



Growth and Instability Analysis of Shrimps Farming in India and Karnataka

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Abstract: The present study was undertaken to analyze the area and production trends of shrimps farming in India and Karnataka. This study was primarily based on secondary data and was analysed using statistical tools like Compound Annual Growth Rate (CAGR) and Instability Indices such as Coefficient of Variation (CV) and Cuddy Della Valle II (CDV-II). During the study period, the area and production of tiger and scampi shrimps in India were trending downward whereas the area and production of white shrimps in India during the same period showed an upward tendency year over year. The same pattern was seen in Karnataka as well. The C.V. of white shrimps was more compared to other types of shrimps in India and Karnataka. CDV-II instability index showed that white shrimp's area and production fluctuated the most followed by Scampi and tiger shrimps. Environmental issues have always been the point of debate in shrimp farming which was the main hindrance to the increased area under shrimp farming. Hence, the policy maker must look upon the issues and allow the development of shrimp farming in an environment-friendly and sustainable manner.

Keywords: Compound Annual Growth Rate (CAGR), Coefficient of Variation (CV), Cuddy-Della Instability Index (CDII)

Aquaculture sector contributes around 1 per cent to India's Gross Domestic Product (GDP) and over 5 per cent to the agricultural GDP (Anonymous 2021a). Brackishwater aquaculture, the farming of shrimps, shellfishes and finfishes along the coastal line of the country and in inland saline areas is a vibrant farming sector, under the aquaculture umbrella. Brackish water aquaculture sector is dominated by shrimp farming is the economic engine of Indian aquaculture when considering the significant contribution of this sector to food production, employment generation and economic benefits. Central Institute of Brackishwater Aquaculture, Chennai, Tamil Nadu. (CIBA) defined the freshwater aquaculture as "the farming of Brackishwater organism, in estuaries, coastline, backwater, lagoons and mangroves. etc. involving interventions in the rearing process to enhance production including shrimps, sea bass, grey mullet mud crabs etc. is called freshwater aquaculture. It is also called coastal aquaculture. These areas are commonly located at estuaries, coastlines, backwater, lagoons and mangroves. There are about 3.9 million ha of estuaries and 0.5 million ha of coastal mangrove areas available in the country. The estimated brackish water area suitable for undertaking shrimp cultivation in India is around 11.90 million ha which is spread over nine states and four Union Territories out of which 1.23 million ha area already under shrimps farming which is only 12.96 per cent of the potential area. Hence, India has a lot of potential in shrimp farming (Marine Product

Export Development Authority, Kochi, Kerala (MPEDA 2021). Shrimps farming is an aquaculture business that exists in a brackish water environment, producing shrimps for human consumption. In India, mainly three types of shrimps are commonly reared which are tiger shrimps (*Penaeus monodon*), white shrimps (*Litopenaeus vannamei*) and scampi shrimps (*Macrobrachium rosenbergii*). Commercial Shrimps farming started in India during the 1900's with the production of tiger and scampi shrimps whereas white shrimp production started in 2009 as a result aquaculture business grew quickly.

Shrimps are an important source of many components such as proteins, vitamins, minerals and omega 3-fatty acids which will help us to protect from heart and brain related problems. The total shrimp production in the world in 2020-21 was 22.50 Million tonnes. Ecuador is the world's top shrimp producer, with 30 per cent (6.72 Million tonnes) of total shrimp production, followed by India with 24 per cent (5.38 Million tonnes). When it comes to shrimp importers, the United States is the largest importer of shrimps which is accounting for nearly 30 per cent (7.00 Million tonnes) of the total exports of India (Anonymous 2021b). The total area under shrimp culture in India is 1,66,722.51 ha with a production of 8,43,633 tonnes (Anonymous 2021c). The total shrimp production in India has decreased from 8,51,664 tonnes in 2019-20 to 7,56,651 tonnes in 2020-21, owing to the COVID-19 pandemic and related lockdown, as well as continuing

production concerns due to diseases, particularly white spot diseases. (<https://aquaasiapac.com/2021/07/31/indias-farmed-shrimp-in-2020-a-white-paper/>)

West Bengal has the highest area and production of shrimps, followed by Odisha and Andhra Pradesh. The total area under shrimp culture in Karnataka is 3145.39 ha, with a production of 3185.84 tonnes; among the total shrimps, the area under tiger shrimp culture is 2175 ha, with an output of 1050 tonnes. The area under white shrimps is around 970.39 hectares, with a yield of 2185.84 tonnes. In Karnataka, the area under scampi shrimps is insignificant (https://mpeda.gov.in/?page_id=651). Shrimp production touched more than 7.0 lakh tonnes in 2021-22 of which 87 per cent is exported to the United States of America, China, Japan, European Union and South East Asia earning a robust foreign exchange to the tune of more than Rs. 35,000 crores (Anonymous 2021c). Shrimp farming is gaining importance in recent years due to the increase in the demand in the international market as well as in the domestic market too. In this backdrop, the present study aims at exploring the and magnitude of shrimp farming in India and Karnataka

MATERIAL AND METHODS

The secondary data were collected to fulfil the study's objectives of 2008-09 to 2019-20, from the Statistical Offices of Karnataka, Handbook of Fisheries Statistics, MPEDA Website and other published sources to analyse the growth and instability analysis of shrimp area and production in the state as well as in the country.

Compound annual growth rate: For computing compound annual growth rates of area, production of different types of shrimps, the exponential function of the following form was used.

$$Y_t = a \cdot b^t \cdot e^u(1)$$

Where, Y = Dependent variable (area or production shrimps), a = Intercept term

b = Regression coefficient, t = Time period, e^u = error term

The equation (1) was transformed into log linear form and written as;

$$\log Y = \log a + t \log b + U_t \dots\dots\dots(2)$$

Equation (2) was estimated by using Ordinary Least Squares (OLS) technique.

Compound growth rate (g) was then computed

$$g = (b - 1) \times 100 \dots\dots\dots(3)$$

Where, g = Compound growth rate in per cent per annum, b = Antilog of log b

The standard error of the growth rate was estimated and tested for its significance with 't' test statistic.

Instability analysis: In order to study stability in different types of shrimps with respect to area, and production, co-

efficient of variation was estimated using the expression given below.

$$C.V. = \frac{\text{Standard Deviation}}{\text{Mean}} \times 100$$

Cuddy and Della Instability Index (CD II): The formula suggested by Cuddy and Della (1978) was used to compute the degree of variation and trend as follow:

$$\text{Instability index} = \frac{\text{Standard Deviation}(\sigma)}{\sqrt{1 - R^2} \text{Mean}(\bar{x})} \times 100$$

RESULTS AND DISCUSSION

Extent and magnitude of shrimp farming in India and Karnataka:

The area and production of tiger shrimps in India was showed decreasing over the years from 2008-09 to 2019-20 (Table 1). India's average tiger shrimp area, production from the past twelve years was 81.64 Lakh ha and 82.23 Lakh tons with a negative compound annual growth rate of 6.97 per cent and 8.04 per cent respectively. Similarly, the area and production of scampi shrimps also showed decreasing trend over the years. India's average scampi shrimp area, production over the past twelve years was 8.40 Lakh ha and 6.89 Lakh tons with the compound annual growth rate of -1.87 per cent and 2.56 per cent, respectively. However, the area and production of white shrimps in India significantly increasing over the years from 2008-09 to 2019-20. India's mean white shrimp area, production from the past twelve years was 46.40 Lakh ha and 3039.34 Lakh tons with the compound annual growth rate of 104.76 per cent and 121.43 per cent, respectively. The total area and production of total shrimps in India were significantly increasing over the year in the study period. Its average total area, production from the past twelve years was 136.45 lakh ha and 398.48 Lakh tonnes with the growth rate of 2.93 per cent and 22.62 per cent respectively. The co-efficient of variation of tiger shrimps, white shrimps, and scampi shrimps and total shrimps area was 28.26., 82.54., 44.40., and 11.71 per cent respectively. The coefficient of variation of tiger shrimps, white shrimps, scampi shrimps and total shrimps production were 35.62., 85.00., 44.81., and 57.58 respectively.

The Cuddy and Della Valle-II instability index was used to compute the degree of variation around the trend. The white shrimp's area as well as production fluctuated the most followed by scampi shrimps and tiger shrimps. Cuddy and Valle Instability Index of white shrimps area was highest i.e. 47.62 followed by scampi area and tiger shrimps. Similarly, Cuddy and Valle Instability Index of white shrimps production was highest i.e. 52.25 followed by scampi shrimp, tiger shrimps and total shrimps (13.17). The area and production of tiger shrimps in Karnataka was showed decreasing trend over the years from 2009-10 to 2019-20 (Table 2).

Table 1. Extent and magnitude of shrimp farming in India (2008-09 to 2019-20)

Year	Tiger shrimps		White shrimps		Scampi shrimps		Total	
	Area ('000 ha)	Production ('000 tons)	Area ('000 ha)	Production ('000 tons)	Area ('000 ha)	Production ('000 tons)	Area ('000 ha)	Production ('000 tons)
2008-09	108789	75996	-	-	18421	12806	127210	88802.79
2009-10	102259	95919	283	1731	8154	6568	110696	104218
2010-11	113853	118575	2931	18247	5511	3721	122295	140543
2011-12	114370	135466	7837	80717	6244	4269	128451	220452
2012-13	93110	123302	22715	147516	3432	3625	119257	274443.9
2013-14	72177	76798	57267	250507	9175	3545	138619	330850
2014-15	71400	73155	50240	353413	9307	7989	130947	434557
2015-16	68846	81452	59116	406018	12706	10152	140668	497622
2016-17	58851	58163	87252	501297	6151	3377	152254	562837
2017-18	59099	57691	93496	622327	7121	9983	159716	690001
2018-19	58359	54902	75494	618678	7129	7222	140982	680802
2019-20	58653	35437	100206	711674	7520	9540	166379	756651
MEAN	81647.17	82238.10	46403.16	309343.83	8405.91	6899.75	136456.16	398481.64
S.D.	23078.20	29295.19	38305.33	262959.71	3732.79	3092.35	15991.48	239657.88
CAGR (%)	-6.97***	-8.04***	104.76***	121.43***	-1.87*	2.56 *	2.93***	22.62**
C.V. (%)	28.26	35.62	82.54	85.00	44.40	44.81	11.71	60.14
R ²	0.87	0.60	0.66	0.62	0.72	0.83	0.74	0.95
Cuddy Della Valle II	32.35	22.37	47.62	52.25	43.82	44.03	5.96	13.17

Note: 1. * Significant at 10 per cent level of significance

2. ** Significant at 5 per cent level of significance

3. *** Significant at 1 per cent level of significance

4. S.D. Standard Deviation

5. C.V. = Co-efficient of Variation

6. R² = Co-efficient of Discrimination

Source: MPEDA, Govt. of India, 2009-2020

Table 2. Extent and magnitude of shrimp farming in Karnataka (2009-10 to 2019-20)

Year	Tiger shrimps		White shrimps		Total	
	Area ('000 ha)	Production ('000 tons)	Area ('000 ha)	Production ('000 tons)	Area ('000 ha)	Production ('000 tons)
2009-10	1484	1581	01	01	1485	1582
2010-11	1715	2090	03	01	1716	2091
2011-12	650	609	72	232	722	841
2012-13	240	180	154	484	394	664
2013-14	94	56	157	517	251	573
2014-15	688.6	498.7	124.7	623.2	813.4	1121.9
2015-16	1948	682	333	1045	2281	1727
2016-17	735	635	405	1457	1140	2092
2017-18	302	59	399	1465	701	1524
2018-19	690	94	219	918	909	1012
2019-20	590	34	539.97	1195.1	1129.97	1229.1
MEAN	830.6	592.60	218.69	721.66	1049.30	1314.27
S.D.	585.27	642.54	169.66	508.74	567.01	506.87
CAGR (%)	-4.68*	-26.31**	73.85***	90.95***	0.305**	0.92**
C.V. (%)	70.46	108.42	77.57	70.49	54.03	38.56
R ²	0.73	0.73	0.65	0.61	0.83	0.84
Cuddy Della Valle II	69.35	76.24	45.57	43.86	54.03	38.47

See Table 1 for details

Karnataka's average tiger shrimp area, production from the past eleven years was 0.83 Lakh ha and 0.53 Lakh tons with a negative compound annual growth rate of -4.68 and -26.31 per cent, respectively. Similarly, the area and production of white shrimp in Karnataka was significantly increasing over the years from 2009-10 to 2019-20. Karnataka's average white shrimp's area, production over the past eleven years was 0.218 Lakh ha and 0.721 Lakh tons with the compound annual growth rate of 73.85 per cent and 90.95 per cent respectively. The area and production of total shrimps in Karnataka was significantly increasing over the year in the study period. Its average total area, production from the past eleven years was 1.04 lakh ha and 1.31 lakh tonnes with CAGR of 0.3 per cent and approximately one per cent, respectively. Scampi Shrimps area and production in Karnataka were negligible during the study period. The coefficient of variation explains the variability in both area and production of shrimps in Karnataka. The co-efficient of variation of tiger shrimps, white shrimps and total shrimps area was 70.46, 77.57, and 54.03 per cent respectively. Similarly, co-efficient of variation of the shrimp's production was 108.42, 70.49, and 38.56 respectively (Guledagudda et al 2020). The Cuddy and Della Valle instability index was used to compute the degree of variation around the trend. The index showed that tiger shrimp's area as well as production fluctuated the most as compared to white shrimps in Karnataka. The Cuddy & Valle Instability Index of tiger shrimps area was 69.35 followed by total shrimps, white shrimps. The, tiger shrimps production the instability values was 76.24 followed by white shrimps (43.86), total shrimps (38.47) (Kumar et al 2021). The results indicated that the area and production of tiger shrimps and scampi shrimps in India as well as in Karnataka showed decreasing trend over the study period which was associated with a negative Compound Annual Growth Rate (CAGR) which was mainly due to the Number of the shrimps life cycle in a year is less which is almost two crop a year, poor quality of fingerlings, non-availability of good quality fingerlings, less number of hatcheries specifically for the rearing of tiger and scampi shrimps, the productivity of tiger and scampi shrimps is less, susceptible to many diseases such as white spot syndrome

viruses, gregarine diseases, lack of demand in the international market. The white shrimps in India and Karnataka showed an increasing trend during the study period with positive CAGR which was mainly due to the number of cycles in a year is more which is almost three crops a year, the productivity of white shrimps or Exotic Shrimps was more. Improvements in production and farming technologies, introduction of genetically improved species, very high demand in the international market, more number of modern types of hatcheries specifically meant for the exotic shrimps which are controlled by aquaculture authority of India.

CONCLUSIONS

The white shrimps/ exotic shrimps area and production were increasing over the study period due to the high demand in the international market. The domestic shrimps like tiger and scampi shrimps area and production showing a decreasing trend. Hence, the policy maker should provide enough emphasis on shrimp farming by providing them credit and other extension facilities and should not neglect tiger shrimps and scampi shrimps farming because of its their low yield. The promotion of this farming helps to improve rural livelihood which is one of the major goals of sustainable aquaculture.

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