Recent Farming Practices for Culturing Sustainable Pacific White Shrimp, *Peneaus Vannamei*

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Abstract: ***Marine shrimp farming is an age-old practice in many Asian countries. The cultured shrimp have maximum unique importance due to its taste, high nutritive value and demand in the world market. The present study deals with the culturing of Pacific white shrimp, Peneaus vannamei. The salinity of the culture pond ranged between 25 - 35 ppt and the pH ranges between 7.5 - 9.0. The maximum temperature ranged between 20 - 30°C and the transparency was about 30 - 40cm. The minimum dissolved oxygen of 3.5 ppm and maximum of 4.0 ppm were recorded during the culture period. The culture was done for a period of 170 days and the average body weight of the harvested shrimp ranges from 20 - 25 g. The total product rate was about 865 Kg and the survival rate ranges from 80 - 85%. So it may be confirmed that 20/m^2 is an ideal stocking density for the culturing of P. vannamei. To get a better profit, proper water quality management and feed management are essential.***

Keywords: *Peneaus vannamei*, salinity, pH, temperature and water quality management.

1. Introduction

Food is of utmost importance in culturing of any organism and thus induces *Penaeids*. In order to properly feed the organism and be able to plan efficient, low cost diets are necessary to know the nutrients requirements of the species. It also includes vitamins, protein, fat, lipid, carbohydrates and minerals.

About 25% of shrimp were sold on the world market are raised on shrimp farms (Boyd *et al.*, 1998). Shrimp farms operated with good management and business practices can be profitable and benefit the local economy by creating jobs in production, processing, marketing, feed manufacture, transportation and related support services. In common with most human endeavours, shrimp aquaculture requires resources and has an effect on the environment and local communities in which it is conducted. As with any young and rapidly growing industry, a wide range of mistakes have been made and negative environment and social impacts have occurred.

Shrimp are highly nutritive valuable commodity among the edible crustaceans (Lemos *et al.*, 2004). It demands both the domestic as well as export over exploitation of this resource throughout the World during 1988-1992. Shrimp product of world has been stagnating of about 2.5 million tonnes per year, with an average of about 3.7 lakhs tonnes (17%) is contributed from the Indian Ocean. Poor water quality leads to deteriorate water, which causes stress to the organisms being raised. Efficient feed conversion, growth and marketability of the final product cannot occur unless the pond system is balanced. Therefore the overriding concern of the fish culturist is to maintain, „balance‟ or „equilibrium conditions‟ with respect to water quality and its natural consequence is good water quality. There is no serious problems with water quality during the initial stages of farming, were the stocked animals are small and their metabolism rate and amounts of supplementary feed are low. In India, aquaculture industry is growing at an alarming rate surprising some major hurdles (disease outbreak and pollution) during its development (Lightner & Redman 1998). The higher stocking density and poor water quality management might be the reason for disease outbreak. To overcome these problems there is a need of good and sustainable shrimp farming unit. The present study deals with shrimp farming practice in a pond at Kalainanapuram village, Thoothukudi District, Tamil Nadu, India.

2. Materials and Methods

2.1 Description of the study area

This study was carried out in Vaippar at latitude 9°01'40.8"N and longitude 78°16'14.6"E and the pond is located at Kalainanapuram village (near sea shore), Thoothukudi District, Tamil Nadu, India (Figure 1, 2 & 3).

Figure 1: Map of Study area

Figure 2 & 3: Description of the pond

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2.2 Pond Preparation

The pond was initially subjected to dry and crack to increase the capacity of oxidation of hydrogen sulphide gas and eliminate fish eggs, predators, crab larvae and some other aquatic living. The bottom of the pond was scrapped using tractor blade up to 5 - 10 cm depth to avoid topsoil. Subsequently the pond bottom was ploughed vertically and horizontally of a depth of 30 - 50 cm to remove the obnoxious gases, oxygenate the bottom soil, dis coloration of the black soil to remove the hydrogen sulphide odour and to increase the fertility of the soil (Shailender *et al.*, 2012).

The soil pH was recorded in the pond with the help of cone type pH meter. The average pH was noted and calculated around the pond and required amount of pond lime was applied to maintain the optimum pH in the soil.

Initially the water level in the pond was maintained at 50 - 70 cm level for blooming and was fertilized with fertilizers. Commonly used fertilizers were ground nut oil cake, rice bran, dry cow dung and they were soaked in water overnight and the extract was applied to the culture pond.

After three days the water colour of the pond turned to light green colour it shows blooms were adapted (Phytoplanktons). The water level was raised up to 150 cm high of the pond and some quantity of molasses and urea were added to improve the phytoplankton growth (Table 1). After the optimal algal blooms were set in the pond by using organic fertilizer, and the transparency was checked by using "Secchi disk" which ranged from 30 - 50 cm depth. These parameters were checked and maintained before seed stocking in the pond.

Table 1: Amount of fertilizer applied / used during culture period

Fertilizer	Dosage (litre/hectare)
Cow dung	100
Molasses	50

2.3 Seeds Stocking Parameters and Seed Quality

The healthy *P. vannamei* seeds were purchased from CP Aqua Hatchery, Chennai. The seeds were stocked at the density of 15 - 20/m^2. Before stocking the seeds, it was checked for its quality and quantity. The quality was checked by adding formalin (1000 ml of water and 1ml of formalin) to 100 seeds, allowed for 10 - 20 min and further rotated gently. The healthy seeds will move faster than the unhealthy seeds. The quality was checked by counting one bag seeds.

The seeds were acclimated to the pond environmental condition before stocking. The seed bags were allowed to float on the surface of the water in the pond for 30 min in order to adjust the temperature. The bags were opened and the pond water was slowly sprinkled over the bags for 30-60 min. Subsequently, the bags were dragged to four corner of the pond and the seeds were allowed to release slowly by inverting the bags inside the water (Figure 4 & 5). During the culture period lime and fertilizers were added / applied for maintaining the algal blooms and pH (Table 2).

Table 2: Types of lime applied during the culture period in the pond

Types of lime	*Chemical formula*	*Dosage (Kg/hect are)*
Calcium carbonate	$CaClO_3$ (Agricultural lime)	150-200
Pond lime	-	350-400
Diammonium phosphate (DAP)	$(NH_4)_2HPO_4$	6.0

Figure 4 & 5: Post larval seeds stocking

2.4 Aeration

The aeration was provided after the seed stocked in a week. The aerators were installed at four corners of the pond. The aerators were allowed to run during oxygen depletion times.

2.5 Water quality

Waste generated by aquaculture was (faeces and unconsumed feed) first settle in the bottom, as a consequence of organic waste and metabolites of degraded organic matter are accumulated in sediment and water. Part of the waste was flushed out of the ponds immediately or later after the organic matter has been degraded. The water quality parameters have to be followed during culturing period.

Table 3: Water quality parameters

Parameters of water quality	*Optimum level*
Dissolved Oxygen	3.5-4 ppm
Salinity	25-35 ppt
Water Temperature	25-30 (°C)
pH	6.8-8.7
Total nitrite nitrogen	1.0 ppm
Total ammonia (less than)	1.0 ppm
Biological Oxygen Demand (BOD)	10 ppm
Chemical Oxygen Demand (COD)	70 ppm
Transparency	35 cm
Carbon dioxide (less than)	10 ppm
Sulphide (less than)	0.003 ppm

2.6 Feeding Schedule

The feeding schedule was calculated based on the feed chart given by the company. Blind feeding was given for the first 20 days of stocking. Later the feeding ratio was calculated based on the feed intake by the animal. For feed intake and its health condition, check trays were monitored daily (Figure 6). Four check trays were installed in the pond. The feed % and the feeding ratio time was divided into 4 interval a day as 25%, 20%, 25% and 20%, at morning (6:30 am), forenoon (10:30 am), afternoon (2:30 pm) and evening (6:30 pm) respectively. The feed was altered or changed regarding

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the size of the animal (feed sizes ranges from No. 1, No. 2, No. 3, No. 4, No. 5 and No. 6). The feeding method was broadcasted by using rope method (Figure 7). Feed contains 40% crude protein, 10% crude lipid, 7.5% moisture (max.), 5% fibre (max.), 3% calcium (max.), 1.45% phosphorus (min.), 4000 (UI) vitamin A, 2000 (UI) vitamin D_3, 150 (U.I.) vitamin E and 130 mg vitamin C (pellets from 0.4 to 1 mm in diameter) (Lemos *et al.*, 2004).

The water exchange in the pond was not recommended for first 40 days of seed stock. Thereafter if there was any disease outbreak or over blooms, 15 - 30 cm of water was exchanged regularly in every two weeks. Sampling was done in the pond fortnightly during early hours of the day with a cast net to check signs or symptoms of animal. Randomly the shrimps were caught by using check tray and the individual weights were recorded. The water quality parameters were monitored regularly (water pH and phytoplanktons density). The water level was monitored once in a week, of it reduces by leaking. The salinity of the water was measured by using a hand machine called hand refractometer. The pH of the water was measured by using electronic device called pH meter and also by easy pH strip method. The temperature of the water was measured by using standard centigrade thermometer. The dissolved oxygen was estimated by using dissolved oxygen meter.

2.7 Harvesting

The harvesting methods can be varied according to the farms or according to the harvesters. In this study harvesting was done using a big bag net which was fitted on the outlet canal with 20 number mesh size of width 1 meter and the length of 4 meters (Figure 8 & 9). The pond water was removed slowly by pumping out. Using the net the shrimp was caught and collected in bag and taken to the processing area for further process.


Figure 8 & 9: Finger lings of *P. vannamei*

3. Results

The site selected for this study is at Kalainanapuram village, Thoothukudi District, Tamil Nadu, India. The study deals with the culturing period, fertilizers used, salinity, pH, harvesting shrimp weight and the production cost. The pond water salinity ranged between 25 - 35 ppt during the culture period. The average pH observed during the culture period between 7.5 - 9.0. The temperature of the water ranged between 20 - 30°C during the culture period. The dissolved oxygen was recorded as a maximum of 4.0 ppm and minimum of 3.5 ppm.

The culture system was maintained with phytoplanktons for the growth of shrimp during the entire culture period. The culture period of the shrimp was about 170 days and the average body weight of the harvested shrimp ranged between 20 - 25 g. The culture pond was about 0.40 hectare in area. The seeds were stocked at the quantity of about 60,000. The production of the harvested shrimp was about 865 Kg approximately and the survival rate ranged from 80 - 85% (Table-3).

Table 4: Harvest and economic status of *P. vannamei* culture

Economic parameters	*Conventional details (0.4 hectare)*
Pond preparation (Fertilizer and lime) (₹)	5,000
Stocking density (m^2)	20
Size of the PL at stocking	PL_{15}
Initial seeds stocking (thousand)	60,000
Seeds cost (₹)	30,000
Culturing period (days)	170
Water exchange and related expenses (₹)	5,000
Chemicals and other fertilizers used (₹)	7,000
Labour and other managements cost (₹)	24,000
Harvesting and related expenses (₹)	15,000
Productivity (Kg)	865
Cost of production (per Kg) (₹)	300.00
Average body weight (grams)	20-25
Survival rate (%)	80-85
Feed intake (Kg)	2,000
Feed cost (₹)	1,20,000
Total operational cost (₹)	1,76,000.00
Profit (₹)	2,59,500.00
Net profit (₹)	83,500.00

4. Discussion

There has been considerable increase in the culture of brackish water shrimp due to its taste, market demand both in national and international markets. In order to prevent many problems faced by shrimp cultivation, sustainable shrimp farming is the need of the hour. When a pond is ready for operation, the optimum stocking density of seeds in a pond was determined in accordance with the production capacity of the pond and the culture system, which included the soil and water quality, food availability and seasonal variations, target production and farmers experience (Shailender *et al.*, 2013). The stocking density between 10-20 PLs/m^2 is ideal for successful shrimp farms (Shailender *et al.*, 2012).

In the present study the seeds were stocked at the stocking density of 20/m^2. The maintenance of good water quality is essential for optimum growth and survival of shrimps. The levels of physical, chemical and biological parameters controls the quality of pond water. The level of metabolites in pond water can have an adverse effect on the growth. Good water quality is characterized by adequate oxygen and limited level of metabolites. Excess feed, faecal matter and metabolites exert tremendous influence on the water oxygen in all the culture ponds. Hence critical water quality parameters are to be monitored carefully as adverse conditions may have disastrous effect on the growing shrimps (Shailender *et al.*, 2012). Salinity is one of the

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important parameters to control growth and survival of shrimps.

5. Conclusion

In the present study the shrimp farming is an optimum output cannot be assured even after taking risk of huge investment, besides controlling distinct quality measures, without the application of scientific method, proper water quality control and presence of modern technology. This may corrupt the total export policy system which was targeted for sustainability and long term viability of the industry.

It is essential that extensive training programme can be conducted for farmers, in order to develop confidence to practice shrimp culture for maintaining the sustainability to industry. The crop insurance facilities should be introduced for the farmers because they would not bury them under debt burden if there is a loss.

The motto should be to practice an economically and ecologically viable shrimp culture. Besides the Government should take efforts to implement a proper planning and management oriented marketing strategies for the sustainability of industry.

6. Acknowledgement

The authors are very much thankful to the farmers located at Kalainanapuram village, Thoothukudi District, Tamil Nadu, India for providing me the land facility and financial support provided by the management of DSTSERB, New Delhi (India).

References

[1] D. Lemosa, A. Navarrete Del Toro, J.H. CordovaMurueta, F. Garcia-Carreno. Testing feeds and feed ingredients for juvenile pink shrimp *Farfantepenaeus paulensis*: in vitro determination of protein digestibility and proteinase inhibition. Aquaculture 239 (2004) 307–321.
[2] D.V. Lightner, R.M. Redman. Shrimp diseases and current diagnostic methods. Aquaculture 164 (1998) 201–220.
[3] Boyd, C. E. and C. S. Tucker,. Pond Aquaculture Water Quality Management. Kluwer Academic Publishers, Boston, Massachusetts, (1998) 700 pp.
[4] Shailender M, Suresh Babu CH, Srikanth B, Kishor B, Silambarasan D, Jayagopal P. Sustainable Culture method of Giant Black Tiger Shrimp, Penaeus Monodon (Fabricius) in Andhra Pradesh, India. Journal of Agriculture and Veterinary Sciences, 1 (3), (2012), 12-16.
[5] Shailender M, Suresh Babu CH, Krishna PV, Recent Culture methods of Giant Black Tiger Shrimp, Peneaus Monodon (Fabricius) in Andhra Pradesh, South India, International Journal of Research in Fisheries and Aquaculture (2013); 3(2): 34-37.

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