period. This will increase the input cost of biomass maintenance, lower water productivity and increase water footprint [12, 13]. The longer the duration of the culture, the higher is the water exchange, evaporation and seepage losses [14, 15], which in turn will increase the water use [16, 17] and decrease the water use efficiency [12]. Low yield due to minimal/less fishing efforts in the capture fisheries sector and late stocking in various aquaculture systems will lead to a lower market supply of aqua-food products. This will have a knock-on effect that in turn will increase the market price and make the produce less affordable for consumers. On the other hand, small-scale aquaculture may benefit from the reduced competition with fish imports [18].

3.2 Economic concept

The COVID-19 pandemic has drastically impacted every aspect of the economy in Kerala, including aquaculture. The entire aquaculture supply chain and marketing system are facing multiple challenges. Many vannamei shrimp farmers have reduced their activities due to low demand and uncertainty in the export market. Many farmers are reluctant to invest in aquaculture in these challenging times while a few of the technically advanced and enterprising vannamei farmers in Kerala have successfully continued with their shrimp production and trading activities. They sold their all harvested shrimp in the domestic market with the help of traders by providing proper sanitizing facilities in their farms and maintaining basic preventive procedures adhering to the government-issued COVID-19 protocols. The vannamei farmers in Kerala understand that the adoption of emerging technologies and innovative practices in aquaculture value chains coupled with digital extension activities can enhance productivity and accelerate growth even in challenging times.

3.3 Shrimp growth and Survival

As per the available data and our observations, there was no apparent variation in shrimp growth and survival reported in Kerala during the COVID pandemic. But during the COVID-19 pandemic period farmers gave much more importance to lower counts like 50-100 due to the dependence of the domestic market for sale. The majority of the farmers reported that the average harvest size of shrimp was 40-44 counts with lower culture durations like 100-110 days due to the uncertainty in the export market. According to a survey conducted by India's ^[8] Central Institute of Brackishwater Aquaculture (CIBA), farmers in Kerala have chosen to carry out "panic harvesting" of small-sized shrimp to sell at lower prices. The vannamei farmers under investigation reported that the survival rates during the first wave of COVID-19 period ranged from 70-75% which was normally above 80% during the pre-COVID period.

3.4 Production cost

The Vannamei farming in Kerala was getting majorly affected during the COVID-19 pandemic period due to the restrictions on inter-state transportation for a long period which in turn impacted the movement of seed, feed and farmed produce, resulting in a tangible increase in the overall production cost. In spite of wide acceptance for vannamei farming in the state, Kerala is still dependent on the neighbouring states like Andhra-Pradesh and Tamil Nadu for seed, feed and other major inputs. A farmer from Kodungallore reported that he had incurred a loss of Rs.57, 000 due to mortality of post-larvae during the transportation in the lockdown period. Scarcity of seed, feed and the availability of labour force for which Kerala depends majorly on the immigrant labour force, were a few of the major reasons for the decrease of vannamei farming in the State. Many immigrant labourers working permanently in Aquaculture farms were unable to travel to their native places and is said to be living in terrible conditions. Workers who travelled to their home states when the lockdown was announced, and are now unable to return to work due to continued restrictions on movement. This also increased the production cost to the farmer in terms of labour and input costs. During this abrupt lockdown, farmers' were also reluctant to stock their farms due to low profitability outlooks and a shortage of workforce.

3.5 Shrimp farming area

The farm area is a significant determinant of fish productivity as it provides living space for shrimps. In the present study, during the COVID period, it was found that most of the vannamei shrimp farmers had increased their farming area to 0.60- 2.011 for increasing the production to compensate for increased production cost. Farmers are also exploring options to modify their practices increasing the size of the ponds and increasing the stocking density and upgrading technologies by establishing nurseries and providing additional aeration in ponds through air blowers. Seed reared in shrimp nurseries are proven to exhibit notable compensatory growth in grow-out farms, thereby supporting in reducing the culture duration by 30-40 days and help the farmer in raking profits. The above mentioned survey conducted by ^[8] CIBA, also found that the State has lost around 30% of its shrimp-farming area due to logistic issues, hikes in feed cost and the unavailability of other farming inputs.

3.6 The number of crops per year

It was observed that during the COVID-19 pandemic period about 40% of the vannamei shrimp farmers have successfully done two crops/ year and opted for the summer and winter crops which were harvested out completely. Our interactions show that majority of the vannamei farmers in Kerala are find it extremely challenging to pursue shrimp farming due to the unavailability of seed, feed and other farming inputs on time. ^[8] CIBA further reported that about 50% of farmers in the State have abandoned the farming activities due to the obstacles in the purchase of high-quality seed and potential risks in production and market access.

3.7 Stocking density

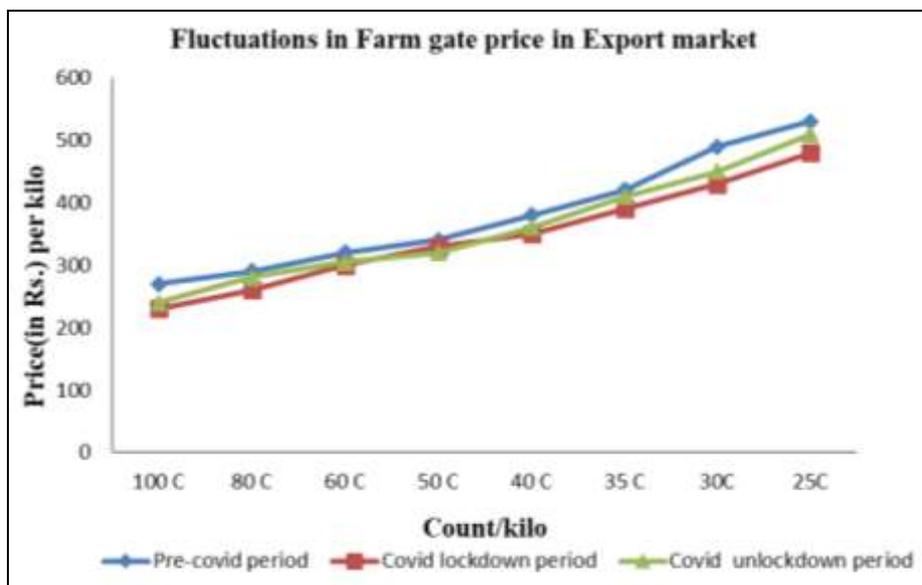
Vannamei shrimp Farmers in Kerala are planning to keep a lesser stocking density of 30-40 nos. /m² and target to produce smaller-sized shrimps during the COVID-19 pandemic period due to local marketed demand. Some of the progressive and technically efficient farmers have done vannamei farming with two large crops by opting for higher densities and targeting smaller sizes in 100 days and continued their culture up to 120-130 days for bigger sizes like 25 counts.

3.8 Seed stocking

The seed stocking for the first crop at the onset of the COVID period was delayed in several areas of Kerala. An increase in the price of shrimp feed and seed transportation and the reluctance of feed dealers to extend credit along with the fears that the novel corona virus epidemic in China could adversely impact shrimp prices have dampened the enthusiasm among the farmers ahead of the season. Due to strict travel restrictions, seed stocking is likely to commence only in the month of April.

3.9 Farm gate price

Farm gate prices for different counts in the Export market are given in Figure 3. With the Corona virus outbreak in China affecting the import of stocks, there was a major impact on the shrimp prices in the COVID-19 pandemic period. Prices for all counts decreased by about Rs.20-30/kg during this COVID period and rise marginally in the month of December 2020 due to reduced farm productivity as the stocking has been very slow and 30-40% lesser than the previous crop. Even today the export markets are to flourish to bring the farm gate price to the pre- COVID times.



Where C denotes count/kg

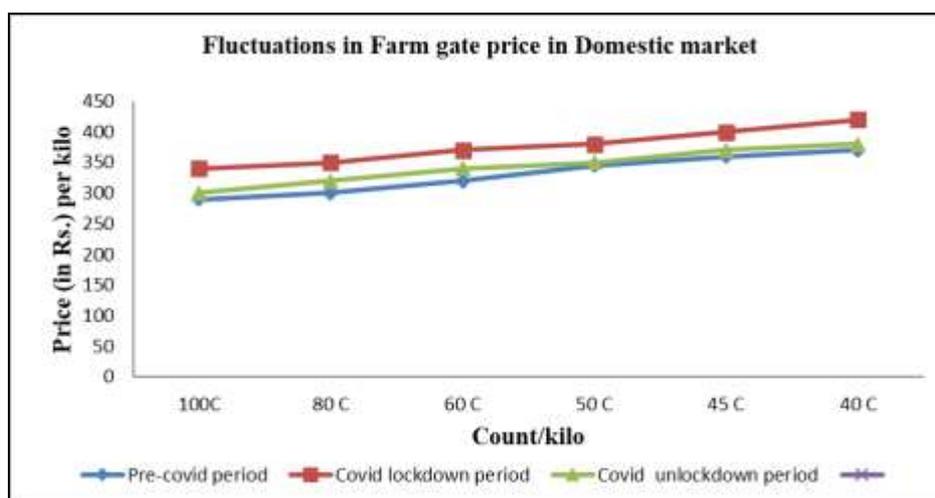
Fig 3: Price fluctuations of farm gate price of Vannamei shrimp in the export market during the period from September 2019 to February 2021.

International exports were also severely affected. Frozen shrimp, which makes up to 70% of India’s seafood export earnings, have seen a sharp slump in demand from the United States and Europe following the lockdowns in those geographies. To make matters worse, when China opened for imports again in March, a shortage of workers in processing plants made it impossible to process the shrimps. The cycle of shrimp hatchery operations was also observed to be disrupted. The import of vannamei shrimp broodstock from the United States has been halted, delaying the breeding cycle, which can impact the shrimp production by a 20-30% fall.

4. Domestic market

The farmer from the Kollam districts reported a lack of

labour, transportation, or ice to preserve the catch. Curfews leading to hundreds of boat being prevented from landing catch due to harbour closures, in turn, proved beneficial to the shrimp farmers as it helped to increase the local market demand for vannamei shrimp. Some farmers reported that this adverse situation has favoured them due to increased demand in the domestic market especially for lower counts like 60-100 which gave some enthusiasm to the farmers. The domestic market for vannamei shrimp farming is well developed during the COVID pandemic period. So, there is a changed trend in using this situation to develop domestic markets for shrimp, especially of small size groups. Price fluctuations for different counts in the Domestic market were given in Figure 4.



Where C denotes count/kilo

Fig 4: Price fluctuations of farm gate price of Vannamei shrimp in the Domestic market during the period from September 2019 to February 2021.

5. Conclusion

The higher lease amount and increased cost of production forced the farmers to go for a lower stocking density at a minimum of 30-40 nos. /m². Presently, one of the major worries of farmers in Kerala is the sudden reduction in farm gate price of shrimp by Rs.20-30 for all the counts and this situation could be overcome by stocking nursery reared seeds

on this occasion to take advantage of faster growth rate which facilitates in achieving the break-even point faster. There is an imminent need for a reduction in culture duration by upgrading technology and improving efficiency in shrimp farming to make it more attractive and profitable to farmers. The state urgently needs to develop hatcheries for the production of vannamei seeds and adopt nursery rearing

facilities in the state to avoid the dependency on the neighbouring states and also increasing productivity while reducing the production cost to benefit the vannamei farmers in Kerala.

6. Acknowledgement

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