

# A COMPARATIVE STUDY OF PRODUCTIVITY AMONG P.MONODON AND L.VANNAMEI SPECIES OF SHRIMP IN INDIA.

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**Abstract:** Introduction of SPF vannamei shrimp species in India, transformed the entire shrimp aquaculture industry in the country. Earlier p. monodon species dominated the shrimp aquaculture industry, which has come under direct pressure since vannamei species has become a new favourite for the shrimp aquaculture farmers. Vannamei with its higher resistance and higher farmer friendly characteristics as compared to monodon has now become the major cultivated species of shrimp in India. The study aims at analysing the productivity of two different shrimp species, namely P. Monodon and L. vannamei. State wise area under culture for each of the species and its production has been considered to determine the productivity.

**Key Words:** Shrimp, Aquaculture, Productivity, India.

## INTRODUCTION

Aquaculture has been defined by the Japanese Resource Council, Science and Technology Agency as “Aquaculture is an industrial process of raising aquatic organisms up to final commercial production within properly partitioned aquatic areas, controlling the environmental factors and administering the life history of the organism positively and it has to be considered as an independent industry from the fisheries hitherto.”

Aquaculture is organized production of a crop in the aquatic medium. The crop may be that of an animal or a plant.

Examples of crops:

- Finfish which includes catfish, carp, etc
- Shell fish like, shrimps, prawns, pearl oyster, etc
- Plants like water chestnut, red alga, etc

Aquaculture in India has a long history, there are references to fish culture in Kautilya's Arthashastra (321 – 300 B.C.) and King Someswara's Manasoltara (1127 A.D.). The traditional practice of fish culture in small ponds in eastern India is known to have existed for over hundreds of years.

In the last decade there has been a global upsurge for aquaculture industry. Scientific approach towards aquaculture farming practices has developed modern aquaculture into a dynamic, often capital intensive business frequently controlled by vertically integrated corporate giants of the food and retail industry. As a result of which there has been a rise in aquaculture productivity along the entire production and supply chain.

Aquaculture in India, in general, is practiced with the utilization of low to moderate levels of inputs, especially organic based fertilizers and feed. India utilizes only about 40% of the available 2.36 million hectares of ponds and tanks for freshwater aquaculture and 13% of a total potential brackishwater resource of 1.2 million hectares, in other words there is room for both horizontal and vertical expansion of these sectors. With over 8000 km of coastline there is immense potential for the development of mariculture which has taken roots only in recent years with culture of mussels and oysters. The production of carp in freshwater and shrimps in brackishwater form the major areas of activity. Over the years aquaculture has emerged as one of the major food generating sectors in the world, thereby providing an alternative source of seafood for the consumption needs of ever growing population in the world.

Aquaculture as a sector has been witnessing increased interest in diversification with the inclusion of high valued species, including medium and minor carps, catfishes, murels etc. While carp and other fin fishes are grown for the domestic market, a large proportion of freshwater prawn production is exported. In contrast, the development of brackish water aquaculture has been confined to a single species, *Penaeus monodon*, the scientific farming of which began during the early 1990s.

Indian aquaculture has demonstrated a six and half fold growth over the last two decades, with freshwater aquaculture contributing over 95% of the total aquaculture production. The production of carp in freshwater and shrimps in brackishwater form the major areas of activity.

**Table: 1 - 10 major aquaculture species in India.**

Sl. No.	Common Name	Scientific Name
1	Tiger shrimp	<i>Penaeus monodon</i>
2	Giant Freshwater prawn( Scampi)	<i>Macrobrachium rosenbergii</i>
3	Pacific white shrimp	<i>Litopenaeus vannamei</i>
4	Indian white shrimp	<i>Fenneropenaeus indicus</i>
5	Mangrove crabs	<i>Scylla serrata</i>
6	Asian Sea bass	<i>Lates calcarifer</i>
7	Nile Tilapia	<i>Oreochromis niloticus</i>
8	Cobia	<i>Rachycentron canadum</i>
9	Tiger Grouper	<i>Epinephelus fuscoguttatus</i>
10	Edible oyster	<i>Crassostrea madrasensis</i>

(Source: MPEDA, India)

India has an estimated total estuarine area of 3.9 million hectares; of which, 1.2 million hectares of coastal salt affected lands have been identified to be potentially suitable for brackish water shrimp farming. Of this, about 15% of the potential area has been put into aquaculture purpose.

The following study covers two species of brackishwater shrimps, *P. Monodon* and *L. Vannamei* and studies their state wise productivity trends in India

#### LITERATURE REVIEW:

James L Anderson in his studies “Shrimp production estimates and trends” (2010) studies shrimp aquaculture industry in five different regions around the world. These regions were Southeast Asia, China, India/Bangladesh, America, Africa/middle east. The studies ranged in the period of 2004 to 2012. His studies also focused on the issues and challenges in shrimp aquaculture. His analysis of these issues and challenges were rated on the basis of Not Important, Moderately Important and extremely Important. The study also compared the prices of *P.monodon* and *P vannamei* along with the export trends.

the paper entitled 'AQUACULTURE AND ITS ROLE IN INTEGRATED COASTAL ZONE MANAGEMENT' by S.M. STEAD, G.BURNELL and P. GOULLETQUER focuses on the two main objectives: to aid the development of stronger interdisciplinary communication between the natural and social sciences and to improve the utility of available scientific information and knowledge; and to promote new perspectives on the sustainable use of coastal areas and natural resources. The paper also summarizes the debates following each of the three workshop thematic sessions: aquaculture and ICZM; socio economic and political dimensions; developing sustainable production systems; and identifies the key recommendations that may be applied to the formulation of policy on integrated aquaculture management in coastal and marine environments.

A paper entitled "A comparative study of the aquaculture practices adopted by fish farmers in Andhra Pradesh and West Bengal" by T. JAWAHAR ABRAHAM, S. K. SIL AND P. VINEETHA (Faculty of Fishery Sciences, West Bengal University of Animal and Fishery Sciences Chakgaria, Panchasayar P. O., Kolkata 700 094, West Bengal, India) studies the socio economic profile of the fish farmers and the aquaculture practices of Andhra Pradesh and West Bengal, India. The study covered 153 farms culturing Indian major and minor carps. It presented the comparative analysis of the socio economic variables for the carp farmers in the two states along with the practices and the role of government policies towards aquaculture.

'AQUACULTURE AS A FOOD PRODUCTION SYSTEM: A REVIEW' by Khan MA, Khan S, Miyan K makes an effort to understand the continuous growing requirement of food for the ever growing human population and as to how aquaculture can play a huge role in fulfilling that requirement. Aquaculture as a food production system shows the potential to provide the quality proteins to ever increasing human population and to combat malnutrition.

#### **RESEARCH METHODOLOGY:**

##### **OBJECTIVE OF THE STUDY:**

- To compare the productivity of P. Monodon and L. Vannamei, shrimps in India

##### **SCOPE OF THE STUDY**

- The study is based on productivity of P. Monodon & L. Vannamei species of shrimp.
- Productivity is calculated as Total production / Area under culture (MT / ha / year)
- The study covers a total of 9 shrimp producing states in India.
- The study covers a period of 15 years ending 2016.

##### **RESEARCH METHODS:**

- Type of Data: Secondary
- Source of data: mpeda.gov.in
- Type of study: descriptive
- Tools used for analysis: trend analysis, t-test

**DATA ANALYSIS**

Following below is the table showing the species wise area under culture, total production and the productivity levels of major aquaculture practicing states in India.

**Table: 2 – state wise – species wise production**

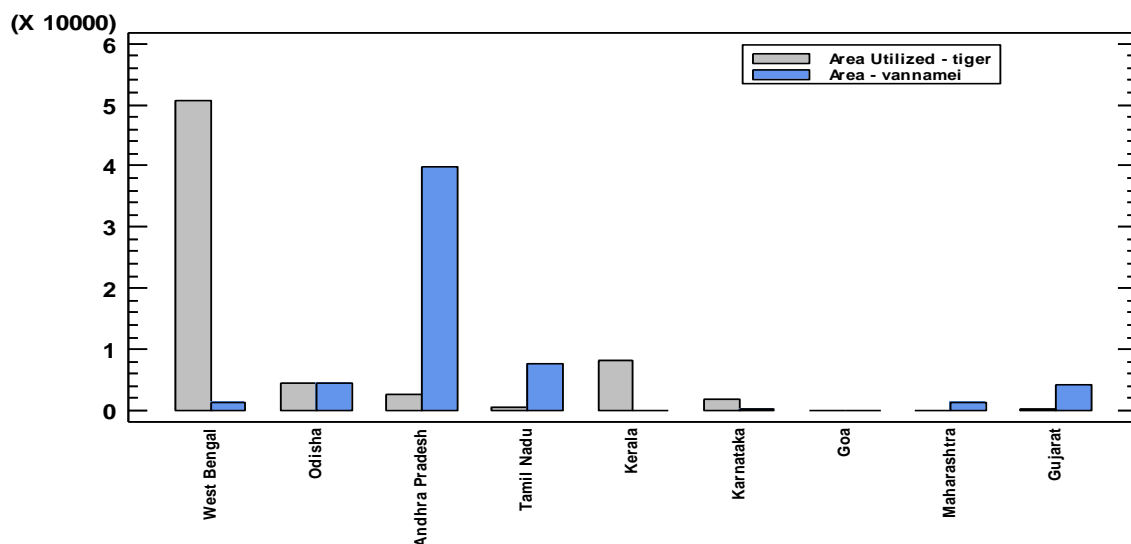
State	Area Utilized - tiger (Ha)	Production - tiger (MT)	Productivity - tiger (MT/ha/Yr)	Area - vannamei (Ha)	Prod. - vannamei (MT)	Productivity - vannamei (MT/ha/Year)	Area - total (Ha)	Prod. - total (MT)	Productivity - total (MT/ha/Yr)
West Bengal	50,593	61,998	1.23	1,387	6776	4.89	51,980	68,774	1.32
Odisha	4,552	9,191	2.02	4,439	19,241	4.33	8,991	28,432	3.16
Andhra Pradesh	2,637	3,739	1.42	39,800	2,95,332	7.42	42,437	2,99,071	7.05
Tamil Nadu	409	1,103	2.7	7,615	44,453	5.84	8,024	45,556	5.68
Kerala	8,306	3,490	0.42	22	74	3.36	8,328	3,564	0.43
Karnataka	1,948	682	0.35	333	1,045	3.14	2,281	1,727	0.76
Goa	0	0	0	10	33	3.3	10	33	3.3
Maharashtra	3	6	2	1,356	6,118	4.51	1,359	6,124	4.51
Gujarat	398	1,243	3.12	4,154	32,946	7.93	4,552	34,189	7.51
<b>Total</b>	<b>68,846</b>	<b>81,452</b>	<b>1.18</b>	<b>59,116</b>	<b>4,06,018</b>	<b>6.87</b>	<b>1,27,962</b>	<b>4,87,470</b>	<b>3.81</b>

(Source: Marine Products Exports Development Authority, (MPEDA) Kochi)

Shrimp aquaculture practices are mainly carried out in nine states of India, of which West Bengal and Andhra Pradesh are dominant for culture of P. Monodon and L vannamei species of shrimp respectively.

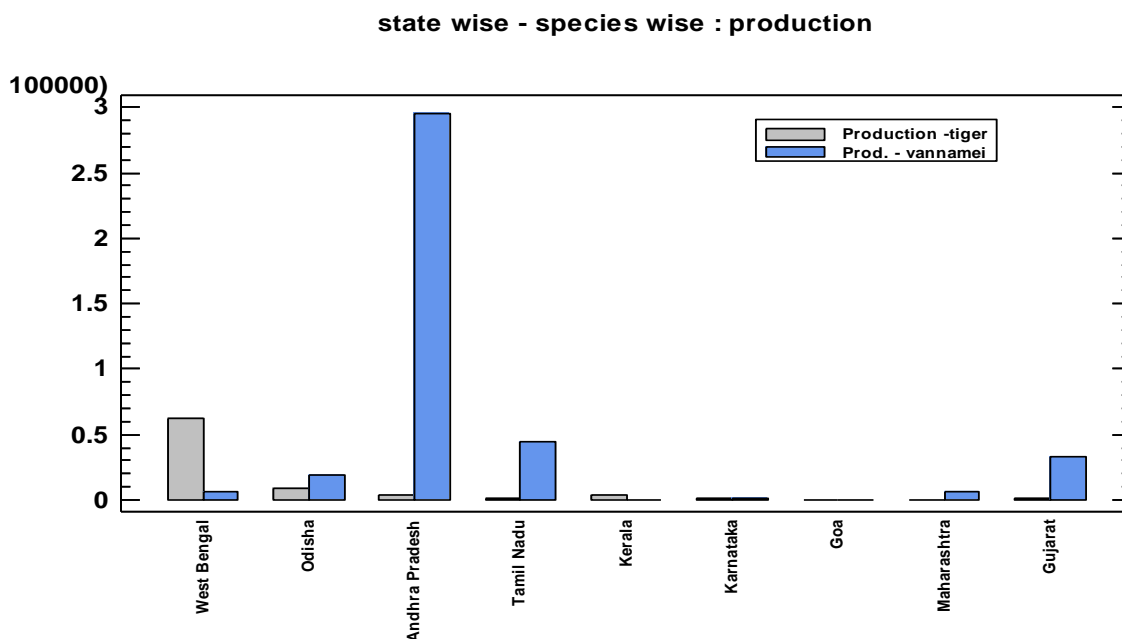
**Figure: 1 – state wise – species wise : area under culture**

**State wise - species wise : area under culture**



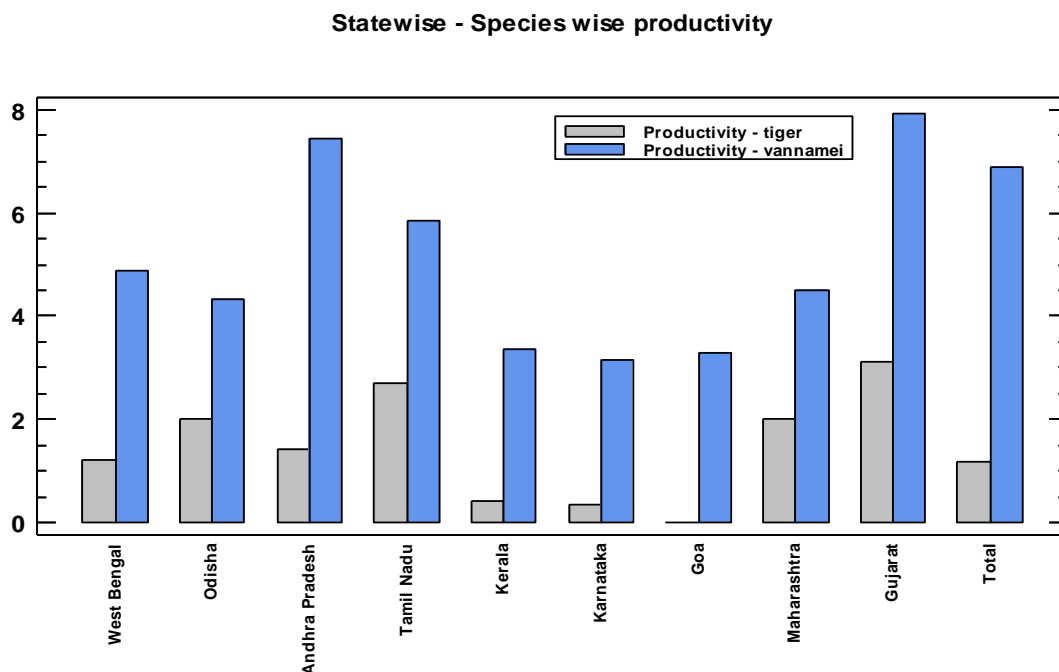
Total area under culture for each species of shrimp, among different states in India. In case of P. Monodon, with a total area of 50,593 ha, west Bengal had highest culture land in the country. While with regards to L. Vannamei, Andhra Pradesh with 39,800 ha had highest culture land in India.

Figure: 2 – state wise – species wise : production



the highest production of monodon species, came from west Bengal with 61998 MT, while for that of vannamei shrimps was Andhra Pradesh with 2,95,332 MT.

Figure: 3 – state wise – species wise : productivity



Productivity for each of the species was calculated by dividing the estimated production of the respective species during a given year with the total area under culture for that species. The productivity is represented in MT/Ha/Year.

Productivity of L. Vannamei shrimps in Gujarat and Andhra Pradesh is recorded higher as compared to all India average. These states have emerged as a major vannamei producing states in India. Among the two in terms of total production Andhra Pradesh ranks first, however in terms of the productivity Gujarat is above every other shrimp producing states in India. In case of productivity of P.Monodon species, Gujarat and

Tamil Nadu are leading states in India. On an overall comparison, the productivity of P. Monodon is significantly less against L. Vannamei in India.

The following table shows descriptive statistics for the combined area under culture, production and the overall productivity in India.

**Table:3 - One Variable analysis – descriptive analysis for both species combined**

	area- total	production - total	productivity total
Count	9	9	9
Average	14218.0	54163.3	3.74667
Standard deviation	19124.0	94786.7	2.63979
Coeff. of variation	134.505%	175.002%	70.4571%
Minimum	10.0	33.0	0.43
Maximum	51980.0	299071.	7.51
Range	51970.0	299038.	7.08
Std. skewness	1.91752	3.26444	0.206612
Std. kurtosis	0.595129	4.56922	-0.876155

### Species wise analysis (overall):

#### One Variable Analysis - TOTAL Tiger

Data variable: TOTAL Tiger

DURATION: 15 Years, ending 2016

15 values ranging from 0.654003 to 1.32427

**Table : 4 – Summary Statistics for TOTAL Tiger**

Count	15
Average	0.958356
Standard deviation	0.193285
Coeff. of variation	20.1684%
Minimum	0.654003
Maximum	1.32427
Range	0.67027
Std. skewness	0.142524
Std. kurtosis	-0.441382

#### One Variable Analysis - TOTAL Vannamei

Data variable: TOTAL Vannamei

DURATION: 15 Years, ending 2016

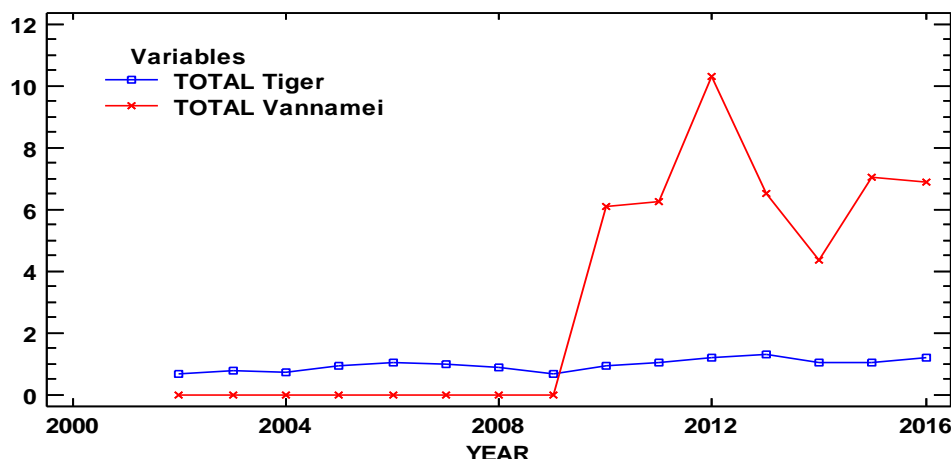
15 values ranging from 0 to 10.2995

**Table : 5 - Summary Statistics for TOTAL Vannamei**

Count	15
Average	3.16084
Standard deviation	3.68731
Coeff. of variation	116.656%
Minimum	0
Maximum	10.2995
Range	10.2995
Std. skewness	0.815284
Std. kurtosis	-1.05316

Figure: 4 – Comparison of productivity for P. Monodon & L. Vannamei

Multiple X-Y Plot



In order to test whether there exists any difference in the productivity of tiger and vannamei shrimps in India, hypothesis was framed.

Ho: There is no significant difference between the overall productivity of tiger shrimps and vannamei shrimps in India

H1: There is a significant difference between the overall productivity of tiger shrimps and vannamei shrimps in India

**Two Sample Comparison - TOTAL Tiger & TOTAL Vannamei**

Sample 1: TOTAL Tiger

Sample 2: TOTAL Vannamei

Sample 1: 15 values ranging from 0.654003 to 1.32427

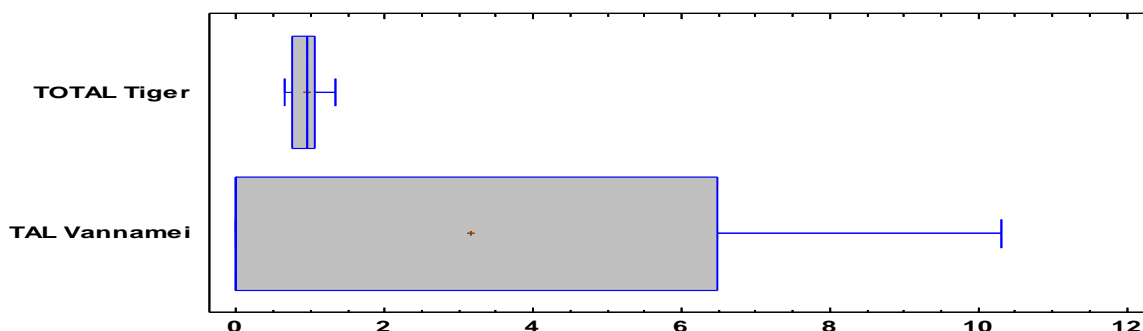
Sample 2: 15 values ranging from 0 to 10.2995

Table: 6 - Summary Statistics

	TOTAL Tiger	TOTAL Vannamei
Count	15	15
Average	0.958356	3.16084
Standard deviation	0.193285	3.68731
Coeff. of variation	20.1684%	116.656%
Minimum	0.654003	0
Maximum	1.32427	10.2995
Range	0.67027	10.2995
Std. skewness	0.142524	0.815284
Std. kurtosis	-0.441382	-1.05316

Figure: 5 – box and whisker plot for species wise productivity

Box-and-Whisker Plot



**Comparison of Means**

95.0% confidence interval for mean of TOTAL Tiger: 0.958356 +/- 0.107038 [0.851318, 1.06539]

95.0% confidence interval for mean of TOTAL Vannamei: 3.16084 +/- 2.04197 [1.11887, 5.2028]

95.0% confidence interval for the difference between the means

assuming equal variances: -2.20248 +/- 1.95289 [-4.15537, -0.249593]

**t test to compare means**

Null hypothesis: mean1 = mean2

Alt. hypothesis: mean1 NE mean2

assuming equal variances: t = -2.31021 P-value = 0.0284618

Reject the null hypothesis for alpha = 0.05.

**Table: 7 - Comparison of Standard Deviations**

	<i>TOTAL Tiger</i>	<i>TOTAL Vannamei</i>
Standard deviation	0.193285	3.68731
Variance	0.037359	13.5963
Df	14	14

Ratio of Variances = 0.00274774

**95.0% Confidence Intervals**

Standard deviation of TOTAL Tiger: [0.141509, 0.304829]

Standard deviation of TOTAL Vannamei: [2.69958, 5.81525]

Ratio of Variances: [0.000922499, 0.0081844]

**F-test to Compare Standard Deviations**

Null hypothesis: sigma1 = sigma2

Alt. hypothesis: sigma1 NE sigma2

F = 0.00274774 P-value = 0

Reject the null hypothesis for alpha = 0.05.

**FINDINGS AND CONCLUSION**

The study considers the productivity of P. Monodon and L. Vannamei species of shrimps in all the major aquaculture shrimp producing states in India, over a period of 15 years and has led to following findings:

The statistical test conducted on the productivity data for both the species indicated following results:

- In order to determine whether there existed a significant difference between the productivity in two species, hypothesis was framed and t test was applied, which gave a p value of 0.0284618. as a result, at 95% level of significance, the test has rejected the null (Ho) hypothesis, and thus the alternative hypothesis (H1) can be accepted
- The test signifies that there exists a significant difference between the productivity of two species in India.

In India, the commercial cultivation of L. Vannamei began around 2010, prior to which P. Monodon was the only major brackishwater species of shrimp that was cultivated. On one side where P. Monodon offered some benefits to the farmers, it was exposed to several risks which led to a search for a better culture friendly shrimp species in India.

With the introduction of L. Vannamei shrimps in the Indian aquaculture space, there has been a radical shift in terms of the preferred species for cultivation, owing to its SPF seeds availability and higher resistance against diseases. SPF seeds ensured higher production and helped farmers manage a significant level of disease in their culture operations. Today a significant share of the total shrimp production in India comes from Vannamei shrimps. The overall productivity among the two species shows a significant difference,



where vannamei has managed to achieve a higher production during the period. In terms of the respective state wise productive trend the study shows no significant differences.

L. vannamei, as a brackishwater culture shrimp is currently the preferred species for cultivation by the shrimp farmers in India, and owing to the advancements in culture techniques and better management practices, the production for vannamei shrimps are expected to rise for every unit of area under culture allocated to shrimp farming.

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