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RESEARCH ARTICLE
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EXPERIMENTAL STUDY ON THE GROWTH AND SURVIVAL RATE OF CULTURED WHITE LEG SHRIMP (*LITOPENAEUS VANNAMEI*) IN DIFFERENT STOCKING DENSITIES AT ANTHARVEDI, MALKIPURAM MANDAL, EAST GODAVARI DISTRICT, AP, INDIA

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Abstract:
This study was conducted at a *Litopenaeus vannamei* culture farm in Antharvedi, Malkipuram Mandal, East Godavari district, Andhra Pradesh, India. The experiment involved four culture ponds with varying stocking densities. Protective measures were implemented to ensure the water pumped into the ponds remained uncontaminated. The pH levels were observed to range from 7.9 to 8.7 in the morning and 8.3 to 8.9 in the evening. After 120 days of pond culture, the average weights of the shrimp in Antharvedi were recorded as 25g, 20g, 26.31g, and 16.66g, while the survival rates were 90%, 60%, 50%, and 50% respectively. The feed conversion ratio (FCR) for the ponds was measured as 1.3, 1.5, 1.5, and 1.43. The average production per acre was found to be 2250kg, 1800kg, 2302kg, and 1666kg for ponds P1, P2, P3, and P4 respectively. The results indicated a significant correlation between stocking density and average body weight, with lower stocking density resulting in higher average body weight, and vice versa. The growth rate was found to be directly proportional to stocking density.

Keywords: *Litopenaeus vannamei*, Average body weight, stocking densities.

INTRODUCTION

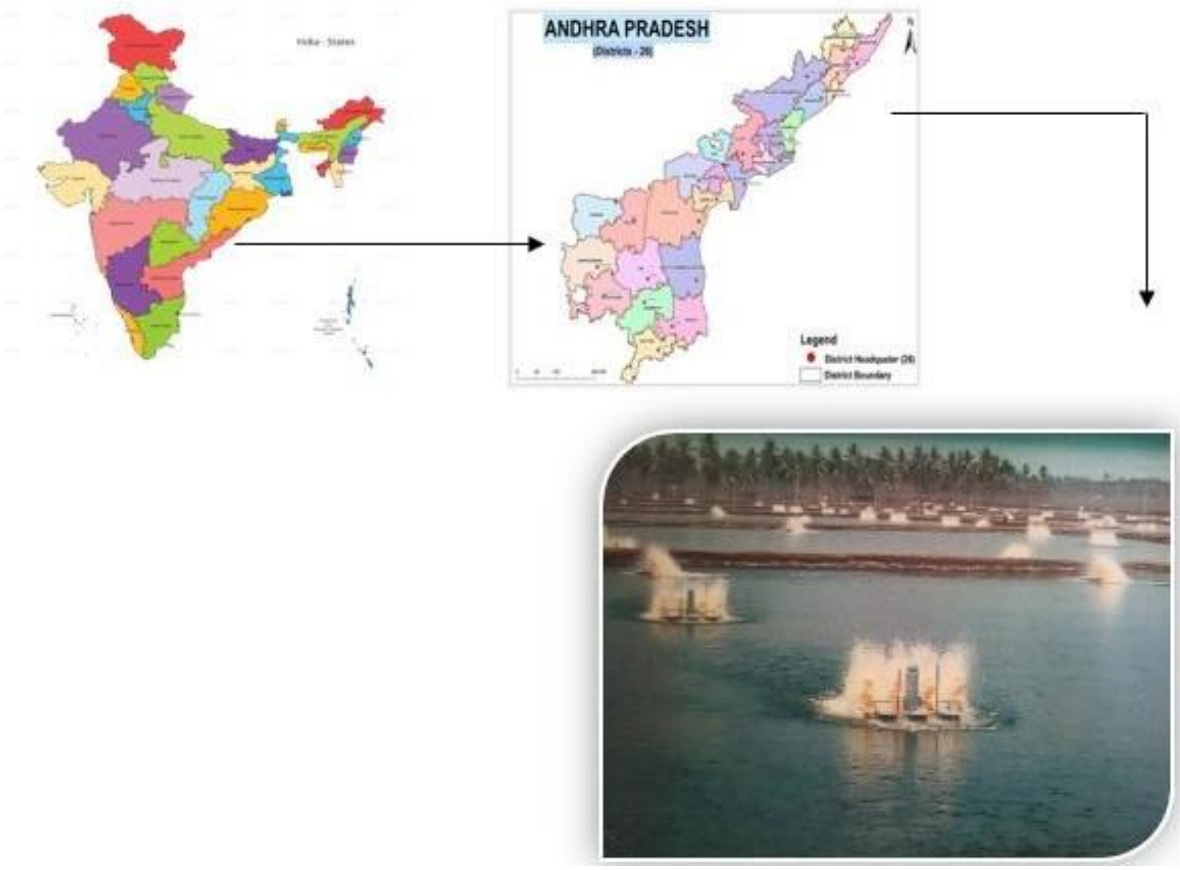
The aquaculture sector plays a vital role in the socio-economic development of a country as it contributes to economic growth, food production, employment generation, and substantial foreign exchange earnings. According to the Handbook on Fisheries Statistics 2022, published by the Ministry of Fisheries, Animal Husbandry, and Dairying, India's total inland fisheries production

increased from 24.42 lakh metric tons in 1980-81 to 162.48 lakh metric tons in 2021-22. Inland fish production accounted for 121.21 lakh metric tons in the latter period, while marine fish production stood at 41.27 lakh metric tons. This data emphasizes the significance of inland fish production in India.

In 2009, the Indian government permitted the importation of *L. vannamei* for breeding and farming purposes, leading to its introduction into the country. The Central Marine Fisheries Research Institute (CMFRI), an organization under the Ministry of Fisheries, played a pivotal role in this introduction by establishing a hatchery and breeding program to supply shrimp seeds to farmers. Shrimp culture is a crucial industry and a major contributor to foreign exchange earnings through exports. *L. vannamei* has become a prominent species in India's aquaculture production (Giri, 2016).

The success of *L. vannamei* farming and its establishment in numerous countries across East, Southeast, and South Asia showcases its significant role in shrimp aquaculture production. However, limited research has been conducted on the culture and growth performance of *L. vannamei* with varying stocking densities in brackish water ponds in India. Therefore, the present study aims to evaluate the survival, growth, and feed conversion ratio (FCR) of *L. vannamei* culture under different stocking densities in brackish water.

STUDY AREA:



Antharvedi village, malikipuram mandal, East Godavari District

MATERIALS AND METHODS

The study took place at a shrimp farm located in Antharvedi, Malkipuram Mandal, East Godavari district, Andhra Pradesh, India. Four shrimp culture ponds, each measuring one acre in area, were used for the experiment. The ponds had an average depth of 1.3 – 1.6m and had a soil type of sandy clay. Before the study, the ponds were prepared by drying and tilting, followed by liming to achieve the optimal pH level of the soil. Inorganic fertilizers were also added to enhance the natural food

source in the ponds.

To ensure water quality and prevent contamination, security measures were implemented before pumping water into the ponds. After filling the ponds, the water was left undisturbed for one day to allow sedimentation. Subsequently, the water was chlorinated (30 ppm/acre), and any excess chlorine was neutralized through a 72-hour dechlorination process. Probiotics were then added to promote a healthy environment for beneficial bacteria. Over time, algal bloom was observed in the ponds.

Litopenaeus vannamei seeds in the post-larval stage 11 were acquired from Sai Marine Exports Private Limited, Payakarao Peta Mandal, Visakhapatnam District. Prior to transport, the seeds were acclimated to a salinity level of 18 ppt and tested negative for the white spot syndrome virus (WSSV) using polymerase chain reaction (PCR) and stress tests which included monitoring temperature and salinity levels. The seeds were transported in oxygenated double-layered polythene bags with crushed ice packs to maintain an optimal temperature and minimize stress. Upon arrival at the site, the bags containing the seeds were kept in the pond water for some time to adjust the temperature. Then, the pond water was slowly added to the seed bags to adjust the salinity and pH levels. Finally, the seeds were gradually released into the ponds, with stocking densities of 25/m², 37/m², 43/m², and 50/m² for ponds 1, 2, 3, and 4, respectively.

Avanthi Feeds Pvt Ltd feed pellets were provided to the post-larvae four times a day at 7am, 10.30 am, 12.30 pm, and 3.30 pm. Every ten days, a 20% water exchange was conducted throughout the culture period. During harvest, all the water from the culture ponds was drained into a sedimentation pond and eventually reached a reservoir pond. Starting from day 60 of the culture process, shrimp growth and health were monitored every seven days using a cast net for sampling. Various water quality parameters such as salinity, pH, temperature, dissolved oxygen, and light transparency were measured using a hand refractometer, pH pen, thermometer, dissolved oxygen meter, and secchi disc, respectively. Aeration was provided for the entire culture period in all ponds, with four 8hp aerators fixed in each pond. The placement of the aerators aimed to maximize the dissolved oxygen (DO) levels in the pond water and create a suitable environment for shrimp culture. Feed conversion ratio (FCR) and average daily growth (ADG) were calculated using the following formulas.

FCR= Total weight of the harvested shrimps / total feed used ADG=Total weight gained by the shrimps/Total days of culture

RESULTS AND DISCUSSION

The water quality analysis for the culture ponds is presented in Tables 1,1a and 2,2a (see below). In order to provide a comprehensive overview, pH, temperature, and dissolved oxygen (DO) readings were taken in the early morning and late evening. Across all four culture ponds, the average pH in the morning ranged from 7.7 to 8.2, while in the evening, the pH values were between 8.2 and 8.7. For DO, the values ranged from 4.0 mg/l to 5.4 mg/l in the morning and from 4.6 mg/l to 5.4 mg/l in the evening (Table 2). The average temperature throughout the culture period varied from 25°C to 32°C (Table 1). The temperature trends indicated an initial temperature of approximately 28.5°C, which then dropped to 23°C during the third and fourth week due to cloud cover. Subsequently, the temperature rose again, reaching a range of 29°C to 32°C. Throughout the culture period, the maximum salinity recorded was 10 ppt, while the minimum salinity recorded was 5 ppt for all the ponds.

Table-1: Water Temperature Analysis

Culture Pond	Temperature Range (°C)
Pond 1	25-30
Pond 2	28-32
Pond 3	26-31
Pond 4	27-32

Table-2: Water Quality Analysis

Culture Pond	pH (Morning)	pH (Evening)	DO (Morning)	DO (Evening)
Pond 1	7.7-8.0	8.3-8.6	4.0-4.2	4.8-5.0
Pond 2	7.9-8.2	8.2-8.7	4.2-4.4	4.6-4.9
Pond 3	7.8-8.1	8.3-8.5	4.1-4.3	4.7-4.9
Pond 4	7.7-8.1	8.2-8.6	4.3-4.5	4.9-5.2

Table-1a Average water quality parameters

parameters	**Range**
Salinity (ppt)	5-10
Temperature °C	25-32
pH AM	7.7 -8.2
pH PM	8.2–8.7

Table 3 provides weekly averages of shrimp weights. At the end of 120 days of pond culture, the average weights of the harvested shrimp were found to be 25g, 20g, 26.3g, and 16.66g. The survival rates for these batches were 90%, 60%, 50%, and 50% respectively. Additionally, the feed conversion ratio (FCR) for each batch was calculated to be 1.3, 1.5, 1.5, and 1.43.
Table 4 shows that the average production per acre was 2250kg, 1800kg, 2302kg, and 1666kg for P1, P2, P3, and P4, respectively.).

Table2a Average Dissolve Oxygen concentration

Days of culture (DOC)	1	10	30	50	60	70	80	90	95	100	110	115	120
MORNING(mg/l)	4.5	4.5	4.5	4.5	4.0	4.0	4.0	4.8	5.0	5.2	5.4	5.5	5.4
EVENING(mg/l)	4.7	4.6	4.7	4.8	5.0	5.0	5.3	5.2	5.2	5.2	5.3	5.3	5.4

Table-3 Weekly growth performances (g)

Ponds	**Days Of Culture (DOC)**								
	60	**67**	**74**	**81**	**88**	**95**	**102**	**110**	**120**
P1	10	11.11	12.5	14.2	16.6	18.18	20.0	22.22	25
P2	9.09	10	11.11	12.5	14.28	16.66	18.18	19.14	20
P3	11.1	12.5	14.28	16.6	18.18	20.0	22.22	25	26.31
P4	6.66	7.69	8.69	10	11.11	12.5	14.28	15.38	16.66

Table4 Pond performance details

Details	**Pond1**	**Pond2**	**Pond3**	**Pond4**
Area(Ac)	1 acre	1 acre	1 acre	1 acre
Initial Stocking(Numbers)	1,00,000	1,50,000	1,75,000	2,00,000
Density(Numbers/m²)	25	37	43	50
Stocking Date	1-4-22	1-4-22	21-4-22	21-4-22
Harvest Date	29-7-22	29-7-22	18-8-22	18-8-22
Culture Period	120	120	120	120
Harvest Size(g)	25	20	26.31	16.66
Count(numbers/Kg)	40	50	38	60
Shrimp Harvest(Kg)	2250	1800	2302	1666
Survival percentage	90	60	50	50
Total Feed Used(Kg)	2925	2700	3453	2166
FCR	1.3	1.5	1.5	1.43
ADG	0.20	0.16	0.21	0.13
Production(Kg/Ac)	2250	1800	2302	1666

To assess the cost associated with low stocking density ponds, a comprehensive analysis was conducted. The production cost for 1kg shrimp, weighing 25 grams with 40 counts, was calculated

to be Rs 330. The major cost component was the feed, which amounted to Rs 88 per kilogram, followed by the seed cost of Rs 35,000 per lakh.

The total production for this particular study reached 2.25 metric tons (MT), with a total feed consumption of 2.925 metric tons (MT). The average feed conversion ratio (FCR) was observed to be 1.3, while the average body weight of the shrimp was 25g. The average stocking density recorded was 40 numbers per square meter. The overall total production cost amounted to Rs 501,400, and a profit of Rs 241,100 was generated as depicted in Table 5.

Table.5. Average Cost Analysis of low stocking density pond

Area(Acre)	1
Density(Numbers/m²)	25
Harvest size(g)	25
Count(numbers/kg)	40
Doc	120
Survival(%)	90
FCR	1:3
Production(kg)	2250
Total feed(kg)	2925
Seed cost shrimp/lakh	35000
Feed cost/ kg shrimp	88
Pond preparation cost (Rs)	5000
Liming cost (Rs)	7000
Minerals, Probiotics& Feed supplements cost (Rs)	60000
Diesel cost & Electicty cost (Rs)	25000
Labour cost (Rs)	50000
Farm lease cost cost (Rs)	50000
Other expenses, Maintenance & repair cost (Rs)	12000
Total production cost (Rs)/ kg of shrimp	330
Total production cost	501400
Total profit (Rs)	241,100

The present study is the report on the culture of *Litopeanus vannamei* shrimp farm at antharvedi, malkipuram mandal East Godavari district, Andhra pradesh, India. This study shows that stocking density affects growth of *L. vannamei* .Samocha *et al.,* 1999 and Emberson *et al* .,1999 reported on the growth and survivalof *L. vannamei*in different salinities and densities.

Ayyat *et al.,* 2011repoted that optimum stocking density based on pond carrying is necessary for shrimp culture system, for maintaining a positive correlation between density and growth rate and achieve maximum biomass with minimum incidence of physiological and behavioral disorders. In this study in high stocking density ponds running mortality syndrome, white feaces, slow growth were observed. Mena-Herrera *et al.,* 2006 reported that Stocking density is inversely proportional to shrimp growth and is one of the most important factors in shrimp culture, high stocking density can affect growth and survival of shrimp due to stress response induced by crowding. In this study survival rate also is only 50% in P3 and P4 ponds in these ponds stocking densities were 43 and 50 Numbers/m² area respectively.

The growth of the shrimps depends on the quality of feed. In the present study avanthi feed was used for all the ponds and the amount was followed as per feed chat. The maximum feed was used in pond P3 followed by P1, P2 and P4. In the present study the average FCR was 1.43for all ponds. Similar results were recorded by Ramakrishna 2000, even though the stocking densities was quiet high could able to achieve the better FCR in all the ponds because of quality of the feed, feed management, water quality, pond bottom management and other effective farm management.

Almost all farming sector, for increasing bulk production resulting in increasing stocking density

that depends upon varieties and quality of shrimp species (Sugathan et al, 2014) ultimately increase in feed input usually increases the deterioration of pond sediments (Garnier and Barillier, 1991; Ray and Chien, 1992) and water quality., reduces metabolism and food conversion efficiency (Martin et al, 1998) and rises in total feed costs (New, 1987).

CONCLUSION

World population reached to 8 billion, aquaculture is the good hope for the future food security concern. Therefore it our moral duty to protect the aquaculture sector through sustainable practices. Low stoking density is one of such practice to avoid adverse effects of aquaculture, in this context every farmer and technician should encourage the low stocking density and boost up the sustainable aquaculture practices.

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